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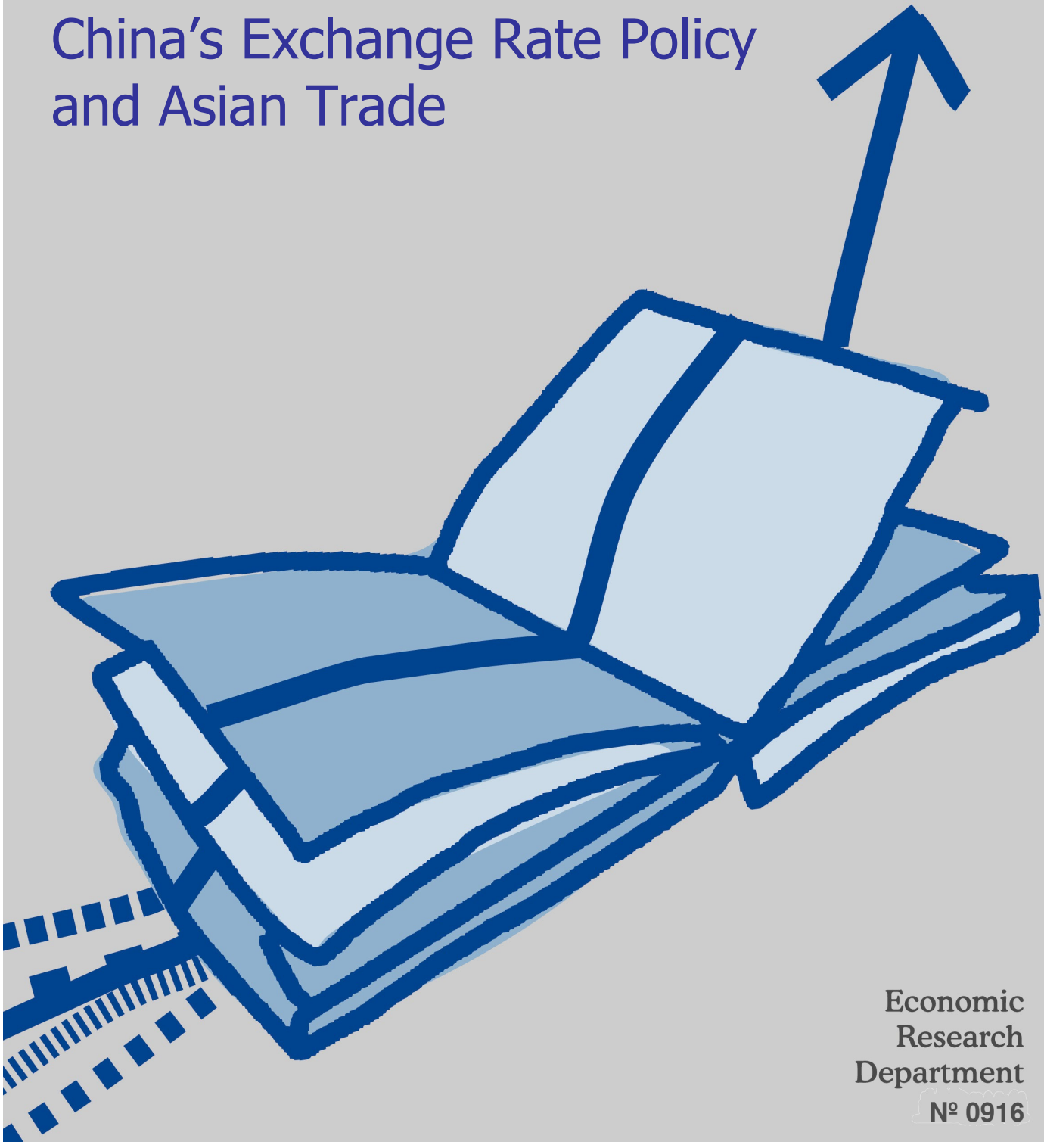
China's Exchange Rate Policy and Asian Trade



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China's Exchange Rate Policy and Asian Trade

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Abstract

This paper shows empirically that China's trade balance is sensitive to fluctuations in the renminbi real effective exchange rate. However, the current size of the trade surplus is such that exchange rate policy, alone, will probably not be able to address the imbalance. The reduction in the trade surplus is limited mainly because Chinese imports do not react as expected to exchange rate appreciation. In fact, they tend to fall rather than increase. By estimating bilateral import equations for China and its major trading partners, we find that such reaction of imports to exchange rate appreciation is generally confirmed for South-East Asian countries but not for others. This might be a direct consequence of Asia's vertical integration as a large share of Chinese imports from Southeast Asia is directed to re-exporting. We also find that the total exports from a number of Asian countries react negatively to a renminbi appreciation, which points to a dependence of Asian countries' exports on those of China.

Keywords: China, trade, exports, real exchange rate

JEL classification: F1, F14

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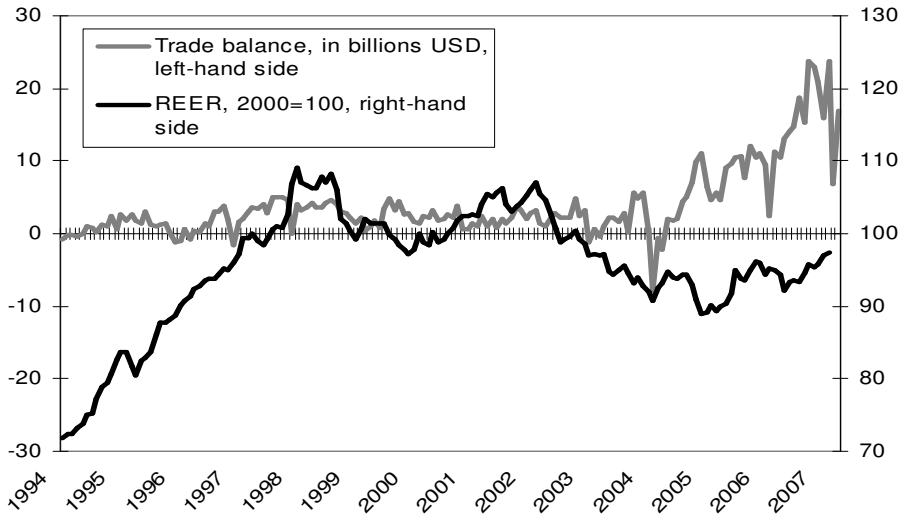
1. Introduction

China's share in world trade has increased extremely fast during the last years. In fact, it is already one of the largest exporters in the world, together with Germany and the US.[4]

China's trade was very much in balance until rather recently. According to China's customs statistics, trade surplus amounted to mere 32 billion US dollars (or 1.7 % of GDP) in 2004 (Graph 1). However, in 2005-2007 the trade surplus ballooned: it reached nearly 180 billion US dollars in 2006 (close to 7 % of China's GDP) and increased further in 2007.[5] In fact, the current account surplus amounted to over 10% of GDP in 2007.

On the one hand, there has been the impression that Chinese policy makers are maintaining an undervalued exchange rate so as to profit from external demand and achieve a much needed high growth rate. On the other hand, there have been doubts that the exchange rate can be an effective tool in reducing the trade surplus, as China is an economy in transition where prices may still play a limited role in supply and demand decisions.

Graph 1. China's trade balance and real effective exchange rate, monthly figures



Source: China's customs statistics, CEIC, IFC

Linked to the first argument, China is facing a strong pressure from industrial countries to appreciate the renminbi. In fact, the real effective exchange rate (REER) experienced a very steep appreciation from 1994 until end-1997 but tended to depreciate since then until the move to a more flexible exchange rate regime was announced in July 2005. Thereafter the renminbi has appreciated in real effective terms.

The large size of China's trade surplus makes the issue important not only for China but also for the rest of the world. Notwithstanding the general interest in the issue, the existing literature is not conclusive. The lack of appropriate data and long time-series has discouraged research on the link between the renminbi exchange rate and China's trade. Since the summer of 2003, when discussions on the renminbi undervaluation came to the

[4] According to the Direction of Trade Statistics (March 2007), China's share of world's total imports was already higher than the shares of Germany or the US. However, according to the countries' own statistics, the value of exports from Germany and the US are still higher than the value of the Chinese exports.

[5] China's balance of payments trade statistics generally show slightly larger trade surpluses than the customs statistics. According to the balance of payments, the trade surplus in 2006 amounted to 218 billion US dollars or more than 8% of GDP.

forefront, research on China's exchange rate policy has blossomed but much of it has focused on estimating the long-run equilibrium exchange rate for China or exploring what kind of exchange rate regime best suits the Chinese economy. While both questions are clearly relevant, the most urgent issue - given the size of global imbalances - is whether China should let its currency appreciate as a tool to reduce its huge trade surplus.

Our paper analyzes empirically this question using cointegration analysis and data for the period 1994-2005. According to our results, a renminbi real appreciation would reduce China's trade surplus in the long run but the effect would be limited. The relatively small impact – compared to the size of the imbalance – is mainly explained by the peculiar price elasticity we find for imports: namely, Chinese imports are negatively affected by renminbi's real appreciation. By estimating bilateral import equations, we find that it is imports from other Asian countries which tend to fall but not others. This apparently counterintuitive result might well be explained by the particular nature of intraregional trade in Asia, namely that of vertical integration. In fact, Chinese imports from the rest of Southeast Asia are mostly geared towards re-exporting. In addition, we show evidence that the Asian countries do not seem able to compensate the reduction in their exports to China by increasing exports to other countries as their total exports are generally negatively affected by renminbi's appreciation. In other words, exports from South East Asian countries seem to be more complementary than a substitute to those of China.

The rest of the paper is organized as follows. Section 2 reviews the existing literature. Section 3 describes the methodology and the data used. Section 4 presents the results on how China's exports and imports react to changes in the exchange rate and demand. In Chapter 5, we try to dig deeper into the issue why Chinese imports do not get a boost from renminbi's appreciation by estimating bilateral trade equations with its main trade partners and then by analysing selected Asian countries' export equations. Chapter 6 concludes.

2. Literature Review

The existing literature on the impact of a renminbi real appreciation on China's trade may be divided into two groups according to the policy implications. The first strand –and largest – shows evidence that a renminbi's real exchange appreciation reduces the trade balance, either through exports or imports or both. The second strand either finds no significant impact on the trade balance or even a positive one. Table 1 summarizes the existing literature as well as the methodology used.

Within the first strand, Cerra and Dayal-Gulati (1999) estimate the price elasticities of China's exports and imports for the period 1983-1997 with an error correction model and find them to be negative and significant for exports (-0.3) and positive and significant for imports (0.7). In addition, they show that both elasticities increase over time. Dees (2001) improves on the previous analysis by separating China's exports and imports into two categories, those processed (i.e., imports of components for assembly) and ordinary ones. He finds that, in the long term, exchange rate appreciation decreases exports. He also reports that ordinary exports are more price sensitive than processing exports and imports for processing slightly increase in a case of a renminbi appreciation. Bénassy-Quéré and Lahrèche-Révil (2003) simulate the impact of a 10 per cent renminbi real depreciation and report an increase in China's exports to the OECD countries and a reduction of China's imports from emerging Asia if their exchange rates remained unchanged. Kamada and Takagawa (2005) do some model simulations to calculate the effects of China's exchange rate reform. They show that a 10 per cent revaluation would boost Chinese imports slightly while the impact on China's exports would be tiny. These four papers thus find exports to be affected negatively and imports positively by a renminbi appreciation. All of these studies use data prior to China's WTO membership.

A few more papers using the data practically prior to the WTO membership concentrate on studying solely the Chinese exports. Yue and Hua (2002) and Eckaus (2004) both confirm the earlier result that a a real exchange rate appreciation reduces China's exports.

As Cerra and Dayal-Guyati, but with more recent data, Yue and Hua show that Chinese exports are becoming more price-sensitive. Voon, Guangzhong and Ran (2006) use sectoral data for 1978-1998 and incorporate the degree of overvaluation of the renminbi when estimating China's export equations; they also find a negative link between appreciation and China's exports.

The papers using more recent data support the earlier results on exports' negative exchange rate elasticity but challenged the result that a renminbi appreciation would increase imports to China. Lau, Mo and Li (2004) estimate China's exports to and imports from the G-3 using quarterly data. In the long-run, an appreciation of the real effective exchange rate is found significant in lowering exports. Instead, neither ordinary imports nor imports for processing seem to be affected by the REER. In any event, the results are difficult to interpret since it is not clear how they discount exports and imports and the number of observations is small. Thorbecke (2006) uses a gravity model to study the effect of exchange rate changes on triangular trading patterns in Asia. To that end, he disaggregates exports into intermediate, capital and final goods. His results indicate that a 10 per cent renminbi appreciation reduces Chinese final exports by nearly 13%. However, the appreciation would not significantly affect Chinese imports from the US. Finally, Shu and Yip (2006) estimate the impact of exchange rate movements on the Chinese economy as a whole and find that an appreciation can reduce exports due to an expenditure-switching effect, resulting in a moderate contraction in aggregate demand.

While the earlier papers have come to a conclusion that a renminbi appreciation would lead to a decline in China's trade surplus mainly via its negative impact on the Chinese exports, some other papers offer a somewhat different view on how exchange rate policy may affect China's trade surplus. For example, Jin (2003) estimates the relationship among real interest rates, real exchange rates and China's balance of payments and concludes that a real appreciation tends actually to increase the surplus of the balance of payments. Cerra and Saxena (2003) use sectoral data to study the behaviour of Chinese exporters and find that higher export prices have increased the supply of exports, particularly in recent years. The impact of nominal exchange rate on exports is not robust. In any event, their results – as any other with sectoral data - should be taken with care since only about half of Chinese exports are covered in the sectoral data and no quality adjustment is reported in the unit price series.

One of the most recent attempts to estimate Chinese import and export equations is that of Marquez and Schindler (2006). They use shares of world total trade instead of import and export volumes to avoid employing proxies for China's export and import prices. According to their results, the real appreciation of the renminbi not only affects China's export share negatively but also the import share, at least for ordinary trade. While interesting, estimated impacts are on import and export shares so that no inference can be made on the trade account. In addition, no cointegration techniques are used so that only short-run elasticities can be estimated.

As a short summary, a clear majority of earlier studies have found that a real appreciation of exchange rate reduces Chinese exports. The result is robust to changes in research method, time period and data coverage. However, the results on Chinese imports' exchange rate elasticity are much more ambiguous. While the earlier studies found an appreciation to increase Chinese imports, the more recent studies have ended up with very different finding. Overall, no clear conclusions about the impacts of a renminbi revaluation on China's trade balance can be made based on the earlier studies.

In this paper we look at the impact of the real exchange rate on China's trade with more recent data. In addition, cointegration techniques are used in order to focus on longer-term structural developments. We also expand the analysis from aggregate import and export equations to bilateral ones so as to investigate whether large differences exist among China's trade partners. This is particularly important for the rest of Asia, as we shall show later.

Table 1. Earlier literature

Authors	Data	Methodology	Impact of REER on exports/imports	Estimated price elasticities	Impact of demand	Other control variables
Bénassy-Quéré and Lahrèche-Révil, 2003	Yearly 1984-2001	Gravity model	A renminbi real depreciation increases China's exports to the OECD and reduces Asian exports to China.	-1.2 (exports)	-	-
Cerra and Dayal-Gulati, 1999	Quarterly, 1983-1997	Error Correction Model	No effect on exports/imports for 1983-97. For 1988 to 1997, negative and significant impact on exports and positive and significant on imports.	-0.3 (exports) 0.7 (imports)	Significant and positive for 1988-1997 period	FDI, industrial production, output gap
Cerra and Saxena, 2003	Quarterly sectoral data, 1985-2001	Dynamic OLS	Price elasticity of exports increases towards end of period. NEER does not have a robust significant impact and industry-level results mixed.	1985-2001: -1.0 1994-2001: 3.8 (export supply)	-	Domestic credit
Dees, 2001	Monthly, 1994-1999	Error Correction Model	Appreciation decreases exports. Effect stronger on ordinary exports than on processed ones. No significant effect on ordinary imports but appreciation slightly increases processed imports.	-0.3 (exports) 0.2 (imports for processing)	Positive and significant for exports and imports.	Simulation of a shock to the economy gives the same results.
Eckaus, 2004	Yearly, 1985-2002	OLS	Negative and significant effect on exports to the U.S. and China's share of U.S. imports.	-0.3 (exports to the U.S)	Positive and significant effect	
Kamada and Takagawa, 2005	Monthly, 1994-2000	Theoretical model and OLS estimation	Revaluation causes a one-time import boost in the model but OLS shows no significant effect.	-	-	-
Lau, Mo and Li, 2004	Quarterly, 1995-2003	Dynamic OLS	Negative and significant effect on exports and imports for processing. No significant effect on ordinary imports.	-1.47 (exports) -1.28 (imports for processing)	Positive effect on exports.	FDI, VAT tax rebates and exports
Marquez and Schindler, 2006	Monthly, 1/1997-2/2004	OLS, studies effect on China's market share in world exports and imports	An appreciation lowers ordinary imports but for processed imports effect not robust. Effect on exports also not robust.	10% appreciation reduces China's export share by 0.5% and the import share by 0.1%	Positive for imports but not robust for exports.	FDI
Shu and Yip, 2006	Quarterly, 1995-2006	Error Correction Model	Appreciation reduces exports.	-1.3 (exports)	Positive and significant	Market share
Thorbecke, 2006	Annual, 1982-2003	Gravity model, Error Correction Model, OLS	In gravity model, an appreciation decreases China's exports. In VEC and OLS, exports to the U.S. decrease in a case of appreciation. No significant coefficient for imports. When studying	-1.3 (exports)	Positive and significant for exports. Income	Distances and common language in gravity models

			US-China trade in a gravity model, no clear outcome.		elasticity for imports no robust.	
Voon, Guangzhong and Ran, 2006	Annual, sectoral data 1978-1998	OLS	Negative impact of an appreciation on exports.	-	Positive and significant for exports.	Exchange rate volatility and misalignment
Yue and Hua, 2003	Annual, provincial 1980-2000	OLS, TSLS and fixed effect panel	Depreciation increases exports. Exchange rate sensitivity increases in the 1990s.	From -0.97 to -0.16 (exports)	Not significant.	Domestic production capacity

3. Methodology and data

To assess the sensitivity of Chinese exports and imports to changes in the renminbi real exchange rate, we estimate standard export and import equations. We use cointegration techniques because we are interested in the long-run relationships. In addition, we use a reduced form export and import equations to avoid simultaneous equation bias which would result from estimating supply and demand functions alone. However, to avoid potential problems with omitted variables, we include supply and demand determinants in the reduced form equation.[6]

The two estimating equations are as follows:

$$X_t = \alpha_0 + \alpha_1 REER_t + \alpha_2 Y_t^* + \sum_{i=3}^{n} \alpha_i controls_t + \varepsilon_t$$

$$M_t = \beta_0 + \beta_1 REER_t + \beta_2 Y_t + \sum_{i=3}^{n} \beta_i controls_t + \varepsilon_t$$

where X_t stands for the volume of exports from China, M_t for the volume of imports into China, $REER_t$ for the real effective exchange rate of the renminbi, Y_t^* for foreign demand and Y_t for China's domestic demand. The estimated parameters are: α_1 exchange rate elasticity of exports, α_2 income elasticity of exports, β_1 exchange rate elasticity of imports and β_2 income elasticity of imports.

Given the importance of the processing sector for the Chinese economy, we estimate separate equations for processed and ordinary exports. In the same way, we differentiate between imports for processing and ordinary imports.[7] Graphs A1 and A2 in the Appendix show the trends in ordinary and processed exports and imports: Both grew much faster from 2001 onwards, in conjunction with China's WTO entry.

A noticeable difficulty in working with the Chinese trade data is that values and volumes cannot be easily disentangled as no export and import price indices exist at the aggregate level. We, therefore, need to use proxies for the price data. As a proxy for export prices, we use China's consumer price index (CPI). The reason why we take such a general price measure is that China's National Bureau of Statistics does not provide data for a producer price index and the whole sale price index does not exist for our whole sample.[8] For import prices we calculate a weighted index of China's twenty-five most important trade partners' export prices and deflate China's imports with this index (data sources can be found in Table A1 in the Appendix). As a robustness test, we use Hong Kong export prices as a proxy for China's export prices and the results are maintained.[9]

The real effective exchange rate (REER) is drawn from the IMF international financial statistics and is constructed as follows:

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[6] See Goldstein and Khan (1985) for a critique of the prevailing assumption in export equations that supply is infinitively elastic.

[7] Imports for processing comprise imports of parts and components that are used in the processing sector as inputs to manufacture exports. Processed exports include components exported from China for assembly in other countries and exports of goods that are assembled using imported components. Ordinary trade, in turn, refers to goods which are not subject to further processing and not assembled from imported components.

[8] We also prefer the CPI to other external deflators, such as a weighted average of China's partners import prices. This is because China's has rapidly increased its market share and it already is a major world exporter so it is hard to argue that it is a pure price taker.

[9] The underlying assumption is that most of Hong Kong exports are originally produced in the Mainland China and that Hong Kong's mark-up of these goods remains relatively constant.

$$REER = \prod_{i=1}^{N} (rer_i)^{w_i}$$

Where N stands for the number of currencies included in the index, w_i is the weight of the i_{th} currency and $rer_{i,t}$ is the bilateral real exchange rate against each of China's trading partners.[10] We also use the REER constructed by the BIS as a robustness test but the results do not change.

We expect the exchange rate elasticity for exports to be negative as Chinese products compete in the world market. The expected sign for the exchange rate elasticity of imports is less clear in the Chinese case. A real appreciation should foster imports if the gained purchasing power is stronger than the reduced demand following the associated fall in exports. The reaction will very much depend also on the import structure. If imports are mainly substitutes for the domestic production, the price elasticity should be positive i.e. an appreciation should increase imports. However, if imports are basically components and investment goods directed to the export industry, which is very large in China's case, they may be affected negatively by an appreciation in the same way as exports are.

Foreign demand for Chinese exports is measured by world imports (excluding imports to China) and deflated by the global import price index. Obviously, some production-based measure could have also been used but the data does not exist in monthly terms. Furthermore, that kind of data may have even more serious difficulties in capturing the fast growth in world trade in the last few years, clearly faster than GDP growth, due to the opening up of emerging economies.

For China's domestic demand for ordinary imports we take the volume of industrial production. GDP would of course be a broader measure of economic output but China's statistical authorities have yet to publish quarterly GDP statistics for 1994-2005 since the major statistical reform in 2005. For imports for processing, we use processed exports as a demand factor in the long-run. The expected sign for the income elasticity is positive both for exports and imports.

Additional controls are included in the export and import equations on the basis of their relevance in the trade literature as well as the Chinese case. For exports, we test for the relevance of value-added tax (VAT) rebates that are used in China as a policy tool either to encourage or discourage exports depending on the business cycles. The expected sign on VAT rebates is obviously positive.[11] In order to introduce supply considerations in our reduced–form equation, we use a measure of capacity utilization. The a priori is that high capacity utilization should point to potential supply constraints, which could hinder export growth. Capacity utilization is defined as the difference between the industrial production and its trend, the latter being calculated using a Hodrick Prescott filter.

The final control variable in the export equation is the real stock of inward foreign direct investment (FDI). While the relation between trade and exports is well established in the literature, it could be particularly relevant for China given the large amount of FDI directed to the export sector. Although in general one would expect that an increase in the stock of FDI should foster China's exports, the complicated structures of production chains, where components and unfinished products may travel via several countries before the final market, may complicate such a priori.[12]

Moving to the import equation, import tariffs clearly need to be included since they have experienced substantial reductions, particularly since WTO entry. The second control is

[10] For more details, see Bayoumi et al. (2005).

[11] Data for VAT rebates starts only from 1995 and ends already in 2004.

[12] Chinese monthly data on FDI only exists from 1997.

again the FDI stock. We would, in principle, expect to find a positive coefficient on the FDI stock as far as foreign companies are more likely to use imported machinery, components and parts in their production than Chinese companies. However, as foreign companies start to gear the whole production chain to China, the need for imports could actually be reduced along an increase in the FDI stock.

Finally, a deterministic trend is included in both export and import equations when it is statistically significant. The trend variable should help to capture productivity improvements and the on-going reforms in the Chinese economy which we cannot easily measure otherwise.

All other variables except VAT rebates and import tariffs, which are measured as a share of value of exports and imports, are in logarithms. As Chinese may not follow the standard seasonal pattern, we prefer to use unadjusted series but to introduce dummies for the Chinese New Year and December.[13]

We use monthly data for the period 1994-2005. Starting the analysis prior to 1994 would have made little sense since that year was a breakthrough in China's market reforms. Some of the reforms are especially relevant for the question we pose to ourselves. Namely, the two exchange rate systems were unified, mandatory planning for imports was eliminated and licensing requirements and quotas were reduced. Also the price reform[14] was pushed forward, the renminbi started to be convertible on the current account and private sector development benefited from the new company law.

The continuous move toward a market economy allowed China to enter the WTO in December 2001. Due to the lengthy preparation for the accession and the agreed transition period thereafter, it is very difficult to estimate when, and how much, China's WTO membership started to influence China's trade. Factual information points to 2000 as the point when China' entry become clear. We also support the choice of 2000 to break our sample by statistical techniques, namely we find a structural break in the beginning of 2000 through a Chow test. In conclusion, we test whether China's foreign trade has become more price sensitive with WTO by dividing our sample into two periods: from 1994 to the end of 1999 and from the beginning of 2000 to the end of our sample.

4. Results for China's import and export equations

As a preliminary step, we test for the order of integration of the variables included in our analysis. We use the Augmented Dickey Fuller (ADF) tests for the existence of a unit root. Nearly all variables are found non-stationary in levels but stationary in the first differences.[15] We, then, test for the existence of cointegration vectors using the Johansen procedure. We do find at least one cointegrating vector for each variable group. As proposed by Phillips and Loretan (1991),[16] this allows us to estimate a regression of the lagged determinants and their differences through a non-linear least square approach. Such approach will yield unbiased and consistent estimates of the long-run and short-run parameters.[17]

[13] The final regression will only include the dummies when statistically significant.

[14] According to the OECD Economic Survey (2005), the share of transactions conducted at market prices among producer goods increased to 78 % in 1995, from 46 % in 1991.

[15] There are only a couple of exceptions: capacity utilization, which appears to be I(0), and the FDI stock which is not stationary even in the first differences. The latter result seems to be due to the relatively large number of lags suggested by the Akaike information criteria. If we use only one lag, as suggested by the Schwarz criterion, we can reject the unit root even at a 1% level.

[16] This approach tackles the simultaneity problem by including lagged values of the stationary deviation from the cointegrating relationship.

[17] The results of unit root and cointegration tests are available on a request from the authors.

As mentioned earlier, we ran regressions on export and import equations for our full sample (1994-2005), and for a shorter period (from 2000 to 2005), which concentrates on the post-WTO experience. In both cases, we consider important to distinguish between processed and ordinary trade and, therefore, run separate equations for each of them both in the case of exports and imports. The maximum number of short-term lags introduced into equations was three and we finally included only those ones that were statistically significant.

The full results for the export equations can be found on Table A2 in the Appendix.[18] As expected long-run exchange rate elasticities of China's exports – both processed and ordinary – are negative and significant in our full sample and also since WTO entry. When appropriately transformed (see Table 2), the estimated long-run impact of the real exchange rate is around -1.3 for processed exports for both periods. For ordinary exports, it drops from -2.3 measured for the whole period to -1.6 for the most recent sub-sample. Our results are very close to those previously found by other authors using cointegration analysis (-1.5 for total exports according to Lau, Mo and Li, 2004 and -1.3 for Shu and Yip, 2006). They are also similar to the estimated export price elasticities for major industrial countries (-1.5 and -1.6 for the US and the UK, respectively, according to Hooper et al., 1998).

The long-run positive effect from the world demand to Chinese exports is very small and not statistically significant in our full sample but it does become significant after WTO membership. This is the case both for ordinary and processed exports. This result is in line with the idea that China was facing considerable barriers to profiting from other countries' growth before WTO entry. In addition, for the most recent sample, the income elasticity of Chinese exports is very close to one, as expected.

Table 2. Long-run exchange rate and demand elasticities

		Ordinary exports	**Processed exports**	**Ordinary imports**	**Imports for processing**
Exchange rate elasticity	1994-2005	-2.3	-1.3	-1.0	-0.8
	2000-2005	-1.6	-1.4	-0.4	(-0.3)
Demand elasticity	1994-2005	(0.5)	(0.2)	-0.3	(0.2)
	2000-2005	1.0	0.8	0.3	0.4

Values in parentheses are not statistically significant.

As for the control variables, capacity utilization has a significant impact on exports only contemporaneously or with one month delay. The sign of the capacity utilization is negative, in line with the idea a larger share of the production stays in the domestic market in high growth periods. The VAT rebates are not statistically significant in any of the specifications and we thus leave them out from the final estimations as their inclusion would shorten the estimation period due to data constraints.[19] As mentioned above the data on FDI stock starts in 1997 and is thus introduced as an explanatory variable only during the most recent subperiod. Somewhat surprisingly, the FDI stock, however, does not affect Chinese exports statistically significantly. The trend is positive and significant for all equations while the Chinese New Year seems to decrease and December decrease exports quite noticeably. If we leave the trend out from estimations, the coefficients on both world demand and the FDI stock would become strongly positive and significant. However, our results on the exchange rate elasticity would remain very much unchanged.

[18] All the reported results pass the serial correlation test on residuals.

[19] VAT rebates could not be included as a short-run variable because we only had annual data on tariffs and thus changes were rare throughout the sample.

The estimated coefficients of the import equations are shown in Table A3 in the Appendix. Demand factors seem to play relatively moderate role in explaining imports in the past.[20] In the later subsample, imports for processing do react positively to external demand, measured by processed exports. Domestic industrial output increases ordinary imports as expected.

As one would expect, the FDI stock appears to have a positive effect in the long-run both on ordinary imports and imports for processing. Finally, a reduction in import tariffs does seem to foster imports for processing in the long-run.[21] As for exports, dummies for the Chinese New Year as well as for December were significant in most cases.

Finally, the exchange rate elasticity of imports is always negative and generally significant. The only exception is the case of imports for processing in the latter subperiod where the negative coefficient on the exchange rate is significant only at 15% level. In addition to the direct link from the exchange rate, the imports for processing are affected by the exchange rate also indirectly via the demand component i.e. processed exports. When also the indirect link is taken into account, the negative reaction of imports for processing to a real appreciation is actually stronger than the reaction of ordinary imports.

As a summary, a renminbi real appreciation tends to reduce imports rather than to increase them. While counterintuitive at first sight, such negative elasticity has already been reported in some of the most recent literature, such as Marquez and Schindler (2006). The finding basically implies that imports – even ordinary ones - are more sensitive to lower exports induced by the renminbi real appreciation than to a rise in the purchasing power.

5. Looking at the reasons behind the negative exchange rate elasticity

The fact that the impact of the renminbi real appreciation on imports is negative is an interesting phenomenon which requires careful analysis. This is all the more so given its negative implications for the reduction of China's trade surplus in the event of a real exchange appreciation. Our a priori hypothesis is that this is related to the special characteristics of China's trade as illustrated by the large differences in China's bilateral trade balances across countries (Graphs 2 and 3).

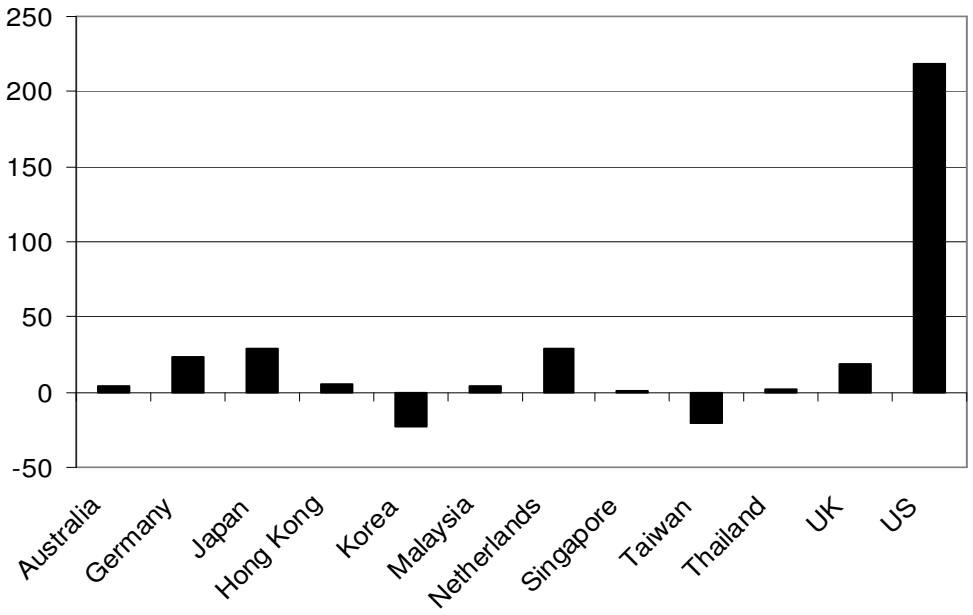
China imports a large amount of intermediate goods from the rest of Asia for processing and re-exporting. As a result, the high degree of vertical integration among Asian exporting industries makes their exports more complementary than substitutes of Chinese goods. This implies that an appreciation of the renminbi could lead to a decrease not only in Chinese exports but also in imports.

While the vertical integration applies more for the processing industry, one should not forget that also many ordinary imports function as inputs to the export sector, for example investment goods. Overall, it seems that only a small share of import products do compete with Chinese domestic production. This is because the share of non-high quality consumption goods in China's imports is relatively small. In addition, a considerable part of imports consists of energy and raw materials and some of the import products only follow foreign direct investment.

[20] In the case of ordinary imports, the income elasticity becomes positive and significant for 1994-2005 if we leave trend variable out from the regression.

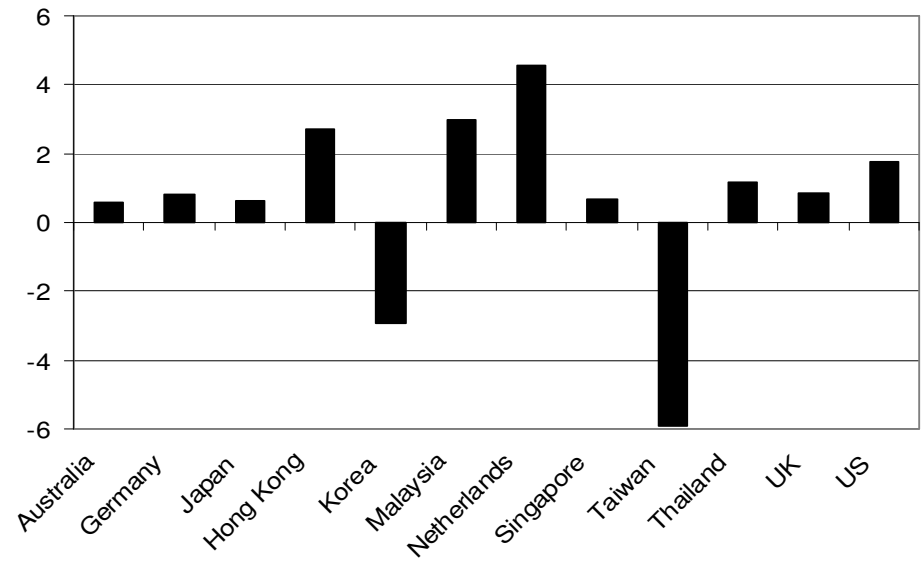
[21] Import tariffs could not be included as a short-run variable because we only had annual data on tariffs and thus changes were rare throughout the sample.

Graph 2. China's bilateral trade balances with selected countries in 2005, bn USD



Source: IMF Direction of Trade, the data for Taiwan from the Bureau of Foreign Trade
Note: Data from partners' side.

Graph 3. China's bilateral trade balances with selected countries in 2005, % of each country's GDP.



Source: IMF Direction of Trade, the data for Taiwan from the Bureau of Foreign Trade
Note: Data from partners' side.

In order to explore the issue further with readably available date, we run bilateral regressions for China's ten largest trade partners so as to assess possible different impacts of a renminbi real appreciation across countries. Our a priori is that imports from Southeast Asian countries should respond negatively to a renminbi appreciation, being mainly intermediary products for China to assemble and re-export. In turn, imports from other

countries are expected to react to renminbi appreciation more ambiguously depending their export structure. The estimated bilateral equations take the following format:

$$X_{tj} = \alpha_{0j} + \alpha_{1j} RER_{tj} + \alpha_{2j} Y_{tj}^{*} + \sum_{i=3}^{n} \alpha_{ij} controls_{tj} + \varepsilon_{tj}$$

$$M_{tj} = \beta_{0j} + \beta_{1j} RER_{tj} + \beta_{2j} Y_{t} + \sum_{i=3}^{n} \beta_{ij} controls_{tj} + \varepsilon_{tj}$$

Where Chinese exports and imports to/from country j (X_{tj} and M_{tj}, respectively) are explained by the bilateral real exchange rate (RER_{jt}), external and domestic demand (Y_{tj}^* and Y_t) and other control variables. Unfortunately, we cannot separate exports and imports for ordinary and processing products as no such data exists. As in the previous exercise, the CPI is used as a deflator for Chinese exports and imports to China are converted into volumes by using the export price index of each trade partner.[22] The bilateral real exchange rate between the renminbi and the currency of each of China's export and import partners is measured in CPI terms. The demand for China's exports is proxied by the real GDP of each of its export partners while China's domestic demand is again captured by industrial production. We also introduce the stock of bilateral FDI in both export and import equations. As before, we introduce the capacity utilization for China's export equations. Finally, a trend was introduced when statistically significant.[23] Data sources are again reported in the Table A1 in the Appendix.

We estimate the bilateral trade equations for 2000-2005 because for some countries, data did not exist for the whole period. This practise allows us to compare results between countries and also with those for aggregate export and import equations. Following the same procedure as before, we conduct unit root tests for all bilateral variables. Virtually all of them are I(1) and at least one cointegration vector was found for each bilateral import and export equation.[24]

The results for the bilateral export equations are very similar to our aggregate estimations and also across countries (see Table A4 in the Appendix).[25] The bilateral appreciation of the renminbi real exchange rate against that of each of China's major partners reduces Chinese exports although for the US and Taiwan the link is not statistically significant. The only exception is Hong Kong which coefficient is positive but not statistically significant. The result for Hong Kong is not surprising given the difficulties in interpreting the trade data between the Mainland China and Hong Kong. After transformation (see Table 3), the

[22] When we formulate the bilateral equations, we will not use China's trade data but the trade partners' statistics to alleviate the incorrect account of China's trade with Hong Kong. China's statistics show a large amount of exports to Hong Kong, which in reality only transit via Hong Kong to other countries. In any event, the data we use has other well-known caveats. For example, due to some taxation reasons and its large ports, the Netherlands is often signed as a final destiny although the goods might continue their way to other European countries. This explains the significance of the Netherlands as one of China's major trade partners and also its large trade deficit with China. In reality, the bilateral equation on the trade between China and the Netherlands reflects the dynamics of trade between China and Europe more generally.

[23] The number of short-term lags included into the final estimations is again based on their statistical significance. We use now data that is seasonally adjusted by the authors by using the CensusX12 programme in order to avoid seasonal fluctuations in China's trade partners' data. If statistically significant, we continued to introduce dummies for Chinese New Year and December.

[24] Capacity utilization was again I(0). The results of unit root and cointegration tests are available on a request from the authors.

[25] We do not report the equation on China's exports to Japan as it does not pass the standard misspecification tests. All reported results have passed the LM test on residuals' serial correlation.

exchange rate elasticity is highest for exports to Singapore if we ignore the insignificant coefficient on exports to the US.

We also find that economic activity in China's trade partners increases Chinese exports as one would expect. Bilateral income elasticities are highly significant for all countries except Germany. For the US and the European countries, such elasticities are very large.[26] This might be due to the relatively short time since China's entered WTO, a major structural change for world trade. In addition, it points to the importance of demand factors to explain the growing trade imbalance between China and the US or the EU countries.

In some cases, our measure of productivity gains, the trend variable, is also positive and significant. For Korea and Taiwan, however, the trend is negative. As for FDI, an increase of Korean or Taiwanese FDI into China raises Chinese exports to these countries but for Germany and Italy, the impact is the opposite. This might be due to the different behaviour in Asian and European multinationals when dealing with the Chinese markets. As mentioned above, a negative link could reflect a transfer of the entire manufacturing processes to China. While before it could be that some semi-finished products were first exported from China to Germany and only after some remodification shipped to the final destination, now the entire manufacturing process has probably been moved to China and there is no need to ship the product to Germany anymore. However, this result should be interpreted with caution as it demands deeper analysis.

The results for the bilateral import equations are much less homogenous as shown in Table A5 in the Appendix.[27] First, our estimated long-run price elasticities show that a renminbi real appreciation reduces imports from all Asian countries to China. The coefficient is significant for Korea and Thailand. For high-income countries – the US, Germany and Japan – the coefficient is negative but not statistically significant. Only for Russia and Australia, the coefficient is positive although not statistically significant.

Table 3. Bilateral long-run exchange rate and demand elasticities

	Export equation			Import equation	
	Bilateral RER	**Demand**		**Bilateral RER**	**Demand**
US	(-2.0)	5.9	**Japan**	(-0.4)	(-0.7)
Hong Kong	(0.2)	1.5	**Korea**	-0.8	2.7
Japan*			**US**	(-3.1)	1.2
Germany	-0.6	(2.0)	**Taiwan**	-1.1	6.8
Korea	-0.6	2.8	**Germany**	(-0.5)	(0.0)
Netherlands	-1.1	7.0	**Singapore***	-	-
UK	-0.6	8.2	**Russia**	(1.2)	(-0.5)
Singapore	-1.6	1.8	**Australia**	(0.1)	1.3
Italy	-1.3	3.6	**Malaysia**	(-0.3)	(0.2)
Taiwan	(-0.4)	5.6	**Thailand**	-1.0	(0.5)

Values in parentheses are not statistically significant. *) Bilateral equations for trade with Japan and Singapore did not pass the misspecification tests.

As for the income elasticities, they are generally positive although rather low and not always statistically significant. Most countries' exports to China increase along bilateral FDI stock. China's imports from Japan, Taiwan, Germany, Russia, Malaysia and Thailand increase along FDI from these countries. Again, Korea is somewhat exceptional with negative and

[26] The high income elasticity of Chinese imports to US is found also by Mann and Plück (2005).

[27] Out of China's ten most important import destinations, we drop Singapore due to econometric problems. All reported results have passed the LM test on residuals' serial correlation.

significant coefficient on FDI. Table 3 summarises the transformed long-run price and income elasticities for China's bilateral export and import equations.

Table 4. Structure of imports to China from major partners as a share of total imports in 2005

	Agricultural product	Mineral products	Chemicals	Textiles	Base metals	Machinery	Electronics	Vehicles	Optical instruments
Australia	4.5	**52.8**	10.2	8.2	**12.7**	1.9	0.8	1	0.4
Germany	0.2	0.2	6.9	0.6	7.8	**35.9**	**13.1**	**11.9**	6
Japan	0.2	1.5	8.8	3.7	**11.4**	**21.5**	**30.0**	4.5	8.7
Korea	0.6	4.7	10.2	3.8	9.7	9.5	**33.6**	2.8	**14.8**
Malaysia	6.4	2.6	4.1	0.7	1.8	8.6	**63.0**	0.1	1.3
Russia	5.0	**48.4**	13.9	0.0	**16.2**	0.5	0.4	1.2	0.0
Taiwan	0.1	0.9	7.4	4.5	10	9.7	**38.7**	0.5	16.1
Thailand	6.1	5.9	4.4	2.6	2.9	**27.5**	**26.5**	0.3	1.3
US	8.6	2	**11.3**	4.3	6.7	**17.1**	**17.5**	8.9	7.8

Source: CEIC

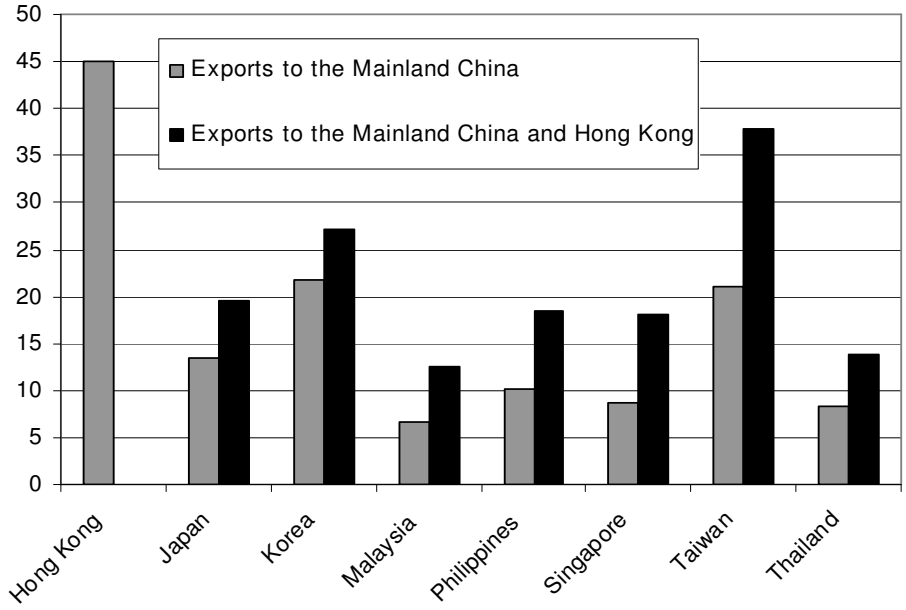
To better understand the diverse results found for Chinese imports' exchange rate elasticity, we look into the composition of China's imports from each of its major trading partners (Table 4). Australia and Russia basically export energy and raw materials to China, which might explain the weak reactions of the Chinese imports from these countries for changes in the bilateral real exchange rate. Somewhat surprising is that an increase in China's economic activity does not have a significant positive impact on Russian imports. Actually, the link is negative although very far from being statistically significant. This could be explained by the underdeveloped transport connections between Russia and China. If the railway capacity has been used, no more oil could have been transported to China despite the level of demand. On the contrary, Australian imports do increase along China's industrial value-added.

A second group of countries that we can separate based on the results, are high-income countries. Exports from Germany, Japan and the US are not sensitive to changes in the bilateral real exchange rate. While in Germany's and Japan's cases the imports are clearly driven by the FDI, US imports seem to benefit more from overall economic development in China. This is natural when looking closely the import structure from these countries. While about a half of German and Japanese exports to China are machinery and electronics – products that are often used in the export-oriented and to a wide extent foreign owned industries – the imports from the US are much more widely disbursed from soybeans to airplanes and high-tech chips. While many of these products are directed to the domestic sector, there are no substitutes or Chinese competition for these products which very much explains the low and even negative exchange rate elasticity.

The third group of countries consists of emerging Asian countries which exports to China are negatively affected by a renminbi appreciation. They mainly export products, parts and components to Chinese export industry and their exports to China are thus negatively linked to renminbi appreciation.

As we can see from the Graph 4, the share of exports going to the Mainland China is very high for a number of Asian countries. If we assume that a part of the exports to Hong Kong also end up to the Mainland China the share becomes even larger. For example, exports from Taiwan to the Mainland China and Hong Kong consist of close to 40 % of all Taiwanese exports.

Graph 4: Share of exports going to the Mainland China and Hong Kong of selected Asian countries in 2005, %



Source: IMF Direction of Trade, the data for Taiwan from the Bureau of Foreign Trade

Therefore, our results pointing to a renminbi appreciation reducing imports from the rest of Asia to China should be a concern for many Asian countries. This is even more so if they are not able to compensate this effect by increasing exports to other destinations. This very much depends upon the degree of complementarity among Asian exports and also upon the reactions of the Asian supply chains to a renminbi revaluation. While testing for this hypothesis would require a detailed sectoral analysis, we attempt to give a preliminary answer by estimating export equations for China's main trade partners in Asia.

The form of the export equation is the same we had for China earlier on so that we explain exports by the country's own real effective exchange rate and world demand. In addition, we include into the equation China's real effective exchange rate as an additional explanatory variable. The data on exchange rates is again CPI-based and the world demand is measured by world total imports. The trend is included when it is found statistically significant.

We estimate the export equations for China's main Asian trade partners for the period 2000-2005.[28] The data we use is seasonally adjusted by the authors by using CensusX12 programme. We find our variables again integrated of degree one and there exists at least one cointegrating vector among each group of variables.[29]

Table 5. Export equations for China's major regional trading partners

	China's REER	REER	Foreign demand
Hong Kong	(-0.4)	(-0.5)	1.0
Japan*	-	-	-
Korea	-0.6	-0.3	1.2
Malaysia	1.4	-2.4	1.1
Philippines	(-0.3)	1.2	(0.3)
Singapore	(-0.1)	-1.1	1.9

[28] We had to drop Indonesia from the data sample due to lack of data.

[29] The results of unit root and cointegration tests are available on a request from the authors.

Taiwan	-2.0	0.8	0.8
Thailand	-0.5	(0.5)	(0.2)

Values in parentheses are not statistically significant. *) Equation for exports from Japan did not pass the misspecification tests.

The detailed results from the export equations for the selected Asian countries are reported in the Table A6 in the Appendix.[30] When transforming the obtained long-run coefficients (Table 5), we can see that exports from most Asian countries are negatively affected by China's real exchange appreciation. For Korea, Taiwan and Thailand, the negative impact of the renminbi appreciation is statistically significant. The only exception is Malaysia, which exports would benefit from renminbi real appreciation. However, this exceptionally result may be due to a fact that besides electronics, Malaysia also exports substantial quantities of oil and other raw materials. Thus, the country-based results from the export equations are very close to ones we found for China's bilateral import equations so that exports from many other Asian countries do not seem to be redirected fully to other countries when China's demand for imports shrinks. As expected income elasticities are always positive although not statistically significant in the case of Philippines and Thailand. Our results are thus very much in line with Ahearne et al. (2006) and Cutler et al. (2004) who found that common factors, like the world demand, drive exports both from China and the other Asian economies.

6. Conclusions

During the last few years, there has been an intensive discussion both in China and in international fora on the desirability of a renminbi appreciation. Many have argued that exchange rate policy would not serve the purpose of reducing China's large trade surplus. This paper shows empirically that China's trade balance is sensitive to fluctuations in the real effective exchange rate. In fact, estimating long-run elasticities of Chinese exports and imports to changes in the renminbi's real effective exchange rate for the period from 1994 to end-2005, we find strong evidence that a real appreciation reduces exports substantially in the long-run. This is the case both for processed exports (i.e. transformed and re-exported goods) and ordinary exports. However, real exchange rate appreciation reduces also imports to China. This limits the net impact of exchange rate policy on the trade surplus.

Based on our estimated elasticities for the period since WTO entry was known, a 5% real appreciation of the renminbi effective exchange rate – other things given - would have led to about 7% reduction in export volume in 2005. When we take into account the direct link from the exchange rate on imports as well as the indirect link from a decrease in processed exports on imports for processing, total volume of imports would have decreased by about 4%. Based on these estimates, the trade surplus would have shrunk almost by a quarter from about USD100 billion to less than USD80 billion. However, these figures have to be treated with extreme care as this is just a very rough calculation without taking into account, for example, the pass-through effects from the exchange rate on export and import prices and thus on the trade surplus. It is likely that our figures overestimate the reduction in the trade surplus as in a case of appreciation, the export prices denominated in foreign currency would probably increase so that the actual impact on the trade balance would actually be even considerably smaller. On the other hand, fluctuations in the renminbi exchange rate may not influence e.g. the oil world market price so that the pass-through effect on the Chinese import prices could be much smaller. Unfortunately, pass-through effects in China are difficult to estimate due to lack of time series data on export and import prices.

Although not completely new, our finding that China's imports decrease as a result of the exchange rate appreciation is very interesting and its reasoning had to be studied deeper. We explore the issue further by estimating bilateral equations for China's trade with its

[30] All the reported results pass the LM misspecification test.

major trading partners. It seems that the renminbi bilateral real appreciation against the currency of a trading partner generally reduces exports particularly from other Asian countries. The result for Chinese imports from Asia is probably explained by the high degree of vertical integration of the exporting sectors of Asian countries. Such Asian production network makes products from other Asian countries more of a complement than a substitute. This hypothesis is supported by our results according to which the total exports from Asian countries – and not only exports to China- are negatively affected by a renminbi's real appreciation.

These findings raise concerns in terms of Asia's reaction to a sudden appreciation of the renminbi, particularly if Asian countries also appreciate against other currencies. Although this study only concentrates on the volumes of imports and exports - so that the conclusions cannot be comprehensive – it does serve to note the importance of investigating further potential effects from a Chinese real appreciation and different combinations of exchange rate policies in Asia. Even though there are a number of papers on this issue, studies using fresh data are needed.

Finally, while Chinese exports have clearly benefited from fast economic growth in advanced economies, the income elasticity of the Chinese imports is found rather low in this paper. It seems that imports to China are more dependent on foreign direct investment than economic activity in the country. Although the data sample in this paper runs only until the end of 2005, these results are confirmed by the more recent economic developments. Strong external demand and increasing FDI inflows kept Chinese exports and imports growing until summer 2008. Since then, the worldwide economic downturn and sudden drops in the FDI have contributed to much weaker Chinese exports as well as imports, specially from Asian partners. In fact, intra-Asian trade has plummeted in the past few months.

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Appendix

Table A1. Data sources

China's export and import equations

Variable	Explanation	Frequency	Source	Method
processed exports	The volume of China's processed exports	Monthly	CEIC	Original data in US dollars. Converted to renminbi and deflated by China's CPI. In logs.
ordinary exports	The volume of China's ordinary exports	Monthly	CEIC	Original data in US dollars. Converted to renminbi and deflated by China's CPI. In logs.
imports for processing	The volume of China's imports for processing	Monthly	CEIC	Original data in US dollars. Converted to renminbi and deflated by China's import price index. In logs.
ordinary imports	The volume of China's ordinary imports	Monthly	CEIC	Original data in US dollars. Converted to renminbi and deflated by China's import price index. In logs.
	China's import price index	Monthly	IFS, own calculations	Index was calculated by taking weighted average of China's 25 most important trading partners' export price indices.
demand for exports	The volume of world total imports excl. imports to China	Monthly	IFS	In US dollars, converted into volumes by world import price index (IFS), in logs.
demand for imports	The volume of industrial production in China	Monthly	CEIC	Index constructed by using real growth rates, in logs.
reer	China's real effective exchange rate	Monthly	IFS	CPI based measure
capacity utilization	Estimate for output gap	Monthly	CEIC, own calculations	Business cycles estimated by using Hodrick-Prescott filter on industrial production data (CEIC)
import tariffs	Weighted average import tariffs as a share of total imports	Annual	IMF Occasional Paper, WTO	The authors calculated the weighted average for 2001-2005 with help of WTO tariff data. Data for 1999-2000 was interpolated as it was not available.
VAT rebates	Value-added tax rebates on exports as a share of total exports	Annual	WTO	The amount of value-added tax returned to the exporters as a share of total exports
FDI	Accumulation of foreign direct investment into China	Monthly	CEIC	Original data in US dollars. Converted to renminbi and deflated by China's CPI. In logs.
	China's CPI	Monthly	CEIC	

China's bilateral export and import equations

Variable	Explanation	Frequency	Source	Method
exports	The volume of China's bilateral exports	Monthly	Direction of trade, except data for Taiwan from CEIC	Data from China's trade partners' side. Original data in US dollars. Converted to renminbi and deflated by China's CPI. Seasonally adjusted. In logs.
imports	The volume of China's bilateral imports	Monthly	Direction of trade, except data for Taiwan from CEIC	Data from China's trade partners' side. Original data in US dollars. Deflated by trade partners' export prices. Seasonally adjusted. In logs.
	Trade partners' export prices	Monthly	IFS, except data for Taiwan from CEIC	Unit price index, not available for Malaysia and Taiwan for which we used CGPI data. For Russia we used IFS export price index for oil-exporting countries.
demand for exports	Real GDP in each trading partner	Quarterly	Bloomberg	The quarterly data on real GDP was interpolated into a monthly data. Seasonally adjusted. In logs
demand for imports	The volume of industrial production in China	Monthly	CEIC	Index constructed by using real growth rates. In logs.
rer	Bilateral real exchange rate	Monthly	Own calculations	Based on nominal exchange rate and CPI data. For Australia, monthly CPI data was not available export price data was used.
	Bilateral nominal exchange rate	Monthly	IFS, except data for Germany, Netherlands and Italy from BIS and for Russia and Taiwan from Bloomberg	
	Consumer price index	Monthly	BIS, except data for Taiwan from Bloomberg	
bilateral FDI	Accumulation of bilateral direct investment into China	Monthly	CEIC	Original data in US dollars. Converted to renminbi and deflated by China's CPI. Seasonally adjusted. In logs.

Export equations for selected Asian countries

Variable	Explanation	Frequency	Source	Method
exports	The volume of each Asian country's total exports	Monthly	IFS, except data for Taiwan from CEIC	Original data in US dollars. Deflated by each country's export price index. For Malaysia, Philippines and Taiwan, export price data was not available and CPI was used. Seasonally adjusted. In logs.
	Each Asian country's export prices	Monthly	IFS, except data for Taiwan from Bloomberg	Unit price index.
demand for exports	The volume of world total imports	Monthly	IFS	Original data in US dollars. Deflated by the world import price index (IFS). Seasonally adjusted. In logs.
China's reer	China's real effective exchange rate	Monthly	IFS	CPI based measure
reer	Each Asian country's real effective exchange rate	Monthly	BIS	

Table A2. China's export equations

	Dependent variable			
	Full sample		From WTO onwards	
	D_ordinary exports	**D_processed exports**	**D_ordinary exports**	**D_processed exports**
Long-run coefficients				
C	6.358*** (2.092)	4.966** (1.424)	5.578 (5.965)	4.789 (6.094)
world imports$_{t-1}$	0.256 (.243)	0.110 (.176)	1.006*** (.326)	0.598* (.360)
reer$_{t-1}$	-1.190*** (.191)	-0.649*** (.108)	-1.604*** (.246)	-0.996*** (.209)
ordinary exports$_{t-1}$	-0.519*** (.066)		-1.005*** (.095)	
processed exports$_{t-1}$		-0.485*** (.055)		-0.719*** (.104)
fdi$_{t-1}$			-0.099 (.399)	-0.107 (.391)
trend	0.006*** (.002)	0.006*** (.001)	0.011*** (.004)	0.010** (.004)
New Year dummy	-0.265*** (.030)	-0.257*** (.022)	-0.269*** (.029)	-0.252*** (.029)
December dummy	0.161*** (.032)	0.104*** (.023)		
Short-run coefficients				
D_world imports$_t$	0.381* (.209)	0.406*** (.149)	-0.055 (.216)	0.209 (.203)
D_world imports$_{t-1}$			-0.976*** (.229)	-0.398* (.203)
D_world imports$_{t-2}$			-0.752*** (.167)	-0.523*** (.141)
D_world imports$_{t-3}$				
D_reer$_t$	-0.673 (.730)	-0.214 (.539)	-1.494** (.617)	-1.160** (.537)
D_reer$_{t-1}$	0.928 (.750)	1.022* (.537)	1.518** (.647)	0.951* (.565)
D_reer$_{t-2}$	-0.023 (.740)	-0.522 (.529)		
D_reer$_{t-3}$	1.485** (.734)	1.059** (.526)		
D_capacity utilization$_t$		-0.607** (.256)	-0.591* (.315)	-1.213*** (.294)
D_capacity utilization$_{t-1}$			-0.709** (.341)	-0.626* (.321)
D_capacity utilization$_{t-2}$				
D_capacity utilization$_{t-3}$				
D_fdi$_t$				
D_fdi$_{t-1}$				
D_fdi$_{t-2}$				
D_fdi$_{t-3}$				
D_ordinary exports$_{t-1}$	-0.167*** (.060)		0.238*** (.078)	

D_processed exports$_{t-1}$		-0.099* (.055)		-0.056 (.085)
Sample period	5/1994-12/2005	5/1994-12/2005	1/2000-12/2005	1/2000-12/2005
Number of obs.	140	140	72	72
R^2 adjusted	.70	.78	.83	.85

Standard errors in parentheses. * Indicates significance at 10% level, ** at 5% level and *** at 1% level.

Table A3. China's import equations

	Dependent variable			
	Full sample		From WTO onwards	
	D_ordinary imports	D_imports for processing	D_ordinary imports	D_imports for processing
Long-run coefficients				
c	2.483***	6.465***	-0.962*	-2.520
	(.302)	(.866)	(.489)	(2.052)
domestic demand$_{t-1}$	-0.099**		0.095***	
	(.042)		(.033)	
processed exports $_{t-1}$		0.134		0.448***
		(.118)		(.152)
reer$_{t-1}$	-0.343***	-0.700***	-0.155**	-0.365
	(.059)	(.119)	(.059)	(.247)
import tariffs$_{t-1}$		-0.329***		-0.339***
		(.076)		(.120)
fdi$_{t-1}$			0.102**	0.685***
			(.050)	(.212)
ordinary imports$_{t-1}$	-0.327***		-0.355**	
	(.122)		(.166)	
imports for processing$_{t-1}$		-0.879***		-1.132***
		(.140)		(.176)
trend	0.005***	0.007***		
	(.000)	(.001)		
New Year dummy	-0.054***	0.239***	-0.014*	-0.220***
	(.008)	(.020)	(.008)	(.022)
December dummy	0.074***	0.117***		
	(.010)	(.025)		
Short-run coefficients				
D_domestic demand$_t$		1.079***	0.140***	2.027***
		(.280)	(.043)	(.306)
D_domestic demand$_t$			-0.105**	1.150***
			(.040)	(.346)
D_domestic demand$_t$			-0.189***	
			(.030)	
D_domestic demand$_t$				
D_reer$_t$	0.207	0.303	-0.445***	-0.998*
	(.237)	(.582)	(.148)	(.609)
D_reer$_{t-1}$	0.030	1.338**	0.520***	2.286***
	(.238)	(.579)	(.157)	(.606)
D_reer$_{t-2}$	-0.002	-0.566		
	(.245)	(.571)		
D_reer$_{t-3}$	0.492**	1.535***		
	(.236)	(.560)		
D_fdi$_t$			0.043	-1.231
			(.253)	(.943)
D_fdi$_{t-1}$			0.933***	0.452
			(.248)	(.883)
D_fdi$_{t-2}$			0.153	-2.725***
			(.241)	(.779)
D_fdi$_{t-3}$			-0.551***	
			(.206)	
D_ordinary imports$_{t-1}$	1.526***		2.155**	
	(.504)		(.840)	
D_imports for processing$_{t-1}$		0.045		-0.096
		(.058)		(.077)
Sample period	5/1994-12/2005	5/1994-12/2005	1/2000-12/2005	1/2000-12/2005
Number of obs.	140	140	72	72
R^2 adjusted	.95	.77	.97	.83

Standard errors in parentheses. * Indicates significance at 10% level, ** at 5% level and *** at 1% level.

Table A4. China's bilateral export equations

	US	HK	Germany	Korea	Netherlands	UK	Singapore	Italy	Taiwan
	Dependent variable: D_exports from China to country i								
Long-run coefficients									
c	-19.128*** (6.164)	-8.191*** (2.153)	-8.784 (26.864)	-34.200*** (10.334)	-20.457** (8.290)	-60.640*** (14.000)	-5.625 (5.366)	-23.138 (19.809)	-42.16*** (9.550)
GDP^i_{t-1}	3.426*** (.906)	1.020*** (.339)	2.340 (2.332)	2.821*** (.881)	2.947*** (1.055)	5.811*** (1.328)	1.664*** (.429)	4.659*** (1.907)	5.224*** (1.179)
rer^i_{t-1}	-1.173 (1.157)	0.108 (.749)	-0.727*** (.199)	-0.629*** (.179)	-0.442** (.173)	-0.456*** (.122)	-1.473*** (.495)	-1.649*** (.249)	-0.334 (.493)
FDI^i_{t-1}	0.082 (.196)	0.014 (.183)	-2.233*** (.363)	1.448*** (.325)	0.076 (.103)	-0.075 (.144)	-0.086 (.142)	-4.178*** (.762)	1.658*** (.480)
$exports^i_{t-1}$	-0.058 (.105)	-0.112 (.110)	-1.194*** (.176)	-1.130*** (.158)	-0.419*** (.117)	-0.707*** (.135)	-0.924*** (.185)	-1.295*** (.163)	-0.940*** (.181)
trend			0.040*** (.006)	-0.019* (0.007)			0.011** (.005)	0.046*** (.007)	-0.007* (.004)
New Year dummy				-0.019*** (.009)					
Short-run coefficients									
$D\_GDP^i_t$			-3.412 (2.884)		-2.574* (4.030)		1.230** (.575)		0.418 (1.214)
$D\_GDP^i_{t-1}$			-2.156 (3.036)		-4.532 (3.945)				-1.547 (1.433)
$D\_GDP^i_{t-2}$			-1.772 (2.960)		3.978 (3.867)				-1.685 (1.377)
$D\_GDP^i_{t-3}$			-8.127*** (2.633)		-10.298** (3.617)				-3.041** (1.217)
$D\_rer^i_t$			-0.562** (.275)		-0.340 (.371)	-1.143*** (.244)	-1.319** (.608)	-0.922*** (.339)	-2.093*** (.715)
$D\_rer^i_{t-1}$					0.646* (.396)	-0.024 (.275)	0.944 (.584)	0.716** (.329)	-0.389 (.777)
$D\_rer^i_{t-2}$						0.754*** (.255)	0.619 (.588)	0.757** (.338)	-1.781** (.771)
$D\_rer^i_{t-3}$							1.352** (.578)	0.864** (.330)	
$D\_FDI^i_t$					-2.003*	-0.193		-3.449	3.471

								**	
								(1.370)	(2.315)
					(1.095)	(.916)		2.468**	0.528
$D\_FDI^{i}_{t-1}$					1.944*	-1.096		(1.222)	(2.167)
						(.845)		3.530**	-4.231*
$D\_FDI^{i}_{t-2}$						2.821***		(1.214)	(2.180)
						(.848)			
$D\_FDI^{i}_{t-3}$									
		-1.047							-0.967
$D\_Cutilization_{t}$	0.197	***		-0.794**	-0.311				***
	(.284)	(.221)		(.282)	(.459)				(.341)
$D\_Cutilization_{t-1}$	-0.989***				-0.155				
	(.284)				(.632)				
$D\_Cutilization_{t-2}$					0.497				
					(.643)				
$D\_Cutilization_{t-3}$					1.040**				
					(.463)				
$D\_exports^{i}_{t-1}$	-0.058	-0.112	0.108	0.010	-0.088	-0.123	-0.070	.152	-0.002
	(.105)	(.110)	(.131)	(.106)	(.129)	(.111)	(.129)	(.112)	(.124)
Sample period	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05
Number of obs.	72	72	72	72	72	72	72	72	72
R^2 adjusted	.53	.59	.55	.64	.38	.60	.47	.57	.56

Standard errors in parentheses. * indicates significance at 10% level, ** at 5% level and *** at 1% level;

Table A5. China's bilateral import equations

	Japan	Korea	US	Taiwan	Germany	Russia	Australia	Malaysia	Thailand
	Dependent variable: D_imports from country i to China								
Long-run coefficients									
c	-3.501***	2.626**	5.902	-33.69***	-1.464	-0.787	-7.564***	-3.289	-0.249
	(.963)	(3.003)	(10.123)	(10.706)	(1.294)	(6.754)	(1.838)	(3.825)	(1.125)
China's demand$_{t-1}$	-0.248	1.888***	0.643***	2.657**	0.018	-0.250	1.562***	0.119	0.272
	(.197)	(.621)	(.224)	(1.149)	(.175)	(.626)	(.394)	(.472)	(.193)
rer$^{i}_{t-1}$	-0.134	-0.588***	-1.630	-0.441	-0.248	0.555	0.161	-0.188	-0.582**
	(.136)	(.201)	(1.781)	(.487)	(.174)	(.858)	(.132)	(.854)	(.236)
FDI$^{i}_{t-1}$	0.884***	-1.022***	-0.073	3.469***	0.598***	0.314*	-0.106	1.159**	0.924***
	(.299)	(.380)	(.390)	(.889)	(.220)	(.172)	(.190)	(.566)	(.309)
China's imports$^{i}_{t-1}$	-0.360***	-0.711***	-0.529***	-0.394***	-0.536***	-0.118	-1.169***	-0.585***	-0.574***
	(.104)	(.131)	(.128)	(.113)	(.136)	(.125)	(.158)	(.139)	(.112)
trend		0.011**		-0.039**					
		(.006)		(.015)					
New Year dummy	0.049**								
	(.019)								
Short-run coefficients									
D_ China's demand$_t$		2.218***		2.530***			1.064**		
		(.377)		(.688)			(.441)		
D_China's demand$_{-1}$									
D_China's demand$_{-2}$									
D_China's demand$_{-3}$									
D_rer$^{i}_t$		-0.928**							-0.467
		(.392)							(.635)
D_rer$^{i}_{t-1}$									1.547**
									(.602)
D_rer$^{i}_{t-2}$									
D_rer$^{i}_{t-3}$									
D_FDI$^{i}_t$	-1.023	3.749*		8.455***			-0.371		-0.755
	(1.504)	(1.977)		(3.145)			(.884)		(2.423)
D_FDI$^{i}_{t-1}$	-4.306***	1.075		-2.108			-0.513		-5.238**
	(1.444)	(2.101)		(3.083)			(.953)		(2.448)
D_FDI$^{i}_{t-2}$		-1.398		-5.730**			-1.998**		
		(2.071)		(2.854)			(.951)		
D_FDI$^{i}_{t-3}$		5.271***							

		(1.822)							
D_China's imports$^{i}_{t-1}$	-0.347**	-0.095	-0.193*	-0.328***	-0.239**	-0.118	0.112	-0.077	-0.050
	(.118)	(.098)	(.115)	(.107)	(.116)	(.125)	(.111)	(.122)	(.108)
Sample period	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05
Number of obs.	72	72	72	72	72	72	72	72	72
R^2 adjusted	.37	.73	.33	.48	.35	.22	.52	.27	.36

Standard errors in parentheses.

* indicates significance at 10% level, ** at 5% level and *** at 1% level

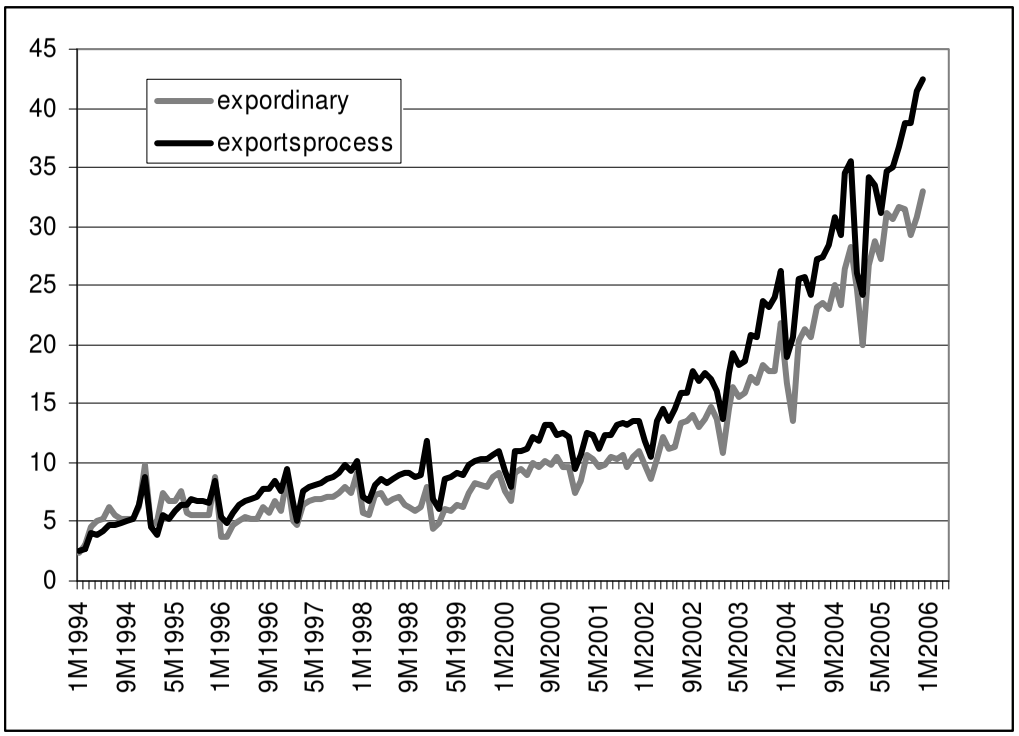
Table A6. Export equations for selected Asian countries

	Hong Kong	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
	Dependent variable: D_Total exports from Asian country i						
Long-run coefficients							
c	0.875	-1.019	-0.335	-0.827	-4.598*	1.805	1.276
	(2.086)	(1.104)	(1.274)	(1.973)	(2.318)	(2.423)	(2.356)
world imports$_{t-1}$	0.962***	0.841***	0.644***	0.075	1.422***	0.465***	0.149
	(.235)	(.211)	(.160)	(.112)	(.169)	(.214)	(.187)
China's reer$_{t-1}$	-0.383	-0.443***	0.817***	-0.087	-0.087	-1.105***	-0.317*
	(.304)	(.130)	(.374)	(.233)	(.202)	(.360)	(.190)
reer$^{i}_{t-1}$	-0.483	-0.182***	-1.394***	0.320***	-0.774***	0.426*	0.328
	(.309)	(.087)	(.465)	(.150)	(.453)	(.214)	(.255)
exports$^{i}_{t-1}$	-1.004***	-0.719***	-0.582***	-0.268***	-0.734***	-0.558***	-0.679***
	(.167)	(.141)	(.134)	(.080)	(.146)	(.142)	(.133)
trend					-0.002***		0.002*
					(.001)		(.001)
Short-run coefficients							
D_world imports$_{t}$	0.545***	1.174***	0.726***	0.787***	1.449***	0.919***	0.447
	(.184)	(.138)	(.213)	(.291)	(.169)	(.379)	(.275)
D_world imports$_{t-1}$		0.262	0.658***	0.507		0.455	0.406
		(.209)	(.254)	(.346)		(.399)	(.333)
D_World imports$_{t-2}$		0.302***	0.443*	0.519*		1.154***	0.492*
		(.135)	(.259)	(.277)		(.334)	(.262)
D_world imports$_{t-3}$			0.459***				
			(.201)				
D_China's reer$_{t}$	-0.596		-0.590*	-0.275***			-1.652***
	(.396)		(.352)	(.122)			(.441)
D_China's reer$_{t-1}$	0.446						1.384***
	(.426)						(.482)
D_China's reer$_{t-2}$	-0.448						
	(.397)						
D_China's reer$_{t-3}$	0.864***						
	(.410)						
D_reer$^{i}_{t}$				0.213		-0.891	1.008*
				(.333)		(.583)	(.569)
D_reer$^{i}_{t-1}$				-0.518		0.689	-1.067*
				(.320)		(.583)	(.586)
D_reer$^{i}_{t-2}$				-0.238*		-1.074*	
				(.327)		(.599)	
D_reer$^{i}_{t-3}$							
D_ exports$^{i}_{t-1}$	-0.002	-0.049	-0.324***	-0.275***	-0.235***	-0.325***	0.148

	(.114)	(.112)	(.100)	(.122)	(.081)	(.112)	(.115)
Sample period	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05	1/00-12/05
Number of obs.	72	72	72	72	72	72	72
R^2 adjusted	.53	.70	.65	.28	.70	.55	.46

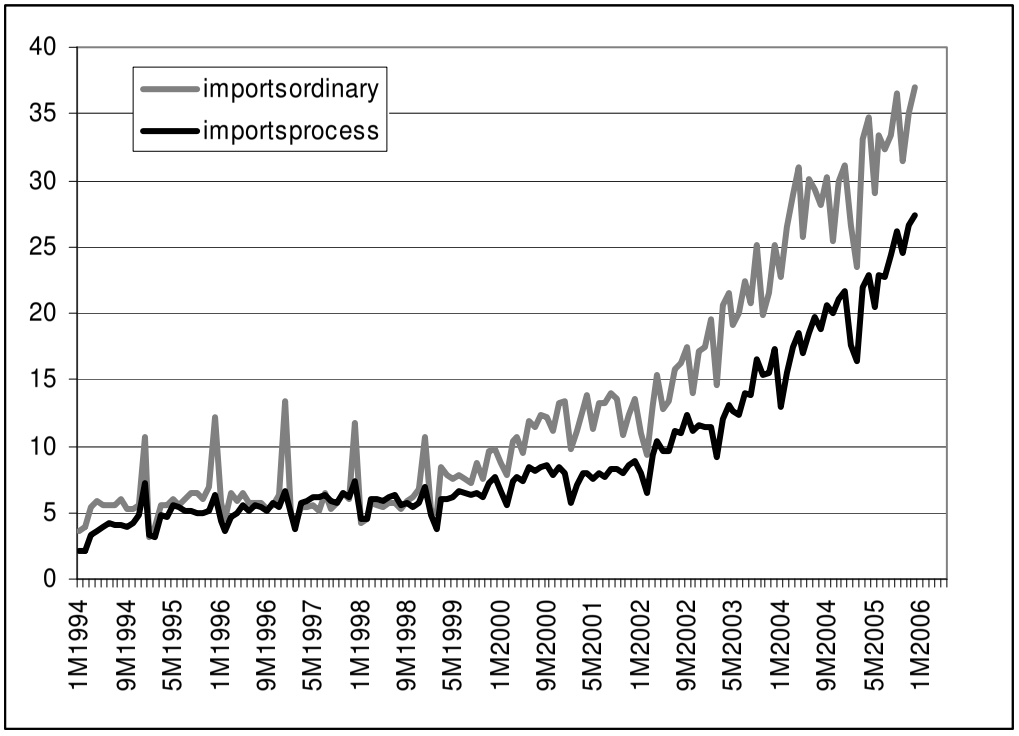
Standard errors in parentheses. * indicates significance at 10% level, ** at 5% level and *** at 1% level;

Graph A1. Ordinary and processed exports, bn USD



Source: CEIC

Graph A2. Ordinary and processed imports, bn USD



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