The Effect of a Generalized Appreciation of East Asian Currencies on Exports from China

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at George Mason University

By

Gordon R. Smith
Master of Arts
George Mason University, 2002
Master of Business Administration
Virginia Polytechnic Institute and State University, 1994
Bachelor of Arts
Wake Forest University, 1985

Director: Willem Thorbecke, Associate Professor
Department of Economics

Summer Semester 2008
George Mason University
Fairfax, VA

DEDICATION

This is dedicated to my family for encouraging me throughout the process, the head of my committee for his tireless support, and to God for His graciousness in helping me finish this dissertation.

ACKNOWLEDGEMENTS

I would like to thank my committee for their helpful input and advice in writing this dissertation. Their comments and support were greatly appreciated.

I would also like to thank the head of my committee for his tireless support, without which this dissertation would not have been completed.

Finally, I would like to thank my family for believing in me throughout this process. Thank you for seeing me through to the end.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

THE EFFECT OF A GENERALIZED APPRECIATION OF EAST ASIAN
CURRENCIES ON EXPORTS FROM CHINA

Gordon R. Smith, Ph.D.

George Mason University, 2008

Dissertation Director: Dr. Willem Thorbecke

By the end of 2007, China's current account surplus represented 11.1 percent of the
country's gross domestic product. Many have argued that an appreciation of the RMB
would help to reduce this surplus and restore order to global accounts. Using a panel data
set including China's exports to 33 countries, I find that a 10 percent RMB appreciation
would reduce ordinary exports by 10 percent and processed exports by 4 percent.
However, given the nature of ordinary exports and processed exports, a generalized
appreciation in East Asia would generate a greater impact on the China's overall level of
exports. A 10 percent appreciation of all East Asian currencies would reduce ordinary
exports by 10 percent and processed exports by 11 percent. A generalized appreciation in
East Asia would impact both types of exports originating out of China and contribute
more to resolving global imbalances than a bilateral appreciation of the RMB alone.

1. INTRODUCTION

Over the past several years, China has seen a significant rise in its trade and current account surpluses. The International Monetary Fund (IMF) estimates that by the end of 2007, China's current account surplus represented 11.1 percent of the country's gross domestic product (GDP). At $361 billion, it was the largest surplus of any country in the world, more than $100 billion greater than the country with the second largest surplus, Japan.

With such a large overall surplus, it would seem that China would have a trade surplus with just about every other country in the world. Interestingly, this is not the case. There appears to be a fairly clear delineation, as it regards China's trade accounts, between those countries in East Asia and the rest of the world.

Of China's seven largest trading partners in 2007 (countries/regions that represented more than $100 billion in total trade value each), five were in East Asia.[1] They were Japan, ASEAN (Association of Southeast Asian Nations), Hong Kong, South Korea, and Taiwan. Excluding Hong Kong, the four remaining countries/regions, as a group, recorded a trade surplus with China of more than $180 billion.[2] That is, in terms of

---

[1] Data reported by China's Customs Statistics.
[2] A significant percentage of exports from China to Hong Kong are subsequently shipped to the rest of the world, primarily to the European Union and the United States, never reaching the Hong Kong domestic market.

1

its trade accounts, China ran a substantial trade deficit with its major trading partners in East Asia.[3]

On the other side of the equation, China had a substantial trade surplus with its two largest trade partners, the European Union (EU) and the United States (U.S.). With a total value in trade of more than $600 billion (imports plus exports), the EU and U.S. had a combined deficit with China of more than $270 billion.[4]

What this implies is that the trade deficits which China carries with its trading partners in East Asia are more than compensated by the trade surpluses that China carries with the rest of the world. It is the size of these trade surpluses that has become the focus of attention of a number of countries, especially the United States.

China has received a great deal of scrutiny in the U.S. because of the size of its bilateral trade surplus. Several politicians and some economists have called for an appreciation of the RMB as a possible means of affecting China's trade surplus with the United States. This has come largely on the belief that China has intervened in the foreign exchange market in order to keep its currency artificially low with respect to the U.S. dollar. An appreciation of the RMB is seen as a way to increase the cost of, and thus reduce, China's exports. However, an appreciation of the RMB alone may not deliver the desired impact on all exports originating out of China. This is due to the intricate production and trade networks which exist in East Asia.

---

[3] The trade surplus for ASEAN is calculated for the ASEAN 5 nations; Indonesia, Malaysia, the Philippines, Singapore, and Thailand.
[4] This figure does not include the shipment of goods from China, through Hong Kong, to the European Union and the United States.

Referred to as vertical intra-industry trade, manufacturing firms in East Asia have taken advantage of differences in a country's factor endowments (e.g. access to raw materials, low input costs, labor supply) to exploit efficiencies in cost and production. By utilizing foreign direct investment, firms located primarily in developed East Asia (e.g. Japan) have established production platforms throughout the rest of the region. In many cases, extensive trade relationships have been established between emerging Asia (e.g. South Korea, Taiwan), providing intermediate parts and components, and developing Asia (e.g. China), providing assembly and export operations. Therefore, the total value of final goods for export from East Asia is often a combination of value added from several different countries in the region.

Though China maintains a sizeable percentage of trade in goods produced primarily from its own domestic inputs, the majority of its exports have been produced primarily from inputs originating from other countries in East Asia. This accounts for the large trade deficits China has with countries like Taiwan, South Korea, and Japan. A significant percentage of these goods are exported to the EU and the U.S., which helps to explain the large trade surpluses China maintains with these countries/regions.

Therefore, given the value added to China's exports from other countries in East Asia, an appreciation of the RMB alone may not have the same impact as a generalized appreciation of currencies. This generalized appreciation would include not only the RMB, but also the currencies of those countries which are China's primary suppliers of parts and components. This would go a lot further in affecting those goods produced

primarily from Chinese inputs, as well as those goods produced primarily from inputs originating from other countries in East Asia.

This dissertation investigates how a generalized, integrated appreciation of the RMB and the currencies of China's supply chain providers could potentially impact China's export trade. To do this, I begin in Chapter 2 by looking at the trade deficit between the U.S. and China, as well as some of the issues related to the Yuan/dollar exchange rate. This chapter frames the trade issue from a bilateral perspective. However, as important as the United States is as an export market, focusing on the U.S. exclusively does not address China's trade surplus from a global perspective. Evaluating changes in China's export trade from a global perspective is the focus of the remainder of the dissertation.

Chapter 3 starts by looking at China's emergence within the global trading network and the unique trade relationships which exist in East Asia. Chapter 4 continues with this line of thought by utilizing a theoretical approach to investigate the potential effects of a generalized currency appreciation on exports from East Asia. Chapter 5 presents a review the economic research dealing with the undervaluation of the RMB and the potential impact on China's export trade from an appreciation of the RMB. Chapter 6 explains the research methodology, Chapter 7 reviews and discusses the research results, and Chapter 8 concludes with a summary of the dissertation.

2. ISSUES RELATED TO THE U.S. TRADE DEFICIT

A major economic issue currently facing the United States is its rapidly growing trade deficit. In 2006, the U.S. set another record for yearly trade imbalances of over $759 billion. This marked the fifth year in a row of record trade deficits and the eighth year in the past nine years that a record has been set (Figure 2.1). By the end of 2006, the trade deficit represented 5.73 percent of U.S. gross domestic product (GDP). This was up slightly from 2005's figure and over 3 times the percentage in 1998 (Figure 2.2).

Sustainability of the U.S. Trade Deficit

These large deficits have caused a great deal of concern throughout Washington and the rest of the world for several reasons. One reason for concern is the issue of sustainability.

A commonly used sustainability formula assesses the impact of the current account deficit on U.S. net external debt (Yoshitomi, 2006):

NIIP/GDP = (CA/GDP) / $(g - i)$

where   NIIP/GDP   is the net international investment position to GDP[5]

CA/GDP   is the current account deficit to GDP[6]

---

[5] NIIP is often used as a proxy for U.S. net external debt. In this case, the U.S. net debt position implies both foreign-owned assets (e.g. equities, foreign direct investment) and liabilities (e.g.. Treasury securities, Treasury bonds, corporate bonds) in excess of U.S.-owned assets and liabilities abroad.

$$(g - i)$$ is the growth rate of GDP net the effective interest rate on

U.S. net external debt.[7]

In 2006, the current account deficit-to-GDP ratio was 6.1 percent, the growth rate

of GDP was 6.4 percent, and the effective interest rate on U.S. net external debt was -1.7

percent.[8] Applying these figures to the formula yields a stable net external debt-to-GDP

ratio of 75.3 percent.[9] Using 5- and 10-year historical averages for the same variables

yields a similar result of 68.5 present.[10] In 2006, the net external debt-to-GDP ratio was

less than 20 percent.[11] Given the respective rates of growth for net external debt to GDP,

the current account deficit to GDP, and the effective interest rate on U.S. debt, a point of

---

[6] Alternatively, the trade deficit-to-GDP ratio could be used in place of the current account deficit-to-GDP ratio. Since 1992, which marks the beginning of the current string of current account deficits, the trade deficit has averaged approximately 87 percent of the current account deficit; 94 percent over the last 5 years. However, most sustainability formulas use the current account deficit, so in order to hold with convention, the same will be done here.

[7] The effective interest rate on U.S. net external debt is calculated as the ratio of the balance of income payments to the previous year's net international investment position (FDI at market value, not including derivatives).

[8] The negative percentage for the effective interest rate on U.S. net external debt is the result of a positive balance of income payments despite a negative net international investment position. Gourinchas and Rey (2005) refer to this situation as that of a venture capitalist who sells lower yielding, short-term, fixed-income liabilities in order to invest in higher yielding, long-term equity assets. Both return and composition effects on net international investments have contributed to the United States positive balance of income payments. This has especially been the case over the past few years as the gap between foreign-owned assets in the U.S. and U.S.-owned assets abroad has grown.

[9] Substituting the trade deficit-to-GDP ratio (5.7 percent in 2006) for the current account deficit-to-GDP ratio would lower this percentage to 70.4 percent.

[10] The 5- and 10-year averages for the growth rate of GDP have been approximately 5.5 percent. The 5- and 10-year averages for the effective interest rate on net external debt have been approximately -1.8 percent. The 5- and 10-year averages for the current account deficit-to-GDP ratio have been between 5.4 percent and 4.2 percent, respectively. Applying slightly more weight to the 5-year average, 5.0 percent was used.

[11] 2006 NIIP/GDP values are as follows: with FDI at market value = -16.2 percent, with FDI at market value, excluding derivatives = -16.6 percent, with FDI at current cost = -19.7 percent, with FDI at current cost, excluding derivatives = -19.6 percent.

stability will not be reached until the net external debt-to-GDP ratio rises by

approximately 50 percentage points beyond its current level.[12]

To put this into context, assume growth rates remain at their 2006 levels. Even if

the U.S. continues to enjoy an effective rate on U.S. net external debt of -1.7 percent,

adding the yearly current account deficit flows to the stock of the previous year's net

external debt will raise the U.S. net international investment position to a deficit of $13.2

trillion within 10 years time (Table 2.1).[13] This is more than 6 times the $2.2 trillion that

represented the deficit in the U.S. net international investment position in 2006 (FDI at

market value, not including derivatives). It also equates to more than half of projected

U.S. GDP by 2016.

There are several potential dangers that the U.S. faces along this path of deficit

spending. One is the demand for higher rates of return on U.S. investments. Though there

is no explicit investment strategy for the rest of the world, Mann (2003), citing Lewis

(1999), estimates that home bias precludes 70 percent of the rest of the world's gross

financial assets for investment outside of their home country.[14] Using Cline's (2005)

estimate and growth rate for the gross financial assets of the rest of the world, $29.8

trillion was potentially available for investment in assets abroad in 2006.[15] Given $16.2

---

[12] An alternative formula ($d = d_{-1}[(1 + i)/(1 + g)] + ca$) equates current net external debt/GDP to the previous year's financed net external debt/GDP plus the current account deficit/GDP (Gramlich, 2004). Values for net external debt/GDP were comparable to the values obtained from the steady state formula for both the 10- year (53.5 percent to 55.8 percent) and 20-year (68.1 percent to 71.3 percent) time frames.

[13] Historical values would produce a slightly lower amount of $10.5 trillion.

[14] Given the increased access and transparency of financial markets, home bias is not as constraining a factor to foreign investment as it once was (Greenspan, 2004). However, considering that a significant portion of savings available for investment resides in countries with emerging global financial institutions (e.g. China), home bias still plays an important role in investment choices.

[15] Cline estimates the gross financial assets of the rest of the world in 2004 at $84 trillion with a growth rate of 7.5 percent per year. This yields $97 trillion in gross financial assets for the rest of the world in 2006.

trillion in foreign-owned assets in the U.S., this total represented more than 50 percent of

the amount available by the rest of the world for foreign investment.[16] Even on a net

basis, U.S. net external debt, at 7.39 percent of foreign assets available for investment,

would rise to 21.23 percent by 2016.[17] If this is the case, one would expect international

investors to demand higher rates of return in order to justify holding larger shares of U.S.

investments in their portfolios.

This leads to a second potential problem for the U.S., which is its favorable

balance of income payments. Though the U.S. has been a net debtor to the rest of the

world since 1989, its balance of income payments has continued to remain positive.[18]

This has been due to several factors, including the difference in the composition of

foreign-owned and U.S.-owned investments, as well as differentials in the returns on

equity and foreign direct investments (Higgins, Klitgaard and Tille, 2006, Gourinchas

and Rey, 2005, Roubini and Setser, 2004). If the supply of U.S. investments continues to

grow in response to ongoing deficit spending, then one would expect demand for higher

rates of return to ultimately bring this favorable trend in the U.S. balance of income

payments to an end.

Another point of concern is the risk of a sharp and sudden decline in the relative

value of the dollar in relation to other major currencies throughout the world. Krugman

---

[16] In terms of the rest of the world's 2006 estimated total gross financial assets ($97 trillion), $16.2 trillion
in foreign-owned assets in the U.S. represents 16.7 percent of this total amount.
[17] Projected 2016 gross financial assets of the rest of the world is $200.1 trillion, with $62.1 trillion (30
percent) available for investment abroad. The projected 2016 deficit in the U.S. net international investment
position is $13.2 trillion.
[18] This applies to NIIP with FDI at market value, not including derivatives. In terms of NIIP with FDI at
current cost, not including derivatives, the U.S. has been a continuous net debtor to the rest of the world
since 1986.

(2006) has argued that the factors affecting the real rates of return received on U.S. debt will eventually induce foreign holders of dollar-dominated assets to abandon such assets in favor of higher yielding alternatives.[19] Such a flight from the dollar would further erode the relative value of U.S. investments and increase the cost required to finance a growing U.S. net debt position.[20]

The U.S. Trade Deficit and China

These issues highlight just some of the potential outcomes which could result from a consistent and growing U.S. trade and current account deficit. However, the potential problems don't end here. Another issue for the U.S. is the primary driver behind its trade deficit; the deficit in the trade of goods.

Splicing the trade deficit into goods and services, had it not been for a favorable run of trade surpluses in the services sector, the trade deficit would have easily eclipsed 6 percent of GDP by the end of 2005. On a year-to-year basis, trade in goods as a group has represented more than 100 percent of the total trade deficit from as early as 1976, the first year of the current string of consecutive trade deficits (Figure 2.3). Even when deflating the dollar value of the trade in goods and taking it as a percentage of real GDP, the percentages are roughly the same as those obtained using nominal data (Figure 2.4).

When disaggregated into its component parts, and accounting for energy products within the industrial sector, a large part of the trade deficit is in consumer goods (Figure

---

[19] Such factors include the depreciating value of the dollar and the real rates of return on competing foreign assets.
[20] In 2007, the dollar declined by 10.7 percent against a trade-weighted exchange index of major currencies (source: Federal Reserve Bank of St. Louis).

2.5). These goods, which have little income producing value, represent more than 35 percent of the trade deficit. Capital and industrial supplies (excluding energy products), which are primarily used as investment for building and supporting income producing assets, account for less than 5 percent of the total trade deficit. The U.S. is apparently going into debt with the rest of the world in order to increase its levels of personal consumption.

While the U.S. deserves much of the focus for its large trade deficit, most of the attention over the past several years has fallen on China. Of the nations that the U.S. is most indebted to in terms of trade, China is the largest. In 2006, the U.S. trade deficit in goods and services with China was $229.4 billion, or approximately 30 percent of the total U.S. trade deficit with the rest of the world. This is more than ten percentage points higher than the percentage of the deficit represented by all the countries in Europe, more than 50 percent of the entire trade deficit with those countries in the Asia and Pacific region, and three times as large as any other single nation with which the U.S. engages in trade (Figures 2.6 and 2.7).

China has also gained a significant amount of attention with regards to the size and composition of its foreign exchange reserves. By the end of 2006, the People's Bank of China (PBoC) held more than $1 trillion dollars in foreign exchange reserves.[21] This growth has come largely on the heels of China's rapidly expanding export economy. Since 2003, China's economy has grown in real terms by more than 10 percent per year, facilitated by large inflows of foreign direct investment (FDI). When combined with its

---

[21] Data reported by the PBoC. By the end of 2007, this amount had risen to $1.5 trillion.

trade surplus, China has faced significant inflationary pressure due to the potential

increase in the supply of money in the economy. In spite of this phenomenon, China's

inflation rate through 2006 remained relatively benign, rising above 2 percent only once

since 2000.[22] The conversion of dollars into Yuan into RMB-denominated bonds has

provided a substantial barrier to the growth of the RMB over the past several years.[23]

As for the composition of China's foreign exchange reserves, no official

breakdown is available; however, several estimates have been offered.[24] In terms of

dollar reserves, the general range of approximations has been between 60 and 75 percent.

Setser (2007) estimates that China's dollar reserves peaked at around 80 percent in 2003,

but have fallen to around 70 percent since that time.

Though 70 percent in reserve holdings represents a substantial percentage in a

single currency, it doesn't capture the significant increase in dollar holdings that have

taken place in China since 2000. As an example, in terms of fixed income dollar

dominated assets, China has been an aggressive buyer of U.S. Treasury securities over

---

[22] In 2004, the calculated average yearly inflation rate was 3.9 percent (source: International Monetary Fund). In 2007, inflation more than tripled from its 2006 level to an estimated 4.8 percent. This increase was due primarily to a rise in food prices brought on by rising input costs and shortages of pork products (Economist Intelligence Unit, 2008).

[23] In general, there is some question as to whether or not sterilized intervention in the foreign exchange market has any real impact on the exchange rate value of the intervening country's currency. Though central banker's believe that intervention has some effect on the exchange rate value of their currency (Neely, 2007), two recent studies by the IMF (2007a, 2007b) cast doubt on the validity of that belief. As it applies to China, issues with data availability and transparency make it difficult to make any conclusive statements regarding the impact of the PBoC's efforts at sterilized intervention. However, given the long-run stability of the Yuan/dollar exchange rate in the face of consistent double-digit economic growth, the size and composition of reserves, and the barriers to capital mobility, anecdotal evidence would seem to indicate some impact on the exchange rate as a result of China's intervention in the foreign exchange market.

[24] A brief synopsis of these estimates is provided by Setser (2007).

the past several years.[25] Using data from the U.S. Treasury Department, China purchased

an average of $48.2 billion of Treasury securities per year from 2000 to 2007.[26] In

addition, over the same time period, China's average yearly increase in Treasury

securities purchased was 30.3 percent. In the process, the relative size of China's position

in terms of official holdings of U.S. Treasury securities rose from 6.4 percent in 2000 to

18.6 percent in 2007.[27]

While most of East Asia has been a significant buyer of dollar-denominated fixed

income securities, due in part to the speculative runs that took place in the currency

markets at the turn of the century, China's rapid growth in this area stands out by

comparison. In June 2000, Japan dwarfed the other major East Asian holders of U.S.

Treasury securities, including China, by more than 370 percent (Figure 2.8). By June

2007, while Taiwan, Hong Kong, Korea, Singapore, and Thailand had all doubled their

holdings, China's total holdings had grown by 5 times their original amount. Within that

time, the relative gap in U.S. Treasury security holdings between Japan and China had

narrowed to a little more than 50 percent.[28]

---

[25] This includes U.S. Treasury bills, bonds and notes, but does not include agency securities, purchases of which have also risen significantly over the past several years.

[26] Data reported by the U.S. Treasury Department's International Capital System (TIC). Data calculated on a year-to-year basis starting in June, 2000. Data do not account for third-party purchases, on behalf of official government agencies, which originate from locations outside the representative's home country. As an example, a broker in London purchasing U.S. Treasuries on behalf of the People's Bank of China. The purchase would originate in, and be accounted to, the United Kingdom, but the owner of the securities would reside in China (in this case, the PBoC).

[27] Official Treasury holdings by the PBoC do not include holdings by Chinese state banks or the Chinese Investment Corporation, agencies used by the PBoC to offload some of its dollar reserves.

[28] As pointed out earlier, Krugman (2006) contends that the low interest rates offered on U.S. Treasury securities, combined with a depreciating dollar and the effects of inflation, potential yields a negative real rate of return on these securities. Allowing for the safety (low-risk) of these securities, it still makes the significant increases in China's purchases of these securities surprising.

The growth and size of China's dollar reserves have had a direct impact on the foreign exchange rate between China and the United States. From 2000 to 2004, the exchange rate between the Chinese Yuan and U.S. dollar remained essentially unchanged at approximately 8.28 Yuan to 1 U.S. dollar (Table 2.2).[29] Only since 2005, when the Chinese government made a decision to move their foreign exchange rate policy to a basket of currencies and allow the RMB some movement against the dollar did the Yuan actually begin to appreciate, reaching 7.97 Yuan to the dollar by the end of 2006. This represented a small adjustment compared to a number of estimates for the RMB's real bilateral undervaluation with the dollar of 15 to 40 percent.[30]

The Issue of Exchange Rates

All these factors in combination; large trade surpluses with the U.S., a significant percentage of reserves in U.S. dollars, a rapidly growing economy, and a relatively stable and undervalued RMB, have raised important questions regarding the means by which China has achieved its unprecedented growth. There is some belief that China has engaged in unfair trading practices by keeping its exchange rate artificially low. During a trip to China in late 2006, Fed Chairman Ben Bernanke referred to the exchange rate value of the RMB as an "effective subsidy" for Chinese-based firms focused primarily on

---

[29] Exchange rate represents the average annual rate.
[30] Even though there has been a general consensus that the RMB has been undervalued, there is a great amount of debate in terms of its level and significance. In 2007, the Yuan had further appreciated to a level of 7.61 to the dollar (average annual basis; 7.29 on an end of year basis). This represented a nominal appreciation of 8 percent since 2005. The issue of the RMB's undervaluation will be explored in more detail in Chapter 4: Literature Review.

export trade.[31] This has been the contention by several representatives in Congress, precipitating legislation aimed at offsetting the perceived advantage of the current exchange rate by applying duties and tariffs on Chinese imports.[32] In addition, increasing pressure on the White House to address the trade deficit and exchange rate issues with China have resulted in both action taken against China through the World Trade Organization[33] and the imposition of countervailing duties on coated paper imported from China.[34]

In spite of all this legislative wrangling, economists have thus far been split on the appropriate response that the U.S. should take in regards to this situation. A number of economists have investigated the effect that an appreciation of the RMB would have on China's trade surplus. Up to this point, the results have been inconclusive. A major part of the reason involves the unique trading and manufacturing relationships that China and the rest of East Asia have with one another. The triangular trading pattern, in which intermediate goods are exported to China from other East Asian countries, manufactured into final goods, and then exported to the rest of the world, has become an established model for business operations in East Asia.

Given the extensiveness and fluidity of the trading relationships in East Asia, an appreciation of the RMB alone may do little to affect China's trade surplus. A generalized, integrated appreciation of the RMB and the currencies of China's supply

---

[31] Bernanke, Ben S., "The Chinese Economy: Progress and Challenges," December 15, 2006.
[32] Examples include H.R. 321, H.R. 571, H.R. 782 (S. 796), H.R. 1002, H.R. 1229, S. 974, and S. 1607.
[33] Disputes involving Chinese value-added tax and export subsidies have been resolved. Disputes involving access to Chinese markets, including the market for automobile parts, are still ongoing.
[34] A preliminary decision on March 30, 2007 to impose countervailing duties on Chinese coated paper was affirmed by the Department of Commerce on October 18, 2007.

chain providers, which are predominantly countries in East Asia, could potentially have a more beneficial and significant impact on the exports originating out of China. A generalized appreciation would affect the prices of all goods in East Asia, both intermediate and final goods. This would correspondingly impact the prices of China's exports, both those goods produced primarily with Chinese inputs and those goods produced primarily with inputs from China's East Asian trading partners. Chapter 3 will take a closer look at the intricate trade network which exists between China and its East Asian trading partners.
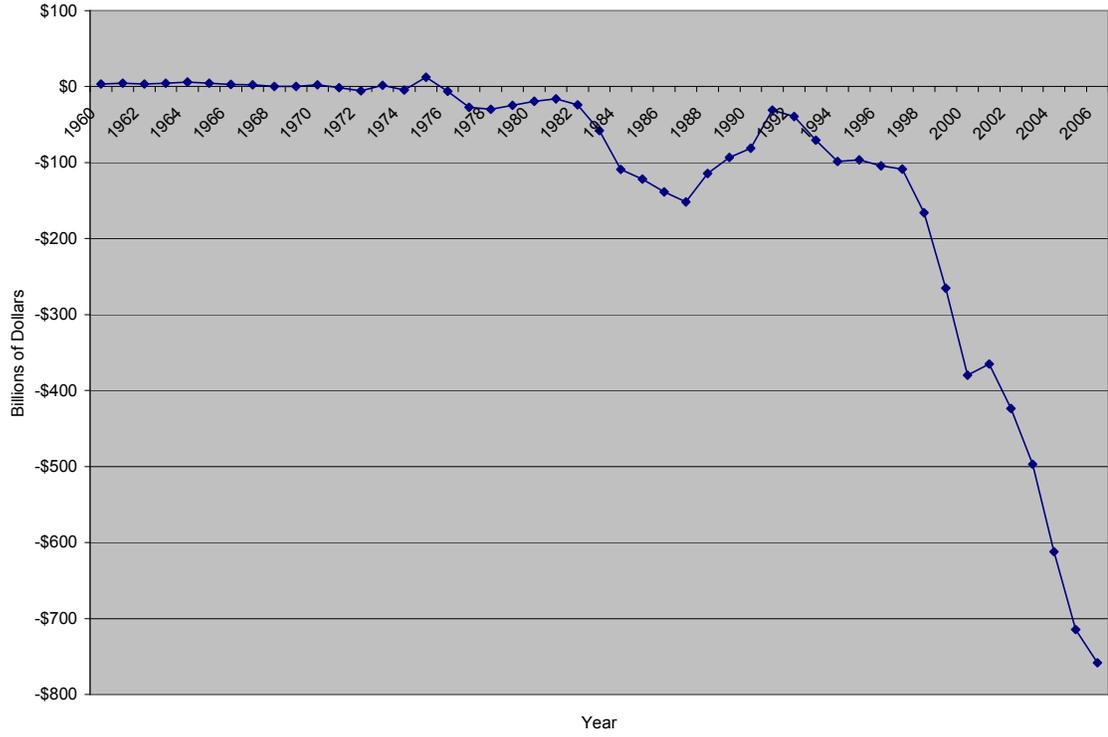
Figure 2.1: U.S. Surplus/Deficit in Trade of Goods and Services

Source: U.S. Department of Commerce – Bureau of Economic Analysis
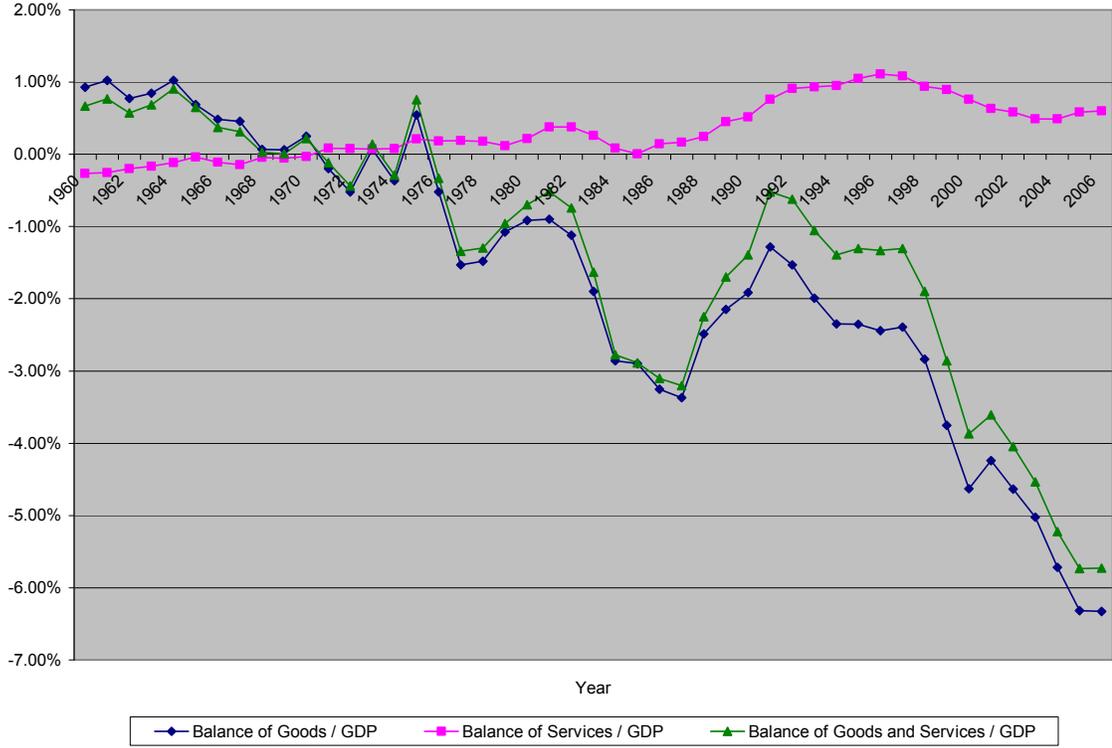
Figure 2.2: U.S. Surplus/Deficit in Trade as a Percentage of GDP

Source: U.S. Department of Commerce – Bureau of Economic Analysis

Table 2.1: Projected Growth of U.S. Net External Debt (billions of dollars)

	Year 2006 actual	2007 est.	2011	2016	Steady State
GDP Growth at 6.4%	$13,247	$14,094	$18,064	$24,633	$66,464
CA/GDP at 6.1% (6.4% net balance of income payments)	-$848	-$902	-$1,156	-$1,577	-$4,254
Balance of Income Payments (-1.7% effective rate on previous year's NIIP (market value))	$37	$37	$101	$201	$794
CA net Income Payments	-$811	-$865	-$1,055	-$1,376	-$3,460
Previous Year's NIIP plus Current Year's CA	-$2,199	-$3,064	-$6,984	-$13,180	-$50,153
NIIP / GDP	-16.60%	-21.74%	-38.66%	-53.51%	-75.46%

Source: U.S. Department of Commerce – Bureau of Economic Analysis, author's calculation
Note: Figures calculated using millions of dollars. Results rounded up to billions of dollars.
The 2006 actual value of the Previous Year's NIIP plus Current Year's CA is the U.S. net external debt position with FDI at market value, not including derivatives.
CA is an abbreviation for current account.
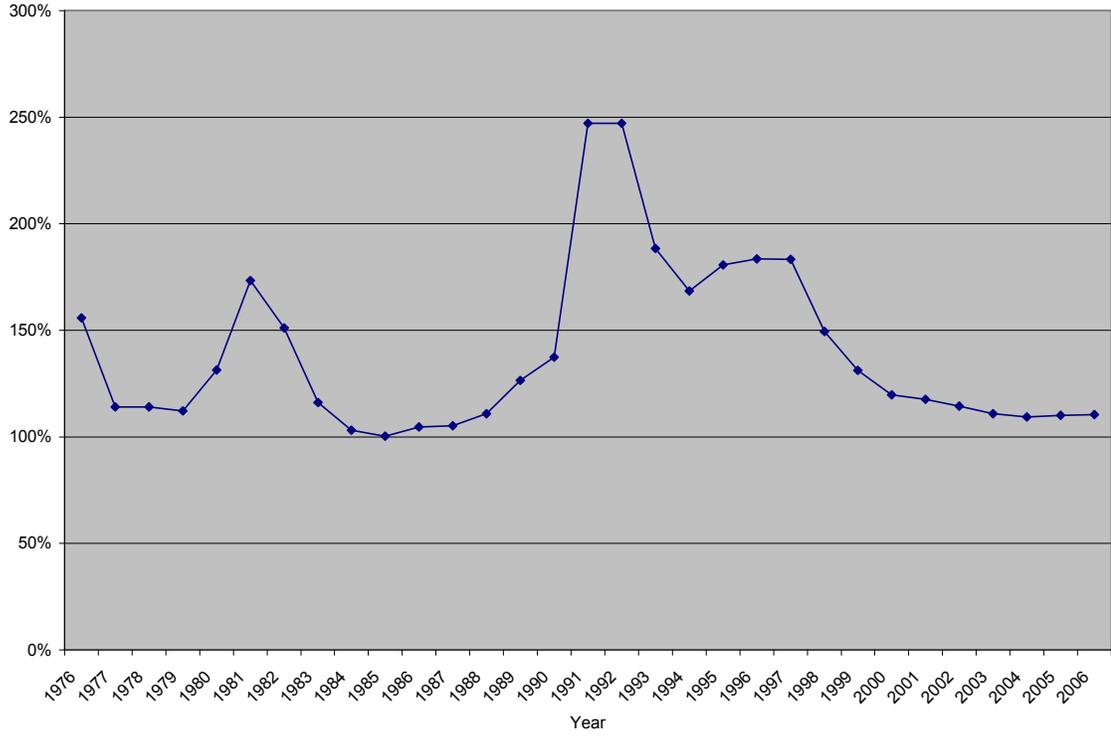
Figure 2.3: U.S. Deficit in Trade of Goods as a Percentage of the Total Trade Deficit

Source: U.S. Department of Commerce – Bureau of Economic Analysis, author's calculation
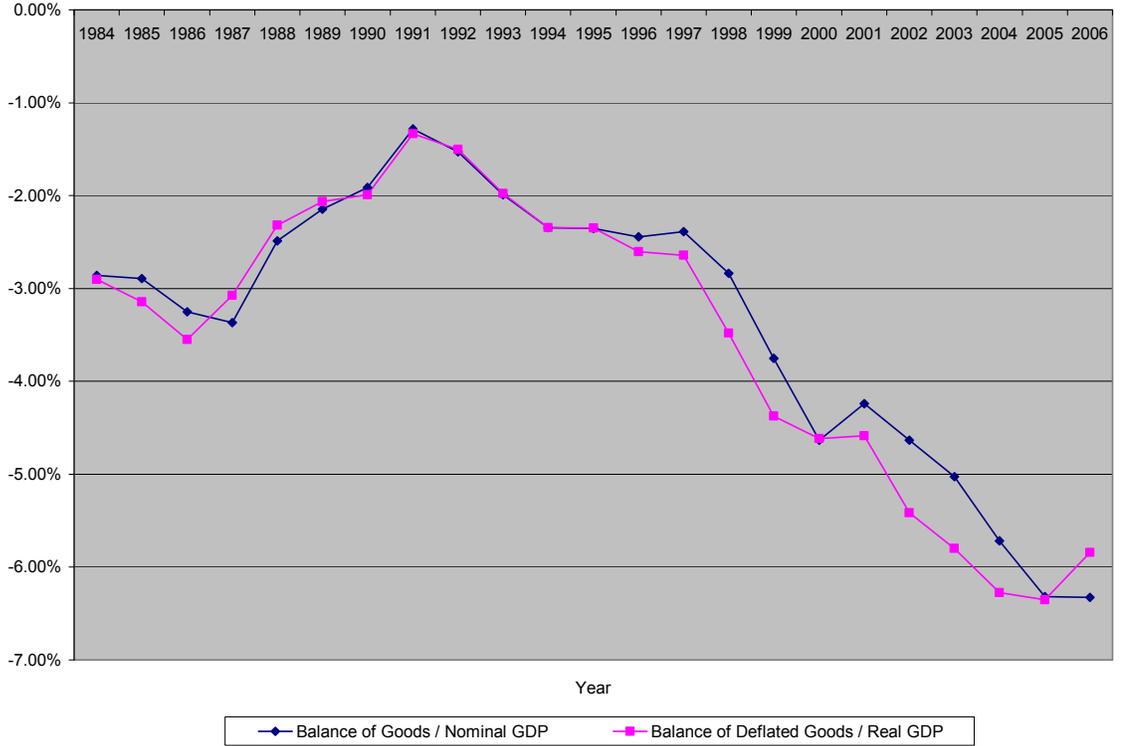
Figure 2.4: U.S. Surplus/Deficit in Trade of Goods as a Percentage of GDP

Source: U.S. Department of Commerce – Bureau of Economic Analysis, U.S. Department of Labor – Bureau of Labor Statistics, author's calculation
Note: Trade data deflated by BEA End Use Indices – All Commodities
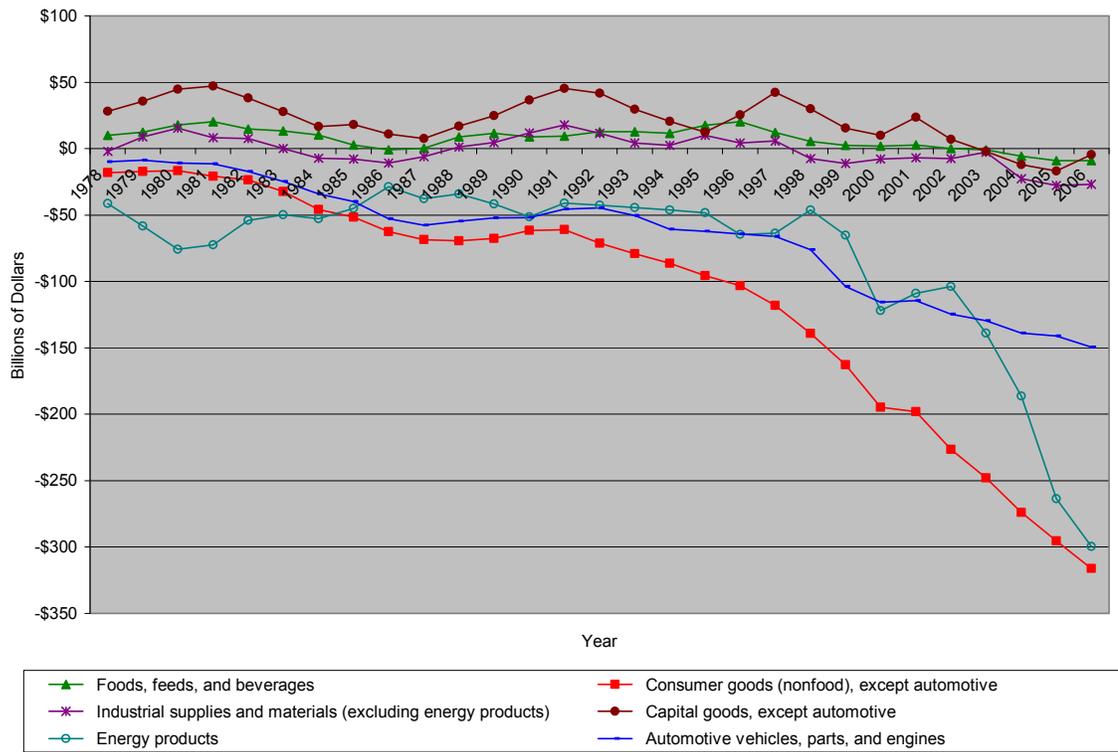
Figure 2.5: Balance of Exports over Imports

Source: U.S. Department of Commerce – Bureau of Economic Analysis, author's calculation
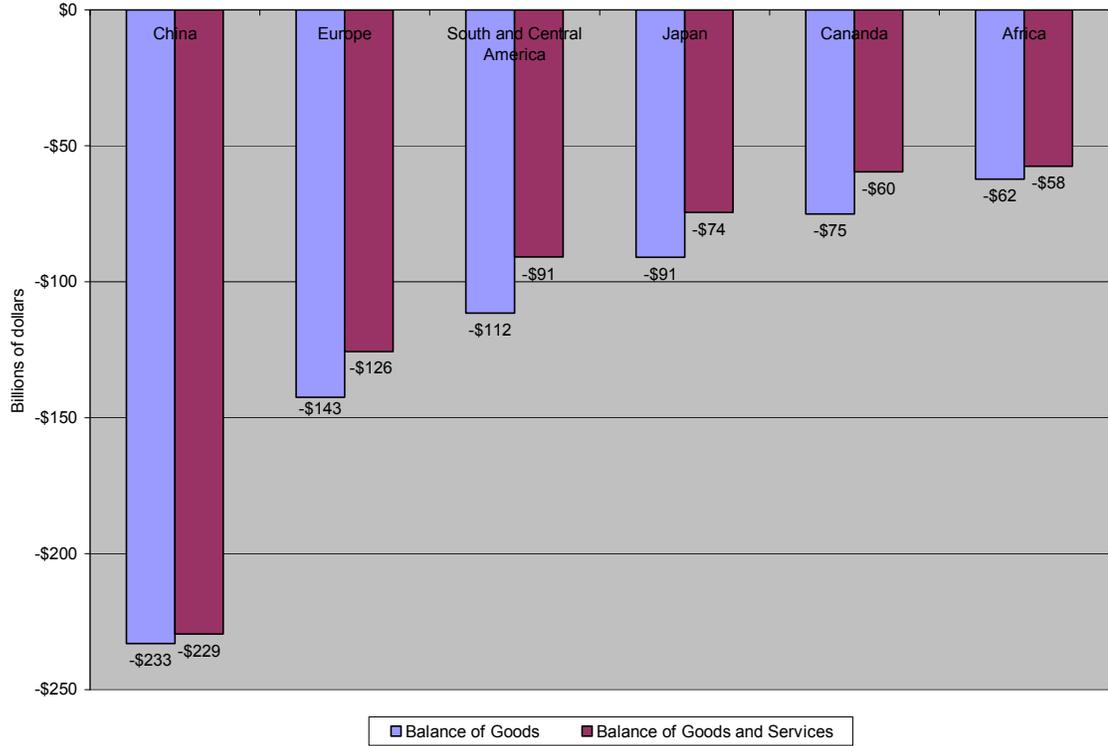
Figure 2.6: 2006 U.S. Trade Deficit with China Compared with other Countries and Regions in the World

Source: U.S. Department of Commerce – Bureau of Economic Analysis, author's calculation
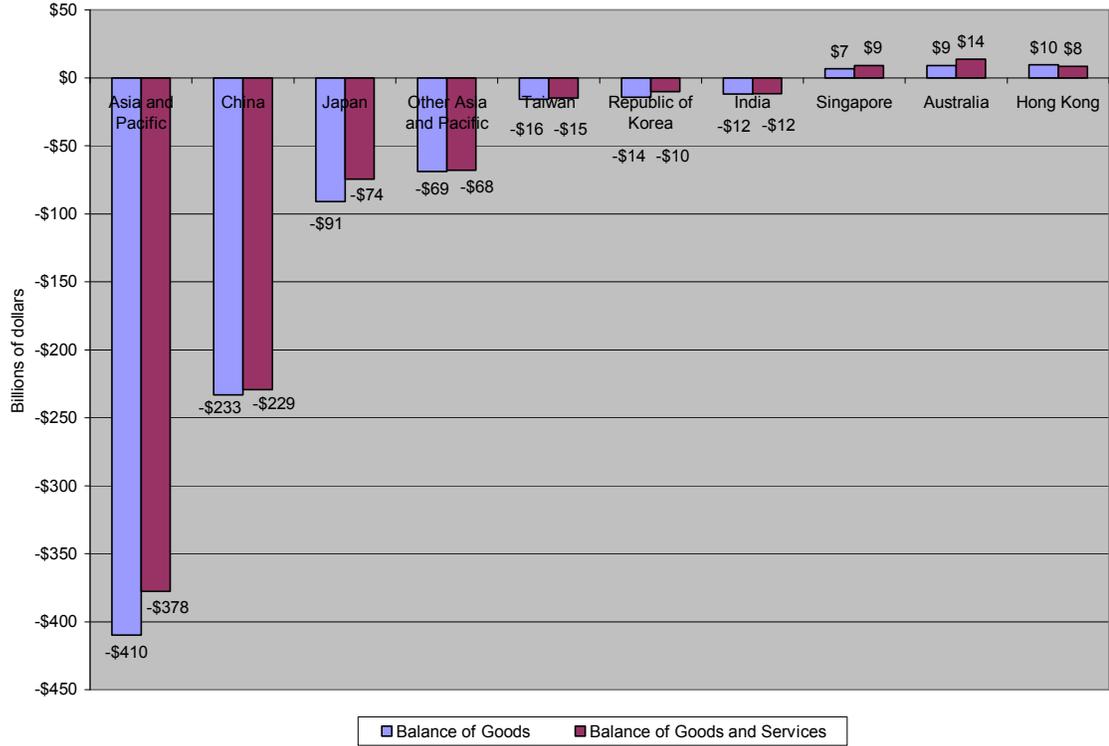
Figure 2.7: 2006 U.S. Trade Deficit with Asia and the Pacific Region

Source: U.S. Department of Commerce – Bureau of Economic Analysis, author's calculation
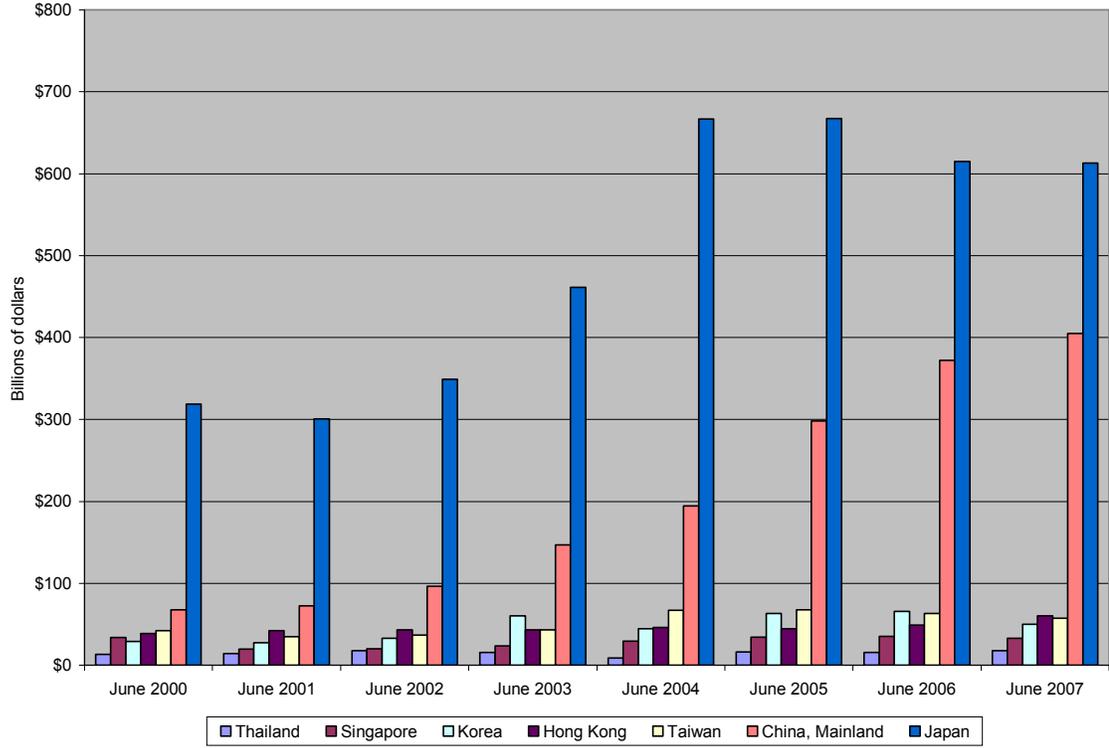
Figure 2.8: Year-by-Year Total of U.S. Treasury Securities Held by Selected Countries in East Asia

Source: U.S. Department of the Treasury

Table 2.2: Comparison of Exchange Rates with the U.S. for Selected Countries in East Asia

Currency	Year 2000	2001	2002	2003	2004	2005	2006
Chinese Yuan	8.28	8.28	8.28	8.28	8.28	8.19	7.97
Hong Kong Dollar	7.79	7.80	7.80	7.79	7.79	7.78	7.77
Japanese Yen	107.80	121.57	125.22	115.94	108.15	110.11	116.31
Malaysian Ringgit	3.80	3.80	3.80	3.80	3.80	3.79	3.67
Singapore Dollar	1.73	1.79	1.79	1.74	1.70	1.66	1.59
South Korean Won	1130.90	1292.01	1250.31	1192.08	1145.24	1023.75	954.32
Taiwanese Dollar	31.26	33.82	34.54	34.41	33.37	32.13	32.51
Thailand Baht	40.21	44.53	43.02	41.56	40.27	40.25	37.88

Currency	Average Yearly Exchange Rate	Standard Deviation	Coefficient of Variation
Chinese Yuan	8.22	0.11	1.39%
Hong Kong Dollar	7.79	0.01	0.15%
Japanese Yen	115.01	6.74	5.86%
Malaysian Ringgit	3.78	0.05	1.32%
Singapore Dollar	1.71	0.07	4.26%
South Korean Won	1141.23	119.78	10.50%
Taiwanese Dollar	33.15	1.23	3.70%
Thailand Baht	41.10	2.17	5.28%

Average Coefficient of Variation   4.06%

Source: The Federal Reserve Bank of the United States, author's calculation
Note: Exchange rates reflect average annual rates

3. CHINA'S ROLE IN THE GLOBAL TRADING NETWORK

China fulfills a unique role within the global trading network. With the help of government incentives, a stable exchange rate, and a relatively inexpensive labor force, China has attracted a significant amount of foreign direct investment (FDI). This investment has been used by foreign-based companies to establish manufacturing operations within China for the purpose of final product assembly. These products are then exported to the rest of the world, primarily to the United States and Europe.

Historical Context

China's rise within the global economy began in the late 1970s. It was precipitated by Deng Xiaoping's economic reforms which allowed more free market flexibility for firms willing to invest in China. This was led by the establishment of Special Economic Zones (SEZ), designated areas within the country in which foreigners could make direct investments into the ownership and operation of manufacturing facilities for the purpose of export. It also carried with it a number of tax and operational incentives that gave significant cost advantages to these newly created foreign-funded enterprises.

The first SEZ, established in 1980, was the Shenzhen Special Economic Zone. Located in the Guangdong province along the Pearl River Delta, the Shenzhen SEZ

became a model for success of foreign-funded private enterprise in China (Figure 3.1).

With its proximity to Hong Kong and Taiwan, Shenzhen and the entire Pearl River Delta

benefited from large inflows of foreign direct investment into the region. Taking

advantage of a number of factors including a relatively inexpensive labor market, easy

access to raw materials, and a highly evolved transportation and distribution network,

manufacturers were able to produce goods at lower costs than most other locations in

East Asia. This, combined with a favorable and very stable exchange rate, allowed the

Pearl River Delta to become one of the largest manufacturing centers in China. In the

process, Guangdong emerged as China's largest province in terms of export share, GDP

share, and industrial output.[35]

The success of the Shenzhen SEZ was followed by various other types of

economic development zones, as well as several additional Special Economic Zones. The

new development and economic zones were located primarily along the eastern coast of

the country, stretching from the China Sea in the south to the Yellow Sea in the north

(Figure 3.2). Of particular importance was the creation of the Shanghai SEZ, which

established China's other major manufacturing center around the Yangtze River Delta.

Along with the Province of Shanghai, the Yangtze River Delta includes the entire

river delta and areas upstream in the surrounding valley. This has led to significant

growth not only in Shanghai, but Jiangsu Province to the north and Zhejiang Province to

the south. The Yangtze River Delta has benefited from several favorable economic

factors, including the formation of a diverse number of economic zones, a large and

---

[35] Data reported by National Bureau of Statistics of China and the Ministry of Commerce of the People's Republic of China.

growing deep water port infrastructure, and close proximity to major sources of foreign direct investment.[36] In terms of economic zones, of particular importance was the creation of the Pudong New Area Special Economic Zone (a district of Shanghai). This zone was granted special privileges by the government to pursue foreign-based investment in the areas of trade, finance, and the services industries.

The location of China's economic zones has been the catalyst to the country's providential growth. As already mentioned, Guangdong, benefiting from the Pearl River Delta, has been a leader in a number of production and output categories. Guangdong's growth has been followed closely by the provinces of Jiangsu, Zhejiang, and Shanghai along the Yangtze River Delta, and Shandong, Henan, Hebei, and Liaoning to the north.

This rapid growth, however, has not been without consequences. The growth of China's coastline provinces has resulted in an increasing disparity between the country's eastern provinces and its more land-locked central and western provinces. Because of the government's focus on export trade, distance and access to deepwater ports has become a critical factor to the location of foreign-funded enterprises (Amiti and Javorcik, 2005). Investment in manufacturing operations has concentrated primarily in areas where barriers to trade are the lowest and available infrastructure is the most developed. In addition, competitive rivalries between provinces have increased the incentives for close spatial proximity of complementary operations. Despite the government's efforts to

---

[36] Of special note is the port at Yangshan, which the Chinese government expects to become the largest port in terms of shipping volume by the time it reaches full completion in 2020. As it applies to FDI, major inflows originate from Taiwan to the south, and Japan and South Korea to the northeast.

compensate for these natural and man-made barriers, convergence of comparable growth rates has been slow.

Complicating the problem has been the inherent uncertainty associated with the evolution of a command economy into a socialist market economy. In many provinces where state-owned enterprises (SOEs) represent a major employer to the area, exposure to competitive forces (resulting from the location of foreign-funded enterprises) has been the lowest (Amiti and Javorcik, 2003).[37] Not only do SOEs provide a substantial tax base, they have also been a significant provider of social services to their employees (e.g., health care). The unwillingness by some government officials to fully embrace the changes associated with globalization has led to a growing disparity within provinces, among provinces, and between urban and rural workers. Though globalization and openness to trade have been shown to close the income gap between urban and rural workers, reluctance to part with previous ways of doing business will continue to make the process toward change difficult (Wei and Wu, 2001).

Another area of concern resulting from China's rapid growth has been the environment. Concentrated development, intense demand for natural resources, and inadequate regulation and enforcement has taken its toll on the country's environment. Air, water, and land resources have all suffered some level of depletion or contamination. As an example, in a report by the Economist Intelligence Unit (2007), official Chinese news and data releases indicated that 70 percent of the country's lakes and rivers and 90

---

[37] The 2003 reference to Amiti and Javorcik's paper, "Trade Costs and Location of Foreign Firms in China," is an earlier version of their 2005 paper of the same title. The earlier version included information regarding China's SOEs, which was not included in their latter version.

percent of its cities' underground water supplies had been polluted. Though research indicates that globalization has had a positive effect on reducing the intensity of China's environmental deterioration, the damage already exacted on the environment will take a number of years to reverse (Dean and Lovely, 2007).

VIIT and the Triangular Trading Network:

At the highest level, the Chinese manufacturing engine involves three essential parts. These three parts make up what has been referred to as the triangular trading pattern. This pattern is part of a more sophisticated production and trade network which operates in East Asia. What is unique about this network is its level of integration and sophistication (Kimura and Ando, 2005). Unlike vertical inter-industry trade and horizontal intra-industry trade, China's manufacturing operations are part of a vertical intra-industry trade network in which production blocks are located between developing, emerging, and developed economies based on factor endowments (Fukao, Ishido and Ito, 2003).

The evolution of the intra-regional trade network in East Asia began with the linking up of Japanese manufacturers with affiliated companies located primarily in South Korea and Taiwan (Haddad, 2007). These low wage manufacturing platforms, used for final product assembly and export, more than offset the related routing and transportation costs of intermediate parts and components. As wage costs increased, however, the position of these countries (now recognized as newly industrialized economies (NIEs)) was overtaken by lower cost manufacturing platforms located in

countries such as Malaysia, the Philippines, and Thailand.[38] In response, the NIEs moved

up the value chain to provide higher-technology intermediate parts and components to the

broader, intra-regional assembly network. Eventually, China's increased openness to

trade and globalization allowed it to take the lead role as the low-cost manufacturer of

final goods for export in East Asia.

Over time, the complexity of these intra-regional trade networks grew, increasing

the transshipment of parts and components within the product assembly system (Haddad,

2007). As the level of complexity increased, so did the importance of wage,

transportation, and distance-related costs (Athukorala and Yamashita, 2005). While the

level and diversity of composition of trade increased, similarity among trading partners

also increased (Haddad, 2007). Thus, the value of cost related factors has now become

key to sustaining competitive advantage. Small changes can have significant effects

among competitors in the region.[39]

In spite of this competitive and dynamically changing environment, China's

economic rise has not inhibited the growth of other countries in the area. Instead of

facilitating a winner-take-all, zero sum game, competing countries have altered their

manufacturing and export strategies by either moving up, or specializing in, the value

---

[38] Historically, the NIEs have included Hong Kong, South Korea, Taiwan, and Singapore. With the rapid
advancement of the Chinese economy, the IMF also adds China to this group. Malaysia, the Philippines,
and Thailand, along with Indonesia and Singapore, make up the ASEAN-5. The IMF replaces Singapore in
this group with Vietnam.
[39] Though one might expect trade agreements to have a significant impact on trade in the region, this has
not been the case. Athukorala and Yamashita (2005) find that, apart from the Asian Free Trade Agreement,
free trade agreements in general have had minimal influence on intraregional trade flows (Haddad (2007)
expressed a similar conclusion).

chain of intermediate parts and components (IMF, 2007b).[40] In fact, the total value of

intra-regional trade is now greater than that of inter-regional trade. However, it's critical

to point out that as important as intra-regional trade is to East Asia, inter-regional trade is

more important, in that it drives the demand for finished goods. It is the demand for

finished goods (primarily from the U.S. and Europe) that produces the need, and related

trade, for the intermediate parts and components that's so critical to the East Asian

economy (Athukorala and Yamashita, 2005, Haddad, 2007).

Traditionally, then, the pattern of manufacturing and trade in East Asia has been

the developed and emerging economies shipping higher-technology intermediate parts

and components to the developing economies for final product assembly and export to

the rest of the world.[41] Within this framework, China, as part of developing Asia, has

relied on its vast, low cost labor force as its key factor endowment (Haddad, 2007).[42] This

is not unlike many other East Asian countries which have similarly relied on a ready and

available low cost labor force in order to secure a competitive advantage in the

manufacturing and export of finished goods. However, in terms of size and scope,

China's advantages have been much greater. This has included an extensive

transportation and shipping infrastructure, access to a wealth of raw materials, and

---

[40] The flying geese model, first introduced by Akamatsu (1962), still prevails, with China taking a lead role in the expansion of trade flows and economic growth throughout East Asia (Ahearne, et al., 2007).
[41] The IMF (2007b) lists the emerging countries in East Asia as China, Hong Kong, Korea, Singapore, Taiwan, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. Developing East Asia includes the newly industrialized economies (NIEs) of China, Hong Kong, Korea, Singapore, and Taiwan. Given the changing economic dynamics within the region, these categorizations should be considered somewhat fluid and dependent upon the criteria used to designate the different groups.
[42] As China has grown, it has become part of the emerging group of nations in East Asia, as recognized by the IMF. In this capacity, it competes with other emerging countries for the production of low- to medium-technology intermediate goods. However, it still retains its role as the largest exporter of finished goods from East Asia to the rest of the world, competing with other developing countries such as Vietnam within this segment of the VIIT network.

financial incentives to foreign-funded enterprises, among other things. In the end, China's

many advantages have allowed it to take the lead role as a distribution center for East

Asian manufactured goods throughout the world (IMF, 2007b).

I. Inflow of FDI

It is from, or due to the emergence of, the VIIT network that the triangular trading

pattern has developed. There are three parts to this pattern. The first part is the inflow of

foreign direct investment into China. According to United Nations statistics, the flow of

foreign direct investment into China more than doubled from an average annual rate of

$30.1 billion in 2000 to $69.5 billion in 2006.[43] As a percentage of the total inward flow

of FDI into East Asia, China's share represented 55.2 percent. More than half of the

utilized value of China's FDI originated from Hong Kong, Japan, Korea, and Taiwan.[44]

Interestingly, some of this growth in FDI has been due to "round tripping". Round

tripping FDI refers to the outward flow of investment funds from China for the purpose

of reinvestment back into China to take advantage of the government benefits afforded to

foreign-funded, export-orientated enterprises. Some estimates indicate that round tripping

FDI may contribute between one-quarter to one-half of the inward foreign investment

flow into China (Xiao, 2004, Xiao, 2005).[45]

The result of this infusion of FDI has been the growth of foreign-funded

enterprises in China. From 2001 to 2005, the total investment in registered foreign-

---

[43] Data reported by the United Nations Conference on Trade and Development. The average annual rate of foreign direct investment flows of $30.1 billion into China was calculated for the period of 1990 to 2000.
[44] Data reported by the National Bureau of Statistics of China.
[45] This figure represents the total originating from China's largest providers of foreign investment funds.

funded enterprises grew by more than 60 percent.[46] In 2006, foreign-funded enterprises

represented between 55 and 60 percent of all Chinese import and export trade (Table 3.1).

This falls in line with the contention that FDI helps to increase both regional and

international trade for the host country (Gaulier, et al., 2005). In addition, FDI helps to

reduce manufacturing costs and solidify trade relationships with new and existing trade

partners.[47]

Not surprisingly, FDI into China has been focused primarily on the country's

coastal regions. This can be attributed to a number of factors, including the development

of a comprehensive and integrated international transportation system, the spatial

proximity of upstream and downstream firms, and the favorable tax and cost incentives

available to firms located in these areas (Amiti and Javorick, 2005). As mentioned earlier,

the Chinese government has pushed to expand the access to, and availability of, these

factors to the more interior locations of the country, but the process of change to these

areas has been slow.

Beyond those already mentioned, there are several other factors that investors

consider when making foreign direct investment decisions. Gaulier, et al. (2006) include

the availability to low cost labor, economies of scale of manufacturing operations, and

the size of the potential market.[48] Kimura and Ando (2005) also include range of control

(managerial independence) over business decisions and the rule of law. Given China's

---

[46] Data reported by the National Bureau of Statistics of China.
[47] Interestingly, FDI has not produced the technological spillover one would expect from such large investment inflows (Haddad, 2007). This is probably due to China's poor record thus far on the protection of intellectual property rights.
[48] The size of the potential market is much more a factor to the location decisions of U.S. and European companies than East Asian companies, which focus primarily on export rather than direct sale to the Chinese market (Gaulier, et al., 2005).

extensive work force, relatively low wage costs, integrated manufacturing environment, production and export incentives, access to raw materials, willingness to incorporate and adapt to new business strategies, and an integrated transportation and distribution infrastructure, securing large inflows of FDI has not been an issue for the country over the past several years (Thorbecke and Yoshitomi, 2006).[49]

In addition, China's entrance into the World Trade Organization (WTO) has had a major impact on alleviating worries concerning transparency and rule of law.[50] Data indicate that, toward the end of the century, China experienced a leveling off and decline in foreign direct investment. World Trade Organization membership helped to reverse this trend by assuaging fears related to the perception of corruption and the arbitrary enforcement of the law which affected normal business operations (Walmsley, et al., 2006). At the same time, FDI-specific legislation, which coincided with China's WTO membership, further opened up China to outside investment (Tuan and Ng, 2004). This allowed foreign directed funds to flow more freely back into the country, helping to contribute to a recovery in China's inward FDI flows.

II. The Manufacturing Process

With their extensive capital investment, Japan, Korea, and Taiwan are also major trading partners in both import and export trade with China.[51] On the import side, Japan,

---

[49] In fact, rather than trying to increase the flow of FDI into the country, China has had to develop strategies to limit investment in the country in order to avoid the potential problems of over-speculation and an over-heated economy (e.g. investment bubbles and inflation).

[50] China officially entered the WTO on December 11, 2001.

[51] Though not a major point of origin for import trade, Hong Kong represents a major destination point for China's exports, primarily for re-export to other destinations throughout the world (IMF (2005)).

Korea, and Taiwan represent more than a third of the total value of imports headed into China. Along with the ASEAN nations, nearly 50 percent of the top 10 points of origination are located in the East Asian region (Table 3.2).

A significant percentage of China's import trade is in medium- and high-technology intermediate, or processed, goods (Thorbecke and Yoshitomi, 2006).[52] These goods, which are primarily electronics and machine-related parts and components, come from developed East Asia and the NIEs in the region (Athukorala and Yamashita, 2005). The imports are used as subsequent inputs into final goods (also designated as processed goods for export purposes) which are then exported out of China to the rest of the world.[53] This transformation process represents the second part of the triangular trading pattern.

China's import trade is divided into ordinary and processed goods.[54] Ordinary goods are further divided into two types; finished goods and intermediate goods. Ordinary finished goods are goods which are imported specifically for sale in the Chinese domestic market. Ordinary intermediate goods are goods which are used to create finished goods, also specifically for sale in the Chinese domestic market. Processed goods, or imports for processing, are primarily intermediate goods which, together with domestic inputs, are used to create finished goods. However, unlike ordinary intermediate

---

[52] Seventy percent or more of the processed imports originating out of Japan, South Korea, Taiwan, and the ASEAN 4 countries are either medium- or high-technology goods.

[53] Recently, China has begun to expand its own production of medium- and high-technology intermediate goods, moving up the value chain within the vertical intra-industry trade network. However, as the IMF (2007b) notes, the production focus of Chinese output is still at the lower end of the technological sophistication scale, indicating that the complementary manufacturing and trade relationships within East Asia's trade network are still in place (at least for now).

[54] Descriptions of ordinary and processed imports and exports are those designated by China's Customs Statistics.

goods, the finished products created with processed goods are destined for export and never reach the Chinese domestic market. It is these goods, the processed imports, which receive many of the special tax and duty exemptions from the state.

In 2006, imports into China were split almost evenly between ordinary and processed goods. This has been a fairly consistent pattern over the past decade (Table 3.3). The split, however, between the types of imports originating from countries within East Asia and countries outside of East Asia is markedly different. Countries within East Asia ship a greater share of processed goods, nearly 2-to-1, into China than countries outside of East Asia (Table 3.4).[55] While the rest of the world has been focused on selling within the Chinese domestic market, China's East Asian trading partners have focused primarily on manufacturing finished products in China and selling them to the rest of the world.

Once received into China, foreign-funded enterprises take a lead role in converting processed goods into exportable finished products. As already mentioned, foreign-funded enterprises account for approximately 60 percent of all import trade into China. As a group, foreign-funded enterprises are overwhelmingly invested in manufacturing operations. In terms of location, they are most prominently located in the largest growth provinces and major export centers in China, including Guangdong (Pearl River Delta) and Jiangsu, Shanghai, and Zhejiang (Yangtze River Delta). This explains the significant contributions to GDP that these areas provide to China's overall economy. In addition, the location of these major manufacturing and exporting centers has created a

---

[55] Data includes Japan, South Korea, Taiwan, Hong Kong, and the ASEAN 5 nations (Indonesia, Malaysia, the Philippines, Singapore, and Thailand).

clustering effect in which upstream and downstream suppliers have located in close proximity to one another in order to better service the supply chain. This type of clustering has developed even further into specialized areas by product type (e.g., automobiles and petrochemicals) in which whole operations are located in a single area supporting several competing manufacturers.

III. Inter-Regional Export

The last part of the triangular trading pattern is the export of finished goods to the rest of the world.[56] Similar to imports, Chinese exports are also divided into two types, ordinary and processed. Ordinary exports are goods which are assembled in China, primarily from domestic inputs, and then exported as final goods to the rest of the world. Processed exports, on the other hand, are goods that are assembled primarily from imports for processing and then exported as final goods.

In 2006, processed exports represented more than half of China's trade with the rest of the world. This reflects a shift over the past several years to a larger share of export trade in processed goods (Table 3.5). While the percentage of processed goods exported to other countries in East Asia has remained steady at around 25 percent, the relative percentage destined for locations outside of East Asia has increased by an additional 5 percentage points (Table 3.6). In addition, the fall in the percentage of

---

[56] Though China maintains a significant share in the export of low technology goods such as toys, shoes, and clothing, its push into higher technology goods such as electronics and machinery has allowed it to gain significant share in the export of these types of products as well.

ordinary goods headed to East Asia has been replaced by an increase in the share headed to countries predominantly outside of East Asia.

The primary destinations for Chinese exports in 2006 were the United States and Europe. The U.S. and EU accounted for 40 percent of China's total outbound traffic (Table 3.7). This was followed closely behind by Hong Kong, with over 15 percent of export trade. However, a significant percentage of the export trade headed to Hong Kong is subsequently rerouted to other destinations throughout the world, so the 15 percent figure is deceiving.[57] Excluding Hong Kong, the largest export markets in East Asia accounted for 24 percent of export trade with China.

The Value-Added Component

Given the structure of manufacturing operations in China, the value that Chinese inputs add to final product assembly of processed goods has been historically small. Estimates in the range of 20 to 25 percent were common throughout the 1990's. Since that time, these percentages have gradually increased. Thorbecke and Yoshitomi (2006) estimated Chinese value-added to processed exports at 30 to 35 percent, while Cui and Syed (2007) estimated a slightly higher value-added percentage of around 40 percent.[58][59]

---

[57] The IMF (2005) estimates that 90 percent of all shipping traffic through Hong Kong, half of which originates from China, is entrepot and transshipments.

[58] The value-added percentage for Cui and Syed (2007) was derived from a graphical representation of the local content in machinery processing trade (processing trade balance dived by processing exports).

[59] It should be noted that a significant amount of export trade is generated by foreign-owned enterprises. When calculating the value of Chinese export trade, exports from foreign-owned enterprises are considered Chinese exports (IMF, 2007b). Therefore, the true value-added dollar amount of Chinese inputs as a percentage of processed exports may be overstated. This is true especially to the degree that foreign inputs such as managerial oversight and production expertise contribute to the final assembly of processed exports. In addition, it should also be noted that regardless of the value-added mix of inputs, the return on capital from foreign-owned enterprises ultimately remains a product of the foreign-based firm.

Nevertheless, a majority of the value-added input which goes into Chinese processed goods still originates from outside the country. What this implies is that even though China maintains large trade surpluses, especially with the U.S. and EU, a significant portion of these imbalances result from goods produced in other parts of East Asia. Within the vertical intra-industry trade network, China's primary role is as a point of final product assembly and export. Therefore, an appreciation of the RMB alone may not deliver the same impact on China's exports as a generalized appreciation of currencies in East Asia.[60] A generalized, integrated currency appreciation of China's major trading partners would provide a more significant step towards affecting China's overall trade surplus with the rest of the world. This idea is more formally presented in the next chapter.

---

[60] This view is supported by the IMF (2007b) in that a greater impact on exports will be achieved by an appreciation of several East Asian currencies rather than an appreciation of the RMB alone.

China: Administration

Province-Level Names

Characters	Pinyin	Pronunciation	Characters	Pinyin	Pronunciation
安徽	Anhui	ahn-way	辽宁	Liaoning	lee_ow-ning
北京	Beijing	bay-jing	内蒙古	Nei Mongol	nay-mung-goo
福建	Fujian	foo-jee_en	宁夏	Ningxia	ning-she_ah
甘肃	Gansu	gahn-soo	青海	Qinghai	ching-hi
广东	Guangdong	g_wong-doong	陕西	Shaanxi	shun-she
广西	Guangxi	g_wong-she	山东	Shandong	shahn-doong
贵州	Guizhou	g_way-joe	上海	Shanghai	shong-hi
海南	Hainan	hi-nan	山西	Shanxi	shahn-she
河北	Hebei	huh-bay	四川	Sichuan	ssu-ch_wan
黑龙江	Heilongjiang	hay-loong-jee_ong	天津	Tianjin	te_en-jin
河南	Henan	huh-nan	新疆	Xinjiang	shin-jee_ong
湖北	Hubei	hoo-bay	西藏	Xizang	she-dzong
湖南	Hunan	hoo-nan	云南	Yunnan	yu_oon-nan
江苏	Jiangsu	jee_ong-su	浙江	Zhejiang	juh-jee_ong
江西	Jiangxi	jee_ong-she			
吉林	Jilin	jee-lynn	台湾	Taiwan	tie-wan

Figure 3.1: Map of China (1991)

Source: University of Texas Libraries, Thematic Maps: China – Administration 1991

41

Figure 3. China: Special Economic Zones

Figure 3.2: Map of China (Special Economic Zones - 1997)

Source: University of Texas Libraries, Thematic Maps: China – Special Economic Zones 1997, from the Handbook of International Economic Statistics

Table 3.1: Chinese Imports and Exports by Enterprise (billions of dollars)

Import by Type of Enterprises (2006)		
Type of Enterprise	Value	Percent of Total
State-owned Enterprises	$225.2	28.45%
Foreign-funded Enterprise	$472.6	59.70%
Other Enterprises	$93.8	11.85%
Total Value	$791.6	100.00%
Export by Type of Enterprises (2006)		
Type of Enterprise	Value	Percent of Total
State-owned Enterprises	$191.4	19.75%
Foreign-funded Enterprise	$563.8	58.18%
Other Enterprises	$213.9	22.07%
Total Value	$969.1	100.00%

Source: Ministry of Commerce of the People's Republic of China (Network Center of MOFCOM), author's calculation

Table 3.2: 2006 Top 10 Points of Origination (billions of dollars)

Country/Region	Value	Percent of Total
Japan	$115.7	14.62%
European Union	$90.3	11.41%
Republic of Korea	$89.8	11.34%
ASEAN	$89.5	11.31%
Taiwan	$87.1	11.00%
United States	$59.2	7.48%
Australia	$19.3	2.44%
Russia	$17.6	2.22%
Saudi Arabia	$15.1	1.91%
Brazil	$12.9	1.63%
Top 10 as a Percentage of the Total Value		75.35%
Total Value	$791.6	

Source: Ministry of Commerce of the People's Republic of China (Network Center of MOFCOM), author's calculation

Table 3.3: Value and Percentage of Imports by Trading Form (billions of dollars)

	Year 2006	2006	2005	1993
Type of Imports	Value	Percent of Total		
Ordinary	$333.2	42.09%	42.00%	37.00%
Processed	$321.5	40.61%	42.00%	35.00%
Other	$136.9	17.29%	16.00%	28.00%
Total Value	$791.6	100.00%	100.00%	100.00%

Source: Thorbecke and Yoshitomi (2006), Ministry of Commerce of the People's Republic of China (Network Center of MOFCOM), author's calculation

Table 3.4: Share of Import Trade for Selected Countries

Selected Countries within East Asia					
	S. Korea & Taiwan	Japan	ASEAN 5	Hong Kong	Total
1993 **Type of Imports**					
Ordinary	2%	8%	3%	1%	14%
Processed	11%	8%	2%	7%	28%
Other	5%	7%	1%	2%	15%
Total Percentage	18%	22%	6%	10%	56%
2005					
Ordinary	6%	5%	3%	1%	15%
Processed	14%	7%	6%	1%	28%
Other	3%	3%	2%	0%	8%
Total Percentage	23%	15%	11%	2%	51%

Countries outside East Asia				
	United States	Europe	Rest of World	Total
1993 **Type of Imports**				
Ordinary	5%	8%	9%	22%
Processed	2%	2%	3%	7%
Other	3%	6%	5%	14%
Total Percentage	10%	15%	19%	44%
2005				
Ordinary	4%	6%	17%	27%
Processed	2%	2%	10%	14%
Other	2%	2%	4%	8%
Total Percentage	7%	11%	31%	49%

Source: Thorbecke and Yoshitomi (2006), author's calculation

Table 3.5: Value and Percentage of Exports by Trading Form (billions of dollars)

Type of Exports	Year 2006 Value	2006	2005	1993
		Percent of Total		
Ordinary	$416.3	42.96%	41.00%	47.00%
Processed	$510.4	52.67%	55.00%	48.00%
Other	$42.4	4.38%	4.00%	5.00%
Total Value	$969.1	100.00%	100.00%	100.00%

Source: Thorbecke and Yoshitomi (2006), Ministry of Commerce of the People's Republic of China (Network Center of MOFCOM), author's calculation

Table 3.6: Share of Export Trade for Selected Countries

Selected Countries within East Asia

	S. Korea & Taiwan	Japan	ASEAN 5	Hong Kong	Total
1993					
Type of Exports					
Ordinary	2%	10%	4%	10%	26%
Processed	2%	7%	1%	14%	24%
Other	0%	0%	0%	0%	0%
Total Percentage	5%	17%	5%	24%	51%
2005					
Ordinary	3%	4%	3%	3%	13%
Processed	3%	7%	3%	12%	25%
Other	0%	0%	0%	1%	1%
Total Percentage	7%	11%	6%	16%	40%

Countries outside East Asia

	United States	Europe	Rest of World	Total
1993				
Ordinary	6%	7%	9%	22%
Processed	13%	7%	4%	24%
Other	0%	0%	5%	5%
Total Percentage	18%	13%	18%	49%
2005				
Ordinary	7%	7%	13%	27%
Processed	14%	10%	6%	30%
Other	1%	0%	2%	3%
Total Percentage	21%	17%	21%	59%

Source: Thorbecke and Yoshitomi (2006), author's calculation

Table 3.7: 2006 Top 10 Points of Destination (billions of dollars)

Country/Region	Value	Percent of Total
United States	$203.5	21.00%
European Union	$182.0	18.78%
Hong Kong	$155.4	16.04%
Japan	$91.6	9.45%
ASEAN	$71.3	7.36%
Republic of Korea	$44.5	4.59%
Taiwan	$20.7	2.14%
Russia	$15.8	1.63%
Canada	$15.5	1.60%
India	$14.6	1.51%
Top 10 as a Percentage of the Total Value		84.09%
Total Value	$969.1	

Source: Ministry of Commerce of the People's Republic of China (Network Center of MOFCOM), author's calculation

4. THEORETICAL PERSPECTIVE

To investigate the effect of a joint appreciation of East Asian currencies on the
U.S. trade imbalance, consider a firm in a developed East Asian country (e.g., Japan)
producing a good partly domestically and partly in a developing East Asian country (e.g.,
China) and selling the final good in a third market (e.g., the United States). Assume that
the good is exported from the developing East Asian country and competes with
domestically produced goods in the third market.

The Model

The utility function for consumers in the third market can be written as follows:[61]

$$U(X_1, X_2) = [\alpha X_1^p + (1-\alpha)X_2^p]^{1/p} \qquad (1)$$

where U is the utility function of consumers in the third market

X_1 is the quantity of the exported good sold in the third market

X_2 is the quantity of the domestically produced good sold in the
third market

α represents preferences for X_1 and X_2

p measures the substitutability between X_1 and X_2

---

[61] This model draws heavily on Bodnar, et al. (2002).

The derivation of the standard demand functions are:

$$P_1 = D_1(X_1, X_2) = \frac{\alpha X_1^{(p-1)} Y}{\alpha X_1^p + (1-\alpha) X_2^p} \qquad (2a)$$

$$P_2 = D_2(X_1, X_2) = \frac{(1-\alpha) X_2^{(p-1)} Y}{\alpha X_1^p + (1-\alpha) X_2^p} \qquad (2b)$$

where P_1 and P_2 represent prices to the exporting firm in its own currency and Y

represents total expenditures on the industry's products.

According to equation (2a), the market share of the exporting firm in the third

market is given by:

$$\lambda = \frac{P_1 X_1}{Y} = \frac{\alpha X_1^p}{\alpha X_1^p + (1-\alpha) X_2^p} \qquad (3)$$

The profit of the exporting firm in its own currency is given by:[62]

$$\pi_1^* = S_1 P_1 X_1 - (C_1^* + S_2 C_1^{**}) X_1 \qquad (4)$$

where S_1 is the price of the third market's currency in units of the developed

   East Asian country's currency (e.g., if a Japanese firm sells its goods

   in the United States, S_1 is yen/dollars)

C_1^* represents the costs incurred by the exporting firm from producing a

   good partly domestically

C_1^{**} represents the costs incurred by the exporting firm from producing a good partly in a developing East Asian country, measured in units of the developing East Asian country's currency

S_2 is the price of the developing East Asian country's currency in units of the exporting firm's home currency (e.g., if Japan partly produces its goods in China, S_2 is yen/Yuan)

Note that $\dfrac{S_1}{S_3} = S_2$, where S_3 is the exchange rate in the developing East Asian economy relative to the third market. For example, if S_1 is the yen/dollar rate and S_2 is the yen/Yuan rate, then S_3 is the Yuan/dollar rate.

The profit of the domestically producing, third market firm in its own currency is given by:

$$\pi_2 = P_2 X_2 - C_2 X_2$$

It is now straightforward to solve this model under both quantity and price competition (see Bodnar, et al., 2002).

	Quantity Competition	Price Competition
Cost Ratio, R	$R = \dfrac{S_1 C_2}{C_1^* + S_2 C_1^{**}}$	$R = \dfrac{S_1 C_2}{C_1^* + S_2 C_1^{**}}$
Equilibrium Market Share, λ	$\lambda = \dfrac{\alpha R^p}{1 + \alpha R^p}$ $\alpha = \dfrac{\alpha}{1 - \alpha}$	$\lambda = \dfrac{\alpha R^p Z^p}{1 + \alpha R^p Z^p}$ $Z = \dfrac{[1 - p(1 - \lambda)]}{1 - p\lambda}$
Exporter's Price in the Third Market, P_1	$P_1 = \dfrac{C_1^* + S_2 C_1^{**}}{S_1 p(1 - \lambda)}$	$P_1 = \dfrac{(C_1^* + S_2 C_1^{**})(1 - p\lambda)}{S_1 p(1 - \lambda)}$
Exporter's Quantity Sold In the Third Market, X_1	$X_1 = \dfrac{\lambda Y S_1 p(1 - \lambda)}{C_1 + S_2 C_1^{**}}$	$X_1 = \dfrac{\lambda Y S_1 p(1 - \lambda)}{(C_1 + S_2 C_1^{**})(1 - p\lambda)}$
Exporter's Revenue in the Third Market's Currency	λY	λY

Assume Y is fixed. The effect on the exporting firm's revenue from a currency change is given by:

$$\frac{\partial \lambda (R(S_n))}{\partial S_n}$$

This implies that the channel by which the relevant exchange rates impact revenue is through the exporting firm's cost structure (and its corresponding change to equilibrium market share in the third country). Thus, an increase in cost reduces the exporting firm's market share (and subsequently, its revenue), while a decrease in costs increases the firm's market share, all other things equal.

Three Cases

Consider three cases. In the first case, S_1 and S_3 move together, as would be the case if the Yuan and the yen appreciated together against the dollar. In the second case, S_3 is fixed, as has been the case with the Yuan fixed relative to the dollar. In the third case, S_3 moves in isolation, as would be the case if the Yuan appreciated against the dollar apart from an appreciation of any other East Asian currency.

I. Case #1

In this case, S_1 and S_3 move together, so S_2 remains constant.[63] This would be true regardless of which direction the two currencies move (either an appreciation or depreciation). Therefore, $S_2 = \dfrac{S_1}{S_3} = \beta$, and $R = \dfrac{S_1 C_2}{C_1^* + \beta C_1^{**}}$. Under this case, a change in S_1 would result in the following change in the exporting firm's revenue:

$$\frac{\partial \lambda(R(S_1))}{\partial S_1} = \frac{\partial \lambda}{\partial R}\frac{\partial R}{\partial S_1} =$$

$$\frac{p\alpha R^{p-1}(1+\alpha R^p) - p\alpha R^{p-1}(\alpha R^p)}{(1+\alpha R^p)^2}\left[\frac{\partial R}{\partial S_1}\right] =$$

$$\frac{p\alpha R^{p-1}(1+\alpha R^p - \alpha R^p)}{(1+\alpha R^p)^2}\left[\frac{\partial R}{\partial S_1}\right] =$$

$$\frac{p\alpha R^{p-1}(1)}{(1+\alpha R^p)^2}\left[\frac{\partial R}{\partial S_1}\right] =$$

---

[63] Note that in order for S_2 to remain constant, the changes in S_1 and S_3 against the third market's currency would have to be the same in percentage terms, not numerical terms.

$$\frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2}\left[\frac{C_2(C_1^* + \beta C_1^{**})}{(C_1^* + \beta C_1^{**})^2}\right] =$$

$$\frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2}\left[\frac{C_2}{C_1^* + \beta C_1^{**}}\right]$$

Notice that all the terms in the differential expression are positive. Thus, a positive change in S_1 leads to a positive change in market share and revenue. This result follows intuitively in that a positive change in S_1 implies a depreciation against the third market's currency. Likewise, a negative change in S_1 (an appreciation against the third market's currency) would lead to a negative change (reduction) in market share and revenue.

II. Case #2

Now consider the second case in which S_3 is fixed. Then S_2 equals a constant times S_1 (for simplicity, assume $S_2 = \gamma S_1$, so $R = \dfrac{S_1 C_2}{C_1^* + \gamma S_1 C_1^{**}}$), and the change in the exporting firm's revenue from a change in S_1 becomes:

$$\frac{\partial \lambda(R(S_1))}{\partial S_1} = \frac{\partial \lambda}{\partial R}\frac{\partial R}{\partial S_1} =$$

$$\frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2}\left[\frac{C_2(C_1^* + \gamma S_1 C_1^{**}) - \gamma C_1^{**} S_1 C_2}{(C_1^* + \gamma S_1 C_1^{**})^2}\right] =$$

$$\frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2}\left[\frac{C_2}{C_1^* + \gamma S_1 C_1^{**}} - \frac{\gamma C_1^{**} S_1 C_2}{(C_1^* + \gamma S_1 C_1^{**})^2}\right]$$

As in Case #1, all three terms are positive and the direction of the change of the differential equation is positive.[64] Therefore, a positive (negative) change in S_1 leads to a positive (negative) change in market share and revenue.

In order to compare the first and second cases, let $S_2 = \beta = \gamma S_1$. Then in the first case:

$$\frac{\partial \lambda}{\partial S_1} = \frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2}\left[\frac{C_2}{C_1^* + S_2 C_1^{**}}\right]$$

and in the second case:

$$\frac{\partial \lambda}{\partial S_1} = \frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2}\left[\frac{C_2}{C_1^* + S_2 C_1^{**}} - \frac{S_2 C_1^{**} C_2}{(C_1^* + S_2 C_1^{**})^2}\right]$$

Notice that the effect of an exchange rate change on the exporting firm's revenue is greater in the first case than in the second case. Thus, a greater impact on the trade balance in the third market (e.g. United States) occurs if there is a joint appreciation of East Asian currencies (e.g. Japan and China) against the third market's currency than the appreciation of a single East Asian currency (in this case, Japan) in isolation.

---

[64] The two terms within the brackets yield a positive result since the first term ($\frac{C_2}{C_1^* + \gamma S_1 C_1^{**}}$) is greater than the second term ($\frac{\gamma C_1^{**} S_1 C_2}{(C_1^* + \gamma S_1 C_1^{**})^2}$). This can be more clearly seen when the second term is broken into its subsequent parts ($\left[\frac{C_2}{C_1^* + \gamma S_1 C_1^{**}}\right]\left[\frac{\gamma S_1 C_1^{**}}{C_1^* + \gamma S_1 C_1^{**}}\right]$).

III. Case #3

Finally, consider the third case in which S_3 moves in isolation (S_1 is fixed relative

to S_3). In this case, the exchange rate of interest is S_3, the Yuan/dollar rate. Therefore, S_2

$$= \frac{S_1}{S_3} = \varphi(S_3)^{-1}, \; S_1 = S_2 S_3, \text{ and } R = \frac{S_2 S_3 C_2}{C_1^* + \varphi(S_3)^{-1} C_1^{**}} \; .$$

$$\frac{\partial \lambda(R(S_3))}{\partial S_3} = \frac{\partial \lambda}{\partial R} \frac{\partial R}{\partial S_3} =$$

$$\frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2} \left[\frac{S_2 C_2 (C_1^* + \varphi(S_3)^{-1} C_1^{**}) - (-\varphi(S_3)^{-2} C_1^{**}) S_2 S_3 C_2}{(C_1^* + \varphi(S_3)^{-1} C_1^{**})^2} \right] =$$

$$\frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2} \left[\frac{S_2 C_2}{C_1^* + \varphi(S_3)^{-1} C_1^{**}} + \frac{\varphi(S_3)^{-2} C_1^{**} S_2 S_3 C_2}{(C_1^* + \varphi(S_3)^{-1} C_1^{**})^2} \right] =$$

$$\frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2} \left[\frac{S_2 C_2}{C_1^* + \varphi(S_3)^{-1} C_1^{**}} + \frac{(\varphi(S_3)^{-1})(S_2 S_3)((S_3)^{-1}) C_1^{**} C_2}{(C_1^* + \varphi(S_3)^{-1} C_1^{**})^2} \right] =$$

Combining terms and converting $\varphi(S_3)^{-1}$ back to S_2 yields the following result:

$$\frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2} \left[\frac{S_2 C_2}{C_1^* + S_2 C_1^{**}} + \frac{(S_2)^2 C_1^{**} C_2}{(C_1^* + S_2 C_1^{**})^2} \right] =$$

$$\frac{p\alpha R^{p-1}}{(1+\alpha R^p)^2} \left[\frac{C_2}{C_1^* + S_2 C_1^{**}} + \frac{S_2 C_1^{**} C_2}{(C_1^* + S_2 C_1^{**})^2} \right] S_2$$

Once again, all three terms are positive, making the partial derivative positive as well

$$(\frac{\partial \lambda}{\partial R} \frac{\partial R}{\partial S_3} > 0).$$

This positive result implies that an increase in S_3 leads to an increase in the cost

ratio ($\frac{S_1 C_2}{C_1^* + S_2 C_1^{**}}$). The reason being, as S_3 increases, S_2 (the bilateral exchange rate

57

between the developed and developing countries) decreases, resulting in a subsequent fall in the total cost of production for the exporting firm ($C_1^* + S_2 C_1^{**}$). This decrease has a positive effect on the cost ratio, making the exporting firm's good relatively less expensive in comparison to the third market's good. The corresponding change increases both market share and revenue for the exporting firm.

While a rise (depreciation) of S_3 gives an incentive for the exporting firm to shift more production to the developing country, a fall (decrease) in S_3 produces an opposite response. In this case, the exporting firm has an incentive to move production to a lower cost location (e.g. from China to Vietnam). To counter this response, the developing country may resist an appreciation of its exchange rate relative to the third market. Assuming that all developing countries in East Asia attach a similar importance to production share, each would have a similar incentive to maintain the status quo in terms of their own exchange rates with the third market. This would lead to the solution with the smallest impact on the trade balance with the third market.

Therefore, if there is a generalized appreciation of currencies in East Asia, it avoids the potential prisoner's dilemma among developing East Asian countries. It also has the potential to produce a larger impact on the trade balance with the third market than if the currency of the home country of the exporting firm were to appreciate and the other East Asian currencies were to remain relatively fixed.

5. LITERATURE REVIEW

There have been a number of research studies performed over the past several years to evaluate the existence and extent of undervaluation of the RMB. These studies have employed three main research approaches; the Purchasing Power Parity (PPP) model, the Behavioral Equilibrium Exchange Rate (BEER) model, and the Fundamental Equilibrium Exchange Rate (FEER) model.[65]

The Purchasing Power Parity Model

The first approach, the PPP model, holds to the theory of the law of one price: within efficient markets, exchange rates must equalize based on their purchasing power against a predetermined basket of goods.[66] Obvious difficulties arise, however, with this approach. The ability to identify a comparable basket of goods, the preferences for each good within the basket, and supply and demand factors which influence pricing decisions are just a few of the problems encountered when using the PPP model. In order to compensate for these issues, an enhanced-PPP model was developed which incorporates

---

[65] It's important to note that, though these three models represent the main approaches used thus far in the literature, they are by no means the only models used. Two other models which have received attention are the PEER model and the NATREX model. However, each model has strong similarities to BEER model and FEER model, respectively. A brief footnote describing the differences of the similar models will appear at the start of the discussion on the BEER and FEER models.

[66] The PPP exchange rate is the bilateral exchange rate which equalizes the purchasing power of two country's currencies against an identical basket of goods. For example, if the value of an identical basket of goods purchased in China and the U.S., as measured in each country's currency, is 8-to-1, then the spot exchange rate between the two country's currencies (the PPP exchange rate) should also be 8-to-1.

the Balassa-Samuelson effect.[67] In this case, currency over or undervaluation is determined by the divergence of a country's real effective exchange rate from the income per capita-to-real exchange rate regression line.[68]

Within the literature, there are several contributions which use the enhanced-PPP model. Coudert and Couharde (2005), using 2003 data on 173 countries, regressed the relative price levels of each country (to the U.S.) against their relative PPP GDP per capita. Relative price levels were used as a proxy for the real exchange rate and calculated as the ratio of the GDP in U.S. dollars to the GDP in PPP dollars against the U.S. consumer price index. Besides using the entire sample, splits were made to compensate for countries at the extremities and countries with populations lower than 1 million inhabitants. They found that Chinese currency undervaluation ranged from between 41 percent (populations greater than 1 million) to 51 percent (all countries in the sample).

In a more recent study, Coudert and Couharde (2007) used 2000 to 2004 data on 132 countries with populations greater than 1 million people. Though the range of RMB undervaluation increased somewhat, it was still within the parameters of the previous study; 44 percent (excluding countries with PPP GDP per capita less than or equal to 5 percent of U.S. PPP GDP) to 64 percent (all countries in the sample).[69]

---

[67] The Balassa-Samuelson effect is the observation that as low-income countries develop, their general price levels rise due to differentials in productivity between tradeable and non-tradeable goods. These differentials produce ratios of the spot exchange rate to the PPP rate that are below unity. Over time, as the economy develops, these ratios theoretically rise to unity.
The term "enhanced-PPP" is the same convention used by Cline and Williamson (2007).
[68] As a normal convention, data are assumed to be measured in natural logs, unless otherwise indicated.
[69] The authors did indicate that they felt the more relevant range for RMB undervaluation was between 44 and 46 percent, given the sub-samples which were run. This range applied to the sub-sample of countries

In another study, Frankel (2006), using 2000 data, regressed the real exchange rates of 118 countries against their real GDP per capita. From this regression, he determined that China's real exchange rate relative to the U.S. dollar was undervalued by 45 percent.[70] An analogous regression using 1990 data produced a similar undervaluation of 42 percent.

Cheung, Chinn and Fujii (2006) expanded the size of the dataset being used by including 160 countries over a 30 year time frame (1975-2004). They ran several pooled ordinary least squares (OLS) regressions using different time series and cross-sectional sub-samples. They also incorporated additional explanatory variables within the regressions, as well as corrected for serial correlation within the data. They obtained a range of values for the level of undervaluation of the RMB, with most estimates around the 50 percent range (2003). They noted, however, that the relative misalignment of the RMB was not statistically significant in that the results were always within two standard errors of the regression line.

In a survey paper by Dunaway, Leigh, and Li (2006), the authors noted that the way explanatory variables were defined within the enhanced-PPP model had a significant impact on the results that were obtained. For example, alternate approaches to the calculation of real productivity and net foreign assets, the addition of terms of trade, and the addition of openness could effect the relative undervaluation of the RMB by as much

---

with PPP GDP per capita greater than 5 percent of U.S. PPP GDP per capita, and the sub-sample of countries with PPP GDP per capita between 5 percent and 70 percent of U.S. PPP GDP per capita.
[70] Frankel obtained results from data measured in both absolute and logarithmic terms. Results reported are those from data measured in natural logs.

as 37 percentage points. In addition, the choice of countries to be included in the study, as well as the sample period for panel data, also had an impact on the results.

The Behavioral Equilibrium Exchange Rate Model

The second approach used to evaluate the exchange rate value of the RMB is the BEER model.[71] First introduced by Clark and MacDonald (1998), the BEER model evaluates a currency's real equilibrium exchange rate value in terms of its deviation from a historical index based on several specified variables. These variables usually include relative productivity and net foreign assets. There are a number of research papers which employ the BEER model. An overview of these papers follows.

Wang (2004) estimated the medium-term real effective exchange rate value of the RMB as a function of three variables.[72] These variables included the relative productivity gains of China in relationship to partner countries in the data, China's net foreign assets, and the openness of its trade regime. Data included the years from 1980 to 2003, and the regression was estimated using a nonlinear least squared method. Wang found that the difference between the actual data and the estimated regression line were fairly small, which may indicate relatively little undervaluation of the RMB.

---

[71] A similar approach to the BEER model is the PEER model. The one difference is that while the BEER model evaluates the impact of misalignment on both economic fundamentals and transitory factors, the PEER model focuses exclusively on the economic fundamentals. Thus, the difference in short- to medium-term (current) misalignment (BEER) and long-term (total) misalignment (PEER).

[72] Wang also performed a NATREX-type analysis comparing the actual current account with two measures of the expected current account (savings-investment balance and stable NFA-to-GDP ratio). Results indicated both overvaluation and undervaluation, essentially implying that the current exchange rate valuation of the RMB was in line with its expected value.

Funke and Rahn (2004) regressed the trade weighted average of the real exchange rate against country productivity differentials and net foreign assets. The quarterly data were initially run over a time frame from 1985 to 2002; however, a structural break in the exchange rate and productivity time series reduced the time frame to 1994 to 2002. By the end of the time period (2002), results indicated a real exchange rate undervaluation of approximately 3 percent. Converting the results obtained from the BEER regression into nominal measures, the bilateral undervaluation of the RMB against the U.S. dollar stood at 11 percent.

Bénassy-Quéré, et al. (2004, 2006) conducted two studies on the valuation of the RMB. In both studies, they compared the real effective exchange rate of the RMB against a set of other comparable currencies. In the first study, they evaluated the equilibrium real exchange rate of 15 of the G-20 countries. Annual data covered the period from 1980 to 2001 and the regressions included net foreign assets and relative productivity in tradeables as explanatory variables. Results indicated that in 2001 the RMB was undervalued by 16.2 percent in comparison to the other currencies in the study (weighted by volume of international trade) and, in relationship to the U.S. dollar, by 44.0 percent.

In the second study, Bénassy-Quéré, et al. (2006) expanded both the time frame (1980 – 2004) and the frequency (quarterly) of the dataset. In addition, a 16th currency was added which represented the rest of the world (64 additional countries based on data availability). The results produced somewhat higher levels of RMB undervaluation. Excluding the rest of the world as an additional currency, real exchange rate

undervaluation was 31.1 percent in 2004. Including the rest of the world, real exchange rate undervaluation rose to 44.6 percent.

Besides their enhanced-PPP regression, Coudert and Couharde (2005) also performed a BEER model regression which included a variable for the Balassa-Samuelson effect. They constructed a relative price index (CPI to PPI) between the home country and the U.S. as a proxy for this effect. The quarterly data included 21 emerging countries and covered a time frame from 1980 to 2002. The results indicated an undervaluation of 17.8 percent (2002) of the real bilateral exchange rate between the RMB and the U.S. dollar. They noted, however, that the Balassa-Samuelson effect seemed to be of little significance in relation to China given that the coefficient (0.64) is not of the expected sign (negative).

Wang, et al. (2007) estimated a BEER model using the Johansen maximum-likelihood cointegration technique. They specified a vector error-correction model and filtered the results using the Hodrick-Prescott filter. The explanatory variables for the reduced form real effective exchange rate included money supply, foreign reserves, per capita GDP, and terms of trade. Results from the BEER analysis indicated that over the 25-year sample period (annual data from 1980 to 2004), the RMB was never undervalued by more than 5 percent at any one time (1993). By the end of the sample period (2004), the relative undervaluation of the RMB was less than 3 percent.

Chen (2007) constructed a BEER model using the Balassa-Samuelson effect, net foreign assets, terms of trade, and degree of openness. He assessed misalignment of the real effective exchange rate against both the current value and the long-run value of the

64

economic fundamentals. Using quarterly data from 1994 to 2006, he found that misalignment of the real effective exchange rate against the current BEER was no greater than 6 percent at any one time throughout the entire sample. It was no greater than 4 percent against the permanent BEER. In 2006, misalignment was less than 2 percent against the current BEER and zero against the permanent BEER.

MacDonald and Dias (2007) used results from a BEER model to run a simulation exercise to determine the adjustments needed to correct existing global imbalances. The study was conducted on 10 of the top 15 industrialized and emerging market economies which have contributed significantly to global imbalances, including the U.S. and China. The BEER model incorporated net exports-to-GDP, real interest rates, terms of trade, and GDP per capita as explanatory variables. The dataset was composed of quarterly data from 1988 to 2006. Both the Johansen maximum-likelihood cointegration and panel DOLS techniques were employed as estimators for the model. Three scenarios were run with targets ranging from a reduction in national current account surpluses to 41 percent of their predicted values by 2011 (as well as a reduction in the U.S. current account deficit to 3 percent of GDP), a reduction in national current account surpluses to 1.1 percent of GDP, and a zero current account balance for China and Malaysia.[73] The results indicated that in order to achieve these range of targets, required adjustments to the RMB would be between 27.3 percent and 46.6 percent.

---

[73] This analytical approach is very similar to the FEER approach. Given that the reported misalignment is in context to external current account targets, results will be reported in the FEER method summary at the end of the chapter.

The Fundamental Equilibrium Exchange Rate Model

The last approach used to evaluate the RMB is the FEER model. This model evaluates exchange rates in terms of their ability to bring about balance to a country's economy. Internally, this applies to the level of output consistent with non-inflationary full employment. Externally, this applies to the sustainable level of the country's current account.[74] In general, these measures are subjective in nature and vary from one model to another.

Jeong and Mazier (2003) defined a FEER model in terms of trading partners; China, Japan, Korea, with the United States, the Euro zone, and the rest of the world. Panel data spanned 1981 to 2000 and included external equilibrium factors (trade volume, import and export prices, etc.), as well as internal equilibrium factors (ratio of exports to imports, trade openness ratio, net external assets and debt, interest rates, etc.). Results for a 1 percent to 1.5 percent deficit in the equilibrium value of the current account indicated a real exchange rate undervaluation of the RMB of approximately 33 percent from 1997 through the end of the sample period (2000). The bilateral undervaluation of the RMB against the U.S. dollar over the same period was approximately 60 percent.

---

[74] Another approach similar to the FEER model is the NATREX model. Both models are similar in that they evaluate a country's exchange rate in terms of internal and external equilibrium. Internal equilibrium is typically modeled as the nonaccelerating inflation rate of unemployment (Williamson, 1983) or the stationary mean of productivity capacity (Stein, 2002). However, for the FEER model, external equilibrium focuses on a sustainable current account balance, while in the NATREX model, it focuses on the investment/savings relationship. Where this distinction in external equilibrium is made, the difference in approaches will be noted (e.g. Wang (2004) footnote). Otherwise, the approach will be designated as a FEER or FEER-type analysis.

In Coudert and Couharde's (2005) contribution to the FEER methodology, they considered five countries for their regressions: the U.S., Japan, the Euro area, South Korea, and China. For China's internal equilibrium, the structural current account was used and set equal to the observed current account with a 3-year lag adjustment for the real exchange rate and output gaps between trading partners. For China's external equilibrium, the sustainable current account balance was assessed from two perspectives. The first was in terms of structural capital flows. In this case, they referenced the work of Williamson and Mahar (1998) and used a current account deficit of 2.8 percent of GDP. The second was in terms of the savings-investment balances across countries. Referencing Williamson (2003), they used a current account target deficit of 1.5 percent. For 2003, their results ranged from 23 to 30 percent undervaluation of the real effective exchange rate and 44 to 54 percent undervaluation of the bilateral exchange rate with the United States.

In a sequential set of papers, Goldstein (2004), along with Lardy (2006, 2007), performed a FEER-type, elasticity-based analysis of the exchange rate value of the RMB by considering the appreciation of the RMB needed in order for China to run a balanced to 1.5 percent deficit (to GDP) in its current account. Goldstein's initial paper dealt with an adjustment to China's current account of approximately 3 to 4 percentage points. However, as China's current account surplus continued to expand over the next several years, each successive paper raised the level from which the current account had to fall. As a result, the necessary adjustment to the real exchange rate rose as well. Their 2007

67

estimate indicated a real appreciation of the RMB in the range of 35 to 60 percent, up from Goldstein's initial estimate of 15 to 30 percent.

Given the number of studies addressing the relative value of the RMB, Cline and Williamson (2007) produced a survey paper which looked at 19 related studies.[75] Each study focused on either the real effective exchange rate of the RMB, or the bilateral exchange rate of the RMB with the U.S. dollar, or both. These papers covered a number of different research methods, datasets, and time frames. The authors found that, on average, the level of undervaluation of the real effective exchange rate of the RMB was 20 percent. For the bilateral exchange rate with the U.S. dollar, the percentage rose to 40 percent.

Table 5.1 provides a similar summary of studies specific to this chapter. The information is broken down by model utilized; enhanced-PPP, BEER, and FEER. The enhanced-PPP model indicated the greatest level of undervaluation, while the BEER model indicated the least. Undervaluation across all models ranged from zero to 47 percent for the real effective rate and 11 to 64 percent for the bilateral dollar rate. For the most part, the averages were in line with those calculated by Cline and Williamson (2007). Average undervaluation of the real effect rate was 19 percent and the bilateral dollar rate was 42 percent.

---

[75] Dunaway and Li (2005) and Siregar and Rajan (2006) perform similar analyses.

Impact of an Appreciation of the RMB on Exports and Trade Balances

In general, it appears that there is a substantial body of evidence which indicates that the RMB is undervalued. Accepting this as true, the relevant issue now becomes one of the effect of an appreciation of the RMB on China's global trade balance, and the significance of this effect. There have been a number of studies that have undertaken the task of addressing this question. The findings have thus far been inconclusive.

Eckaus (2004) investigated the effects of an appreciation of the RMB on Chinese exports to the U.S. (also measured as China's share of imports into the U.S.). Ordinary least squared regressions corrected for autocorrelation and heteroskedasticity were used, with several measures for the real exchange rate, U.S. GDP, and the Euro/Dollar rate representing the explanatory variables. Results indicated that a 10 percent appreciation of the RMB lead to a 3.0 percent reduction in Chinese exports to the U.S. (2.7 percent reduction in China's share of imports into the U.S.). He noted that the results were modest and did not indicate that the rapid rise in China's exports into the U.S. was the result of an undervaluation of the RMB.

Lau, Mo, and Li (2004) studied the impact of an appreciation of the RMB on imports from and exports to the G3 nations (Japan, the EU, and the U.S.). They regressed quarterly data from 1995 to 2003 using a dynamic ordinary least squares (DOLS) approach. In terms of exports, the short-run results for the real effective exchange rate were not significant. They did find that long-run results were significant and yielded a coefficient of -1.47.

The IMF (2005) used a partial equilibrium model to study the impact of a 10 percent appreciation of the RMB against all other currencies on output and the current account. They also studied the impact of a 10 appreciation of the RMB and a 5 percent appreciation of other Asian currencies as well. For China, income and price elasticities were estimated at around 1 with exchange rate pass-through of the U.S. dollar export price of about half. The results indicated that the impact to output originating from Asia would be minimal, as the reduction in output from China would be offset by the increase in output from other Asian countries. An appreciation of all Asian currencies would have a smaller impact on China, but a larger impact on overall output and the current account balance for Asia. In addition, the IMF noted that of the studies undertaken to evaluate the effects of an appreciation of the RMB, which at the time were few, there was significant variance in the results. This was due primarily to the differences in models used and variables specified.

Mann and Plück (2005) constructed a DOLS regression model to determine the price elasticities of U.S. trade flows. The 31-country bilateral trade data were disaggregated into 4 separate commodity categories and deflated by end-use import and export price indexes. Explanatory variables included real consumption, real investment, and real gross domestic product. In context to China, the results for the price elasticities of imports into the U.S. for both capital and consumer goods were of the wrong sign (positive). The coefficients on consumer goods were not significant.

Voon, Guangzhong, and Ran (2006) use a Seemingly Unrelated Regression (SUR) model to test the effects on Chinese exports from an appreciation of the RMB.

This model incorporates the combined effects of changes in the real exchange rate, volatility, and exchange rate misalignment on exports. Export volume data were taken over a 20-year time frame, from 1978 to 1998, and divided into commodity categories. Results indicated that a drop in exports from an increase in the real exchange rate and volatility may be offset by a reduction in exchange rate misalignment.

Thorbecke (2006a) investigated the effects on U.S. trade imbalances from changes in bilateral exchange rates between the U.S. and its largest East Asian trading partners (Japan, Taiwan, South Korea, and China). Utilizing the Bickerdike-Robinson-Metzler imperfect substitutes model for the import and export functions, he applied three different regression techniques; gravity model, Johansen Maximum Likelihood Estimation (Johansen MLE), and DOLS. Both Johansen MLE and DOLS regressions were used to test for individual country export elasticities with the U.S. and indicated statistically significant relationships between a bilateral appreciation of the Japanese, Taiwanese, and South Korean currencies and a reduction in exports to the United States. For China, the results were less conclusive. Though the gravity model regression indicated a 10 percent appreciation in the RMB would result in a 12.9 percent reduction in final goods exports to the rest of the world, statistically significant results from the Johansen MLE and DOLS regressions on export elasticities with the U.S. were dependent on the inclusion of a time trend. In addition, with the time trend, the Marshall-Lerner condition on the import and export demand elasticities could not be met. The Marshall-Lerner condition on U.S. import and export demand elasticities with Japan, Taiwan, and South Korea also failed.

71

In a follow up paper, Thorbecke (2006b) employed Goldstein and Kahn's (1985) imperfect substitutes model to test for the effect of an appreciation of the RMB on the United States' trade balance with China. To control for the impact on China's exports from competition from its' main export competitors (the ASEAN-4 countries), a real exchange rate index for trade between these countries and the U.S. was included in the model. Johansen MLE and DOLS results indicated that a 10 percent appreciation of the RMB/dollar real exchange rate would result in an 8.1 and 17.9 percent reduction in Chinese exports to the U.S., respectively. In addition, a 10 percent depreciation of the ASEAN/dollar real exchange rate would also result in a reduction in Chinese exports to the U.S.; 2.4 percent and 7.4 percent (average among lead and lag results), respectively.

In an updated FEER analysis by Coudert and Couharde (2007), the authors discussed the impact of an appreciation of the RMB on the U.S. trade deficit. They noted that due to the low degree of trade openness in the U.S., as measured by the ratio of imports to GDP, a higher degree of appreciation was required in the bilateral exchange rate with China in order for a measurable adjustment in U.S. external imbalances to take place. Consequently, they found that given the crossed price elasticities obtained from their regression, the U.S. external deficit would only be weakly affected by an appreciation of the RMB.

Cheung, Chinn, and Fujii (2007) constructed several DOLS regressions to determine Chinese trade elasticities. Of particular interest were the bilateral trade regressions between China and the United States. Using both U.S. and Chinese data deflated by three separate price indices, the results indicated a statistically significant

72

relationship between U.S. imports of Chinese goods and the bilateral real exchange rate. Point estimates ranged from 0.80 (U.S. data) to 2.03 (Chinese data).

Marquez and Schindler (2007) analyzed exchange rate changes on Chinese imports and exports using an autoregressive distributed lag OLS model which focused on trade shares rather than trade volume. Explanatory variables for exports included the real effective exchange rate, world economic activity, the stock of FDI in China, and the share of imports for processing. Monthly data were gathered primarily from CEIC and the IMF and spanned the years 1997 to 2006. Three separate measures were used for the real exchange rate. In terms of exports, an appreciation of the RMB resulted in a reduction in both the share of ordinary exports and exports of parts for assembly. In the aggregate, a 10 percent appreciation of the RMB resulted in a reduction of 11 to 14 percent in China's share of world exports, or approximately 1 full percentage point.

Finally, Garcia-Herrero and Koivu (2007) utilized cointegration techniques to regress the volume of Chinese imports and exports. Explanatory variables for the non-linear least squared regression included the real effective exchange rate, domestic (imports) or foreign (exports) demand, and several other control variables. For exports, these control variables included value-added tax rebates to exporting companies, capacity utilization, and the stock of FDI. Monthly data were disaggregated into processed and ordinary trade. The data spanned 1994 to 2005, but was also split to account for China's membership into the World Trade Organization. Long-run price elasticities were negative, statistically significant, and greater than 1 in absolute terms; -1.3 for processed goods and -1.8 for ordinary goods.

Table 5.2 provides a summary of the studies on the impact of an appreciation of the RMB on China's exports and trade balances. As mentioned at the beginning of this section, results varied. In some cases, the research was inconclusive (Mann and Plück, 2005) or the results were minimal (Coudert and Couharde, 2007). In other cases, the impact on exports was more measurable (Lau, Mo, and Li, 2004, Marquez and Schindler, 2007, Garcia-Herrero and Koivu, 2007). In general, however, the research does seem to indicate that a 10 percent appreciation of the RMB leads to an average reduction in China's exports of about 12 percent.

This dissertation adds to the current body of research by determining the effects from both a bilateral appreciation of the RMB and a weighted appreciation of the currencies of China's largest trading partners in processed imports (predominantly countries within East Asia) on China's exports. Panel data from 1992 to 2005 on 33 countries were regressed using a DOLS model. Exports were divided into ordinary and processed and deflated by 3 separate indices. A complete description of the modeling approach follows in the next chapter.

Table 5.1: Summary Data on RMB Misalignment for Selected Studies

Method: Enhanced-PPP

Study	Year	Type of Exchange Rate	Misalignment
Coudert and Couharde (2005)	2003	Bilateral Dollar	-41% to -51%
Coudert and Couharde (2007)	2004	Bilateral Dollar	-44% to -64%
Frankel (2006)	2000	Bilateral Dollar	-45%
Cheung, Chinn and Fujii (2006)	2003	Bilateral Dollar	≈ -50%

Method: BEER

Study	Year	Type of Exchange Rate	Misalignment
Wang (2004)	2003	Real Effective	≈ -5%
Funke and Rahn (2004)	2002	Real Effective Bilateral Dollar	≈ -3% -11%
Bénassy-Quéré et al. (2004)	2001	Real Effective Bilateral Dollar	-16% -44%
Coudert and Couharde (2005)	2002	Bilateral Dollar	-18%
Bénassy-Quéré et al. (2006)	2004	Real Effective Bilateral Dollar	-31% to -45% -30% to -59%
Wang, et al. (2007)	2004	Real Effective	≈ -3%
Chen (2007)	2006	Real Effective	0% to -2%

Table 5.1: Summary Data on RMB Misalignment for Selected Studies - Continued

Method: FEER

Study	Year	Type of Exchange Rate	Misalignment
Wang (2004)	2003	Real Effective	≈ 0%
Jeong and Mazier (2003)	1997-2000	Real Effective Bilateral Dollar	≈ -33% ≈ -60%
Coudert and Couharde (2005)	2003	Real Effective Bilateral Dollar	-23% to -30% -44% to -54%
Goldstein and Lardy (2007)	2007	Real Effective	-35% to -60%
MacDonald and Dias (2007)	2006	Real Effective	-27% to -47%

Source: Siregar and Rajan (2006), Cline and Williamson (2007), and author's summary of research
Note: Negative percentages indicate an undervaluation of the currency.

Table 5.2: Summary Data on Effect of 10 Percent Appreciation of RMB for Selected Studies

Study	Model	Findings
Eckaus (2004)	OLS	3% reduction in exports to U.S.
Lau, Mo, and Li (2004)	DOLS	14.7% long-run reduction in exports to G-3 nations
IMF (2005)	Partial Equilibrium	5.8 percentage point reduction in total export volume
Mann and Plück (2005)	DOLS	Price elasticities for imports to U.S. of the wrong sign or not significant
Voon, Guangzhong, and Ran (2006)	SUR	Negative effects from appreciation of RMB potentially offset of positive effects from correction of currency misalignment
Thorbecke (2006a)	Gravity Model Johansen MLE DOLS	12.9% reduction in total exports (Gravity) Johansen MLE and DOLS results on trade with U.S. dependent on time trend, do not meet Marshall-Lerner condition
Thorbecke (2006b)	Johansen MLE DOLS	8.1% to 17.9% reduction in exports to U.S.
Coudert and Couharde (2007)	FEER	Low crossed price elasticities would yield minimal impact on U.S. trade imbalance
Cheung, Chinn, and Fujii (2007)	DOLS	8% reduction in exports to U.S. (U.S. data)
Marquez and Schindler (2007)	OLS	11% to 14% reduction in share of world exports
Garcia-Herrero and Koivu (2007)	Non-linear OLS	13% long-run reduction in total exports of processed goods 18% long-run reduction in total exports of ordinary goods

Source: Author's summary of research

6. RESEARCH METHODOLOGY

A discussion on the theoretical framework, the determination of the dependent and independent variables, and the regression model follows.

Theoretical Framework

The theoretical framework that will be used to construct the regression model is the imperfect substitutes model. The advantage to this model is that it combines export supply and demand functions into a single equation. This reduces potential issues related to consistency of the data, as well as having to solve two equations simultaneously.

I. Overview of the Imperfect Substitutes Model

The log-linear equilibrium export demand and supply equations for the imperfect substitutes model can be written in the following manner (Goldstein and Kahn, 1985):[76]

$$ex_D = \alpha_0 - \alpha_1 \left(\frac{P^{X,j}}{P^{D,j}} \right) + \alpha_2 Y \tag{1}$$

$$ex_S = \delta_0 + \delta_1 \left(\frac{P^{X,j}}{P^{X,i}} \right) er + \delta_2 Z \tag{2}$$

where ex_D is the volume of exports demanded

---

[76] The general layout of this approach follows the work presented in the ADB Outlook Update (2007).

ex_S is the volume of exports supplied

$P^{X,j}$ is the price of exports in the destination market's currency

$P^{D,j}$ is the price of the destination market's competing goods in its own

       currency

$P^{X,i}$ is the price of exports in the exporting country's currency

er is the nominal exchange rate (exporting country's currency per unit

       of the destination market's currency)

Y is the destination market's national income (GDP)

Z is the exporting country's manufacturing capacity in tradeables

Thus, export demand is a negative function of the price of the exported good

relative to the destination market's competing good, and a positive function of the

destination market's national income. Export supply is a positive function of the price of

the exported good (in its own currency) in the destination market, and a positive function

of the exporting country's manufacturing capacity in tradeable goods.

Equating supply and demand and solving the equations simultaneously yields the

following equation for total exports:

$$ex = \beta_0 + \beta_1 \left(\frac{P^{D,j}}{P^{X,i}} \right) er + \beta_2 Y + \beta_3 Z \qquad\qquad (4)$$

where ex is the total volume of exports

$\left(\dfrac{P^{D,j}}{P^{X,i}} \right) er$ is the real exchange rate (exporting country's currency per

                unit of the destination market's currency)

$\beta_0, \beta_1, \beta_2, \beta_3$ are all parameters such that

$$\beta_0 = \frac{\alpha_0 \delta_1 + \alpha_1 \delta_0}{\alpha_1 + \delta_1}$$

$$\beta_1 = \frac{\alpha_1 \delta_1}{\alpha_1 + \delta_1}$$

$$\beta_2 = \frac{\alpha_2 \delta_1}{\alpha_1 + \delta_1}$$

$$\beta_3 = \frac{\alpha_1 \delta_2}{\alpha_1 + \delta_1}$$

Therefore, total exports are a positive function of the real exchange rate, the destination market's national income, and the exporting country's manufacturing capacity: $ex = f(rer, Y, Z)$. Expressing national income as GDP and converting exports and national income to real values yields the following equation:

$$rex = \beta_0 + \beta_1 rer + \beta_2 rgdp + \beta_3 Z \tag{5}$$

where   *rex*   represents real exports

      rer   represents the real exchange rate

      rgdp   represents real foreign income (GDP)

      Z   represents manufacturing capacity in tradeables

II. Assumption of Infinite Elasticity of Supply

In the equation, the real exchange rate and real foreign income are taken as given (Rose and Yellen, 1989). The problem with this assumption is simultaneous-equation and omitted-variable bias, which becomes an issue unless the elasticity of supply is infinite.

In the case of China, however, there are reasons to believe that the perfect supply elasticity assumption may be reasonable.

China has an estimated population of 1.3 billion people. Of this amount, approximately 800 million are in the labor force, with a majority of these workers employed in the lower paying agricultural sector.[77] The higher paying jobs, located in the urban areas, are primarily focused on export-oriented manufacturing and service operations.[78]

Though official estimates for unemployment in the urban areas have been around 4 percent, Giles, et. al. (2005) indicates that official measurements of unemployment can be misleading and potentially understated by more than twice the official measure.[79] The Chinese Academy of Social Sciences estimates that besides the 14 million urban workers who are unemployed or underemployed, there are an additional 150 to 200 million redundant rural laborers and 7 to 8 million new workers joining the labor force each year.[80] Given this large pool of workers seeking employment in the export sector, Chinese exporters may be able to increase supply at constant prices.

Along these same lines, the IMF (2005) argues that the supply of imports for processing will vary one for one with the demand for processed exports. Marquez and

---

[77] According to China Statistical Yearbook (2007), the total labor force in 2006 was 764 million people, with 283.1 million employed in urban areas and 480.9 million employed in rural areas. According to the CIA World Factbook, an estimate for the labor force in 2007 was 803.3 million. Applying their 2006 estimates for the percentages in agriculture, industry, and services, 345.4 million were working in the agricultural sector, 200.8 in the industrial sector, and 257.1 in the services sector.

[78] Data from a report by the Economist Intelligence Unit (2007) indicate a 3-to-1 difference in yearly salary between urban and rural workers.

[79] According to China Statistical Yearbook (2007), in 2006 the urban population was 577.1 million people and the rural population was 737.4 million people. Of the amount in urban areas, 283.1 million were employed. This would indicate that, at 4 percent unemployment, the total labor force in urban areas was approximately 294.9 million people.

[80] I am indebted to the Chinese Academy of Social Sciences for this information.

Schindler (2007) present formal evidence supporting this assertion. They report that the coefficient on imports for processing is nearly always one in regressions where the dependent variable is China's processed exports. Thus, both labor and sophisticated intermediate goods tend to flow elastically into China's export industries to accommodate increases in demand from the rest of the world. This gives reason to believe that, in China's case, the infinite elasticity of supply assumption can be accepted for the imperfect substitutes model.

One final note on this issue, even though infinite elasticity of supply will be assumed, it's still important to control for potential supply side factors. Having addressed the issue of labor and input supply, a remaining supply side factor that should be accounted for is the stock of manufacturing capital. Discussion on the inclusion of this variable in the model will take place in the following section.

Key Variables

Having laid out the theoretical framework, there are several key variables that need to be considered for inclusion in the regression model. A discussion of each variable follows.

I. Real Exports

Since Chinese exports are the dependent variable, careful consideration on how these exports are defined is critical. If exports are being evaluated in their totality, this could miss potentially valuable information associated with the differences in the types of

goods being exported. A number of research studies have focused on disaggregated data in order to gain a deeper understanding of the impact of explanatory variables on China's export trade (e.g. Mann and Plück, 2005, Thorbecke, 2006a, and Marquez and Schindler, 2007). However, an important issue arises in terms of how fine a disaggregation is necessary. Overly detailed breakdowns of the data may end up being more cumbersome without providing any additional understanding into the model posited.

Though a breakdown of the data by SITC codes may provide some important insights, this level of detail is not necessary to address the central question of this dissertation. The impact on China's exports from a generalized currency appreciation deals most specifically with the differences between ordinary and processed exports. In this regard, the delineating factor in China's exports is the difference between those goods which are manufactured primarily from domestic inputs (ordinary exports) and those goods which are manufactured primarily from imported inputs (processed exports). In keeping with this approach, the dependent variable, Chinese exports, will be disaggregated into ordinary and processed exports. This allows for the clearest analysis of the impact from a bilateral appreciation of the RMB versus a generalized, integrated appreciation of the RMB and the currencies of China's intermediate parts and components providers (predominantly countries in East Asia).

Data for Chinese exports (measured in U.S. dollars) are available from China's Customs Statistics. China's Customs Statistics distinguishes between ordinary and processed exports based on the composition of their inputs (Gaulier, et. al., 2005). Exports manufactured primarily from inputs which do not receive special tariff

exemptions are designated as ordinary exports. Exports manufactured primarily from inputs which do receive special tariff exemptions are designated as processed exports.

Ordinary exports are manufactured primarily from domestically produced parts and components. Processed exports are manufactured primarily from foreign produced parts and components. Inputs for processed exports (also described as processed imports or imports for processing) are supplied and imported by the firm itself (through a contractual agreement) or imported from a foreign third-party provider.[81] These inputs, as well as the final goods which they produce, are not intended for sale in the domestic market. Because of their designation, processed inputs receive special tariff exemptions from the Chinese government.

Three deflators are used in order to convert exports from nominal dollar amounts to real dollar amounts. The first is the U.S. import price index for manufactured articles from non-industrialized countries. This follows the convention used by Cheung, Chinn, and Fujii (2006). The second is the Hong Kong export price index. Given the significant re-export of Chinese goods through Hong Kong, this deflator is used as a proxy for Chinese export prices. The third is the U.S. consumer price index (Eichengreen, Rhee, and Tong, 2004).

---

[81] Ordinary imports, on the other hand, are final goods intended for sale in the Chinese market. They are not intended as inputs into further processing of final goods and they do not receive special tariff exemptions from the Chinese government.

II. Real Exchange Rate

In terms of independent variables, the explanatory variable of first importance is the exchange rate. A bilateral measure against the RMB will be utilized when the dependent variable is ordinary exports. This represents the real exchange rate between China and each country purchasing ordinary exports. Given that ordinary exports are manufactured primarily from Chinese inputs, this is the most appropriate measure to use.

When the dependent variable is processed exports, a generalized measure using a weighted set of currencies will be utilized. This represents the real exchange rate between an integrated, weighted set of currencies representing those countries (including China) supplying inputs to the manufacturing of processed exports and each country purchasing processed exports. The use of a weighted set of currencies reflects the fact that China's processed exports are manufactured primarily from processed imports. Thus, a set of currencies which includes those countries with which China maintains the greatest trade in processed imports would be the most appropriate.

Therefore, using processed imports as the key criterion, the currencies of China's largest trading partners will be included in the integrated set of currencies in proportion to their overall weight in the value of their contribution to China's processed exports.[82] This will help to capture the impact on China's processed exports (which represent a majority of China's total exports) from a generalized, integrated appreciation of China's largest

---

[82] China's processed imports come primarily from countries in East Asia. As indicated in Table 3.4 of Chapter 3: China's Role in the Global Trading Network, their total contribution in 2005 was approximately 67 percent.

intermediate parts and components suppliers. For this reason, this exchange rate will be referred to as the generalized real exchange rate.

There are three steps needed in order to determine the generalized real exchange rate. The first step is to ascertain the value-added from Chinese inputs in the production of processed exports. This is done by considering the total value of intermediate, or processed, imports as a fraction of the total value of processed exports.

For example, in 2006, China imported $3.2 trillion and exported $5.1 trillion in processed goods. Thus, the total value of processed imports in processed exports was 63 percent. The remaining 37 percent can be considered China's value-added to the manufacturing of these goods. Therefore, China's value-added is only part of the total value of processed exports and, theoretically, the only part affected by a change in the exchange rate with the RMB.

In order to account for the other 63 percent contribution to processed exports, processed imports needs to be broken down by country of origination. Each country's relative contribution can then be multiplied to the percentage of processed imports in processed exports to determine the total contribution to processed exports.

For example, in 2006, Japan accounted for 15 percent of China's processed imports. Taking this as Japan's contributing share of processed imports to processed exports, Japan's total contribution to processed exports would be 15 percent of 63 percent, or approximately 10 percent.[83] Once each country's contribution to processed

---

[83] As has already been discussed, Japan, Korea, and Taiwan make up a sizeable percentage of China's imports. However, when broken out into processed imports, this percentage grows substantially. In 2006, these three nations alone accounted for more than 50 percent of China's processed imports.

exports has been determined, this percentage can be used to create a weighted exchange rate for China's processed exports.

The construction of the generalized real exchange rate follows:

A. China's Value-added to Processed Exports

$$VA_t = VPE_t - \sum_{i=1}^{33} VPI_{it} \qquad (3)$$

where VA_t is China's value-added amount to processed exports at time t

VPE_t is the value of China's processed exports at time t

$\sum_{i=1}^{33} VPI_{it}$ is the summation of the value of China's processed imports at time t

B. Weighted Real Exchange Rate

$$wrer_{it} = \sum_{j=1}^{33} \left(w_{jt} rer_{ijt} \right) \qquad (4)$$

where $wrer_{it}$ is the weighted real exchange rate for country i at time t

w_{jt} is the value of imports for processing from country j relative to the total value of processed exports, expressed as a percent[84]

---

[84] This includes only those countries in the dataset which contributed at least 1 percent to China's processed imports. Each year t was calculated separately.

rer_{ijt} is the real exchange rate between country i purchasing processed exports and country j supplying value-added processed imports at time t

C. Generalized Real Exchange Rate

$$grer_{it} = (VA_t)(urer_{it}) + (1 - VA_t)(wrer_{it}) \qquad (5)$$

where $grer_{it}$ is the generalized, integrated real exchange rate for country i at time t

$(VA_t)(urer_{it})$ is China's value-added in processed exports times the bilateral real exchange rate between China and country i, both at time t

$(1 - VA_t)(wrer_{it})$ is the contribution of imports for processing to processed exports times the weighted real exchange rate for country i, both at time t

Real exchange rate data will be obtained from the Centre D'Etudes Prospectives et D'Information Internationales CHELEM (CEPII-CHELEM) database. A large and diverse dataset will be employed in order to help better identify (econometrically) the relationship between the exchange rate and exports. This applies to both the real exchange rate between China and each country purchasing ordinary exports, as well as the real exchange rate between an integrated, weighted set of currencies representing those countries supplying inputs to the manufacturing of processed exports and each country purchasing processed exports (Figures 6.1 and 6.2). A dataset that includes a

number of different bilateral exchange rates will also help to compensate for issues related to exchange rates that are fixed or pegged (either explicitly or implicitly) to a specific currency or set of currencies.

The real exchange rates are constructed by CEPII by comparing observed exchange rates to purchasing power parity exchange rates. A common numeraire is used in order to compare exchange rates both cross sectionally and over time. The base is 100, with overvaluation greater than 100 and undervaluation less than one hundred.

III. Real Foreign Income

Another key component to consider as an explanatory variable is foreign national income (GDP). The inclusion of this variable should prove profitable in determining differences in demand for ordinary and processed exports. Ordinary exports tend to be lower cost, lower technology goods, while processed exports tend to be higher cost, higher technology goods. Given this difference, one would expect to find a higher income elasticity associated with processed exports than with ordinary exports. Data on real GDP will be obtained from the CEPII-CHELEM database.

IV. Capital Stock for Manufacturing

Along with demand side variables, consideration should be made for the impact on China's exports from supply side variables. Cheung, Chinn, and Fujii (2007) indicate that demand for Chinese exports responds as expected to a depreciation of the RMB as long as a supply variable is included in the econometric equation. In order to test for the

effects of supply side factors on exports, and having already addressed the supply of labor and processed inputs, a measure for China's manufacturing capacity will be included in the model. Following the convention of Cheung, Chinn, and Fujii (2007), this variable will take the form of capital stock for manufacturing.

Regression Model Specifications

The construction of the regression model for China's ordinary and processed exports is below. The model will be estimated using a DOLS approach. Dynamic ordinary least squared involves regressing the dependent variable on a constant, the independent variables, and leads and lags associated with the independent variables. In order to preserve the degrees of freedom, one lead and one lag will be used for each of the independent variables. The lead and the lag will help to determine the impact on exports from expectations and adjustments associated with the independent variables. A complete specification of the model follows:

$$rex_{it} = \beta_0 + \beta_1 \, rer_{it} + \beta_2 \, rgdp_{it} + \beta_3 \, K_t + \sum_{j=-p}^{p} \Delta rer_{it-j} + \sum_{j=-p}^{p} \Delta rgdp_{it-j} +$$

$$\sum_{j=-p}^{p} \Delta K_{t-j} + \mu_i + \nu_{it} \qquad (2)$$

where $t = 1, 2, \ldots, 12$

$i = 1, 2, \ldots, 33.$

The dataset includes 33 countries and covers a period of 12 years, from 1994 to 2005. The size of the dataset helps to circumvent the problems associated with the relatively fixed nature of some of the exchange rates (e.g. the Yuan/dollar exchange rate).

It also helps to increase the econometric value of the results. Finally, it provides a means to assess the impact on exports from movements in China's exchange rate both cross sectionally and over time.

Variable Specifications

t represents time. The sample period begins in 1994, following the example of Cheung, Chinn, and Fujii (2007) and Marquez and Schindler (2007). This avoids some of the data issues associated with the transition of China to a market economy. The sample period extends to 2005.

i is a number countries used in the regression; 33 in total.[85] These countries represent various markets both in relative importance to (in terms of export share), and distance from, China.

rex_{it} represents real exports, measured in natural logs, from China to country *i* at time *t*. In the regression, exports are qualified as either ordinary or processed.

rer_{it} represents the real exchange rate, measured in natural logs. This exchange rate is either bilateral or generalized, depending on the type of export being considered. When looking at ordinary exports, the bilateral real exchange rate is used ($brer_{it}$). This is the real exchange rate between China and country *i* purchasing ordinary exports at time *t* (Figure 6.1). When looking at processed exports, the generalized real exchange rate is

---

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

used ($grer_{it}$). This is the real exchange rate between the weighted set of currencies representing those countries (including China) supplying value-added inputs to processed exports and country i purchasing processed exports at time t (Figure 6.2).

$rgdp_{it}$ is real GDP, measured in natural logs, of country i at time t. This variable represents national income.

K_t represents China's manufacturing capital stock, measured in natural logs, at time t. Capital stock is included in order to control for supply side factors.

μ_i represents the fixed effect for country i.

ν_{it} is the error term.

Additional Tests

I. Exchange Rate Volatility

In order to test for the effects of price volatility on exports, a measure of exchange rate volatility will be incorporated in the regression. This follows from the work of Bénassy-Quéré and Lahrèche-Révil (2003), in which nominal exchange rate volatility was used in combination with the real exchange rate in order to evaluate a change in China's exchange-rate regime on exports.[86]

The exchange rate volatility variable (ver_{it}) will be calculated as the yearly coefficient of variation using quarterly bilateral nominal exchange rate data. It will be included with one lead and one lag. It is expected that the full effect of exchange rate

---

[86] Following the discussion in Chapter 1, China has experienced a very low level of exchange rate volatility with respect to the U.S. dollar. Given the inclusion of 32 additional bilateral exchange rate measures, the volatility variable should provide a better picture of the true impact of volatility on China's exports.

volatility on exports will be most clearly reflected in the regressions on ordinary exports.

The inclusion of the variable in the model will take the following form:

$$rex_{it} = \beta_0 + \beta_1 rer_{it} + \beta_2 rgdp_{it} + \beta_3 K_t + \beta_4 ver_{it} + \sum_{j=-p}^{p} \Delta rer_{it-j} + \sum_{j=-p}^{p} \Delta rgdp_{it-j} +$$

$$\sum_{j=-p}^{p} \Delta K_{t-j} + \sum_{j=-p}^{p} \Delta ver_{it-j} + \mu_i + v_{it} \qquad (6)$$

II. Robustness

Finally, as a way to test for the robustness of the results, an OLS model will be employed. The construction of the OLS model will be similar to the DOLS model except for the exclusion of the associated leads and lags on the explanatory variables. The model and a full analysis of the results are available in Appendix A.

Figure 6.1: Bilateral Real Exchange Rates with China (1992 – 2005)

1.	Argentina	12.	Hong Kong	23.	New Zealand
2.	Australia	13.	Iceland	24.	Philippines
3.	Austria	14.	Indonesia	25.	Portugal
4.	Belgium	15.	Ireland	26.	Russia
5.	Brazil	16.	Italy	27.	Singapore
6.	Canada	17.	Japan	28.	Spain
7.	Denmark	18.	Korea	29.	Sweden
8.	Finland	19.	Luxemburg	30.	Taiwan
9.	France	20.	Malaysia	31.	Thailand
10.	Germany	21.	Mexico	32.	United Kingdom
11.	Greece	22.	Netherlands	33.	United States

Source: CEPII-CHELEM database
Note: An increase in the real exchange rate implies an appreciation of the RMB.

Figure 6.2: Generalized Real Exchange Rates with an Integrated Set of Weighted
Currencies Based on Value-added to Processed Exports (1992 – 2005)

1. Argentina	12. Hong Kong	23. New Zealand
2. Australia	13. Iceland	24. Philippines
3. Austria	14. Indonesia	25. Portugal
4. Belgium	15. Ireland	26. Russia
5. Brazil	16. Italy	27. Singapore
6. Canada	17. Japan	28. Spain
7. Denmark	18. Korea	29. Sweden
8. Finland	19. Luxemburg	30. Taiwan
9. France	20. Malaysia	31. Thailand
10. Germany	21. Mexico	32. United Kingdom
11. Greece	22. Netherlands	33. United States

Source: CEPII-CHELEM database
Note: An increase in the real exchange rate implies an appreciation of the weighted set of currencies.

7. RESEARCH RESULTS

The regression results are in Tables 7.1 through 7.4. Tables 7.1 and 7.2 contain the results for ordinary exports. Tables 7.3 and 7.4 contain the results for processed exports. Tables 7.2 and 7.4 include exchange rate volatility as an explanatory variable. The column headings represent the real deflator for Chinese exports; either the U.S. import price index, the Hong Kong export price index, or the U.S. consumer price index (U.S. CPI).

In general, the results obtained were statistically significant and robust (Appendix A). The results indicated that a 10 percent appreciation of the RMB would lead to a 10 percent reduction in ordinary exports. Similarly, a 10 percent appreciation of the generalized exchange rate would lead to an 11 percent reduction in processed exports. Real GDP was significant for processed exports, with higher coefficient values attached to processed exports than to ordinary exports. The capital stock was significant for both types of exports, with coefficient values above 1.00 in most cases and higher values attached to ordinary exports than to processed exports. A complete description and analysis of the results follows.

Results for Ordinary Exports

Table 7.1 contains the regression results for ordinary exports. In this regression, the exchange rate used was the bilateral real exchange rate ($brer_{it}$). This is the real exchange rate between China and the country purchasing ordinary exports.

In all cases, the coefficient for the bilateral real exchange rate was of the correct sign (negative), approximately 1.00 in absolute terms (-0.97 to -1.03), and statistically significant at the 5 percent level.[87] This implies that a 10 percent appreciation of the RMB would result in a 10 percent reduction in ordinary exports. In comparison, the coefficient on real GDP was between 0.57 and 0.60, of the correct sign, but insignificant.[88]

This difference between the two coefficients may be due to the composition of ordinary exports. Ordinary exports are primarily lower cost, lower technology goods such as textiles and toys. At a lower level of product sophistication, consumers may be more influenced by differences in cost than differences in product characteristics. Price, then, would be the most important factor in determining the consumer's purchasing decision. In addition, these types of goods are unlikely to take up a large percentage of disposable income. Therefore, the product's cost as a percentage of total income would not be as salient a factor to the consumer as would the product's relative price among competing

---

[87] These results were in line with the results obtained from the OLS model. This was true not only of the coefficient for the real exchange rate, but of all the independent variable coefficients for ordinary exports (please see Appendix A for a discussion on the OLS results). In addition, the results for the real exchange rate coefficient were in line, though slightly lower on average, with other OLS and DOLS model results summarized in Table 5.2 of Chapter 5: Literature Review (Lau, Mo, and Li, 2004, Thorbecke, 2006b, Cheung, Chinn, and Fujii, 2007, Garcia-Herrero and Koivu, 2007).
[88] The coefficient on real GDP was significant at the 10 percent level.

products. The result would be a greater impact on ordinary exports from a change in the real exchange rate than a change in real GDP.

As for the other explanatory variables, the capital stock was statistically significant in all cases (1 percent level). In addition, the coefficient was fairly large, between 1.77 (U.S. CPI deflator) and 2.24 (Hong Kong export price index deflator). These results are comparable to those obtained by Cheung, Chinn, and Fujii (2007). In fact, when comparing results using a similar price deflator (Hong Kong export price index), the two coefficients were almost identical (0.02 point difference; 2.22 versus 2.24).

The size of the coefficient on the capital stock may indicate the high level of Chinese investment needed in order to produce ordinary goods. Ordinary goods, in general, are manufactured by Chinese firms from Chinese inputs using Chinese capital (Lemoine and Ünal-Kesenci, 2004). Thus, one would expect the production of ordinary goods to be especially sensitive to the available stock of Chinese capital for manufacturing.

Finally, exchange rate volatility as an explanatory variable had a minimal impact on the regression results (Table 7.2). The coefficient was small (0.02 to 0.03) and not statistically significant. In addition, there was very little change in the other variable coefficients from its inclusion in the model. The coefficient for real GDP remained essentially the same, while the coefficients for the real exchange rate and the capital stock showed slight increases.

Results for Processed Exports

Table 7.3 contains the regression results for processed exports. In this regression,

the exchange rate used was the generalized real exchange rate ($grer_{it}$). This is the real

exchange rate between a weighted set of currencies representing those countries

providing value-added inputs to processed exports and the country purchasing processed

exports.

Once again, in all cases, the coefficient for the real exchange rate was of the

correct sign (negative), slightly larger than 1.00 in absolute terms (1.03 to 1.06), and

statistically significant at the 1 percent level.[89] This implies that a 10 percent appreciation

in the generalized real exchange rate would result in a 10 percent reduction in processed

exports.

For real GDP, the coefficient averaged 2.32 (2.30 to 2.32) and was statistically

significant at the 1 percent level for all three price deflators. In comparison to real GDP

for ordinary exports, the coefficient value for processed exports was significantly higher.

This difference in values could be due to the composition of processed exports.

Processed exports tend to be technologically more sophisticated, higher cost

goods like digital cameras, televisions, and computers. The purchase of these goods

---

[89] Results for processed exports for the real GDP and the capital stock coefficients were in line with those obtained from the OLS model. The coefficient on the real exchange rate was somewhat larger in the DOLS model than the OLS model (please see Appendix A for a discussion of the results from the OLS model).

represents a larger share of the consumer's disposable income. Therefore, one would expect that these goods would be more sensitive to changes in income.

For the capital stock, the coefficient was statistically significant (at the 1 percent level) and ranged from 0.98 (U.S. CPI deflator) to 1.46 (Hong Kong price deflator). Given that 35 to 40 percent of the value-added to processed exports comes from China, it makes sense that the availability of Chinese capital would be influential to the export of processed goods. Likewise, it also makes sense that the impact of the capital stock would be more of an influence on ordinary exports than on processed exports. In their research, Cheung, Chinn, and Fujii (2007) also found that the capital stock had a larger effect on ordinary exports than on processed exports.

Finally, the impact of exchange rate volatility on the regression results was negligible (Table 7.4). The coefficient was small (0.03) and not statistically significant. There was essentially no change in the coefficients for the capital stock and only slight changes in the coefficients for the real exchange rate and real gross domestic product.

Discussion of Results

There are three important implications from these results. The first is the difference in income elasticity between ordinary and processed exports. While the average for the coefficient on real GDP for ordinary exports was 0.59, the average for processed exports was 2.32. This is a significant difference and one that reflects strongly on the composition of ordinary and processed exports.

As has already been discussed, ordinary exports tend to be technologically less sophisticated, less expensive goods. They take up only a small percentage of a consumer's total budget. The opposite is true of processed exports. These are goods which are technologically more sophisticated and, thus, more expensive. They take up a larger share of the consumer's budget. Therefore, the differences in income elasticity between the two types of exports falls in line with their differences in product composition, and is supported by the distinction in the results between the two regressions.

The second important implication pertains to the coefficient on the capital stock. While both types of exports demonstrated sensitivity to the available stock of Chinese capital in manufacturing, the coefficient on the capital stock for ordinary exports was approximately 0.80 points higher than that for processed exports. This can be explained by the fact that ordinary exports are manufactured primarily from Chinese inputs. Processed exports, on the other hand, are manufactured predominantly from processed parts and components imported from countries in China's supply chain network. Thus, the capital stock of other East Asian countries has a similar importance in the manufacturing of processed exports as does the availability of the capital stock in China. This would imply that, in comparison to one another, the impact from the available stock of Chinese capital on ordinary exports would be greater than that on processed exports.

Finally, a third important implication deals with the exchange rate. Regardless of the relative impact of the different explanatory variables on ordinary and processed exports, the exchange rate always matters. However, the type of exchange rate

appreciation, whether bilateral or generalized, can significantly affect the degree of change on China's exports.

For example, a 10 percent bilateral appreciation of the RMB would produce a 10 percent reduction in ordinary exports. However, in terms of processed exports, this percentage could end up being much smaller. The reason for this difference is the relative value-added of Chinese inputs in the production of processed exports. As Figure 7.1 reveals, China's value-added throughout the entire sample period was never more than 40 percent. This would indicate that an appreciation of the RMB would have only a partial impact on the total value of processed exports. The remaining value-added amount, coming predominantly from China's East Asian trading partners, could potentially remain unaffected.[90]

Thus, an appreciation of the RMB would affect only part of the total value of processed exports. Continuing with the example from above, in 2006, China's total value-added to processed exports was 37 percent. If the RMB were to appreciate by 10 percent, then only 37 percent of the total value of processed exports would be affected. The remaining 63 percent would remain unaffected, barring a similar appreciation in the currencies of China's major suppliers of processed imports. Assuming that this did not take place, then the potential 10.5 percent reduction in processed exports (resulting from

[90] This would depend upon a corresponding appreciation of other East Asian currencies in response to an appreciation of the RMB. However, there are no guarantees that an appreciation of the RMB would necessarily result in a corresponding appreciation of other currencies in East Asia (Ogawa and Ito, 2002, Eichengreen, 2004). As Ito (2007) points out, despite the fact that some countries in East Asia use trade-weighted currency baskets to manage their exchange rates, currency values that appreciate too sharply may still elicit market intervention. Thus, even though an appreciation of the RMB may trigger an appreciation of other currencies in East Asia (e.g. Korea, Singapore, and Thailand), there is nothing to ensure that those changes would hold. The intent of this example is to demonstrate that without a corresponding appreciation of other currencies in East Asia, the impact on processed exports would be much smaller.

a 10 percent appreciation in the generalized exchange rate) would be reduced to 3.9 percent (0.39*10.5). The remaining 6.6 percent of the total would be unrealized.

Therefore, a generalized appreciation of currencies is needed in order for the full effect of a currency appreciation to be felt on both types of China's exports. This generalized appreciation needs to include not only China's currency, but the currencies of China's major trading partners in processed imports, predominantly countries in East Asia. A generalized, integrated currency appreciation has the greatest potential for affecting China's overall trade surplus because it addresses not only ordinary exports, but the larger majority of goods exported from China, processed exports.

Table 7.1: Panel DOLS Estimates of China's Ordinary Exports to 33 Countries from
1994-2005

Independent Variables	Exports Deflated by:		
	U.S. Import Price Index	Hong Kong Export Price Index	U.S. Consumer Price Index
Bilateral RER	-0.98**	-0.97**	-1.03**
	(0.49)	(0.49)	(0.48)
Real GDP	0.60*	0.59*	0.57*
	(0.44)	(0.44)	(0.44)
Capital Stock	2.22***	2.24***	1.77***
	(0.31)	(0.31)	(0.31)
Adjusted R-Squared	0.99	0.99	0.99
Number of Observations	363	363	363

Note: Heteroskedasticity-consistent standard errors are in parentheses.
U.S. Import Price Index is the index for non-industrialized (Other) countries, manufactured articles, June
Hong Kong Export Price Index is the merchandise trade unit value index for re-exports
U.S. Consumer Price Index is the annual index for all urban consumers, not seasonally adjusted
*** (**) [*] denotes significance at the 1% (5%) [10%] level.

Table 7.2: Panel DOLS Estimates of China's Ordinary Exports to 33 Countries from 1994-2005

Independent Variables	Exports Deflated by:		
	U.S. Import Price Index	Hong Kong Export Price Index	U.S. Consumer Price Index
Bilateral RER	-1.04**	-1.04**	-1.09**
	(0.50)	(0.50)	(0.49)
Real GDP	0.59	0.59	0.56
	(0.46)	(0.46)	(0.46)
Capital Stock	2.25***	2.27***	1.80***
	(0.33)	(0.33)	(0.33)
NER Volatility	0.03	0.02	0.03
	(0.03)	(0.03)	(0.03)
Adjusted R-Squared	0.99	0.99	0.99
Number of Observations	363	363	363

Note: Heteroskedasticity-consistent standard errors are in parentheses.
U.S. Import Price Index is the index for non-industrialized (Other) countries, manufactured articles, June
Hong Kong Export Price Index is the merchandise trade unit value index for re-exports
U.S. Consumer Price Index is the annual index for all urban consumers, not seasonally adjusted
*** (**) [*] denotes significance at the 1% (5%) [10%] level.

Table 7.3: Panel DOLS Estimates of China's Processed Exports to 33 Countries from 1994-2005

Independent Variables	Exports Deflated by:		
	U.S. Import Price Index	Hong Kong Export Price Index	U.S. Consumer Price Index
Generalized RER	-1.06***	-1.05***	-1.03***
	(0.30)	(0.30)	(0.30)
Real GDP	2.32***	2.32***	2.30***
	(0.70)	(0.70)	(0.70)
Capital Stock	1.43***	1.46***	0.98***
	(0.24)	(0.24)	(0.24)
Adjusted R-Squared	0.98	0.98	0.98
Number of Observations	363	363	363

Note: Heteroskedasticity-consistent standard errors are in parentheses.
U.S. Import Price Index is the index for non-industrialized (Other) countries, manufactured articles, June
Hong Kong Export Price Index is the merchandise trade unit value index for re-exports
U.S. Consumer Price Index is the annual index for all urban consumers, not seasonally adjusted
*** (**) [*] denotes significance at the 1% (5%) [10%] level.

Table 7.4: Panel DOLS Estimates of China's Processed Exports to 33 Countries from 1994-2005

Independent Variables	Exports Deflated by:		
	U.S. Import Price Index	Hong Kong Export Price Index	U.S. Consumer Price Index
Generalized RER	-1.09***	-1.08***	-1.06***
	(0.33)	(0.33)	(0.33)
Real GDP	2.29***	2.29***	2.27***
	(0.70)	(0.70)	(0.70)
Capital Stock	1.43***	1.46***	0.97***
	(0.23)	(0.23)	(0.24)
NER Volatility	0.03	0.03	0.03
	(0.05)	(0.05)	(0.05)
Adjusted R-Squared	0.98	0.98	0.98
Number of Observations	363	363	363

Note: Heteroskedasticity-consistent standard errors are in parentheses.
U.S. Import Price Index is the index for non-industrialized (Other) countries, manufactured articles, June
Hong Kong Export Price Index is the merchandise trade unit value index for re-exports
U.S. Consumer Price Index is the annual index for all urban consumers, not seasonally adjusted
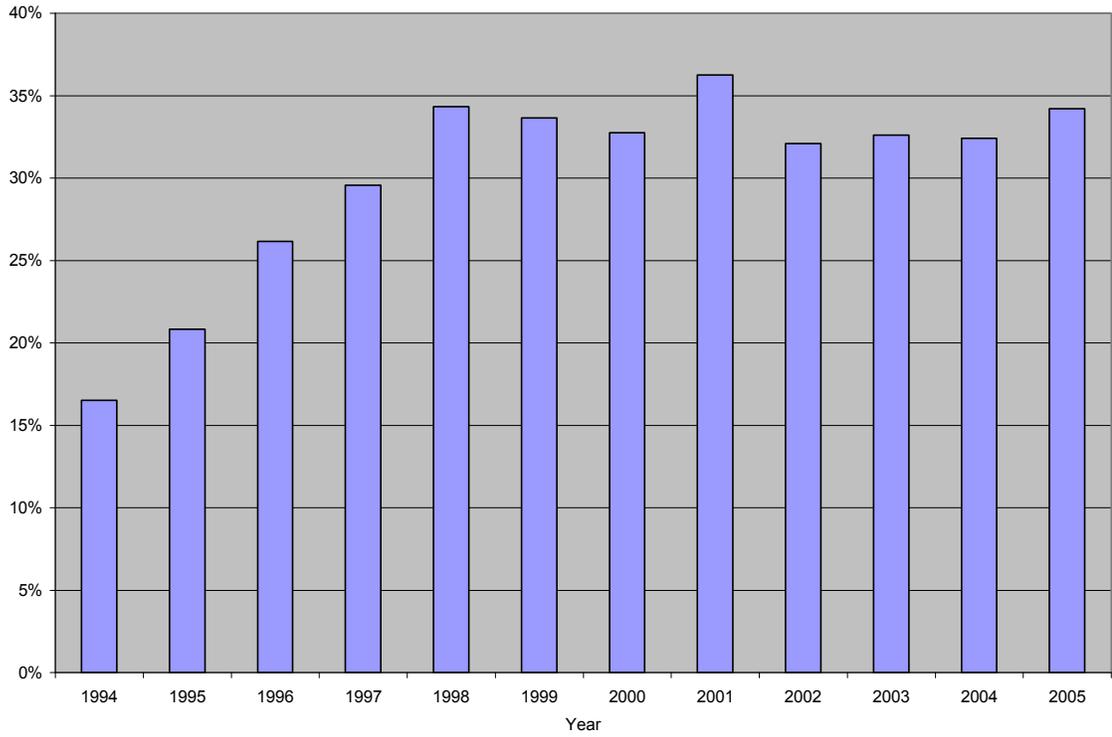*** (**) [*] denotes significance at the 1% (5%) [10%] level.

Figure 7.1: China's Value-added to Processed Exports

Source: China's Customs Statistics, author's calculation

8. CONCLUSION

As China's trade with the rest of the world has grown, so has its bilateral trade balances. For those countries in East Asia, China has seen a significant increase in its trade deficit with this region as a whole. However, for its two largest trade partners, the EU and the U.S., China has seen significant increases in the opposite direction, substantial trade surpluses.

Many view the overall U.S. trade deficit as unsustainable. However, there is disagreement on how a reduction of the deficit should take place. Given that the largest bilateral trade imbalance is with China, some have argued that the focus of attention should start there. Several members of Congress, believing that China has systematically manipulated its currency in order to gain an unfair trade advantage, have pushed for the administration to pressure China into allowing its currency to appreciate. Short of this strategy, legislation has been put forward that would either enact tariffs on Chinese imports or remove China's most favored nation's status.

Among economists, opinions on the issue vary. Some economists have argued that China should not be forced to appreciate their currency (McKinnon, 2006, 2007, Tatom, 2007). Others have argued that significant currency appreciation is required now in order to avoid further distress in the future (Tung and Baker, 2004, Goldstein and Lardy, 2006). In the middle are a number of economists who believe that some

adjustment to the value of the RMB needs to take place, but are not in agreement on how, or by how much, this should happen.

Synopsis of Dissertation

In this dissertation, an effort was made to determine the impact of an appreciation of the RMB on China's exports. This was done by analyzing the unique production networks in place within East Asia. China is part of a highly integrated system of trading relationships in which intermediate parts and components flow fluidly from one country to another. Unlike other types of integrated production networks, this vertical intra-industry trade network focuses on production blocks, based on factor endowments, located across developing, emerging, and developed economies in the region. Within this production network, China has become the primary location for final product assembly and export to the rest of the world.

For this reason, exports which originate out of China fall into two broad categories. First there are those goods which are manufactured primarily from Chinese inputs; ordinary exports. These goods tend to be less sophisticated, lower technology goods like textiles and toys. There are also those goods which are manufactured primarily from parts and components imported from other countries in East Asia; processed exports. These goods tend to be more sophisticated, higher technology goods like computers and electronics. It is this latter group of goods which have represented a majority of the exports which have originated out of China. Thus, in order to gain a better

understanding of how an appreciation of the RMB would affect China's exports, a disaggregation of these exports into ordinary and processed goods was necessary.

The next step was to address the issue of the value-added component to processed exports. In order to properly assess the impact of an appreciation of the RMB on processed exports, it was necessary to determine the contribution of Chinese inputs into the production of processed exports. By subtracting the value of processed imports from processed exports, China's total value-added could be obtained. This amount, expressed as a percentage of the total value of processed exports, would represent the amount which would theoretically be affected by an appreciation of the RMB. The remaining value of processed exports would be affected by an appreciation of the currencies of China's largest providers of processed imports, predominantly countries in East Asia.

The remaining value-added to processed exports was determined by each countries relative contribution of processed imports to processed exports. Once these percentages were calculated, a generalized exchange rate was constructed using an integrated, weighted set of currencies representing those countries which had contributed to the production of processed exports. It was this generalized exchange rate that was used to determine the effect of an appreciation of a set of currencies in East Asia on processed exports.

Using an imperfect substitutes framework, a DOLS regression model was constructed with ordinary and processed exports as the dependent variable. The primary explanatory variables were the real exchange rate, real GDP, and the capital stock. The bilateral real exchange rate was used when the dependent variable was ordinary exports,

and the generalized real exchange rate was used when the dependent variable was processed exports. The model was run against a panel dataset of 33 countries over a span of 12 years, from 1994 to 2005. An OLS model was also utilized in order to determine the robustness of the results.

Regression results indicated that a 10 percent appreciation of the bilateral real exchange rate with the RMB would reduce ordinary exports by 10 percent. Similarly, a 10 percent appreciation of the generalized real exchange rate with a set of currencies would reduce processed exports by approximately the same amount; 10 percent. However, an appreciation of the RMB alone would mean a loss of more than 6 percentage points from this 10 percent figure. The reason is that the value that China adds to the production of processed goods is less than 40 percent of the goods' total value. The remaining 60 to 70 percent comes from inputs imported into China from countries predominantly in East Asia. These processed imports represent the remaining value of processed exports. Thus, while an appreciation of the RMB would fully affect ordinary exports, it would theoretically only partially affect processed exports.

Therefore, seeking an appreciation of the RMB alone as a potential solution to the U.S. trade imbalance would provide a poor means of addressing the problem. While this may have an effect on ordinary exports, it would not fully address the majority of goods being exported out of China; processed exports. In order to fully impact export trade out of China, an appreciation of several currencies in East Asia, representing China's major trading partners in processed imports, would need to take place. This would affect the full

value of processed exports, as well as ordinary exports, and provide a larger impact on China's overall export trade than an appreciation of the RMB alone.

Concluding Remarks

In conclusion, given the nature of China's ordinary and processed exports, a joint appreciation of currencies in East Asia has a greater potential for reducing the size of China's trade surplus than an appreciation of the RMB alone. Policy measures which lead to an appreciation of the RMB exclusively do not provide the most effective means of dealing with the totality of China's exports. An appreciation of the RMB has the potential for impacting ordinary exports because these exports are produced primarily from Chinese inputs; however, it's less effective with China's processed exports. These exports are produced primarily from inputs imported from other countries in East Asia. These goods are impacted more by an appreciation of the RMB and the currencies of the countries from which the parts and components originate than an appreciation of the RMB alone.

Therefore, policy measures which lead to an appreciation of several East Asian currencies would provide a better strategy for reducing the size of China's trade surplus than one which focuses on the RMB alone. An approach of this type has the potential to affect both types of exports from China, ordinary and processed. A multi-currency appreciation not only impacts China's contribution to the production of ordinary and processed exports, but also the value-added in processed exports which comes from China's largest providers of intermediate inputs.

113

APPENDIX A

In order to test for the robustness of the DOLS results, an OLS model was
employed. The model was run with and without the nominal exchange rate volatility
variable (ver_{it}). The general form of the model follows:

$$rex_{it} = \beta_0 + \beta_1\, rer_{it} + \beta_2\, rgdp_{it} + \beta_3\, K_t + \mu_i + \nu_{it} \tag{1}$$

Regression Results for Ordinary Exports

The results for ordinary exports are in Table A.1. In all cases, the coefficient for
the bilateral real exchange rate was of the correct sign (negative), above 1.00 in absolute
terms (-1.01 to -1.09), and statistically significant at the 1 percent level.

The coefficient for real GDP showed similar uniformity. The coefficient ranged
from 0.63 for the U.S. CPI deflator (excluding exchange rate volatility) to 0.76 for the
U.S. import price index deflator (including exchange rate volatility). All results were
statistically significant at the 5 percent level.

The coefficient for the capital stock was between 1.83 (average for U.S. CPI
deflator) and 2.26 (average for Hong Kong export price index deflator). In all case, the
coefficient was statistically significant at the 1 percent level.

The inclusion of exchange rate volatility had a minimal impact on the regression
results. The coefficient was not statistically significant and inclusion of the variable had
little effect on the values of the coefficients of the other explanatory variables.

In comparison to the results for the DOLS model, the values and significance of the coefficients were similar. When the exchange rate volatility was excluded, the OLS model produced slightly higher coefficient values for all variables across the board. When exchange rate volatility was included, the differences in variable coefficients were less pronounced and demonstrated slightly more consistency between models. In general, the results of the OLS model indicated robustness with the results obtained from the DOLS model.

Regression Results for Processed Exports

The results for processed exports are in Table A.2. In all cases, the coefficient for the generalized real exchange rate was of the correct sign (negative), approximately 0.75 in absolute terms (-0.71 to -0.79), and statistically significant at the 1 percent level.

The coefficient for real GDP was also statistically significant and averaged 2.37 across all regression results. The coefficient was lowest for the U.S. CPI deflator (2.31, excluding exchange rate volatility) and highest for the U.S. import price index deflator (2.46, including exchange rate volatility).

The coefficient for the capital stock was always statistically significant (1 percent level) and ranged from 1.07 for the U.S. CPI deflator (including exchange rate volatility) to 2.26 for the Hong Kong export price index deflator (including exchange rate volatility).

The coefficient for exchange rate volatility was 0.02 for all three deflators and was not statistically significant. Coefficient values for the other explanatory values

changed by only a few hundredths of a point with the inclusion of exchange rate volatility in the regression.

Comparing OLS and DOLS results for processed exports revealed coefficient values for both real GDP and the capital stock in line with one another. On average, coefficients for both variables were slightly higher for the OLS model than the DOLS model. There was somewhat more divergence in the coefficient values for the real exchange rate, with the DOLS model yielding results which were, on average, approximately 0.30 points higher than those for the OLS model. However, results in general were fairly close in line and indicated robustness, especially for real GDP and the capital stock.

Additional Test for Robustness of Results

One final test was run which included a time trend (*TIME*). The specification of the model follows:

$$rex_{it} = \beta_0 + \beta_1\, rer_{it} + \beta_2\, rgdp_{it} + \beta_3\, K_t + \beta_4 Time + \mu_i + v_{it} \tag{3}$$

Regression Results

The results for ordinary exports are in Table A.3. They indicate that the coefficient for the real exchange rate and real GDP were in line across the different regression models and specifications (DOLS, and OLS with and without the time trend).

116

The average from the regressions on the three main explanatory variables indicated a coefficient value for the real exchange rate of -1.03 and for real GDP of 0.65. The total spread in coefficient values was between -0.97 and -1.09 for the real exchange rate, and between 0.57 and 0.76 for real GDP, indicating robustness in the results for the coefficients of these two explanatory variables.

The results for processed exports are in Table A.4. They indicate that the coefficient values for real GDP were fairly uniform throughout. They ranged from an average of 2.32 without the time trend (DOLS) to 2.55 with the time trend. The coefficient values on the real exchange rate were also uniform between the two OLS models (with and without the time trend), but lower than the values obtained from the DOLS model.

In conclusion, OLS model results indicate robustness of the results obtained from the DOLS model. Coefficients for all three explanatory variables were of the correct sign across all model specifications. For ordinary exports, coefficients on the real exchange rate and the capital stock were always significant at either the 1 percent or 5 percent level. In addition, coefficient values for the real exchange rate and real GDP were uniform throughout. For processed exports, all coefficients for the three main explanatory variables were statistically significant at the 1 percent level. Coefficient values for real GDP were uniform for all model specifications while coefficients for the real exchange rate were slightly lower in the OLS model than in the DOLS model.

Table A.1: Panel OLS Estimates of China's Ordinary Exports to 33 Countries from 1994-2005

Independent Variables	Exports Deflated by:					
	U.S. Import Price Index		Hong Kong Export Price Index		U.S. Consumer Price Index	
Bilateral RER	-1.01***	-1.01***	-1.02***	-1.02***	-1.08***	-1.09***
	(0.18)	(0.18)	(0.17)	(0.17)	(0.17)	(0.17)
Real GDP	0.74**	0.76**	0.73**	0.74**	0.63**	0.65**
	(0.35)	(0.35)	(0.34)	(0.35)	(0.34)	(0.35)
Capital Stock	2.22***	2.21***	2.26***	2.25***	1.84***	1.82***
	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)	(0.18)
NER Volatility		0.01		0.01		0.01
		(0.01)		(0.01)		(0.02)
Adjusted R-Squared	0.98	0.98	0.98	0.98	0.98	0.98
Number of Observations	396	396	396	396	396	396

Note: Heteroskedasticity-consistent standard errors are in parentheses.
U.S. Import Price Index is the index for non-industrialized (Other) countries, manufactured articles, June
Hong Kong Export Price Index is the merchandise trade unit value index for re-exports
U.S. Consumer Price Index is the annual index for all urban consumers, not seasonally adjusted
*** (**) [*] denotes significance at the 1% (5%) [10%] level.

Table A.2: Panel OLS Estimates of China's Processed Exports to 33 Countries from 1994-2005

Independent Variables	Exports Deflated by:					
	U.S. Import Price Index		Hong Kong Export Price Index		U.S. Consumer Price Index	
Generalized RER	-0.71***	-0.73***	-0.71***	-0.73***	-0.76***	-0.79***
	(0.16)	(0.17)	(0.16)	(0.17)	(0.15)	(0.16)
Real GDP	2.43***	2.46***	2.42***	2.45***	2.31***	2.34***
	(0.56)	(0.57)	(0.56)	(0.57)	(0.56)	(0.56)
Capital Stock	1.51***	1.48***	1.55***	1.52***	1.10***	1.07***
	(0.17)	(0.18)	(0.16)	(0.18)	(0.16)	(0.18)
NER Volatility		0.02		0.02		0.02
		(0.02)		(0.02)		(0.02)
Adjusted R-Squared	0.98	0.98	0.98	0.98	0.98	0.98
Number of Observations	396	396	396	396	396	396

Note: Heteroskedasticity-consistent standard errors are in parentheses.
U.S. Import Price Index is the index for non-industrialized (Other) countries, manufactured articles, June
Hong Kong Export Price Index is the merchandise trade unit value index for re-exports
U.S. Consumer Price Index is the annual index for all urban consumers, not seasonally adjusted
*** (**) [*] denotes significance at the 1% (5%) [10%] level.

Table A.3: Panel OLS Estimates of China's Ordinary Exports to 33 Countries from 1994-2005

	Exports Deflated by:		
Independent Variables	U.S. Import Price Index	Hong Kong Export Price Index	U.S. Consumer Price Index
Bilateral RER	-1.07***	-1.07***	-1.04***
	(0.24)	(0.24)	(0.24)
Real GDP	0.64*	0.64*	0.69**
	(0.40)	(0.40)	(0.40)
Capital Stock	1.62**	1.76**	2.18***
	(0.78)	(0.78)	(0.77)
Time	0.05	0.04	-0.03
	(0.07)	(0.07)	(0.07)
Adjusted R-Squared	0.98	0.98	0.98
Number of Observations	396	396	396

Note: Heteroskedasticity-consistent standard errors are in parentheses.
U.S. Import Price Index is the index for non-industrialized (Other) countries, manufactured articles, June
Hong Kong Export Price Index is the merchandise trade unit value index for re-exports
U.S. Consumer Price Index is the annual index for all urban consumers, not seasonally adjusted
*** (**) [*] denotes significance at the 1% (5%) [10%] level.

Table A.4: Panel OLS Estimates of China's Processed Exports to 33 Countries from 1994-2005

	Exports Deflated by:		
Independent Variables	U.S. Import Price Index	Hong Kong Export Price Index	U.S. Consumer Price Index
Generalized RER	-0.67***	-0.67***	-0.68***
	(0.16)	(0.16)	(0.16)
Real GDP	2.54***	2.55***	2.56***
	(0.65)	(0.65)	(0.65)
Capital Stock	2.20***	2.35***	2.68***
	(0.88)	(0.88)	(0.88)
Time	-0.06	-0.06	-0.13**
	(0.08)	(0.08)	(0.08)
Adjusted R-Squared	0.98	0.98	0.98
Number of Observations	396	396	396

Note: Heteroskedasticity-consistent standard errors are in parentheses.
U.S. Import Price Index is the index for non-industrialized (Other) countries, manufactured articles, June
Hong Kong Export Price Index is the merchandise trade unit value index for re-exports
U.S. Consumer Price Index is the annual index for all urban consumers, not seasonally adjusted
*** (**) [*] denotes significance at the 1% (5%) [10%] level.

LIST OF REFERENCES

LIST OF REFERENCES

ADB (2007), *Asian Development Outlook 2007 Update*, September 2007, Manila, Philippines: Asian Development Bank.

Ahearne, Shaghil, Brahima Coulibaly, Jane T. Haltmaier, Ross Knippenberg, Sylvain Leduc, Mario Marazzi, and Beth Anne Wilson (2007), "China's Role as Engine and Conduit of Growth," presented at the IMF Conference on Global Implications of China's Trade, Investment and Growth, Washington, DC, April 6, 2007. Available at: http://www.imf.org/external/np/seminars/eng/2007/china/

Akamatsu, Kaname (1962), "A Historical Pattern of Economic Growth in Developing Countries," *The Developing Economies* Preliminary Issue, 2: 3-25.

Amiti, Mary and Beata Smarzynska Javorcik (2003), "Trade Costs and Location of Foreign Firms in China," presented at the International Conference on "China's Economic Geography and Regional Development," Hong Kong, December 15, 2003. Available at: http://www.hiebs.hku.hk/events_updates/pdf/amiti.pdf

Amiti, Mary and Beata Smarzynska Javorcik (2005), "Trade Costs and Location of Foreign Firms in China," World Bank Policy Research Working Paper 3564, Washington, DC: The World Bank, April 2005.

Athukorala, Prema-chandra and Nobuaki Yamashita (2005), "Product Fragmentation and Trade Integration: East Asia in a Global Context," Australian National University, Economics RSPAS, Departmental Working Papers, Canberra, AUS: The Australian National University, 2005.

Bénassy-Quéré, Agnès, and Amina Lahrèche-Révil (2003), "Trade Linkages and Exchange Rates in Asia: The Role of China," CEPII Working Papers No. 2003 – 21, France: Centre D'Etudes Prospectives Et D'Informations Internationales, December 2003.

Bénassy-Quéré, Agnès, Amina Lahrèche-Révil, and Valérie Mignon (2006), "World Consistent Equilibrium Exchange Rates," CEPII Working Papers No. 2006 – 20, France: Centre D'Etudes Prospectives Et D'Informations Internationales, December 2006.

Bénassy-Quéré, Agnès, Pascale Duran-Vigneron, Amina Lahrèche-Révil, and Valérie Mignon (2004), "Burden Sharing and Exchange Rate Misalignments Within the Group of Twenty," in C. Fred Bergsten and John Williamson, (eds.), *Dollar Adjustment: How Far? Against What?*, Special Report 17, Washington, DC: Institute for International Economics, 2004.

Bernanke, Ben S. (2006), "The Chinese Economy: Progress and Challenges," remarks presented at the Chinese Academy of Social Sciences, Beijing, China, December 15, 2006. Available at:
http://www.federalreserve.gov/newsevents/speech/2006speech.htm

Bodnar, Gordon M., Bernard Dumas, and Richard C. Marston (2002), "Pass-through and Exposure," *The Journal of Finance* 57, 1 (Feb): 199-231.

Chen, Jinzhao (2007), "Behavior Equilibrium Exchange Rate and Misalignment of Renminbi: A Recent Empirical Study," presented at the Dynamics, Economic Growth, and International Trade Conference, Melbourne, Australia, June 29, 2007. Available at: http://www.degit.ifw-kiel.de/papers/listco12

Cheung, Yin-Wong, Menzie D. Chinn, and Eiji Fujii (2006), "The Illusion of Precision and the Role of the Renminbi in Regional Interaction," La Follette School Working Paper No. 2006 – 023: The University of Wisconsin-Madison, August 2006.

Cheung, Yin-Wong, Menzie D. Chinn, and Eiji Fujii (2007), "China's Current Account and Exchange Rate," presented at the NBER Conference on China's Growing Role in World Trade, Cape Cod, MA, August 3-4, 2007. Available at:
http://www.nber.org/books_in_progress/china07/cwt07/chinn.pdf

Clark, Peter B., and Ronald MacDonald (1998), "Exchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs," IMF Working Paper No. 98/67: International Monetary Fund, May 1998.

Cline, William (2005), *The United States as a Debtor Nation*, Washington, DC: Institute for International Economics.

Cline, William R., and John Williamson (2007), "Estimates of the Equilibrium Exchange Rate of the Renminbi: Is There a Consensus and, If Not, Why Not?," presented at the Conference on China's Exchange Rate Policy, Washington, DC, October 19, 2007. Available at: http://www.petersoninstitute.org/events/event_detail.cfm?EventID=47

Coudert, Virginie, and Cécile Couharde (2005), "Real Equilibrium Exchange Rate in China," CEPII Working Papers No. 2005 – 01, France: Centre D'Etudes Prospectives Et D'Informations Internationales, January 2005.

Coudert, Virginie, and Cécile Couharde (2007), "Real Equilibrium Exchange Rate in China: Is the Renminbi Undervalued?," *Journal of Asian Economics* 18: 568-594.

Cui, Li, and Murtaza Husain Syed (2007), "Is China Changing its Stripes? The Shifting Structure of China's External Trade and its Implication," presented at the IMF Conference on Global Implications of China's Trade, Investment and Growth, Washington, DC, April 6, 2007. Available at: http://www.imf.org/external/np/seminars/eng/2007/china/

Dean, Judith M. and Mary E. Lovely (2007), "Trade Growth, Production Fragmentation, and China's Environment," presented at the NBER Conference on China's Growing Role in World Trade, Cape Cod, MA, August 4, 2007. Available at: http://www.nber.org/books_in_progress/china07/dean-lovely8-31-07.pdf

Dunaway, Steven, Lamin Leigh, and Xiangming Li (2006), "How Robust are Estimates of Equilibrium Real Exchange Rates: The Case of China," IMF Working Paper No. 06/220: International Monetary Fund, October 2006.

Dunaway, Steven, and Xiangming Li (2005), "Estimating China's 'Equilibrium' Real Exchange Rate," IMF Working Paper No. 05/202: International Monetary Fund, October 2005.

Eckaus, Richard S. (2004), "Should China Appreciate the Yuan," MIT Working Paper No. 04-16, Massachusetts Institute of Technology: Department of Economics, January 2004.

Economist Intelligence Unit (2007), *Country Profile 2007: China*, London, United Kingdom: The Economist Intelligence Unit.

Economist Intelligence Unit (2008), *Country Profile 2008: China*, London, United Kingdom: The Economist Intelligence Unit.

Eichengreen, Barry (2004), "Global Imbalances and the Lessons of Bretton Woods," *Économie Internationale* 100, 4: 39-50.

Eichengreen, Barry, Yeongseop Rhee, and Hui Tong (2004), "The Impact of China on the Exports of Other Asian Countries," NBER Working Paper No. 10768: National Bureau of Economic Research, August 2004.

Frankel, Jeffrey (2006), "On the Yuan: The Choice between Adjustment under a Fixed Exchange Rate and Adjustment under a Flexible Rate," *CESinfo Economic Studies* 52, 2: 246-275.

Fukao, Kyoji, Hiakri Ishido, and Keiko Ito (2003), "Vertical Intra-Industry Trade and Foreign Direct Investment in East Asia," Asian Development Bank Institute Research Paper No. 51, Tokyo: Asian Development Bank Institute, January 2003.

Funke, Michael and Jörg Rahn (2004), "Just How Undervalued is the Chinese Renminbi," BOFIT Discussion Papers No. 14/2004, Bank of Finland: Institute of Economies in Transition, July 2004.

García-Herrero, Alicia, and Koivu, Tuuli (2007), "Can the Chinese Trade Surplus be Reduced Through Exchange Rate Policy?," BOFIT Discussion Papers No. 6/2007, Bank of Finland: Institute of Economies in Transition, August 2007.

Gaulier, Guillaume, Francoise Lemoine, and Deniz Ünal-Kesenci (2005), "China's Integration in East Asia: Production Sharing, FDI & High-Tech Trade," CEPII Working Papers No. 2005 – 09, France: Centre D'Etudes Prospectives Et D'Informations Internationales, June 2005.

Gaulier, Guillaume, Francoise Lemoine, and Deniz Ünal-Kesenci (2006), "China's Emergence and the Reorganisation of Trade Flows in Asia," CEPII Working Papers No. 2006 – 05, France: Centre D'Etudes Prospectives Et D'Informations Internationales, March 2006.

Giles, John, Albert Park, and Juwei Zhang (2005), "What is China's True Unemployment Rate?," *China Economic Review* 16, 2: 149-170.

Goldstein, Morris (2004), "Adjusting China's Exchange Rate Policies," IIE Working Paper No. 04-1: The Peterson Institute for International Economics, June 2004.

Goldstein, Morris, and Mohsin S. Kahn (1985), "Income and Price Effects in Foreign Trade," in Ronald Jones and Peter Kenen, (eds.), *Handbook of International Economics*, Vol. 2, Amsterdam: North-Holland, 1985.

Goldstein, Morris, and Nicholas Lardy (2006), "China's Exchange Rate Policy Dilemma," *American Economic Review* 96, 2: 422-426.

Goldstein, Morris, and Nicholas Lardy (2007), "China's Exchange Rate Policy: An Overview of Some Key Issues," presented at the Conference on China's Exchange Rate Policy, Washington, DC, October 19, 2007. Available at: http://www.petersoninstitute.org/events/event_detail.cfm?EventID=47

Gourinchas, Pierre-Olivier, and Hélène Rey (2005), "From World Banker to World Venture Capitalist: US External Adjustment and the Exorbitant Privilege," The University of California, Berkeley,

http://socrates.berkeley.edu/~pog/academic/exorbitant/exorb_privilege_0804.pdf, (July 2007).

Gramlich, Edward M. (2004), "Budget and Trade Deficits: Linked, Both Worrisome in the Long Run, but not Twins," remarks presented at the Isenberg School of Management Seminar Series, Amherst, MA, May 14, 2004. Available at: http://www.federalreserve.gov/newsevents/speech/2004speech.htm

Greenspan, Alan (2004), "Current Account," remarks presented before the Economic Club of New York, New York, March 2, 2004. Available at: http://www.federalreserve.gov/newsevents/speech/2004speech.htm

Haddad, Mona (2007), "Trade Integration in East Asia: The Role of China and Production Networks," World Bank Policy Research Working Paper 4106, Washington, DC: The World Bank, March 2007.

Higgins, Matthew, Thomas Klitgaard, and Cédric Tille (2006), "Borrowing without Debt? Understanding the U.S. International Investment Position," Staff Report no. 271, New York, NY: Federal Reserve Bank of New York.

IMF (2005), *Asia-Pacific Regional Outlook*, September 2005, Washington, DC: International Monetary Fund.

IMF (2007a), *World Economic Outlook*, October 2007, Washington, DC: International Monetary Fund.

IMF (2007b), *Regional Economic Outlook, Asia and Pacific*, October 2007, Washington, DC: International Monetary Fund.

Ito, Takatoshi (2007), "The Influence of the RMB on Exchange Rate Policy in Other Economies," presented at the Conference on China's Exchange Rate Policy, Washington, DC, October 12, 2007. Available at: http://www.petersoninstitute.org/events/event_detail.cfm?EventID=47

Jeong, Se-Eun, and Jacques Mazier (2003), "Exchange Rate Regimes and Equilibrium Exchange Rates in East Asia," *Revue Économique* 54, 5: 1161-1182.

Kimura, Fukunari, and Mitsuyo Ando (2005), "Two-dimensional Fragmentation in East Asia: Conceptual Framework and Empirics," *International Review of Economics and Finance* 14 (2005): 317-348.

Krugman, Paul (2006), "Will There be a Dollar Crisis?," Princeton University, http://www.econ.princeton.edu/seminars/weekly%20seminar%20schedule/spring_05-06/April_24/Krugman.pdf, (November 2006).

Lau, Francis, Yik-ko Mo, and Kim-hung Li (2004), "The Impact of a Renminbi Appreciation on Global Imbalances and Intra-regional Trade," *Hong Kong Monetary Authority Quarterly Bulletin* March 2004: 16-26.

Lemoine, Françoise, and Deniz Ünal-Kesenci (2004), "Assembly Trade and Technology Transfer: The Case of China" *World Development* 32, 5: 829-850.

Lewis, Karen K. (1999), "Trying to Explain Home Bias in Equities and Consumption," *Journal of Economic Literature* 37, 2 (June): 571-608

MacDonald, Ronald and Preethike Dias (2007), "Behavior Equilibrium Exchange Rate Estimates and Implied Exchange Rate Adjustments for Ten Countries," presented at the Workshop on Policy to Reduce Global Imbalances, Washington, DC, February 8-9, 2007. Available at: http://www.petersoninstitute.org/events/print.cfm?EventID=22

Mann, Catherine L. (2003), "How Long the Strong Dollar?," in C. Fred Bergsten and John Williamson, (eds.), *Dollar Overvaluation and the World Economy*, Special Report 16, Washington, DC: Institute for International Economics, 2003.

Mann, Catherine L., and Katharina Plück (2005), "The US Trade Deficit: A Disaggregated Perspective," IIE Working Paper No. 05-11: The Peterson Institute for International Economics, September 2005.

Marquez, Jaime, and John Schindler (2007), "Exchange Rate Effects on China's Trade," *Review of International Economics* 15, 5: 837-853.

McKinnon, Ronald (2006), "China's Exchange Rate Trap: Japan Redux?," *American Economic Review* 96, 2: 427-431.

McKinnon, Ronald (2007), "Why Should China Keep Its Dollar Peg," *International Finance* 10, 1: 43-70.

National Bureau of Statistics of China (2007), China Statistical Yearbook 2007, China: National Bureau of Statistics of China. Available at: http://www.stats.gov.cn/tjsj/ndsj/2007/indexeh.htm

Neely, Christopher J. (2008), "Central Bank Authorities' Beliefs about Foreign Exchange Intervention," *Journal of International Money and Finance* 27: 1-25.

Ogawa, Eiji, and Takatoshi Ito (2002), "On the Desirability of a Regional Basket Currency Arrangement," *Journal of the Japanese and International Economies* 16, 3: 317-334.

Rose, Andrew K., and Janet L. Yellen (1989), "Is There a J-Curve?" *Journal of Monetary Economics* 24, 1: 53-68.

Roubini, Nouriel and Brad Setser (2004), "The US as a Net Debtor: The Sustainability of the US External Imbalances," Stern School of Business, New York University, http://pages.stern.nyu.edu/~nroubini/papers/Roubini-Setser-US-External-Imbalances.pdf, (July 2007).

Setser, Brad (2007), "Estimating the Currency Composition of China's Reserves," RGE Monitor, May 22, 2007, http://www.rgemonitor.com/redir.php?sid=1&tgid=0&cid=196971, (July 2007).

Siregar, Reza, and Ramkishen S. Rajan (2006), "Models of Equilibrium Real Exchange Rates Revisited: A Selective Review of the Literature," Working Paper: George Mason University, August 2006. Available at: http://mason.gmu.edu/~rrajan1/workingpapers.html

Stein, Jerome L. (2002), "The Equilibrium Real Exchange Rate of the Euro: An Evaluation of Research," ifo Studien 3/2002: 349-381. Available at: http://www.cesifo-group.de/portal/page/portal/ifoContent/B/IFO_INSTITUT/PUBLIKATIONEN_X_PUBLICATIONS/IFO_STUDIEN/

Tatom, John A. (2007), "The US-China Currency Dispute: Is a Rise in the Yuan Necessary, Inevitable or Desirable?," *Global Economy Journal* 7, 3: Article 2.

Thorbecke, Willem (2006a), "The Effect of Exchange Rate Changes on Trade in East Asia," RIETI Discussion Paper Series 05-E-009, Japan: Research Institute of Economy, Trade, and Industry, March 2006.

Thorbecke, Willem (2006b) "How Would an Appreciation of the Renminbi Affect the U.S. Trade Deficit with China?," *Topics in Macroeconomics* 6, 3: Article 3.

Thorbecke, Willem, and Masaru Yoshitomi (2006), "Trade-FDI-Technology Linkages in East Asia," presented at the NEAT Working Group 4th Meeting, Tokyo, Japan, July 7, 2006. Available at: http://www.rieti.go.jp/users/neat/en/pdf/finalreport.pdf

Tuan, Chyau, and Linda F.Y. Ng (2004), "Manufacturing Agglomeration as Incentives to Asian FDI in China after WTO," *Journal of Asian Economics* 15: 673-693.

Tung, Chen-Yuan, and Sam Baker, (2004), "RMB Revaluation Will Serve China's Self-interest," *China Economic Review* 15: 331-335.

Voon, Jan P., Li Guangzhong, and Jimmy Ran (2006), "Does China Really Lose from RMB Revaluation? Evidence from Some Export Industries," *Applied Economics Bulletin* 38, 15: 1715-1723.

Walmsley, Terrie L., Thomas W. Hertel, and Elena Ianchovichina (2006), "Assessing the Impact of China's WTO Accession on Investment," *Pacific Economic Review* 11, 3: 315-339.

Wang, Tao (2004), "Exchange Rate Dynamics," in Eswar Prasad, (ed.), *China's Growth and Integration into the World Economy: Prospects and Challenges*, Washington, DC: International Monetary Fund, 2004.

Wang, Yajie, Xiaofeng Hui, and Abdol S. Soofi (2007), "Estimating Renminbi (RMB) Equilibrium Exchange Rate," *Journal of Policy Modeling* 29: 417-429.

Wei, Shang-Jin and Yi Wu (2001), "Globalization and Inequality: Evidence from Within China," The Brookings Institute, http://www.brookings.edu/papers/2001/1031china_wei.aspx, (February 2008).

Williamson, John (1983), *The Exchange Rate System*, Washington, DC: Institute for International Economics.

Williamson, John (2003), "The Renminbi Exchange Rate and the Global Monetary System," outline of lecture delivered at Central University of Finance and Economics, Beijing, China, October 29, 2003. Available at: http://www.petersoninstitute.org/publications/papers/paper.cfm?ResearchID=269

Williamson, John, and Molly Mahar (1998), "Current Account Targets," in Simon Wren-Lewis and Rebecca Driver, (eds.), *Real Exchange Rates for the Year 2000*, Washington, DC: Institute for International Economics, 1998.

Xiao, Gene (2004), "People's Republic of China's Round-Tripping FDI: Scale, Causes and Implications," HIEBS Working Paper 1137, Hong Kong: Hong Kong Institute of Economics and Business Strategy, July 2004.

Xiao, Gene (2005), "Estimating PRC's Round Tripping FDI," ADB Institute, January 20, 2005, http://www.adbi.org/research-paper/2005/01/20/880.prc.fdi.rp/estimating.prcs.round.tripping.fdi/ (February 2008).

Yoshitomi, Masaru (2006), "Global Imbalances and East Asian Monetary Cooperation," in Duck-Koo Chung and Barry Eichengreen, (eds.), *Toward an East Asian Exchange Rate Regime*, Washington, DC: Brookings Institution Press, 2007.

CURRICULUM VITAE

Gordon R. Smith was born on September 14, 1963, in Radford, Virginia. He grew up in Atlanta, Georgia and graduated from Marist School in 1981. He received his Bachelor of Arts degree in Economics from Wake Forest University in 1985. After working for a number of years, he returned to school to work on his Master of Business Administration, which he received from Virginia Polytechnic Institute and State University in 1994. After graduating, he worked in Washington, DC for a consulting firm before returning to school once again to work on his Ph.D. in Economics. He received his Ph.D. in Economics from George Mason University in 2008.