IMPACT OF FOREIGN EXCHANGE POLICIES OF ASIAN COUNTRIES ON THE WORLD ECONOMY

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ผลกระทบของนโยบายอัตราแลกเปลี่ยนของประเทศในเอเชียต่อเศรษฐกิจโลก

นายนุชิต พฤกษ์ธนากุล

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรมหาบัณฑิต
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ตลอดหลายปีที่ผ่านมา ประเด็นที่ได้รับความสนใจมากที่สุดประเด็นหนึ่งเกี่ยวกับความไม่สมดุลของบัญชีเดินสะพัดโลก คือ การเกินดุลบัญชีเดินสะพัดต่อเนื่องอย่างมากของประเทศเศรษฐกิจเกิดใหม่และประเทศกำลังพัฒนาในเอเชีย ซึ่งสอดคล้องกับการขาดดุลบัญชีเดินสะพัดอย่างมหาศาลของสหรัฐอเมริกา รัฐบาลสหรัฐฯ รวมถึงนักเศรษฐศาสตร์ได้วิพากษ์วิจารณ์ประเทศจีนในการรักษาอัตราแลกเปลี่ยนที่แท้จริงให้ต่ำหรือต่ำกว่าความเป็นจริงว่า เป็นส่วนหนึ่งของยุทธศาสตร์การพัฒนาเศรษฐกิจแบบส่งเสริมการส่งออกที่ถูกนำมาใช้อย่างแพร่หลายโดยประเทศในเอเชีย Bergsten (2006) ได้วิจารณ์ว่าประเทศอื่นๆ ในเอเชียมีแนวโน้มที่จะเข้าไปแทรกแซงในตลาดเงินตราต่างประเทศเพื่อรักษาอัตราแลกเปลี่ยนของตนให้อ่อนค่าเมื่อเทียบกับดอลลาร์สหรัฐฯ ในการแข่งขันกับสินค้าของประเทศจีน ดังนั้น วัตถุประสงค์ในการศึกษาครั้งนี้เพื่อทราบว่า การดำเนินนโยบายที่ทำให้อัตราแลกเปลี่ยนที่แท้จริงของประเทศในภูมิภาคเอเชียแข็งค่าขึ้น โดยเฉพาะอย่างยิ่งประเทศจีน จะสามารถช่วยปรับสมดุลของบัญชีเดินสะพัดโลกได้หรือไม่ โดยใช้แบบจำลองเศรษฐกิจมหภาคของโลก (CAM) ซึ่งถูกสร้างโดย Cripps และ Godley (1978) หรือกล่าวอีกนัยหนึ่งว่า ผลกระทบของการแข็งค่าร่วมกันของกลุ่มสกุลเงินหลักในภูมิภาคเอเชียมีนัยสำคัญต่อทั้งการปรับลดการเกินดุลการค้าของเอเชีย และการปรับลดการขาดดุลการค้าของสหรัฐฯ หรือไม่

ผลจากการจำลองพบว่า การแข็งค่าของอัตราแลกเปลี่ยนที่แท้จริงของจีนไม่เพียงแต่ช่วยลดการขาดดุลทางการค้าของสหรัฐฯ แต่ยังช่วยเพิ่มดุลการค้าให้กับประเทศในยุโรปและญี่ปุ่น รวมทั้งประเทศอื่นๆ ในเอเชีย นอกจากนี้ยังพบได้ว่า การลดลงในดุลการค้าของจีนอันเนื่องมาจากการแข็งค่าของค่าเงินหยวนจะเพิ่มมากขึ้น หากประเทศจีนมีการดำเนินนโยบายแบบขยายตัวผ่านการใช้จ่ายภาครัฐฯ ควบคู่กันไปด้วย ถึงแม้จะพบว่าการแข็งค่าของอัตราแลกเปลี่ยนที่แท้จริงแบบพหุภาคีให้ผลลัพธ์ที่ดีกว่าการที่ต่างฝ่ายต่างแข็งค่า อย่างไรก็ตามความร่วมมือระดับภูมิภาคนี้จะไม่เกิดขึ้นจนกว่าจะมีความเห็นชอบร่วมกันอย่างชัดเจนเกี่ยวกับวัตถุประสงค์ระหว่างประเทศสมาชิก

สาขาวิชา เศรษฐศาสตร์และการเงินระหว่างประเทศ ลายมือชื่อนิสิต .....

ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก .....

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KEYWORDS : ASIA / GLOBAL REBALANCING / EXCHANGE RATE APPRECIATION / REGIONAL COORDINATION / SIMULATION

NUCHIT PRUEKTANAKUL : IMPACT OF FOREIGN EXCHANGE POLICIES OF ASIAN COUNTRIES ON THE WORLD ECONOMY. ADVISOR : ASSOC. PROF. PAITOON WIBOONCHUTIKULA, Ph.D., CO-ADVISOR : ASST. PROF. BANGORN TUBTIMTONG, Ph.D., 103 pp.

Over the recent years, a prominent issue of global imbalances has centered upon increasingly large current account surpluses in emerging and developing Asia, corresponding to a huge deficit in the United States (US). The US government and economists have criticized China for keeping its currency value low or undervalued as part of its export-led growth strategy, being widely adopted by Asian countries. Bergsten (2006) also criticizes that other Asian countries have a tendency to intervene in currency markets in order to keep their currencies weak against the dollar to stay competitive with Chinese goods. Thus, this paper aims to investigate whether the Asian region, in particular China, can help global current account rebalancing through their exchange rate appreciation by using a global macroeconomic model, namely CAM, originated by Cripps and Godley (1978). More specifically, does the real exchange rate appreciation of a group of Asian currencies have a significant impact on reducing their own trade surplus, and improving the US trade deficit?

From simulation results, real appreciation of Chinese yuan improves not only the US trade deficit, but also enhances trade balances for Europe and Japan as well as other selected Asian countries. Moreover, it is evident that a reduction in China's trade surplus due to the yuan appreciation would be amplified if there was an expansionary policy in China, especially through government spending. In addition, although joint appreciation among Asian countries is absolutely better than unilateral appreciation of individual Asian real exchange rates, such a regional realignment would not occur unless there was explicit agreement between the participants regarding the purpose.

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Most importantly, I wish to dedicate this thesis to my beloved parents and related families whom I owe everything. This is the best way I can show my gratefulness for their hardship, unconditional love and support. Moreover, I would like to extend my genuine gratitude to Mr. Francis Cripps, Mr. Naret Khurasee and Mr. Polpat Kotrajaras for their support regarding applications in the Cambridge-Alphametrics Model (CAM). I have also to give special thanks to Ms. Watcharawee Roongrojnantaphong for her endless support and patience.

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LIST OF ABBREVIATIONS

ABF	:	Asian Bond Fund
ABMI	:	Asian Bond Market Initiative
ACU	:	Asian Currency Unit
ADB	:	Asian Development Bank
AMU	:	Asian Monetary Unit
ASEAN	:	Association of Southeast Asian Nations
ASEAN+3	:	ASEAN plus China, Japan, and Korea
BSA	:	Bilateral Swap Arrangement
CAM	:	Cambridge-Alphametrics Model
CMI	:	Chiang Mai Initiative
CMIM	:	CMI Multilateralization
EMEAP	:	Executives' Meeting of East Asia Pacific Central Banks
GDP	:	Gross Domestic Product
IMF	:	International Monetary Fund
MFSC	:	Monetary and Financial Stability Committee
RCU	:	Regional Currency Unit
RIETI	:	Research Institute of Economy, Trade and Industry
RMU	:	Regional Monetary Unit
SEACEN	:	South East Asia Central Banks
SEANZA	:	Southeast Asia, New Zealand, and Australia

CHAPTER I

INTRODUCTION

1.1 Background

Global imbalances[1] have emerged in the world economy since the Asian economic crisis of 1997/98. Over the recent years, a prominent issue of global imbalances in debates among academics and policymakers has centered upon increasingly large current account surpluses in emerging and developing Asia, especially China. The issue is critical because the Asian region accounts for about half the global surpluses which are the counterparts of a huge deficit in the United States (US). Makin and Narayan (2008) also point out that domestic factors played an important role in the US deficit during the period before the Asian crisis, but after that international factors had begun to primarily influence such deficits.

Although there are many reasons for these enhanced current account surpluses, one of them is that Asian emerging and developing countries have attempted to pursue export-oriented strategies over the past few decades in which such policies used to provide a very rapid and successful growth performance for the Four Tigers[2] during the early 1960s and 1990s. Hausmann, Pritchett, and Rodrik (2004) demonstrate that growth acceleration tends to be associated with real exchange rate depreciation. That is, once countries shift their policies towards an export orientation, attention is paid to maintaining real exchange rates for exports, which thereby results in economic growth at desirable rates. On the one hand, the relatively low real exchange rate will make their exports more attractive to world markets; on the other hand, it will act as a barrier deterring them from a large amount of imports in their economies. Accordingly, one may mention that keeping the real exchange rate low or undervalued is a key to achieving the export-led strategies for developing countries.

Unfortunately, a number of empirical evidence suggest that it has become increasingly challenging to maintain their real exchange rate at competitive levels in the recent years. The US government and economists have blamed China's exchange rate regime for the imbalances, and have attempted to call for greater exchange rate flexibility. In response to accusations of undervaluation, Chinese authorities announced in July 2005 that Chinese yuan would immediately appreciate against US dollar by 2.1%, from 8.28 to 8.11 yuan per dollar, and the yuan would become adjustable based on market demand and supply with reference to a basket of currencies instead of pegging to the dollar. However, not only it has no remarkable

[1] Global imbalances (or global current account imbalances) are characterized by large and persistent current account deficit in one group of countries and corresponding surpluses in another group.

[2] The Four Tigers refer to Hong Kong, South Korea, Taiwan and Singapore.

change in the US trade deficit with China, but also never stops pressure from US government contending that China manipulates its currency for the purpose of gaining unfair trade advantage. Bergsten (2006) also criticizes such manipulation induces other Asian countries to intervene in currency markets in order to keep their currencies weak against the dollar to stay competitive with Chinese goods.

However, in the decade since the Asian crisis, the 10 member states of Association of Southeast Asian Nations (ASEAN) plus China, Japan, and Korea (ASEAN+3) have been working together to establish a regional financing facility for the provision of liquidity finance in times of crisis and various regional initiatives to foster the development of local currency bond markets as well as stability of intra-regional currencies of East Asian countries closely connected through trade and investment.

These issues give rise to a research question whether the Asian region can help global current account rebalancing through their exchange rate appreciation. More specifically, does the real exchange rate appreciation of a group of Asian currencies have a significant impact on reducing their own trade surplus, especially in China, and improving the US trade deficit?

1.2 Objectives of the Research

The following objectives are set in order to answer the research question.

1. To examine effects of real exchange rate appreciation on exports, imports, and the trade balance for each of individual Asian countries using the CAM
2. To examine effects of Chinese yuan appreciation and of yuan appreciation combined with China's macroeconomic policies on Asian countries and the G-3 economies[3] using the CAM
3. To investigate effects of regional foreign exchange rate realignment on Asian countries and the G-3 economies using the CAM
4. To provide policy implications of the research for Asian countries

[3] In this research, the group of three (G-3) economies is referred to the world's leading economies comprising the United States, Europe, and Japan. Europe is defined to include the European Union as well as the emerging market economies of Central and Eastern Europe.

1.3 Scope of the Research

By using a global macro-econometric model, namely Cambridge-Alphametrics Model (CAM) of the world economy, originated by Cripps and Godley (1978), a simulation analysis is employed for addressing the objectives listed above as well as for visualizing the results. In the model, annual time-series data for the entire world, ranging from 1980 to 2008, is exploited for panel estimation with fixed effects where most behavioral variables are determined by reaction functions with autoregressive distributed lag (ADL) model in error-correction forms. A current version of the CAM used in this research is implemented on EViews6 that provides facilities for estimating structural parameters from the historical cross-section time-series data and simulating the results of policy innovations and shocks. In the context of the Asian region, this research mainly considers these economies to be China, Indonesia, India, South Korea, Malaysia, Philippines, Singapore, and Thailand.

1.4 Expected Benefits

Many Asian currencies have been appreciating against the US dollar for the last few years. On the one hand, this phenomenon could reflect the stronger economic growth of the Asian economies amid concerns over US economic performance and the ongoing Eurozone crisis. One the other hand, it could be a sign of things to come affecting the region where much of their growth relies on exports. Therefore, this research is expected to be another study of foreign exchange policies that provides various scenarios, especially for several countries in Asia. More than ever, the author hopes that the findings obtained through the investigation will help interested and potential readers in contributing to further related research.

1.5 Organization of the Research

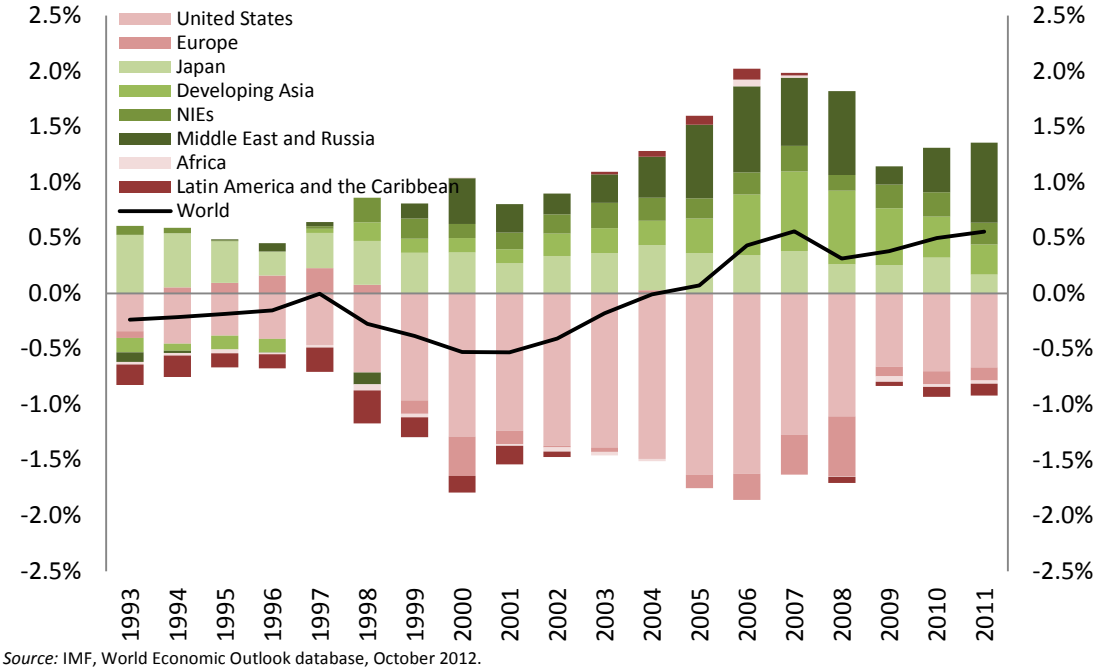
The remainder of the research is organized as follows. Chapter II and III provide an overview of global imbalances issues and related works. Moreover, the underlying concepts and the research framework are discussed in Chapter III. Chapter IV introduces the CAM structure and the simulation analysis, and Chapter V presents the simulation results and analyzes them in relation to global rebalancing. Lastly, Chapter VI concludes the research, and provides plausible policy implications and recommendations.

CHAPTER II

OVERVIEW OF GLOBAL IMBALANCES AND ASIAN COUNTRIES

2.1 Global Imbalances and Asia

Global imbalances, which typically refer to global current account imbalances, have emerged in the world economy for more than a decade. In terms of size and persistence, the imbalances raise some concerns on the areas in which the large current account deficits and surpluses take place. Countries in the former will see a rapid buildup of foreign ownership of their assets financing the current account deficits. Becoming heavily and persistently indebted may fulfill an unfavorable economic environment, eventually triggering a crisis. Conversely, countries in the latter will typically confront with an explosive growth of international reserves. In principle, although accumulating reserves as a precautionary and liquidity measure is favorable for the countries, the excessive reserve accumulation implies correspondingly large welfare losses (Park, 2007).



Source: IMF, World Economic Outlook database, October 2012.

Figure 2.1 Global current account balances (percent of world GDP)

Figure 2.1 traces the current account positions across key countries and regions as a percentage of world GDP during the period 1993-2011. It may be said that the imbalances began with the aftermath of the 1997/98 Asian crisis, and had become wider over time despite breaking off after the eruption of the recent global financial crisis.[4] As is apparent, the United States (US) has been the center of global current account deficits due to its lion's share, followed loosely by European economies. The US current account deficit, averaged out over the last decade, account for 1.3% of world GDP, and its peak in 2005 reached above 6% of GDP which was fairly equivalent to 1.6% of world GDP.

On the surplus side, the concentration of global imbalances is somewhat significant in developing Asia, including the newly industrialized economies (NIEs) of Hong Kong, Singapore, South Korea (Korea hereafter), and Taiwan, rather than Japan and Middle East.[5] This is because of a remarkable turnaround in developing Asia's current account in 1998 that was consistent with the beginning of the imbalances, and since then the fact that current account surpluses of the entire region increasingly grew and moved closely in parallel to the US current account deficit in absolute values. One more interesting thing is the fact that a substantial increase in developing Asia's current account surplus from 2003 to 2007 was in line with the global trend of current accounts that turned from the prolonged deficit to surplus positions during the same period (Figure 2.1). This also confirms that the region's contribution to the recent global imbalances is essential and looking in particular at Asian economies should be worth a great deal.

To shed light on the aggregate behavior of this region[6], Figures 2.2 and 2.3 exhibit the current account positions for selected major economies in Asia, comprising China, India, Korea, Singapore, and other large Association of Southeast Asian Nations (ASEAN) economies[7] as a percentage of GDP and as a percentage of the region's GDP, respectively. The aggregate size of these selected economies accounts, on average, for more than 85% of the region over the past decade, while both Korea and Singapore together have an enough portion, around 63%, of overall GDP in NIEs. Although the region as a whole has an essentially increasing contribution to the global current account imbalances, there are distinct phases and a

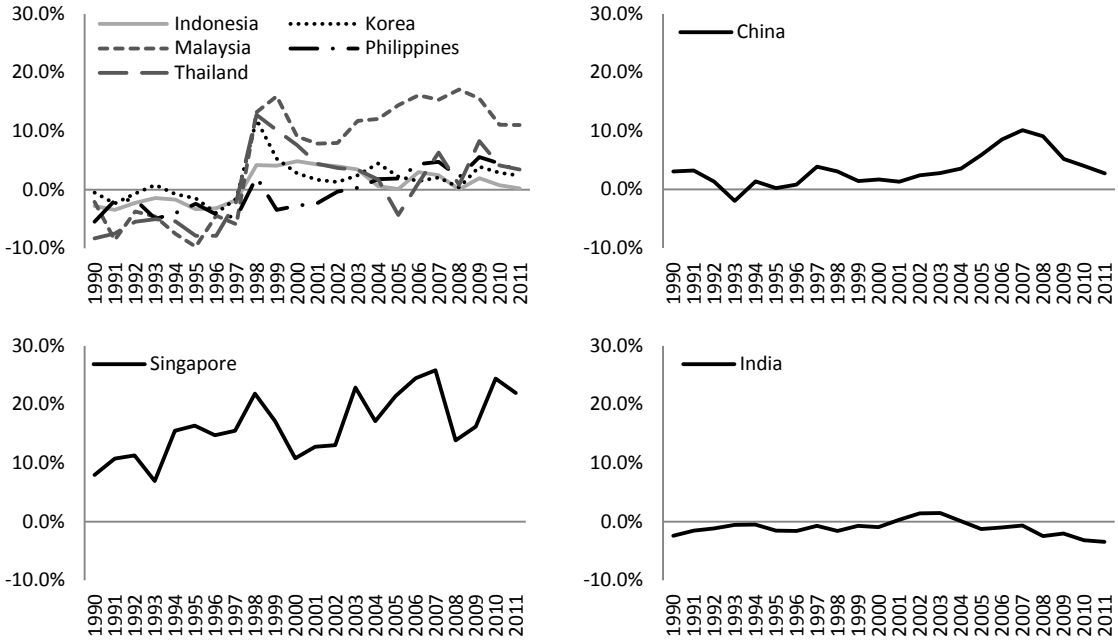
[4] From 2008 onward, a considerable correction in the magnitude of the imbalances is mainly due to a slump in world demand triggered both by US subprime mortgage crisis in mid-2008 and by European sovereign-debt crisis in late-2009. Concerns about their prolonged recession have intensified around the world thereafter, leading to the ongoing global economic slowdown.

[5] Despite a relatively large amount, the current account surplus in Japan has normally been stable over the previous decade while the surpluses in the Middle East and Russia have primarily reflected the soaring commodity prices, in particular oil prices. Indeed, oil-exporting economies are not included within this research.

[6] In this chapter, the Asian region refers to developing and newly industrial Asia.

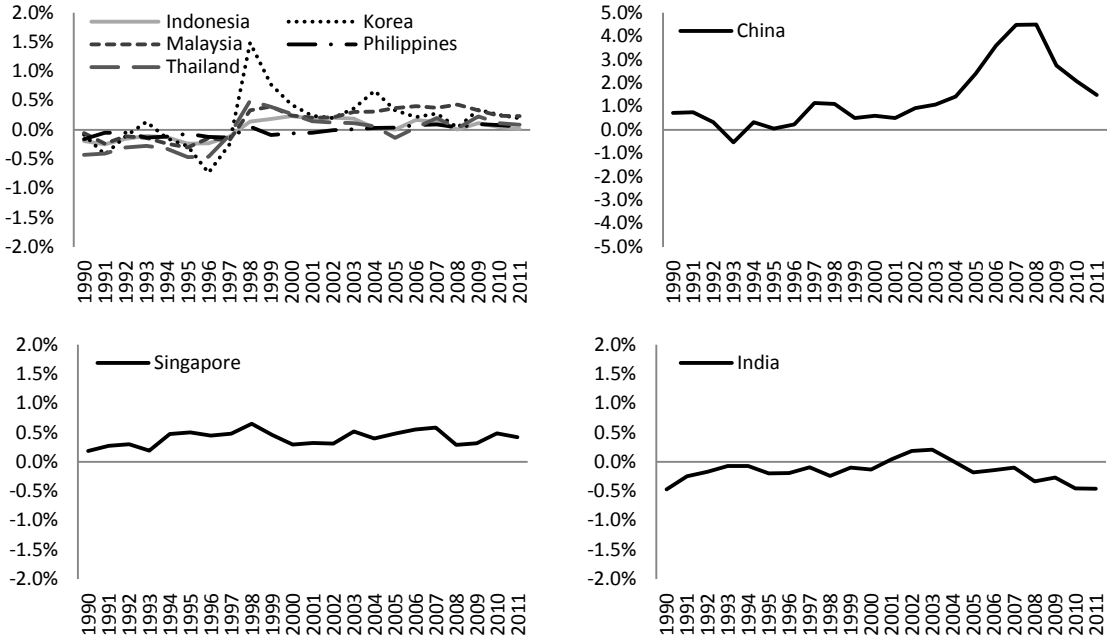
[7] ASEAN4 includes Indonesia, Malaysia, Philippines, and Thailand.

few patterns of current account balances among these economies (Adams and Park, 2009).



Source: IMF, World Economic Outlook database, October 2012.

Figure 2.2 Current account balances of selected Asian countries (percent of GDP)



Source: IMF, World Economic Outlook database, October 2012.

Figure 2.3 Current account balances of selected Asian countries (percent of the region's GDP)

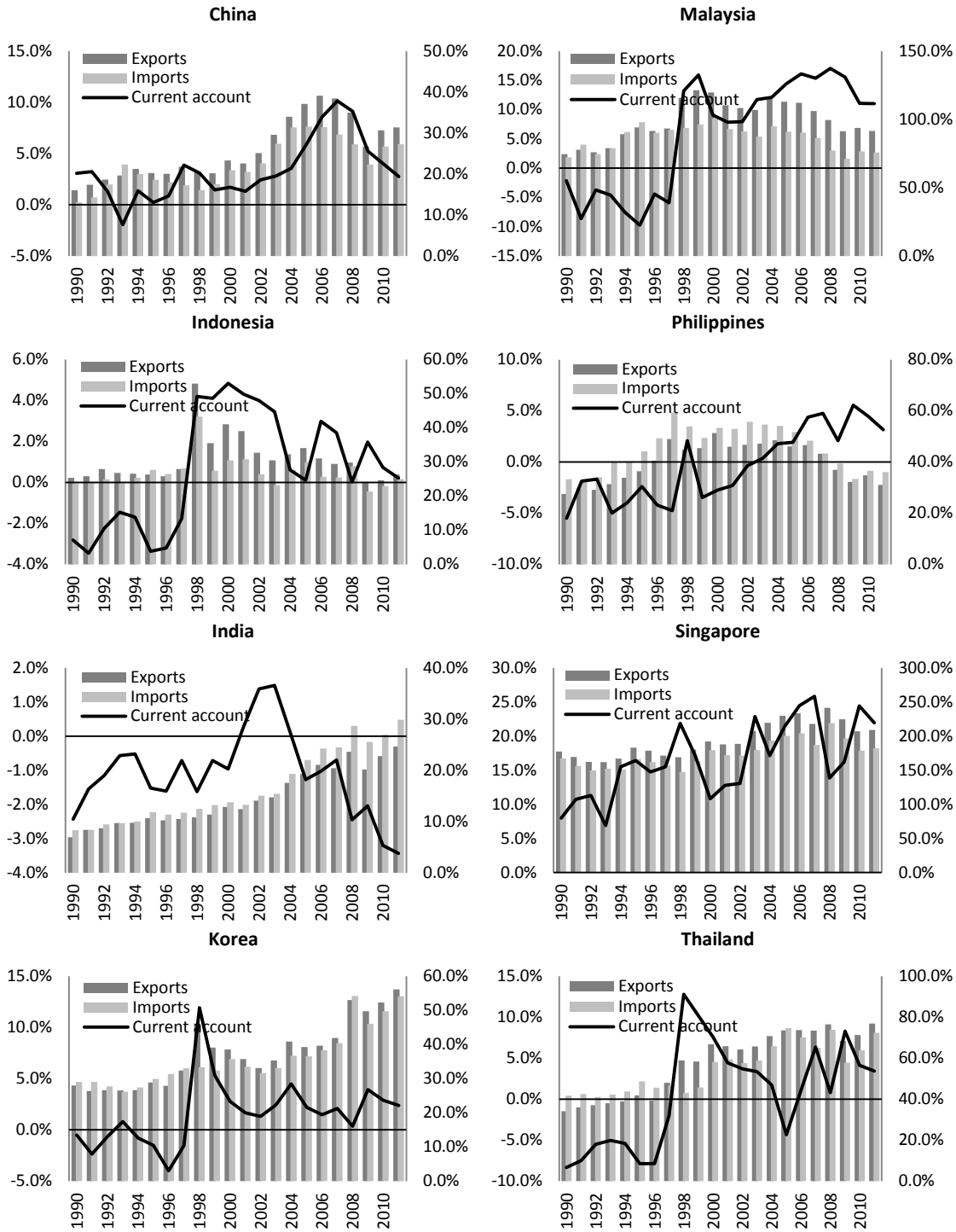
As can be seen for both figures, a group of Asian crisis-affected countries, including Indonesia, Korea, Malaysia, Philippines, and Thailand, sharply turned around from persistent current account deficits to large surpluses in the late 1990s. However, since 2003 such a dramatic improvement in their current account has modestly slowed and largely shifted to China. The China's current account surplus accelerated from around 2% of GDP in the early 2000s to over 10% of GDP (or equivalent 4.5% of the region's GDP) in 2007. While Singapore exhibits prolonged current account surpluses as an intrinsic structural characteristic (Adams and Park, 2009), India is fairly distinct from other economies as it relatively ran current account deficits over this period. This suggests that the overall surpluses of developing Asia's current account in recent years are closely related to that of China because the rest of the region has been relatively balanced, with the exception of Hong Kong and Taiwan as having persistent surpluses and Vietnam as running deficits.

A perspective on the Asian region's large current account surplus has placed emphasis on the success of export-oriented strategies that was achieved by NIEs during the early 1960s and 1990s. It seems likely that their success served as role models for other developing Asia in the aftermath of the Asian crisis. In general, the trade balance account is the largest component of the current account such that a surplus in current accounts should be associated with positive net exports. Figure 2.4 plots both exports and imports accompanied by corresponding current accounts as a percentage of GDP for individual economies.

As is evident except in the case of Philippines[8], positions of the current accounts tend to be in line with what happened to the trade balance. That is, the current account surplus comes about when countries are facing up to a surplus in trade balance, and vice versa.

It is also evident that after the Asian crisis the region's economies have had relatively high degree of export openness measured by export's shares in GDP (Figure 2.4). Among the crisis-affected economies, the shares of exports in GDP went out to 50% in 1998 and still high for Korea, Malaysia, and Thailand in recent years. While Singapore's exports were relatively sustained and fairly large in relation to GDP, China's exports sharply grew up to 40% in 2006 from 22.6% in 2001. Even if an eruption of the recent global crisis has slowed the growing exports in these economies, the region's heavy dependence on exports still exists with surpluses on both the trade and current accounts. However, this indicates that the large increase in the Asian region's current account has been the result of the surge in exports.

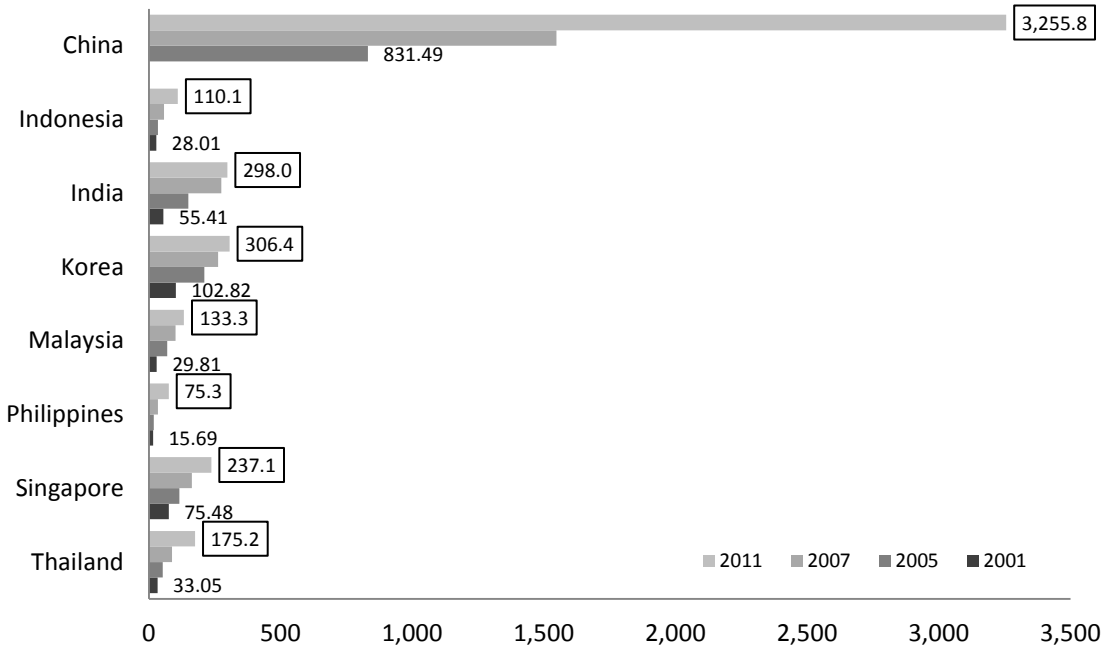
[8] For Philippines, the current account was likely to remain in surplus during in the face of trade deficits as remittances were relatively high in comparison with other economies.



Note that the horizontal axis represents years while the left-vertical axis represents shares of the current account in GDP and the right-vertical axis represent shares of exports and imports in GDP.

Source: World Bank, World Development Indicators database, October 2012.

Figure 2.4 Shares of exports and imports in GDP for selected Asia



Note that for China data is available in the period from 2004 onwards.
Source: CEIC database, downloaded December 2012.

Figure 2.5 Gross international reserves (US$ billion)

One another perspective on the region's large current account surplus has focused on the sizable stockpiles of international reserves in developing Asia, especially China. Figure 2.5 shows the gross international reserves for the selected economies in years 2001, 2005, 2007, and 2011. It is noticeable that the whole region's reserves tend to be dominated by China, with its exceptionally large amounts in comparison with the rest.[9] China's international reserves now stand above US$3,000 billion from US$830 billion in 2004, while the reserve accumulation of other economies has risen dramatically as well. From 2001 to 2011, their accumulating reserves on average accelerated by 330%.

Because of the explosive growth of its reserves, some argues that the global imbalances have also come from a determined effort to hold considerably large amounts of international reserves in this region, especially among crisis-affected economies (Lane and Milesi-Ferritti, 2007). This is because, in response to the 1997/98 crisis, Asian authorities sought self-insurance against a sudden reversal in capital flows at that time and during other episodes of systemic stress. As such, the pace of reserve accumulation as precautionary and liquidity measures began to accelerate in the late 1990s and early 2000s along with sustained current account surpluses, with the exception of India where the accumulation was stemmed from capital and financial account surpluses that financed its mild current account deficit. Adams, Jeong, and Park (2010), however, argue that the region's vast stockpiles of

[9] In Asia, China's contribution to the region's reserve accumulation has been fairly large, followed by the NIEs of Taiwan, Korea, Hong Kong and Singapore, and other large economies of ASEAN.

international reserves have been driven not only by the growing current account surpluses, but also by persistent foreign exchange market intervention, particularly in China where exports as the engine of growth might be less competitive due to its large surpluses on both current account and capital and financial account (i.e., twin surpluses).

In sum, all above evidence show that the Asian region has played a crucial role in contribution to global current account imbalances over the last decade. It stands out for the fact that the region's large and prolonged current account surpluses were consistent with the US current account deficits after the 1997/98 crisis. Perhaps, due to some lessons learned from the Asian crisis, export-led growth strategies have come into play among developing Asia along with the post-crisis efforts to build strong international reserves. As a result, the extent of overall region's current account surpluses has been driven by its increasing dependence on exports. In addition, the acceleration of the region's reserve accumulation seems to be exceptional and may reflect persistent intervention in foreign exchange markets with some particular purpose like maintaining competitiveness.

2.2 Exchange Rate Arrangements in Selected Asian Countries

Due to successful stories of the highly developed Asia, export-oriented strategies have been adopted by many developing Asian countries since the aftermath of the Asian crisis. In general, it is widely accepted that one of the keys to success in Asian industrialization is a competitive and stable exchange rate. Notwithstanding, foreign exchange rate policies in developing Asia often seem to be a source of controversies regarding the global imbalances. More specifically, the region, in particular China, is frequently to blame for the huge and sustained deficit on the US current account as it attempts to keep exchange rates undervalued, thereby gaining an unfair competitive advantage. Thus, it would be useful to discuss on the post-crisis exchange rate arrangements for these selected economies: China, India, Indonesia, Korea, Malaysia, Philippines, Singapore, and Thailand.

Prior to the crisis, it was fairly straightforward to classify the arrangements of Asian exchange rates because most of them were commonly fixed to the US dollar. Since the Asian crisis, however, many developing Asia have abandoned the pegged regime, and then operated a wide range of flexible exchange rate systems. An easy way to observe what kinds of the arrangements they adopted is by referring to their official policy announcements. Table 2.1 summarizes the pronouncements of each country.

As reported, the exchange rate arrangements of these economies are no longer a dollar peg system, and can roughly be divided into 2 groups. The first one, comprising Indonesia, Korea, and Philippines, officially adopts a flexible exchange

rate regime accompanied by inflation targeting frameworks. For the first group, the exchange rates are completely determined by supply and demand in the foreign exchange market, with the exception of official intervention aimed at moderating and preventing excessive fluctuations in their currencies.

The second one, including China, India, Malaysia, Singapore, and Thailand, officially operates various forms of exchange rate policies broadly referred to as a managed float. For the second group, the exchange rates are generally allowed to adjust in the foreign exchange market so long as the fluctuations in value of their currencies do not violate overall economic goal and objectives. As announced, both China and Malaysia in late 2005 officially shifted from the dollar peg to a new system in which the flexible and market-determined exchange rates of yuan and ringgit against a basket of currencies are engaged, while India monitors and manages the exchange rate without a specific target or a pre-announced target or a band, couple with official intervention if and when necessary.

Quite different, Thailand allows its currency to be relatively determined by market forces despite the adoption of a managed float regime along with the inflation targeting framework whereas Singapore considers the managed float policy more conductive to its primary goal of promoting price stability.

Table 2.1 Official policy announcements

Country	*Official pronouncements*
China	In July 2005, Chinese authorities announced the adoption of a managed floating exchange rate regime based on market supply and demand with reference to a basket of currencies. Until now, the new exchange rate system has operated stably, and the exchange rate of Chinese yuan has been kept basically stable at an adaptive and equilibrium level. The yuan has been moving against the US dollar both upward and downward with greater flexibility.
Indonesia	Bank Indonesia (BI) launched a new monetary policy framework known as the inflation targeting framework in July 2005, which has 4 basic elements as follows: 1) Use of the BI rate as a reference rate in monetary control in replacement of the base money operational target, 2) Forward looking monetary policymaking process, 3) More transparent communications strategy, 4) Strengthening of policy coordination with the Government. The exchange rate of Indonesian rupiah is determined wholly by market supply and demand. However, BI has the ability to take some actions to keep the rupiah from undergoing excessive fluctuation.
India	In recent years, the exchange rate policy has been guided by the broad principles of careful monitoring and management of exchange rates with flexibility, without a fixed target or a pre-announced target or a band, couple with the ability to intervene if and when necessary.
Korea	Inflation targeting (IT) is an operating framework of monetary policy in which the central bank announces an explicit inflation target and achieves its target directly. This is based on the recognition that to achieve sustainable economic growth, it is important above all else those inflation expectations, which have a great effect on wage and price decisions, should be stabilized. In this regard, IT

Table 2.1 Official policy announcements

Country	*Official pronouncements*
	places great emphasis on inducing inflation expectations to converge on the central bank's inflation target level by the prior public announcement and successful attainment of that target level. The exchange rate is, in principle, decided by the interplay of supply and demand in the foreign exchange markets. However, the Bank of Korea implements smoothing operations to deal with abrupt swings in the exchange rate caused by temporary imbalances between supply and demand or radical changes in market sentiment.
Malaysia	Malaysia in July 2005shifted from a fixed exchange rate regime of US$1 = RM3.80 to a managed float against a basket of currencies. Under the managed float system, the exchange rate of Malaysia ringgit is largely determined by demand and supply in the foreign exchange market. The central bank does not actively manage or maintain the exchange rate at any particular level – economic fundamentals and market conditions are the primary determinants of the level of the ringgit. In this regard, the central bank intervenes only to minimize volatility, and to ensure that the exchange rate does not become fundamentally misaligned.
Philippines	In Philippines, the primary objective of monetary policy is to promote a low and stable inflation conductive to a balanced and sustainable economic growth. The adoption of inflation targeting framework for monetary policy in January 2002 is aimed at achieving this objective. The Monetary Board determines the exchange rate policy in Philippines, determines the rates at which the central bank buys and sells spot exchange, and establishes deviation limits from the effective exchange rate or rates as it deems proper.
Singapore	Since 1981, monetary policy in Singapore has been centered on the management of the exchange rate, which has some key features as follows: 1) The Singapore dollar is managed against a basket of currencies of major trading partners and competitors, 2) The Monetary Authority of Singapore (MAS) operates a managed float regime for the Singapore dollar. The trade-weighted exchange rate is allowed to fluctuate within an undisclosed policy band, rather than kept to a fixed value, 3) The exchange rate policy band is periodically reviewed to ensure that it remains consistent with the underlying fundamentals of the economy, 4) The choice of the exchange rate as the intermediate target of monetary policy implies that MAS gives up control over domestic interest rates and money supply.
Thailand	Since July 1997, Thailand has adopted the managed-float exchange rate regime in which the exchange rate of Thai baht is determined by market forces, reflecting demand and supply in the foreign exchange market. The Bank of Thailand (BOT) does not target a fixed level for the exchange rate, and aims to ensure that the baht is allowed to fluctuate under the following conditions: 1) The BOT stands ready to intervene in the currency market such that volatility of the exchange rate is at a level that the economy can tolerate, 2) Maintaining national competitiveness, as measured through the Nominal Effective Exchange Rate (NEER), which comprises currencies of major trading partners 3) Any intervention does not go against economic fundamentals which would otherwise lead to further imbalances. Under the inflation targeting along with managed float regime, BOT implements its monetary policy by influencing short-term money market rates via the key policy rate (1-day bilateral repurchase rate).

Source: Compiled by Rajan (2010) from official websites of various central banks.

Table 2.2 De facto IMF exchange rate classification

Country	*Regimes (As of April 31, 2008)*
China	Crawling peg[10]
Indonesia	Managed floating with no pre-determined path for the exchange rate[11]
India	Managed floating with no pre-determined path for the exchange rate
Korea	Independently floating[12]
Malaysia	Managed floating with no pre-determined path for the exchange rate
Philippines	Independently floating
Singapore	Managed floating with no pre-determined path for the exchange rate
Thailand	Managed floating with no pre-determined path for the exchange rate

Source: IMF data on De Facto Classification of Exchange Rate Arrangements and Monetary Frameworks (IMF, 2008).

In practice, however, countries may not follow their announcements, so that a divergence in policy implementation is recognizable. Reinhart and Rogoff (2004) notice the distinction between the observed and official regimes among these developing Asia (Rajan, 2010). In order to define the exchange rate arrangements more precisely, the IMF takes into account various sources, including the behavior of bilateral exchange rates and reserves, not only the official pronouncements.

Table 2.2 shows exchange rate regimes for the selected Asia provided by the IMF. As can be seen, most of the selected economies are classified as managed floaters, broadly consistent with the official pronouncements, with the exception of China and Indonesia. The arrangement of China's exchange rates, which is officially based on a currency basket, is defined as a crawling peg instead. Yet, Indonesia is categorized as a managed floater, rather than as having a freely floating arrangement while both Korea and Philippines are in line with their public announcements.

Likewise, Rajan (2010) shows that many Asian currencies have been managed against either a single currency (i.e., the US dollar) or a basket of major currencies over the period 1999M2-2009M9. It is evident that despite the currency reform of China and Malaysia in the late 2005, China continues to operate a de facto US dollar peg with minor fluctuations whereas there is a gradual decrease in the influence of the US dollar in Malaysia. Meanwhile, Singapore and Thailand appear to manage its

[10] The currency is adjusted periodically in small amounts at a fixed rate or in response to changes in selective quantitative indicators, such as past inflation differentials vis-à-vis major trading partners, differentials between the inflation target and expected inflation in major trading partners, and so forth. The rate of crawl can be set to generate inflation-adjusted changes in the exchange rate (backward looking), or set at a pre-announced fixed rate and/or below the projected inflation differentials (forward looking), Maintaining a crawling peg imposes constraints on monetary policy in a manner similar to a fixed peg system.

[11] The monetary authority attempts to influence the exchange rate without having a specific exchange rate path or target. Indicators for managing the rate are broadly judgmental (e.g., balance of payments position, international reserves, parallel market developments), and adjustments may not be automatic. Intervention may be direct or indirect.

[12] The exchange rate is market-determined, with any official foreign exchange market intervention aimed at moderating the rate of change and preventing undue fluctuations in the exchange rate, rather than at establishing a level for it.

currency vis-à-vis a currency basket in line with the pronouncements, the evidence for Philippines is distinct from the IMF as it exhibits a strong management against the US dollar.

In contrast, there exists relatively greater exchange rate flexibility in Indonesia and India compared with others, while the evidence on Korea's intervention in foreign exchange markets is not enough. All in all, albeit a lowering degree of the US dollar influence on the region, most of Asian currencies with the exception of Indonesia, India, and Korea remain highly managed against the dollar; however, sometimes against a currency basket.

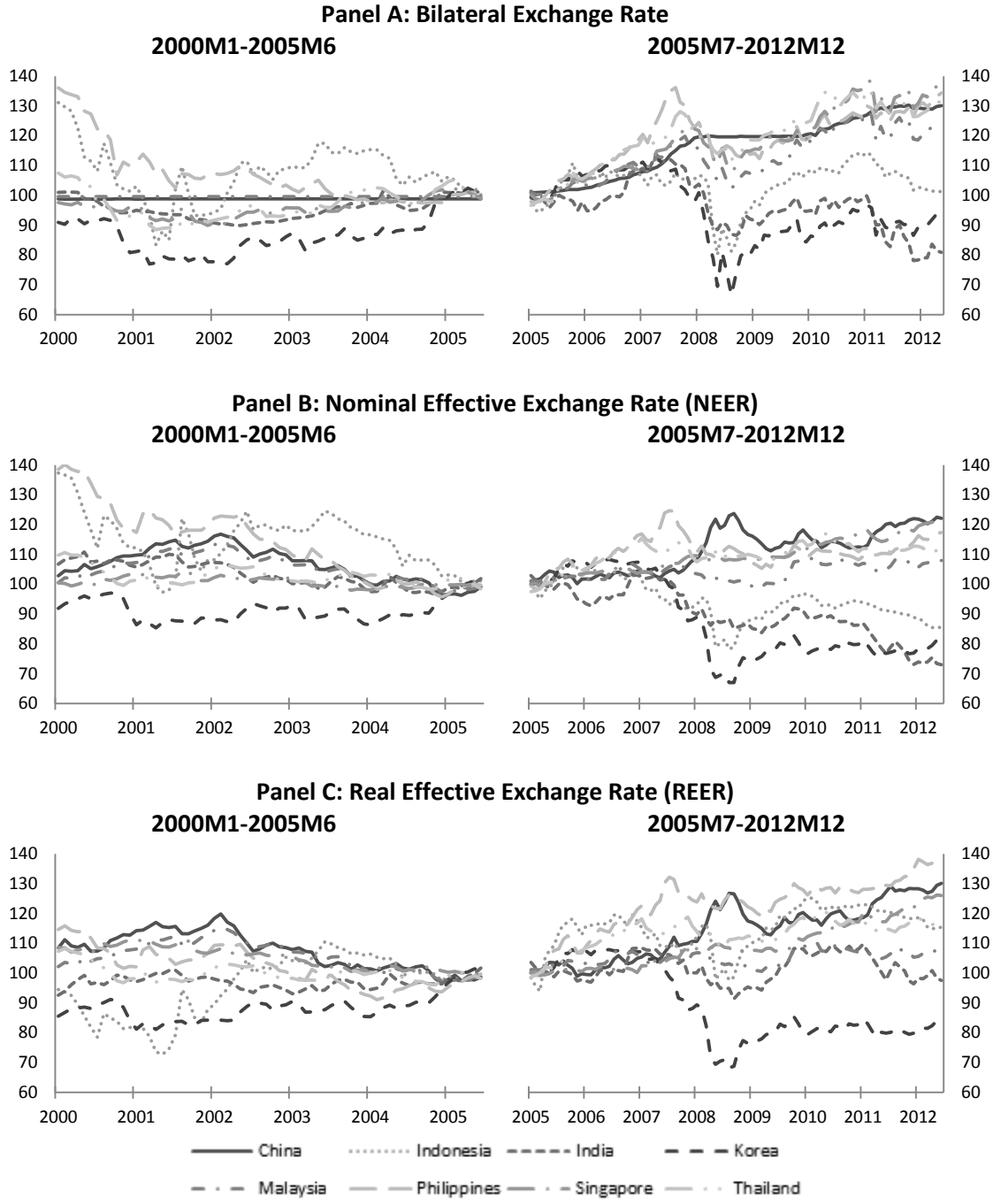
Given the adoption of managed float regimes, foreign exchange market intervention is entirely conceivable in the sense of dealing with fluctuations that may be harmful for the economy. By the way, the explosive stockpiles of reserves in Asian economies (Figure 2.5), which have been more likely driven by massive and persistent intervention in foreign exchange markets, are indicative of undervalued currencies, perhaps in order to support export-led growth. Jongwanich (2010), who estimates the equilibrium real exchange rate as a benchmark for measuring currency misalignments in Asia, reveals that many developing Asia's currencies were effectively undervalued in real terms and there was no sign of persistent overvaluation after the crisis in 1997/98.

The undervaluation had been found in Malaysia and Thailand since the Asian crisis, and was noticeable in China during 2003-2006, while Singapore exhibited a relatively long period of undervaluation until the ongoing global crisis. By contrast, during this period the real exchange rate tended to be consistent with its equilibrium in Indonesia, India, and Korea, suggesting that there was no significant evidence of currency misalignments on these 3 countries. Moreover, it is strongly evident that the performance of developing Asia's exports was relatively influenced by the real exchange rate as expected and the misalignments regardless of directions could have a negative impact on exports.[13] This indicates that an incentive for maintaining undervalued exchange rates in order to sustain exports and trade balances by intervention was kept open within limits.

Beyond the aspect of individual exchange rate arrangements, Sheng *et al.* (2007, 2009) point to the importance of a leading country in providing currency stability for other countries, thereby reducing risks of excessive exchange rate volatilities across the region. In this regard, some argument indicates that Asian

[13] Real overvaluation mirrors a loss in the country's competitiveness and misallocations of resources toward non-tradable sectors that discourages production in tradable sectors. Also, persistent real undervaluation could lead the economy to overheating and higher import prices, thereby facing inflationary pressures and generating expected appreciation of the currency in the future.

countries made more efforts to monitor the region's exchange rates and keep their currencies in line with others in the region.



Note that bilateral exchange rates (US dollars per local currency at the end of month), NEER, and REER are obtained from CEIC database, and rebased with 2005 = 100. A rise in figures means appreciation of the corresponding exchange rates.
Source: Author's calculation

Figure 2.6 Patterns of Asian currencies

Figure 2.6 shows various forms of the exchange rate index, namely bilateral exchange rate against the US dollar as well as nominal and real effective exchange rate (NEER and REER) for the selected Asian currencies after the crisis. Because all of these currencies have completely turned to exchange rate flexibility with the latest currency reform in China and Malaysia since July 2005, the figures are split up for such circumstances. As is apparent, the overall index had similar trends across country until the eruption of the ongoing global crisis. During the 2000-early 2005 period these currencies tended to move together with narrow fluctuations against the US dollar. And, they still moved in concert with each other after the late 2005, but in 2 different trends. China's currency tended to appreciate against the dollar in line with other currencies, such as Malaysian ringgit, Philippine peso, Singaporean dollar, and Thai baht, while there was a depreciation trend in Indonesian rupiah, Indian rupee, and Korean won (Figure 2.6-A, B). Also, this pattern broadly exhibited in the REER index except the case of Indonesia due to relatively high inflation.

Roughly speaking, the co-movements of the exchange rates in Figure 2.6 tend to support the above argument that Asian countries attempted to maintain competitiveness by keeping their own currencies in line with each other. If so, the exceptional growth of reserves in the region was partly a result of heavy intervention in foreign exchange markets as well. However, there are possible 2 reasons standing out for this pattern of currency behavior in Asia. First, an increase in the region's trade flows due to the presence of Asian production networks[14] tends to reduce fluctuations in exchange rates (Mundell, 1961; Hau, 2002; and Broda and Romalis, 2011). Second, the growing regional cooperative efforts, especially to promote financial stability and sustainable growth which have been driven by various regional bodies tend to improve Asia's exchange rate synchronization.

In conclusion, the exchange rate regimes, which determined the post-crisis arrangements for the Asian countries are defined as managed floating and freely floating exchange rates. Despite the adoption of greater exchange rate flexibility, it is evident that most of these currencies have been managed heavily and persistently in order to maintain competitiveness in line with each other, resulting in the accelerated growth of reserve accumulations. As such, a prolonged period of undervalued currencies in some developing Asia could form part of the huge and sustained US trade deficits because the countries were reluctant to allow too much appreciation of their own currencies vis-à-vis the anchor currencies. In addition, the similar pattern of Asian exchange rate movements should be a reflection of the closer trade integration and more regional cooperation in general (Sheng *et al.*, 2009).

[14] Production networks are processes that break up the chain of production into several stages and then assign them to specialized agents in finishing each stage.

2.3 Asian Financial and Monetary Cooperation

Regional cooperation has turned to be of concern to Asian policymakers in a way of resolving and preventing any future crises. Due to a lack of cooperation in the region, Asian countries were subject to a limited source of funds for buffering external shocks during the Asian crisis in 1997. That is, why in the recent era of which international trade and investment have grown rapidly, economies of Asian countries are closely integrated along with more development of regional cooperation, particularly in monetary and financial framework. This section then provides some progress on Asian monetary and financial cooperation over the past decades.

A forum held by central banks among Southeast Asia, New Zealand, and Australia (SEANZA) in the late 1950s might be an earliest discussion on monetary cooperation in this region aiming to provide training for central bankers. Like SEANZA, in 1966 South East Asia Central Banks (SEACEN) discussed on such training and research activities to improve central banker's capacities.

A significant step towards Asian financial and monetary cooperation occurred during the 1990s with the creation of Executives' Meeting of East Asia Pacific Central Banks (EMEAP) as well as with the formal cooperative forum under the Association of Southeast Asian Nations plus China, Japan, and Korea (ASEAN+3). Although EMEAP focused at first glance on the exchange of information on market developments in the economies of 11-member countries, it established 2 working groups and a study group to share knowledge and expertise on financial market development, central bank operations, and banking supervision issues, respectively in 1996.

However, the experience during the 1997 crisis raised more concerns about the lack of Asian cooperation and less developed financial markets in the region. Since then, a region's financial cooperation body led by ASEAN+3 had been promoted by some contribution of close relationship among member states of ASEAN. With the aim of providing an emergency support to members in the face of balance of payment difficulties, the ASEAN+3 countries started the so-called Chiang Mai Initiative (CMI) to discuss an establishment of a network of bilateral swap arrangements (BSAs) in May 2000. The amounts of BSAs funding support doubled in 2005. Because of the success in establishing the financing network of BSAs, in 2009 the regional countries decided to enhance their liquidity provision framework into a more advanced one by pooling their foreign exchange reserves through a self-managed reserve pooling arrangement, namely CMI multilateralization (CMIM). In recent years, the funding of CMIM has been expanded from $120 billion in 2010 to $240 billion.

As one of their major goals, Asian countries have made joint efforts to strengthen their surveillance and monitoring framework. In 2007, the ASEAN+3

promoted the surveillance system of regional financial and economic developments through tightening the connections among their working groups in relevant fields. Also, the Monetary and Financial Stability Committee (MFSC), comprising deputy governor-level staff of EMEAP central banks, lunched a regional monetary financial monitoring system, and decided to build a regional crisis management and resolution network in the same year.

With respect to Asia's financial market development there have been progressive discussions in many regional forums after the crisis, aimed at reducing dependence on funding from outside the region as well as enhancing regional funds. To foster regional bond markets and diversify the investment targets of foreign exchange reserves, the EMEAP introduced the Asian Bond Fund (ABF) that invested in jointly by member countries in 2003 and 2005, and has been active ever since. Moreover, the establishment of Asian Bond Market Initiative (ABMI) by ASEAN+3 has organized working groups in parallel to seek ways to spur and standardize issuance of bonds within the region and member countries.

In addition, studies on how regional countries can cooperate in their foreign exchange-related policies and unify their currencies have continually been carried out even if the main interest of Asian financial and monetary cooperation is to build an emergency funding system in preparation for any future financial crises. Currently in Asian economies, there are a number of related studies conducted by regional financial organizations, financial cooperation bodies, and individual researchers; for example, Asian Currency Unit (ACU) proposed by the Asian Development Bank (ADB) in 2005, Regional Monetary Unit (RMU) led by ASEAN+3 research group in 2005, Regional Currency Unit (RCU) proposed by Moon, Rhee, and Yoon in 2005, and Asian Monetary Unit (AMU) developed by Ogawa and Shimizu in 2006.

To sum up, the EMEAP and ASEAN+3 play major roles in the current regional cooperation, in particular financial and monetary frameworks. With the aim of promoting regional financial stability, there has been remarkable progress on enhancing crisis management, developing regional bond markets, and studying regional exchange rate cooperation and monetary integration.

CHAPTER III

LITERATURE REVIEW AND CONCEPTS

3.1 Impacts of Chinese Yuan Revaluation

Over the past decades, a number of literatures devoted to the global current account imbalances have paid attention to what would happen on the imbalances if undervalued Asian currencies, in particular Chinese yuan, became stronger. Table 3.1 concludes literature on the revaluation of the yuan.

Kwack *et al.* (2007) evaluate the effect of exchange rate policy changes through income and price elasticity of demand for imports for China and other twenty-nine countries. Using ordinary least squares method, gravity-based import demand equation for each country is estimated with pooled cross-country time-series data from 1984 to 2003. It is found that the income elasticity estimates range from 1.05 to 3.10, while the price elasticity estimates are between 0.4 and 1.2. For China, the income and price elasticities are 1.57 and 0.50, respectively. Taking the estimates of price elasticity, they also investigate effects of 10% real appreciation of yuan on China's exports, imports, and trade balance with other countries. The effects on exports are found to be generally low as China's dollar values of exports increase by about 1.3%. Nevertheless, exports to China from other countries increase moderately with China's imports rising by 5%. Overall, the 10% real appreciation has a negative effect on China's trade balance with all the individual countries by 30.4% contraction in the reference year 2004. The results indicate that the yuan revaluation is likely to reduce China's GDP and prices whereas increasing foreign GDP and prices.

Similarly, Yu (2009) finds that the revaluation of yuan can help reduce the bilateral trade imbalance between China and the US. Using an augmented gravity equation, effects of the revaluation on China's industrial exports to Japan and the US are estimated during 2002 to 2007. In addition, he also takes into consideration the reverse causality of bilateral trade on the exchange rate in the analysis. A simultaneous equations model is applied to the estimation by three-stage least squares (3SLS) method controlling for the simultaneous bias between bilateral trade and the exchange rate. Although China's exports to both Japan and the US have insignificant effects on their bilateral exchange rates, the results show that such an appreciation of yuan against the dollar significantly reduce China's exports to the US but it has no significant effect on China's export to Japan.

Hoggarth and Tong (2007), however, reveal some empirical evidence that reduction of China's exports from yuan appreciation may also lower the exports of its neighbor countries, especially Japan and Korea because of a drop in China's demand for capital imports from these advanced Asian countries. In the analysis, they use

panel data with three empirical models to examine the appreciation impacts on China's own exports, exports to China, and the competition for exports between China and Asian countries[15] in third markets. Movements in the exchange rate are interacted with commodity structures of corresponding country's exports capturing the heterogeneity across countries. Estimation results report that the appreciation of Chinese yuan has significantly negative effects on China's exports as well as on capital exports from Japan and Korea to China supporting the supply-chain story such that China imports capital goods from more advanced economies in order to produce final products, and in turn, exports to third markets. Thus, China's suppliers of capital become worse off when the appreciation leads to a contraction of exports from China. Nevertheless, there is little evidence that other Asian countries can be beneficial from the yuan appreciation for exporting to third markets.

According to Chinese monetary policies that totally absorb the excessive supply of foreign currencies (i.e., dollars) in order to maintain a given desirable level of yuan, Whalley and Wang (2011) introduce a general equilibrium trade model with a simple monetary structure in which the actual China's exchange rate and monetary policy are captured. Three sectors consisting of agriculture and energy, manufactures, and services are considered as commodities traded. With processing trade embedded in China's production function, they treat a part of imports as for final consumption and a part for use as intermediate inputs. Calibration of the model to China's trade surplus in 2005 is used for simulation exercise under substitution elasticities of two in CES demand functions. It is evident that China's import volumes rise by 11.8%, 25.7% and 61.5%, and exports fall by 9.7%, 18.9% and 35.8% associated with, respectively, 5%, 10% and 20% appreciation of yuan. Not surprisingly, China's trade surplus reduces by 12.7% 25.8% and 53.7% corresponding to such the appreciation from the reference year 2005.

As suggested by Goldstein (2004) that a 4% decline in China's current account to GDP ratio will yield equilibrium for the current balance of payments, Willenbockel (2006) provides insight to structural effects of yuan appreciation causing such a reduction in current account on sectoral employment in China. Using a seventeen-sector computable general equilibrium (CGE) model of Chinese economy and its trade relations with other countries, a China's real appreciation shock that endogenously generates the 4% decline in current account is imposed. As is expected, China's terms of trade improves due to the appreciation. It is found that the textile, sewing, and leather sectors are most severely affected with the strongest negative employment effect and reduction in exports exhibiting a shift in employment from the manufacturing sectors to non-tradable service sectors. The results indicate that it is

[15] Nine Asian countries include India, Indonesia, Japan, Korea, Malaysia, Pakistan, Philippines, Singapore, and Thailand.

advisable to combine active policy measures with the revaluation in order to cope with the negative effects on domestic employment.

Meanwhile, Zhang (2006) also recommend that China should not revalue the yuan considerably unless effective fiscal or monetary policies are implemented simultaneously to accommodate the decrease in net exports. With a multi-country macro-econometric model, namely the Fair model, based on regressions of long-term historical data from 1960 to 2005 for 39 countries in addition to a separated model of US economy, Chinese policy scenarios are investigated whether yuan revaluation with additional expansionary fiscal policy can help remove negative effects of the currency appreciation on its economy or not. The simulation exercises report that the revaluation is unlikely to be appealing to China as it may reinforce deflation, reduces competitiveness of export sectors, and then decreases GDP. However, although China's exports fall, it is not as much beneficial as to China's major trading partners, in particular the US, Japan, and Australia as their current account balances also worsen.

In sum, it is strongly evident to the extent that such a currency revaluation would bring about an economic contraction in China through substantial trade balance deterioration although the size of impacts differs depending on methods and variables used. A sharp fall in exports and/or a surge in imports adversely contribute to China's economic growth. There are suggestive pieces of evidence in mitigating such adverse impacts on the Chinese economy from currency revaluation by either expansive fiscal or monetary policy intervention. The existing literature also considers the impacts on China's major trading partners, in particular the US. The stronger yuan would discourage US imports from China, but seemed not to encourage US exports. Despite no consensus of the resulting revaluation of the yuan that could significantly increase overall US exports, there is a few evidence of an improvement in US trade balance or in the current account. Moreover, there is little research about such impacts on other economies with respect to yuan revaluation. In addition, none of them takes a regional realignment of exchange rates into consideration regarding a resolution to global current account imbalances.

Table 3.1 Summary of literature on impacts of Chinese yuan revaluation

Author	*Estimation method*	*Country*	*Exports (Vol.)*	*Imports (Vol.)*	*Current account*	*Policy recommendation*	*Remarks*
Willenbockel (2006)	A 17-sector CGE model of the Chinese economy is used to examine structural effects of yuan revaluation in real terms.	China	-10.70%	10.50%	-4.00%	A realignment of Chinese yuan should be accompanied by active policy measures that would lead to a reduction in China's savings and simultaneously support the shifts in employment from manufacturing to services.	1) The impact on exports and imports are the result of yuan revaluation that causes a 4% contraction in China's current account per GDP. 2) Measurement of the impact is measured as a deviation from the base case (%).
Zhang (2006)	A multi-country macroeconometric model (the Fair model) is used to examine economic impacts of yuan revaluation on China and its major trading partners.	China	-10.14%	-5.37%	96.38%	China should not revalue the yuan considerably unless effective fiscal or monetary policies are used simultaneously to accommodate the decrease in net exports.	1) The result is a 4-year average impact caused by 10% nominal revaluation of the yuan. 2) Trade balance is used as proxy for current account balance. 3) Measurement of the impact is measured as a deviation from the base dataset (%).
		USA	0.01%	-1.07%	1.11%		
		Japan	-0.03%	-0.79%	-15.37%		
Kwack *et al.* (2007)	Import demand equations for China and 29 countries are used to estimate world trade elasticities in order to examine effects of yuan revaluation on China's trade balance with selected countries	China (total)	1.31%	5.04%	-31.00%	China should not revalue because the appreciation of the yuan is likely to reduce China's GDP and prices, while it raises foreign GDP and prices	1) The impact of 10% the yuan appreciation on exports and imports measured in terms of US dollar values is analyzed. 2) Trade balance is used as proxy for current account balance. 3) Measurement of the impact is measured as a deviation from the base dataset at year 2004 (%).
		China (w/ USA)	0.65%	5.04%	-1.01%		
		China (w/ Europe)	0.67%	5.04%	-6.05%		
		China (w/ Japan*)	3.07%	5.04%	-299.19%		
		China (w/ Korea*)	5.65%	5.04%	-4.27%		
		China (w/ ASEAN4*)	0.34%	5.04%	-57.41%		

Table 3.1 Summary of literature on impacts of Chinese yuan revaluation (cont.)

Author	*Estimation method*	*Country*	*Exports (Vol.)*	*Imports (Vol.)*	*Current account*	*Policy recommendation*	*Remarks*
Yu (2009)	A gravity model controlling for simultaneous bias is used to investigate the 2-way causality between exchange rates and bilateral trade among China, Japan, and the US.	China (exports to USA)	-56.30%	Not considered	Not considered	A revaluation of the yuan may be helpful in reducing the bilateral trade imbalance between China and the US.	1) Quarterly data of bilateral nominal exchange rates is used. 2) US and Japan's imports from China are used to measure China's exports to the US and Japan respectively.
		China (exports to Japan)	Positive sign but insignificant	Not considered	Not considered		
Hoggarth *et al.* (2007)	Panel data with 3 empirical models is used to examine the yuan revaluation effects on China's own exports, China's imports, and the competition between Asian countries and China in third markets.	China	-3.70%	Insignificant	Not considered	A revaluation of the yuan may not lead to a generalized revaluation of Asian currencies as an important part of the solution to global imbalances.	1) Exports and Imports data used are measured in terms of constant US dollar. 2) Quarterly data of bilateral nominal exchange rates is used.
		Japan and Korea	Negative sign but insignificant	Not considered	Not considered		
Whalley *et al.* (2011)	A general equilibrium trade model with a simple monetary structure is used to analyze impacts of a yuan revaluation on trade flows and reserve accumulation in China	China	-18.90%	25.70%	-25.80%	Current account and capital account liberalization in China aimed at addressing macroeconomic imbalances will depress China's growth in trade surplus.	1) Measurement of the impact is measured as a deviation from the base case (%).

3.2 Feasibilities of Monetary Integration in Asia

In general, there are various forms of cooperation in monetary framework. Initially, sharing of information among central banks is the lowest degree of cooperation. With the higher level of integration, the cooperation requires member countries to intensify efforts at a wide range of economic policy coordination, resource provision, banking supervision and financial regulation. The highest stage of monetary cooperation calls for a common currency, common fiscal policies, and common foreign exchange arrangements in the region, which is so-call monetary integration. The feasibility of Asian monetary integration has been paid lots of attention over the past decade. Table 3.2 summarizes the studies on feasibilities of Asian monetary integration.

Kim *et al.* (2005) consider 3 types of modalities in forming East Asian monetary integration, such as Asian currency unit (ACU), yenization, and monetary union compared with floating regime.[16] Because of the fact that the region has a strong economic link with Japan (inside the region) and the US (outside the region), a static 3-country macroeconomic model consisting of both two large economies and Korea is employed for quantifying welfare changes in different modalities. With the assumption that internal and external balances are equally attractive to the monetary authorities for minimizing social loss, it is found that the ACU peg appears to be superior to other modalities for East Asian region. This is economically reasonable since the ACU peg leads developing countries to a stronger monetary discipline with inflationary bias than the monetary union and also the use of Yen as legal tender limits any ability of using domestic credit as a policy instrument. Therefore, if Asian developing countries are seeking an alternative to a floating regime, the ACU is the only viable choice in the forthcoming period. However, they point out that the impact of monetary integration depends not only on the modality adopted, but also on the economic structure of participants. The net gain from monetary integration was unlikely to be vital if fundamental gaps on economic structure between developing and advanced economies became smaller (Kim *et al.*, 2005)

The theory of optimum currency areas (OCAs), introduced by Mundell (1961) and McKinnon (1963), is the most popular framework for this issue. A simple precondition for a successful monetary union is that member countries should face similar types of macroeconomic shocks, so that common policy responses can be implemented among the members. Huang *et al.* (2006) make an assessment of the

[16] Under the ACU peg, participant countries peg their currencies to a common currency basket such that the exchange rates between member currencies are fixed but they float against the US dollar. The yenization, which refers to an adoption of Japanese yen as legal tender, is considered as an asymmetric integration, whereas the adoption of a new common currency in the monetary union is an equal-cost sharing to all participant countries.

feasibility of creating a monetary union in East Asia[17] based on the traditional OCA properties of symmetry between shocks. A four-variable structural vector autoregressive (VAR) model, covering the period 1970 to 2002, is exploited in order to distinguish structural external supply, domestic supply, demand, and monetary shocks. Using a correlation of underlying shocks as a degree of symmetry among countries, it is found that the correlations of external shocks are highly significant between all East Asian countries, while correlation results of other domestic shocks are varied. However, domestic supply shocks are highly correlated between Hong Kong, Korea, and some ASEAN members, and also the average size of the supply shocks in East Asia is relatively small compared with those in European Monetary Union (EMU). The study also provides impulse response analysis capturing the dynamic effect of specific shocks on real effective exchange rates. With the exception for China, the real effective exchange rates have positive long-run responses to external shocks in spite of somewhat different path and magnitude of responses.[18] Even though the responses of real effective exchange rates to other domestic shocks are generally different, it seems to have closely symmetric patterns for some countries. From these results, a monetary union is likely to be far from achieving in East Asia due to wealth disparities and unilateral exchange rate arrangement. However, it may be beneficial for Hong Kong, Indonesia, Korea, Malaysia, Singapore, and Thailand to take the lead in creating a monetary union in accordance with significant and positive correlations of various shocks, small sizes of shocks, and similar responses of real effective exchange rates (Huang *et al.*, 2006).

Also, Kim (2007) examines empirical nature of macroeconomic shocks in East Asia[19] during 1981 to 2005 using VAR models. Three specific aspects are addressed in the study as follows: (i) the dynamic behavior of prices over business cycles, (ii) the persistence of shocks and pattern of macroeconomic responses to demand and supply shocks, and (iii) the influence of productivity and transitory demand shocks on output and prices. It is found that there are largely distinct patterns of shocks among ASEAN economies, and also within the Northeast Asian countries. Although there is little evidence in favor of forming a monetary union in Asia, he suggests that it could be possible for China and Hong Kong.

Moreover, using the concepts of Purchasing Power Parity (PPP) and Generalized PPP (GPPP), Mishra *et al.* (2010) provide another method for testing the OCA properties of symmetric shocks and the co-movement of bilateral real exchange

[17] Five members of ASEAN, namely, Indonesia, Malaysia, Philippines, Singapore, and Thailand, and the Northeast Asian countries consisting of China, Hong Kong, Japan, and Korea are considered to be sample countries in East Asia.

[18] The Chinese authority would decide to depreciate its currency in the face of external shock in order to enhance the competitiveness of its products and to maintain export-led growth strategy (Huang *et al.*, 2006)

[19] Thailand is excluded because of lack of data during the period of the 1997 crisis.

rates in East Asia. In the paper, Indonesia, Korea, Malaysia, Philippines, Singapore, and Thailand as well as both India and Sri Lanka are also included. The results of validity tests of PPP indicate that shocks to real exchange rates are permanent in nature and the exchange rate does not revert back to its prior equilibrium level after any deviation.[20] However, according to the GPPP theory, although real exchange rates of a group of countries may be individually non-stationary, a liner combination of these non-stationary real exchange rates will be stationary and they will share common trends in the long run if the fundamental macroeconomic factors that drive exchange rate are sufficiently integrated across countries. Using Johansen cointegration test, it is obviously evident that the null hypothesis of no cointegration is strongly rejected supporting evidence for the validity of GPPP. Accordingly, a common currency area among these countries could be formed. Nevertheless, the presence of asymmetries in the adjustment process to shocks and some insignificant adjustment coefficients indicate that a higher degree of economic and monetary integration is still required to satisfy the highly demanding condition of OCA.

Because of the need for relatively long time series for econometric tests, studies investigating OCA properties are by necessity backward looking. Such studies cannot reflect a change in policy preferences, or a switch in policy regime. Some authors believe instead that the OCA properties could be satisfied after forming a union even if it is not fully achieved before. This is so-called the endogeneity of OCA paradigm. In the research article by Lee *et al.* (2010), they specifically investigate the dynamic relationships between trade, finance, specialization, and business cycle synchronization for East Asian economies consisting of China, Japan, Korea, Indonesia, Malaysia, Philippines, Singapore, and Thailand. With the sample period of 1970 to 2006, General Method of Moments (GMM) approach is used for estimation in order to avoid biased and inconsistent estimators of using panel procedures and to control for endogeneity of all explanatory variables. The results indicate that increased trade improves the business cycle synchronization in the region albeit the relationship is much weak. Therefore, policymakers may have little concerns about the region being unsynchronized in their business cycles because after eliminating exchange rate fluctuations among the participants, an enhancing intra-regional trade would potentially increase business cycle synchronization (Lee *et al.*, 2010).

Instead of following the OCA properties, Shirono (2008) places emphasis on questions whether a monetary union in East Asia facilitates international trade among participating countries, and how it affects welfare of those countries. In fact, it is generally accepted that a benefit of using a single currency is that it reduces trade

[20] Several validity tests of weak form of PPP hypothesis by applying panel cointegration tests (Pedroni, 1999, 2004; and Maddala and Wu, 1999), and also individual tests show that the real exchange rates are non-stationary for both US dollar- and Japanese yen-based currencies in the pre-crisis period, whereas just some supports the validity of PPP in the post-crisis period.

costs associated with the use of national currency. Using a micro-founded gravity equation derived from a general equilibrium trade model, a comparative statics analysis before and after adoption of a single currency is conducted. With counter-factual experiments, it is found that a currency union in East Asia will increase regional trade significantly, but the welfare gains are likely to be moderate. Moreover, the results indicate that the welfare of the member countries increases substantially when including additional higher advanced countries like Australia, Japan, and New Zealand in the union, while the trade-creating effects are still large. These results confirm the idea that regional currency arrangements are more beneficial than bilateral arrangements as suggested by Frankel and Rose (1998).

To conclude, the increasing regional cooperative efforts in financial and monetary frameworks as well as the growing intra-regional and international trade in Asia draw lots of attention to the feasibility of Asian monetary integration. Due to its fruitful benefits such as stabilizing regional macroeconomics and exchange rates, fostering intra-regional trade and investment through reducing transaction costs, improving market and legal institutions, and enhancing risk-sharing mechanisms, the monetary integration is so attractive. Unfortunately, the current obstacles to achieving Asian monetary integration, consisting of different stages of economic development, underdeveloped markets and legal institutions, even relatively less intra-regional trade and investment linkages compared with the EU, are the major conditions of success although some evidence argues that the synchronization could potentially increase later. These conditions would be far from satisfactory for the Asian region as a whole; however, the integration was possible for a smaller group of countries, especially between India and Sri Lanka in South Asia, and among ASEAN5, China, Japan, and Korea in East Asia, for example.

Table 3.2 Summary of literature on feasibilities of monetary integration in Asia

Author	*Likelihood of success*	*Obstacles of success*	*Conditions for success*	*Benefits of OCA*	*Research method*
Kim *et al*. (2005)	Monetary integration between Japan and Korea (as a smaller regional economy) is possible, especially in forms of asymmetric exchange rate arrangement such as a peg to a common basket or yenization.	1) Less incentives of Japan for switching from a flexible regime to another one under common currency	1) Convergence in economic structures 2) Synchronization of business cycles	1) Macroeconomic stability imported from Japan to smaller regional countries 2) Reduction in transaction costs and gains in dynamic efficiency	A 3-country macroeconomic model introduced by Hamada (2002) is used to analyze 3 modalities of East Asian monetary integration, namely, the ACU peg, yenization, monetary union.
Huang *et al.* (2006)	Monetary integration between Hong Kong, Indonesia, Korea, Malaysia, Singapore, and Thailand should take the lead in encouraging a common currency zone.	1) Variety of exchange rate systems 2) High levels of dependence on the US economy 3) High wealth disparities	1) More intra-regional migration 2) More intra-regional trade	1) High intra-regional trade 2) Regional exchange rate stability	A four-variable structural VAR model is developed to distinguish structural external supply, domestic supply, demand and monetary shocks in order to examine the feasibility of a currency union in East Asia.
Kim (2007)	Monetary integration between ASEAN4 plus China, Japan, and Korea is likely to be difficult even within sub-group of ASEAN and the Northeast Asian countries (Thailand is not included). However, it is possible for a currency union between China and Hong Kong.	1) Different stages of economic development 2) Different markets and legal institutions	1) Efficient institutional economic and political groundwork	1) More uniform legal and market institutions 2) Better risk-sharing mechanisms	Three alternative VAR models are used to examine following purposes: the dynamic behavior of prices over business cycle; the persistence of shocks and pattern of macroeconomic responses to demand versus supply shocks; and whether it is productivity or transitory demand shocks that drive output variations at different points in time.

Table 3.2 Summary of literature on feasibilities of monetary integration in Asia (cont.)

Author	*Likelihood of success*	*Obstacles of success*	*Conditions for success*	*Benefits of OCA*	*Research method*
Shirono (2008)	Monetary integration between ASEAN5 plus China, Japan, and Korea is possible as it stimulates regional trade and generates economically significant welfare gains.	Not mentioned	1) Stability in regional exchange rates	1) High intra-regional trade 2) Increases in regional economic welfare	A micro-founded gravity equation derived from a general equilibrium trade model is used to assess the impact of common currency arrangements in East Asia on trade and welfare.
Lee *et al.* (2010)	Monetary integration between ASEAN5 plus China, Japan, and Korea is possible. Although their business cycles are less synchronized, the synchronization of business cycles will potentially increase after a monetary union is formed.	1) Much weaker positive link between trade and business cycles in the region 2) Negative relationships between financial integration and business cycles	1) More intra-regional trade 2) Similar economic structures	1) High intra-regional trade due to elimination of exchange fluctuation 2) More business cycle synchronization	A system GMM approach using panel procedures is adopted in order to examine the dynamic relationships between trade, finance, specialization, and business cycle synchronization.
Mishra *et al.* (2010)	Monetary integration between Indonesia, Korea, Malaysia, Philippines, Singapore, and Thailand is possible. Moreover, India and Sri Lanka are potential to become member of this group.	1) Asymmetric responses to shocks in the economy	1) More economic integration 2) More monetary cooperation	Not mentioned	A panel approach with concepts of PPP and GPPP is used to investigate the symmetry in macroeconomic disturbances and the co-movements of bilateral real exchange rates of East Asian countries.

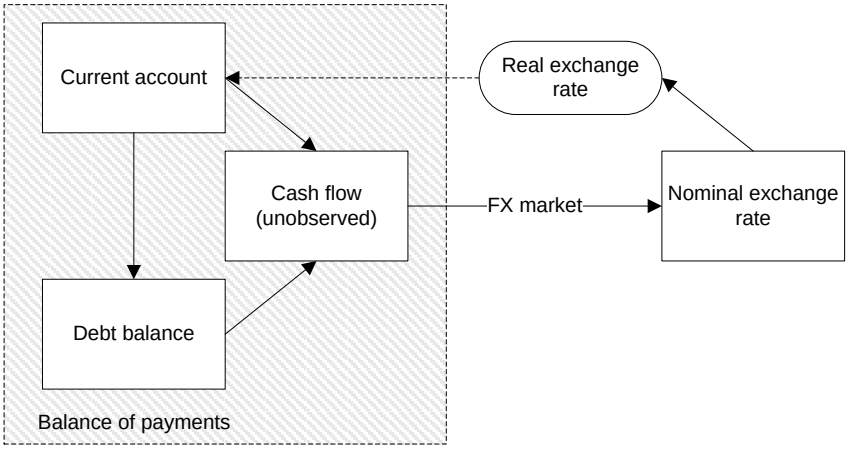
3.3 Conceptual Framework

Broadly speaking, international trade and financial sectors have a major role in linking the entire world. All monetary transactions between a country and the rest of the world, including payments for the country's exports and imports of goods and services, financial capital and financial transfers, are recorded in a balance of payments account. It summarizes these international transactions for a specific period, usually a year, in two principal parts which are the current account and the capital account. As noted, this research intentionally addresses the question whether the Asian region can help global current account rebalancing through regional realignments of their currencies focusing on trade. Hence, a way to assess the impacts of foreign exchange policies on the world economy is to start with a relationship between the current account and exchange rates.

In economics, the current account is the sum of the balance of trade (the difference between values of exports and imports of goods and services), net investment income (i.e., interest and dividends), and net transfer payments (i.e., foreign aids). Because the trade account is typically the largest component of the current account, the position of current accounts may be a measure of the nature of a country's international trade given that all financial transfers, investments, and other components are ignored.

Meanwhile, an exchange rate, by definition, is the rate at which one currency can be exchanged for another currency. The rate of exchange rate is generally quoted in terms of the amount of domestic currency units that can be exchanged for a unit of foreign currency – direct quotation. However, an indirect quotation using the domestic currency as a currency unit for measuring the price of foreign currency is commonly adopted among European countries. An interpretation of exchange rate movements of which people make easily mistakes depends on how the rate is quoted. For example, when the domestic currency is appreciating against foreign currency, the figure of exchange rates falls for the former quote, but such a figure rises for the latter.

Like most variables in economics, the definition of exchange rates described above is well-known as nominal exchange rates, while its real value can be simply defined as the nominal exchange rate (indirect quote) adjusted by a ratio of domestic to foreign price levels. In principle, as a measure of competitiveness the real exchange rate is a relative price of goods across countries, not directly controlled by policymakers. It is somewhat the outcome of other forces and policies affecting demand and supply. A rise in the real exchange rate indicates that the foreign price of a bundle of goods has fallen relative to the domestic price measured in a common currency. It means that the real value of domestic currency has appreciated, that is, the purchasing power of domestic currency has risen in relative terms.



Source: Müller-Plantenberg (2006)

Figure 3.1 Current account and exchange rates

During a situation of excessive domestic demand for exports over imports, the positive net sales abroad corresponding to the excess supply of foreign currencies over demand commonly contribute to a surplus in the current account. In order to bring exchange rates back to equilibrium in foreign exchange markets, prices of foreign currencies must fall relative to domestic currency (Robinson, 1937 and Müller-Plantenberg, 2006), and then cause nominal exchange rates of domestic currency to appreciate. Consequently, the real exchange rate will adjust to the strength of the country's trade performance no matter what kinds of exchange rate regimes are adopted (Figure 3.1).

As illustrated in Figure 3.1, however, a change in the exchange rates also has effects on the current account, in particular through international trade in goods and services. Intuitively, depreciation (appreciation) of domestic currency is likely to improve (worsen) the country's trade balance even though outcomes vary across countries.

Marshall (1923), Robinson (1937), Lerner (1944), and Machlup (1950) develop a theoretical approach to explain such circumstances which is the so-called elasticity approach. In a simple version, this approach is based on the analysis of elasticity of demand for exports and that of demand for imports with respect to the exchange rate. More specifically, it provides conditions at which a success of trade balance improvement by exchange rate devaluation could be reached. With the assumption of initially balanced trade, the currency depreciation is effective in terms of improving trade balance only if the sum of the export elasticity and the import elasticity is greater than 1 which is called the Marshall-Lerner condition. That is, so long as the condition is met, the depreciation (appreciation) of the country's exchange

rates ends up with an improvement (deterioration) in its current account given that all other components of the current account are equal to zero except the trade account.[21]

For instance, a real appreciation induced by an increase in nominal exchange rates worsens net exports and then the current account both by stimulating imports and reducing exports. This is because when the exchange rate of domestic currency appreciates against foreign currencies, prices of foreign goods become cheaper relative to domestic goods, encouraging quantity demand for imports by law of demand, and resulting in an increase in values of imports. At the same time, the appreciation of domestic currency reduces value of exports through a reduction in quantity demand for exports because a decrease in export revenues measured in domestic currency discourages export production as well as the purchasing power of foreign currencies has fallen relative to domestic currency. As a result, such appreciation is likely to be a factor that undermines the current account at home while it tends to do the reverse abroad (Figure 3.2).

Figure 3.2 Effects of real exchange rate appreciation on the trade balance at home and abroad

[21] The condition holds for both nominal and real exchange rates because a real depreciation (appreciation) of exchange rates is equal to a nominal depreciation (appreciation) if the domestic and foreign price levels remain unchanged.

Keep in mind that a reduction in net exports resulting from the appreciation of exchange rates is unfavorable for economic growth, and it is not compulsory for surplus countries in order to rebalance, optional indeed, so that the 2 concepts discussed here may refer to ways by which the current account imbalances would be corrected with a lesser adverse impacts on growth. In this regard, demand rebalancing and coordinated exchange rate alignment are involved in accompanying the exchange appreciation as follows.

The *first* concept is basically subject to internal demand management. Apart from adjusting exchange rates, one another fundamental function of the international monetary system is to adjust domestic demand. Based on absorption approach (Alexander, 1952), positions of the current account can be explained by the difference between domestic income and domestic absorption. Since a surplus in current accounts is, roughly speaking, known as the excess of exports over imports, it can alternatively be expressed as the excess of national income (earning) over absorption (spending) as follows:

$$Y = C + I + G + X - M \quad \text{(Eq. 1)}$$

$$CA = X - M = Y - A \quad \text{(Eq. 2)}$$

According to national income identity (Y) in Eq. 1, the compositions of consumption (C), investment (I), and government expenditure (G) is defined as absorption ($A = C + I + G$), and thus the current account ($CA = X - M$) can be expressed as the difference between domestic income and absorption as shown in Eq. 2. By transforming Eq.2 into difference forms, the adjustment of current account is expressed as below (Eq. 3).

$$\Delta CA = \Delta Y - \Delta A \quad \text{(Eq. 3)}$$

That is, if income rises faster than absorption, then the current account will improve, and vice versa. In order to narrow the surplus, hence, it allows room for traditional uses of macroeconomic policies to increase absorption (aggregate demand) relative to income.

Macroeconomic policies, which involve monetary and fiscal policies, are traditionally used to influence aggregate demand in the economy aiming at achieving economic objectives of price stability, full employment, and economic growth. According to conventional wisdom, an expansionary policy can pull the economy out of recession by stimulating aggregate demand, while a contractionary policy is intended to slow an overheating economy by reducing aggregate demand. Although fiscal and monetary policies are considered to be able to have an influence on

aggregate demand adjustment, the distinction between policy instruments and transmission mechanisms may cause different outcomes in an open world economy where international trade and financial flows can move across countries.

On the one hand, a monetary expansion, which is typically associated with an increase in money supply also a decrease in interest rates, affects the components of aggregate demand by means of cutting the policy rate that is transmitted to a decrease in market interest rates (Figure 3.3). Since the rate of interest is costs of holding and borrowing money, a change in interest rates directly affects the level of domestic consumption and investment in the economy. First, the decline in interest rates as a disincentive to savings tends to boost consumption because household will save less, and then consume more in the current period. The decrease in interest rates also reduces costs of borrowing for spending on durable goods (i.e., home appliances, furniture, and consumer electronics), and consequently creates new consumer expenditure. The monetary expansion can indirectly affect consumption as it tends to increase demand for both financial and non-financial assets that pushes up market prices. The higher prices of assets owned by household will form a perception of being wealthy, thereby generating consumption.

Second, the decrease in interest rates induced by monetary policy tends to increase investment. Because of lower costs of borrowing, firms can finance new projects with low interest loans as well as corporate bonds for their investments. It is beneficial not only to firms, but also to household because there is a good time for refinancing their existing debts. Especially, when a sufficient reduction in interest payments improves their business profitability, employment and income tend to increase, thereby inducing further consumption.

The foregoing effects on consumption and investment are likely to stimulate aggregate demand, increasing absorption relative to income. This implies that the expansionary monetary policy tends to worsen the current account. However, the stimulative effects in reducing the current account surplus could be offset by another effect which comes from nominal depreciation of exchange rates. Since the lower interest rates reduce the expected yields on financial assets denominated in domestic currency relative to those of comparable assets in other currencies, flows of capital that are seeking higher returns shift away from domestic currency and put downward pressure on the value of domestic currency, contributing to a rise in net exports.

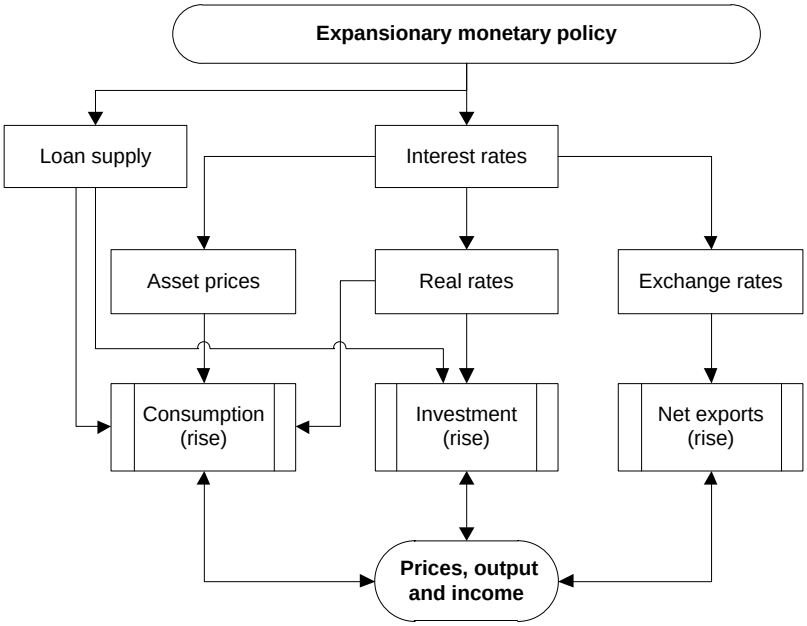


Figure 3.3 Monetary policy

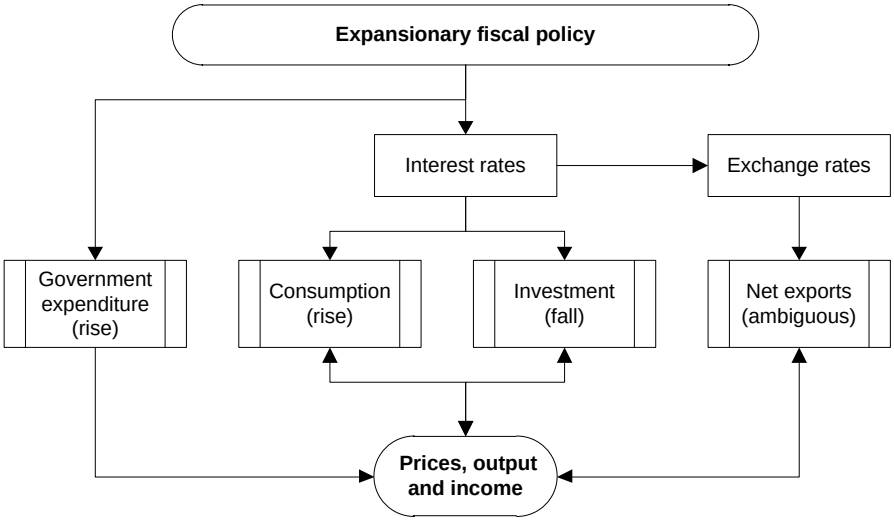


Figure 3.4 Fiscal policy

On the other hand, an expansionary fiscal policy, which is referred to as a rise in government expenditure over its revenues, impacts aggregate demand directly through an increase in government spending (Figure 3.4). As government acquisition of goods and services is usually produced domestically, the increased demand as a result of fiscal stimulus raises economic activities, investment, and consequently increases payments to factors of production and income.

In addition to its direct effect, the increased income induced by government will raise consumption although by less than the increase in income because consumer expenditure more likely depends positively on disposable income, and it is the rest of saving. The fiscal expansion also tends to increase interest rates when the government funds its increasing expenditure with borrowing (i.e., issuing of government bonds). As mentioned before, the interest rates are costs of holding and borrowing money, therefore, this higher demand for loanable funds pushing up such costs for firms and household may cause a decline in investment as well as consumption that will partially offset the stimulative impact of government spending.

Although the fiscal stimulus tends to increase absorption relative to income directly through the increase in government expenditure, the net effects on aggregate demand depend on how much firms and household are sensitive to interest rates. If they were less sensitive to interest rates compared with income in absolute terms, the expansive effects would be the dominant factor in worsening the current account; otherwise the offsetting effects would be large. Moreover, the expansionary fiscal policy could stimulate imports considerably, thereby worsening net exports if the higher the interest rates relative to abroad make domestic assets, in particular financial assets, more attractive to foreign investors causing appreciation of domestic currency.

As shown in Figure 3.5, both monetary and fiscal policy measures can affect the current account through their effects on domestic absorption and the interest rate (Johnson, 1970). In the case of expansionary policies, the effects that a monetary policy would have over absorption and exchange rates tend to cancel each other out, while those effects of a fiscal policy on absorption and exchange rates tend to support each other, so that fiscal policy is relatively effective in effort to narrow the current account surplus. However, both of them play an important role in mitigating the adverse impacts on growth as a result of exchange rate appreciation (Willenbockel, 2006; Zhang, 2006 and IMF, 2010).

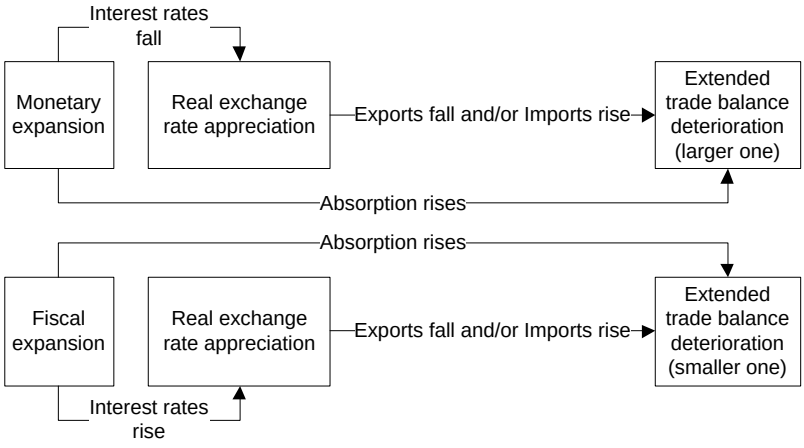


Figure 3.5 Combined effects of real exchange rate appreciation and macroeconomic policy on the trade balance

The *second* concept is based on a flying-in-unison behavior that has been driven by stylized patterns of exchange rate movements. Ma and McCauley (2008) and Sheng *et al*. (2009) observe this pattern on a group of Asian countries that their currencies have been moving in concert with each other and within a common band. Despite abandoning the de facto dollar peg regime, the movements of their exchange rates still move in the same direction.

As mentioned in Chapter 2, such behavior for Asian currencies can partly be a result of the increased intra-regional trade flows that reduce exchange rate fluctuations and the growing regional cooperative efforts that induce exchange rate synchronization. In other words, this can be seen as an informal form of monetary cooperation in which Asian currencies are loosely coordinated for maintaining the competitiveness of their exports to third markets.

Regarding a loose cooperative form, there is no guarantee that stable intra-regional exchange rates still exist when a shock (i.e., currency wars or competitive devaluation) takes place in the region although the countries may experience similar exchange rate movements.

By contrast, monetary cooperation in strict forms of a coordinated exchange rate policy, in principle, firmly provides stable exchange rates within the region and considerable support of stable and competitive extra-regional exchange rates for easing international trade and investment. Since the coordination of exchange rates is to enforce the movements of their currencies, it ensures that there is no unilateral change in the value of a participant's currency, especially devaluation, triggering contagious effects to other countries in the region.[22]

Given that real exchange rate appreciation leads to trade balance deterioration in a particular country, the impact may be not worse as much on the trade balance in this regard because the common foreign exchange-related policy does not affect bilateral competitiveness, and has less impact on their overall competition (Figure 3.6). Consequently, the adverse impact on growth is also small. In addition, the concerted appreciation, namely regional coordinated realignment (co-realignment hereafter) of real exchange rates, tends to make overall exports of goods and services less attractive to their major export markets, hence improves the trade balance abroad through falling foreign demand for imports.

[22] To the extent, devaluation of one currency within the region increases expectations of devaluation of other currencies in the region to foreign investors, causing sudden stops of capital inflows and outflows and the spreading of a financial crisis in the region.

Figure 3.6 Combined effects of regional exchange rate co-realignment on the trade balance

So far, it is of great importance to recalling the research question whether the Asian region can help global current account rebalancing through their real exchange rate appreciation. More specifically, does the real exchange rate appreciation of a group of Asian currencies have a significant impact on reducing their own trade surplus, especially in China, and improving the US trade deficit?

As discussed in this section, the concept of demand rebalancing and coordinated exchange rate alignment, providing the ways to minimize the adverse impact on growth as a result of the real exchange rate appreciation, may help uplift willingness of Asian countries to allow their currencies to appreciate. In dealing with global rebalancing, it is valuable to consider on the impacts not only within Asian countries, but also in world's major leading economies (G-3), including the US, Europe, and Japan. Accordingly, to address the research question, the following 2 hypotheses are made under the concepts discussed earlier.

Hypothesis I: Asian exchange rate co-realignment is superior to unilateral exchange rate appreciation for the individual participating countries.

H_0: its own trade balance $_{\text{co-realignment}} \leq$ its own trade balance $_{\text{unilateral appreciation}}$
H_1: its own trade balance $_{\text{co-realignment}} >$ its own trade balance $_{\text{unilateral appreciation}}$

The first hypothesis testifies whether the regional co-realignment of real exchange rates in Asia is better than unilateral appreciation in terms of minimizing the negative impact on the trade balance. If each participant's trade balance in case of the co-realignment (objective 3 in Figure 3.7) is greater than that in case of unilateral appreciation (objective 1 in Figure 3.7), then cooperation is superior to non-cooperation for a particular country. It is worth noting that this hypothesis aims to testify the willingness to coordinate the real exchange rate, does not intentionally find what countries should be engaged in such cooperation.

Hypothesis II: Asian exchange rate co-realignment is superior to Chinese yuan appreciation for the individual G-3 economies, in particular the US.

H_0: G-3 trade balance $_{\text{co-realignment}} \leq$ G-3 trade balance $_{\text{yuan appreciation}}$
H_1: G-3 trade balance $_{\text{co-realignment}} >$ G-3 trade balance $_{\text{yuan appreciation}}$

The second hypothesis, fulfilling the first one to form a group of exchange rate coordination, testifies whether the Asian co-realignment is better than the sole

appreciation of Chinese yuan in terms of reducing the US trade deficit. For example, if US trade balance in case of the co-realignment (objective 3 in Figure 3.7) is greater than that in case of yuan appreciation (objective 2 in Figure 3.7), then Asian cooperation (co-realignment) is superior to non-cooperation (yuan appreciation) as it brings larger trade balance improvement for the US. In addition, yuan appreciation with macroeconomic policy is also testified by this hypothesis. The research framework as a whole is summarized and illustrated with a diagram in Figure 3.7.

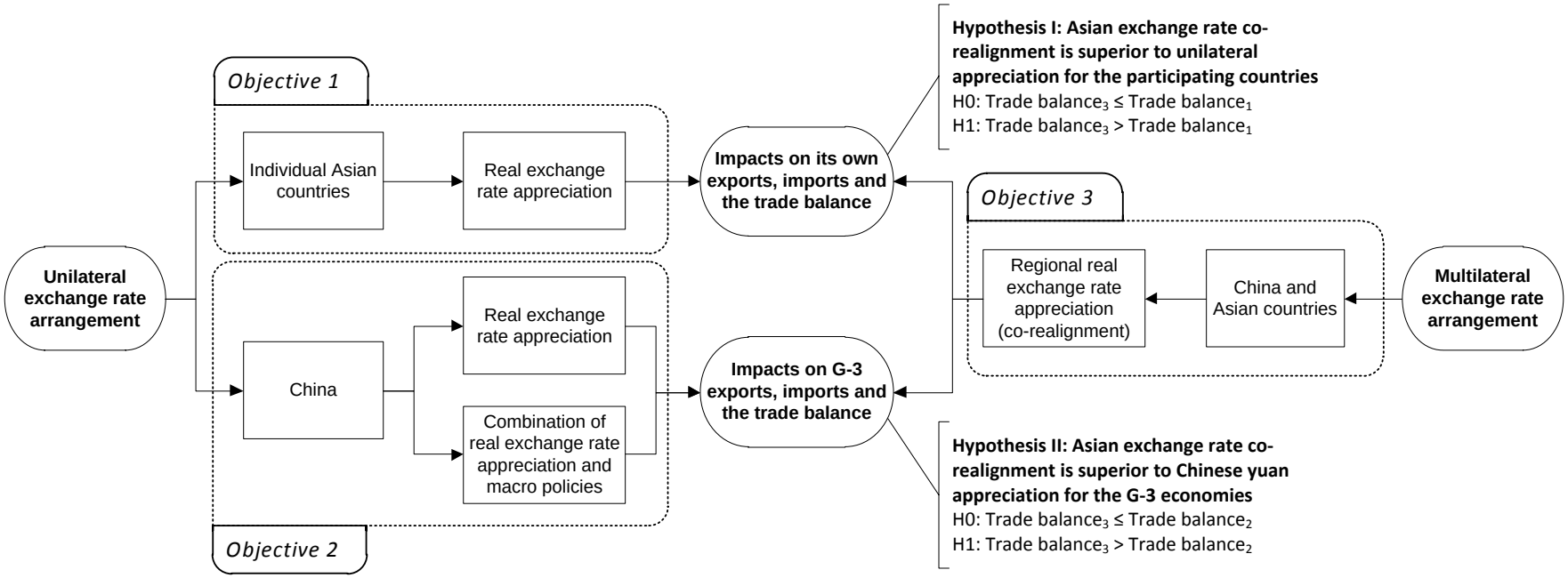


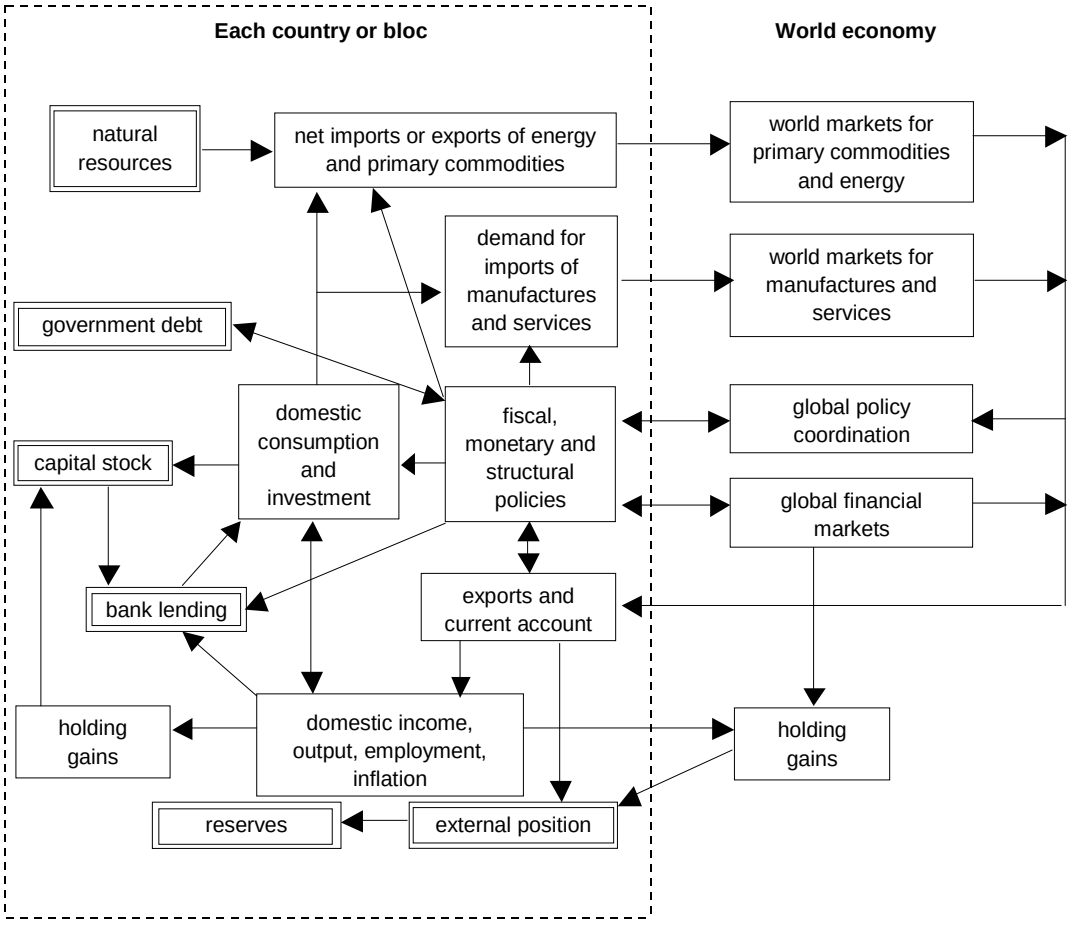
Figure 3.7 Research framework

CHAPTER IV

METHODOLOGY

4.1 A World Economy Model: the CAM

The CAM originated from works, associated with Cripps and Godley, at the Cambridge University Department of Applied Economics in the late 1970s (Izurieta and Singh, 2010: 115-142). Over the past decades, it has been revised and developed progressively by Alphametrics Co., Ltd. as a tool for investigation of global policy issues. The model is designed for assessing implications and their impacts of alternative patterns of policies on countries or country groups within the world economy through exploration of historical data, construction and modification of variables and equations of the model, and then study of simulations of policies and outcomes over medium- and long-term timescales. By using a flexible system of geographical aggregation, the entire world can readily be divided into a number of blocs in which the grouping of countries is pre-specified by purpose.



Source: UN-DESA (2010)

Figure 4.1 Economic structure and global linkages in the CAM

As illustrated in Figure 4.1, the diagram shows interactions between sectors embedded in the CAM structure where policies, including fiscal, monetary, exchange rate, trade and industrial policies, are modeled for all sectors. With a national accounting framework, stock/flow dynamics and other adjustment processes representing private and government sectors, it can be sure that income and expenditure, financial flows, holding gains and assets values are consistent for all blocs as well as for the world as a whole.

Each bloc connects with the rest of the world via the current account while global financial markets match flows of the current account with the capital account and reserves, and determine the valuation of external positions. In the model, the current account and external positions are affected by real exchange rates and international prices. Also, their variations, in turn, have a feedback on domestic spending decisions through the exchange rates and prices (Cripps, Izurieta and Singh, 2011: 228-261).

World markets for manufactures are represented bilaterally in which a demand-driven market with supply-determined prices is assumed. Bilateral market shares for manufactured exports are affected by movements of relative costs of production in different blocs. Such a change in market shares reflects outcomes of competition between international firms and their strategies for locating and sourcing supply. Meanwhile, the world markets for primary commodities, energy products, and services are unified separately. Beside the real exchange rate, fluctuations in world prices have influences on these markets. Movements of the world price of primary commodities are modeled by a demand equation, whereas the world price of oil is solved endogenously in each year so as to bring supply and demand for exports of primary energy into equilibrium.

4.2 Estimation

Since the CAM views the world economy as an integrated system in which the characteristic of each bloc is different due to its specific situations in terms of geography, level of development, financial positions and so on, the model adopts a common set of behavioral equations and identities for all blocs representing that they are part of the same world economy. For this reason, structural parameters are also assumed uniformity across blocs and time leaving the differences explained by intercept terms and by patterns and variances of residuals. Accordingly, dynamic panel estimation with fixed effects and one degree of autocorrelation is mainly employed to estimate behavioral equations in current version. The general specification applied to almost behavioral equations is based on the following reformulation of the autoregressive distributed lag model (*ADL(1,1,…,1)*):

$$\Delta y_{i,t} = \alpha_i + \beta y_{i,t-1} + \gamma \Delta x_{i,t} + \theta x_{i,t-1} + \varepsilon_{i,t}$$

where $\Delta y_{i,t}, \Delta x_{i,t}$ represent the current change in behavioral variables and the current changes in cointegrated explanatory variables of bloc i at time t, respectively. An error correction term is denoted by $y_{i,t-1}$ and comes with coefficient β measured the speed of adjustments of the corresponding behavioral variable. The coefficient γ measures the short-run influence of (weakly) explanatory variables. The θ contains information about their long-run impact to the extent that θ/β measures the long-run response of the behavioral variable to such an explanatory variable. The α_i captures time-invariant bloc-specific differences (fixed effects), which allow permanent differences in the long-run relationship between the behavioral and explanatory variables in each bloc. The $\varepsilon_{i,t}$ is assumed serially uncorrelated random disturbance term with zero mean.

4.3 Key Equations of the CAM

This section makes a brief sketch of the key equations in the CAM that is sufficient to determine income and output in the economy as well as to study impacts on the trade balance and current account triggered by fiscal, monetary, and exchange rate policies. The symbols α_b and ε_b denote bloc-specific fixed terms and stochastic errors and Φ denotes the structural parameters corresponding to β, γ, and θ in the previous section.[23]

4.3.1 Income and expenditure

Private sectors: Private disposable income ($Y_p = Y - Y_g$) is defined as national income not absorbed by the government while private expenditure behavior is defined by 3 main relations, consisting of private savings, investment, and inventory adjustment in Box 4.1. Private consumption ($C = Y_p - S_p$) is resolved in the model by the savings function. The rate of savings (S_p) is moderately path-dependent and follows a schedule that targets an optimal wealth to income ratio (4.1). The first term on the right-hand side of the equation specifies a correction along the path-dependent pattern. The second term introduces a short-term lag in the response of consumption to changes in real income (Y_p) and the third term captures the adjustment to changes in wealth (W_p). A variation in wealth is the result either of savings or of price changes (holding gains). In addition, inflation (*spvi*)[24] and the lagged real interest rate (*irs*) have their own effects on savings.

[23] For simplicity, the same symbols are used in all equations.

[24] *spvi*, whose value ranges from 0 to 1 as inflation increases from lower rates to higher rates, is an index of inflation impact serving as a proxy for inflation itself in mitigating a dominant effect of extremely high rates of inflation in some countries belonging to the same bloc.

Private investment (I_p) follows a standard accelerator pattern responding to the rate of growth of GDP (V), with some degree of path-dependency (4.2). Also, investment is influenced by financial conditions such as the rate of bank lending (ILN), and the long-term interest rate, represented by the real bond rate (irm). Inventory adjustment (IV) shows an accelerator response similar to the investment equation with the short-term interest rate, replacing the bond rate (4.3).

Box 4.1 Private sectors

$$\Delta \frac{Sp}{Yp_{-1}} = \Phi \left\{ \frac{\overset{(-)}{Sp_{-1}}}{Yp_{-2}}, \frac{\overset{(+)}{\Delta Yp}}{Yp_{-1}}, \frac{\overset{(-)}{\Delta Wp_{-1}}}{Wp_{-2}}, \overset{(+)}{spvi}, \overset{(+)}{irs_{-1}}, \alpha_b, \varepsilon_b \right\} \tag{4.1}$$

$$\Delta \log \frac{Ip}{V_{-1}} = \Phi \left\{ \log \frac{\overset{(-)}{Ip_{-1}}}{V_{-2}}, \Delta \overset{(+)}{\log} V, \frac{\overset{(+)}{ILN_{-1}}}{V_{-1}}, \overset{(-)}{irm}, \alpha_b, \varepsilon_b \right\} \tag{4.2}$$

$$\Delta \frac{IV}{V_{-1}} = \Phi \left\{ \frac{\overset{(-)}{IV_{-1}}}{V_{-2}}, \Delta \overset{(+)}{\log} V, \frac{\overset{(+)}{ILN_{-1}}}{V_{-1}}, \Delta \frac{\overset{(+)}{ILN}}{V_{-1}}, \overset{(-)}{irs}, \alpha_b, \varepsilon_b \right\} \tag{4.3}$$

Government: The government is assumed to follow the behavioral equations illustrated in Box 4.2. Net savings or net lending of government represents the difference between net revenue (taxes less subsidies, transfers and debt interest) and spending on goods and services. Government income (Y_g) is moderately path dependent, which is captured by the first term, and follows the growth of gross national income with some lag (4.4). The inherited stock of government debt (L_g) typically calls for increased efforts to raise taxation, while interest on accumulated debt will erode government receipts. Government expenditure (G) on goods and services is strongly path dependent and responds to the level and rate of change of government income (4.5). Further, the spending tends to rise with population (N) and is adjusted in response to the inherited debt burden and the external balance ($CA\$$) as a ratio to GDP.

Box 4.2 Government

$$\frac{\Delta Yg}{Y_{-1}} = \Phi \left\{ \frac{\overset{(-)}{Yg_{-1}}}{Y_{-1}}, \frac{\overset{(+)}{\Delta Y}}{Y_{-1}}, \frac{\overset{(+)}{\Delta Y_{-1}}}{Y_{-1}}, \frac{\overset{(-)}{Lg_{-1}}}{Y_{-1}}, irm_{-1} \cdot \frac{\overset{(-)}{Lg_{-1}}}{Y_{-1}}, \alpha_b, \varepsilon_b \right\} \tag{4.4}$$

$$\Delta \log G = \Phi \left\{ \overset{(-)}{\log G_{-1}}, \Delta \overset{(+)}{\log} Yg, \frac{\overset{(+)}{Yg_{-1}}}{Y_{-1}}, \overset{(+)}{\log N_{-1}}, \log \frac{\overset{(-)}{Lg_{-1}}}{Y_{-1}}, \frac{\overset{(+)}{CA\$_{-1}}}{Y\$_{-1}}, \alpha_b, \varepsilon_b \right\} \tag{4.5}$$

4.3.2 Current account

Trade in primary commodities: The market for primary commodities functions as a price-clearing pool with some friction resulting in partial quantity adjustment.

Given world prices and domestic demand, bloc equations determine net exports or imports. Exports of each bloc are scaled to ensure that world exports will be equal to world imports and the world price responds to growth of world imports. These functions are conducted through the following behavioral equations in Box 4.3.

Box 4.3 Trade in primary commodities

$$\frac{\Delta BA_0}{V_{-1}} = \Phi\left\{\Delta\left(\overset{(+)}{lpa}\right), \left(\overset{(+)}{lpa_{-1}}\right), \frac{\overset{(-)}{\Delta V}}{V_{-1}}, \alpha_b, \varepsilon_b\right\} \tag{4.6}$$

$$\frac{\Delta XA_0}{V_{-1}} = \Phi\left\{\frac{\Delta\left(\max\left\{\overset{(+)}{BA_0}, 0\right\}\right)}{V_{-1}}, \alpha_b, \varepsilon_b\right\} \tag{4.7}$$

$$\Delta \log \frac{MA\$}{MA_0} = \Phi\left\{\Delta \log\left(\overset{(+)}{paw}\right), \Delta \log\left(\overset{(+)}{rx / pp_0}\right), \alpha_b, \varepsilon_b\right\} \tag{4.8}$$

$$\Delta \log \frac{XA\$}{XA_0} = \Phi\left\{\Delta \log\left(\overset{(+)}{paw}\right), \Delta \log\left(\overset{(+)}{rx / pp_0}\right), \alpha_b, \varepsilon_b\right\} \tag{4.9}$$

Because domestic demand for food and raw materials increases with GDP, net exports of primary products at the base year prices (*BA0*), expressed as a ratio to lagged GDP, tends to increase with a rise in world prices ($lpa = \lambda log(paw)+(1-\lambda)log(paw_{-1})$), and diminish with a faster increase in GDP (4.6). The export volume of primary commodities at base year prices (*XA0*) relies primarily on the net export surplus (4.7), while the import volume (*MA0 = XA0 - BA0*) follows as a balancing item. Given the import volume, the value of primary commodity imports (*MA$*), measured in international purchasing power, is a function of prices (4.8). The import value relative to its volume responds positively to world prices of primary commodities (*paw*), and the real exchange rate (*rx*). Similar to imports, the value of primary commodity exports (*XA$*) follows in the same manner (4.9).

Trade in energy products: A world pool for traded energy products is cleared by movements of the world price of oil. Energy production, demand, and trade flows are determined in physical terms as described by equations in Box 4.4. On the production side, growth of energy production (*EP*) is considerably driven by growth of domestic demand for energy (4.10), and also is influenced by a constructed moving lagged real price of oil ($lpep = \lambda log(pew)+(1-\lambda)log(pew-1)$). Differences in resources and market access are reflected in bloc-specific intercepts.

On the demand side, demand for energy (*ED*) relative to population is obviously path dependent (4.11). In the short run, growth of GDP per capita (*V/N*), the terms of trade (tt), total export volume (X0), and another constructed moving lagged real price of oil ($lped = \delta log(pew)+(1-\delta)log(pew-1)$) are considered to play crucial

roles in the cause of variations in energy demanded. In the long run, the energy absorption is expected to be positively related to inventory adjustment and the level of income per capita relative to the world average (Y_r).

Box 4.4 Energy trade

$$\Delta \log EP = \Phi\left\{\Delta \log(ED)\cdot \min\left\{\frac{ED_{-1}}{EP_{-1}},1\right\}, \log\overset{(+)}{(lpep)}, \alpha_b, \varepsilon_b\right\} \quad (4.10)$$

$$\Delta \log \frac{ED}{N} = \Phi\left\{\log\frac{\overset{(-)}{ED_{-1}}}{N_{-1}}, \Delta \log\frac{\overset{(+)}{V}}{N}, \Delta \log\overset{(-)}{(lped)}, \Delta \log\overset{(+)}{(tt)}, \Delta \log\overset{(+)}{(X_0)}, \frac{\overset{(+)}{IV}}{V_{-1}}, \log\overset{(+)}{(1+Yr_{-1})}, \alpha_b, \varepsilon_b\right\} \quad (4.11)$$

$$\Delta \log EM' = \Phi\left\{\log\overset{(-)}{(EM')}, \Delta \log\overset{(+)}{(EPW)}, \alpha_b, \varepsilon_b\right\} \quad (4.12)$$

Trade in energy products required to fill the gap between domestic demand and supply is modeled by an import function leaving exports as a balancing item (*EX = EP - ED + EM'*). The imports of energy products (*EM'*) tend to increase with growth of world energy production (*EPW*), and are clearly path dependent (4.12). At the same time, the world price of oil (*pew*) is solved endogenously to find the value equalizing total world supply and demand for energy or equivalently, total imports and exports, in tons of oil equivalent. Auxiliary equations then convert imports and exports in tons of oil equivalent into imports and exports measured at base-year dollar prices (*ME0* and *XE0*). Consequently, the world oil price is used to determined values of imports and exports (*ME$* and *XE$*) in international purchasing power terms.

Trade in manufactures: The international market for manufactured goods is modeled on a bilateral basis that is somewhat different and more complex that other markets with a pool basis. Imports respond to activity, prices, the real exchange rate, and the price being calculated as a weighted average of export prices of suppliers. Exports are driven by market shares, and respond to relative unit costs, calculated as a weighted average of domestic costs and costs of imports of primary commodities, energy, and services as well as manufactures. Domestic inflation, which enters the unit cost calculation, is influenced by the output gap. Market shares estimated on a bilateral basis are dynamic and strongly path dependent. The core equations are shown in Box 4.5.

Imports of manufactures measured in international purchasing power terms (*MM$*) respond to a weighted sum of final expenditure components (*MH$*) that attributes relatively high import intensity to investment, inventory, and exports of manufactures (*XM$*), and relatively low import intensity to government spending on goods and services (4.13). Since *MH$* is denominated in terms of international purchasing power, it correlates strongly with the real exchange rate. Changes in the

real exchange rate are expected to have a negative sign, partially offsetting the positive effect on domestic purchasing power *MH$* in the short run. The weighted-average supplier price (*ppm0*) tends to have a negative long-run influence.

Given the value of manufactured imports, the import volume of manufactures (*MM0*) is path dependent, with a short-run influence of the supplier price and the real exchange rate to capture delays in passing through of their effects (4.14). Eventually, the volume of imports is scaled up or down to ensure the world total matches export volumes.

Box 4.5 Trade in manufactures

$$\Delta \log MM\$ = \Phi\left\{\log \overset{(-)}{MM\$_{-1}}, \Delta \log \overset{(+)}{MH\$}, \log\left(\overset{(+)}{MH\$_{-1}}\right), \Delta \log\left(\overset{(-)}{rx}\right), \log\left(\overset{(+)}{rx_{-1}}\right), \log\left(\overset{(-)}{pmm_{0_{-1}}}\right), \alpha_b, \varepsilon_b\right\} \quad (4.13)$$

where $MH\$ = rx \cdot \left(C + 0.4 \cdot G + 2 \cdot \left(IP + IV\right)\right) + X\$ + 2 \cdot XM\$$ based on input-output tables.

$$\Delta \log \frac{pmm_0 \cdot MM_0}{MM\$} = \Phi\left\{\log \frac{\overset{(-)}{pmm_{0_{-1}}} \cdot MM_{0_{-1}}}{MM\$_{-1}}, \Delta \log\left(\overset{(+)}{pmm_0}\right), \Delta \log\left(\overset{(-)}{rx}\right), \alpha_b, \varepsilon_b\right\} \quad (4.14)$$

$$\Delta \log\left(sxm\right) = \Phi\left\{\log\left(\overset{(-)}{sxm_{-1}}\right), \log\left(\overset{(-)}{ucx\$_{-1}}\right), \Delta \log\left(\overset{(-)}{ucx\$_{-1}}\right), \alpha_b, \varepsilon_b\right\} \quad (4.15)$$

$$\Delta \log \frac{XM_0}{XM\$} = \Phi\left\{\log \frac{\overset{(-)}{XM_{0_{-1}}}}{XM\$_{-1}}, \log\left(\overset{(-)}{ucx\$_{-1}}\right), \alpha_b, \varepsilon_b\right\} \quad (4.16)$$

Market shares of each supplier in each import market (*sxm*) are path dependent with negative short- and long-run impacts from unit costs (*ucx*). The shares predicted by the equation 4.15 are estimated for each supplier that exports to each importing market, and then are scaled to sum to 1, transforming the result into an Armington-style constant-elasticity function in which market shares depend on trade-weighted relative unit costs of the different suppliers. In this case, intercepts and error terms are bilateral and the intercepts differ substantially as would be expected given size, geographical, and cultural relationships between different groups of countries. Given market shares, the value of manufactured exports of each supplier (*XM$*) is the sum of the product of the supplier's market share and the import value in each market as follows: $XM\$_t^i = \sum_{j=1}^{n}\left(sxm_{j,t}^i \cdot MM\$_t^j\right)$ where *i* stands for exporter, j stands for importing market at time *t*.

The volume of export of manufactures (*XM0*) given the export value is influenced by unit costs (4.16). This reflects that changes in unit costs only gradually passed through; however, the pass-through effect is likely to be incomplete even in the long run due to the oligopolistic nature of industrial international markets.

Trade in services: The international market for services as another pool market is modeled by the behavioral equations in Box 4.6. Net exports of services measured in international purchasing power (*BS$*) is dependent on service requirement of the merchandise trade in primary commodities (*BA$*), energy products (*BE$*), and manufactures (*BM$*) and the real exchange rate (4.17). The import value of services (*MS$*) depends on the net service exports, the merchandise imports, and the real exchange rate (4.18), leaving export value to be calculated as the balancing item (*XS$ = BS$ - MS$*). Global service trade is balanced by scaling exports to ensure that the world total exports equal world imports. Import and export volumes of service at base year dollar prices (*MS0* and *XS0*) are path dependent, with short-run influence of the real exchange rate (4.19 and 4.20).

Box 4.6 Trade in services

$$\frac{\Delta BS\$}{V_{-1}} = \Phi\left\{\overset{(-)}{\Delta\log(rx)}, \frac{\overset{(+)}{\Delta BA\$}}{V_{-1}}, \frac{\overset{(-)}{\Delta BE\$}}{V_{-1}}, \frac{\overset{(+)}{\Delta BM\$}}{V_{-1}}, \alpha_b, \varepsilon_b\right\} \tag{4.17}$$

$$\frac{\Delta MS\$}{V_{-1}} = \Phi\left\{\overset{(+)}{\Delta\log(rx)}, \frac{\Delta\min\left\{\overset{(+)}{0}, BS\$\right\}}{V_{-1}}, \frac{\overset{(-)}{\Delta MA\$}}{V_{-1}}, \frac{\overset{(+)}{\Delta XE\$}}{V_{-1}}, \frac{\overset{(-)}{\Delta MM\$}}{V_{-1}}, \alpha_b, \varepsilon_b\right\} \tag{4.18}$$

$$\Delta\log\frac{MS_0}{MS\$} = \Phi\left\{\overset{(-)}{\log\frac{MS_0}{MS\$}}, \overset{(-)}{\Delta\log(rx)}, \alpha_b, \varepsilon_b\right\} \tag{4.19}$$

$$\Delta\log\frac{XS_0}{XS\$} = \Phi\left\{\overset{(-)}{\log\frac{XS_0}{XS\$}}, \overset{(-)}{\Delta\log(rx)}, \alpha_b, \varepsilon_b\right\} \tag{4.20}$$

External income and transfers: Beside trade account, income and transfers account in which interest payments, dividends, and foreign aids are recorded is another component of current account. The main equation for taking this component into consideration is shown in Box 4.7. Net income and transfers (*BIT$*), which is the difference between income and transfers receipted from abroad and of those paid abroad adjusts to the net external position (*NX$*), and is modestly path dependent (4.21). Interest income derived from multiplying the inherited net external position by the interest rate of US bonds (im_{US}) is assumed to have long-run influence on the net income and transfers because foreign exchange reserves are typically composed of US dollar in the forms of US government bonds.

Box 4.7 External income and transfers

$$\frac{\Delta BIT\$}{Y\$_{-1}} = \Phi\left\{\frac{\overset{(-)}{BIT\$_{-1}}}{Y\$_{-1}}, im_{US}\cdot\frac{\overset{(+)}{NX\$_{-1}}}{Y\$_{-1}}, \frac{\overset{(+)}{\Delta NX\$}}{Y\$_{-1}}, \alpha_b, \varepsilon_b\right\} \tag{4.21}$$

So far, the specification of exports and imports in terms of value and volume and flows of external income and transfers completes modeling of the trade balance and current account. Together with the modules covering government and private income and expenditure and standard national accounting identities, these equations are sufficient to determine GDP (output), the terms of trade, and gross national income.

4.3.3 Interest rates, inflation, and the real exchange rate

Interest rates: There are 2 types of interest rates in the CAM. First, the short-term interest rate is defined as the policy rate for monetary policy. Second, the long-term interest, which is defined as the bond rate, is mainly influenced by market conditions and expectations. Both of them are expressed by behavioral equations in Box 4.8.

Box 4.8 Interest rates

$$\Delta \log(is) = \Phi\left\{ \log(is_{-1})^{(-)}, \log(pi_{-1})^{(+)}, \Delta \log(pi)^{(+)}, \log \frac{V}{VT}^{(+)}, \alpha_b, \varepsilon_b \right\} \tag{4.22}$$

where $VT = (1+\sigma) \cdot \text{mavg}(V, 6) \cdot e^{\left\{\delta \cdot \log \frac{V}{V_{-6}}\right\}}$

$$\log(im) = \Phi\left\{ \log(is_{-1})^{(+)}, \Delta \log(is)^{(+)}, \log(pi_{-1})^{(+)}, \Delta \log(pi)^{(+)}, \alpha_b, \varepsilon_b \right\} \tag{4.23}$$

The policy rate (*is*) follows a Taylor-type rule that features interest rate smoothing and responds to domestic inflation (*pi*) and capacity utilization (*V/VT*), with path dependency (4.22), while the bond rate (*im*) strongly responds to the level and rate of change of the policy rate and inflation (4.23). The potential capacity (*VT*) comes from an extrapolation of GDP growth over the past 6 years that determines the typical level of productive potential as a function of the growth rate.

Inflation: The domestic price inflation (*pi*), measured as annual changes in the domestic expenditure deflator, is determined by movements of the terms of trade and cost inflation. If the terms of trade move in a country's favor, a greater proportion of domestic costs has been passed through to export and/or import prices have reduced to the benefit of the domestic market. However, higher export prices do not by themselves reduce domestic inflation. Indeed, an increase in export prices usually implies higher costs or profits of producers which may result in higher domestic prices. The terms of trade benefit to domestic price inflation only takes effect if and when import prices fall or rise less than export prices while domestic cost (including profit) fall or remain unchanged.

In Box 4.9, domestic cost inflation (*pvi*) is modeled as a path-dependency influenced by capacity utilization, changes in the real exchange rate, and the world price of oil (4.24). An increase in the real exchange rate puts downward pressure on cost inflation by reducing prices of external goods and services in the domestic market and cutting profits of exporters and producers of import substitutes. Increases in the domestic price of oil have a pass-through effect.

Box 4.9 Cost inflation

$$\Delta \log(pvi) = \Phi\left\{ \log(pvi_{-1})^{(-)}, \Delta\frac{V}{VT}^{(+)}, \Delta \log(rx)^{(-)}, \Delta \log\frac{pew}{rx}^{(+)}, \alpha_b, \varepsilon_b \right\} \quad (4.24)$$

The real exchange rate: The real exchange rate represents either one or a combined effect of changes in domestic price level relative to external price level and changes in nominal exchange rates, themselves responding to demand and supply in markets for goods and services and international financial markets. It is particularly of concern to track the real exchange rate as a basis for understanding changes in relative prices of domestic and external goods and services (current account) and assets (capital account). Accordingly, the real exchange rate is directly estimated following the equation in Box 4.10, leaving nominal exchange rate movements to be inferred as consequences of changes in the real exchange rate and rate of inflation.

Box 4.10 Real exchange rate

$$\Delta \log(rx) = \Phi\left\{ \log(rx_{-1})^{(-)}, \frac{CA\$_{-1}}{NXI\$_{-1} + M\$_{-1}}^{(+)}, \frac{NX\$_{-1}}{rx_{-1} \cdot Y_{-1}}^{(+)}, \Delta(spvi_{-1})^{(+)}, \Delta \log(phw)^{(-)}, \alpha_b, \varepsilon_b \right\} \quad (4.25)$$

The real exchange rate (*rx*) is modest path dependency, with short-run influences of domestic inflation (*spvi*) and an acceleration in world price deflator (*phw*) as the nominal exchange rate cannot be relied upon to adjust immediately to compensate for relative inflation (4.25). Also, in the longer run, it is expected to rise (appreciate) as the current account (*CA$*), and external position (*NX$*) improve.

4.4 Data Sources and Variables

The CAM employs a historical databank as a main source of annual time-series data covering over 120 countries and country groups, in principle covering the whole world, for the period 1970 to 2008. The databank relies on various sources where trade statistics by commodity, source, and destination are obtained from United Nations (UN) Comtrade database; balance of payments, international investment positions, monetary data, and government accounts are collected from the

International Monetary Fund (IMF); national account aggregates and population are provided by UN Statistical Division; and some are from other sources such as the Organisation for Economic Co-operation and Development (OECD) and Eurostat. All datasets are compiled and rebased (2005 = 100) for being ready-to-use variables in estimation and simulation.

The real exchange rate for each bloc is defined as a ratio of domestic to international purchasing power of money converted at market exchange rate so far as it adjusts through time in response to either one or a combination of the following factors: (i) changes in the nominal exchange rate against the dollar, (ii) inflation of the price of domestic expenditure, and (iii) inflation of the price of world expenditure aggregated over all blocs. That is, an increase in values of the rate indicates real exchange rate appreciation against world's currencies.

Since international trade transactions in the CAM are broken down into 4 groups[25]: (i) primary commodities, (ii) energy products, (iii) manufactures, and (iv) services, exports for each bloc consist of transactions in such goods and services from a domestic bloc to the rest of the world, and imports are those from the rest to that bloc. For all blocs, the volume of exports and imports measured at base-year dollar prices and market exchange rates is denoted by suffix 0, while the value of exports and imports in terms of current dollar prices is transformed into the corresponding value in global purchasing power terms, denoted by suffix $, with the reason for maintaining comparability across blocs and through time as well as ensuring the balance for the world as a whole. Accordingly, the balance of trade, defined as the difference between the export and import value, is also expressed in terms of global purchasing power. A positive balance of trade indicates a trade surplus when exports exceed imports whereas a negative balance is known as a trade deficit.

The remaining variables and identities of the full model are clearly defined in Appendix A.

4.5 Simulation Analysis

The world economy in this research consists of 20 blocs as summarized in Table 4.1. That is, the standard geographical aggregation of the CAM is modified by separating Asian countries of particular interest from the rest of Asia. China, Indonesia, India, Korea, Malaysia, Philippines, Singapore, and Thailand are taken

[25] The first three groups are defined as consisting of products falling under standard international trade classification (SITC) rev.1, while the last one is straightforward. The primary commodities include categories 0 (food and live animals), 1 (beverages and tobacco), 2 (crude materials, inedible, except fuels) and 4 (animal and vegetable oils and fats). The energy products are under category 3 (mineral fuels, lubricants and related materials). The manufactures consist of categories 5 (chemicals), 6 (manufactured goods classified chiefly by material), 7 (machinery and transport equipment), 8 (miscellaneous manufactured articles) and 9 (commodities and transactions not classified according to kind).

individually among Asian countries apart from Japan that is treated as one of world's leading economic blocs (G-3). The G-3 economies[26] are represented by the US, Europe, and Japan, while other developed economies are merged into a single bloc. The remaining blocs are based on the standard decomposition.

In the analysis, CAM-based simulations are applied to obtaining the impacts from policy implementations by comparing alternative scenarios to a baseline. Any changes in an alternative scenario will make differences between the projected datasets and those from the baseline, thereby yielding net effects of the policies.

By running the model, pooled cross-section data from 1980 to 2008 (20 blocs x 29 years) are used to estimate the structural parameters, commonly applied to all blocs, with fixed effects for individual blocs corresponding to behavioral equations. Estimated results and statistical tests for the parameters, used in the simulation exercises, are reported in Appendix B. A baseline projection is then predicted by the assumption that current patterns continue without significant policy intervention. After that, a specific (alternative) scenario is constructed on top of the baseline by imposing shocks or policy packages. Finally, the impacts on exports and imports measured in percentage (%), and those on trade balances measured in percentage points are computed through the different outcomes of the alternative scenario and the baseline.

Table 4.1 Bloc classification

Bloc	*Symbol*	*Population (millions)*	*List of countries*
China	CN	1,338	Mainland China and Macau
Indonesia	ID	228	Indonesia
India	IN	1,181	India
Korea	KR	48	South Korea
Malaysia	MY	27	Malaysia and Brunei
Philippines	PH	90	Philippines
Singapore	SG	5	Singapore
Thailand	TH	67	Thailand
USA	US	316	United States
Europe	EU	525	Albania, Austria, Belgium-Luxembourg, Bulgaria, Switzerland, Former Czechoslovakia, Germany, Denmark, Spain, Other Europe, Finland, France, United Kingdom, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Romania, Sweden, and Former Yugoslavia
Japan	JA	127	Japan

[26] In the paper, impacts on the world economy are focused on the G-3 because its share of world real GDP in 2008 was more than 60%.

Table 4.1 Bloc classification

Bloc	*Symbol*	*Population (millions)*	*List of countries*
Other developed countries	OD	96	Australia, Canada, Israel, New Zealand, Hong Kong, and Taiwan
CIS	CI	284	Former Soviet Union
West Asia	WA	273	United Arab Emirates, Bahrain, Iraq, Iran (Islamic Republic of), Jordan, Kuwait, Lebanon, Other Middle East, Oman, Saudi Arabia, Syrian Arab Republic, Turkey, and Republic of Yemen
South America	AM	383	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Paraguay, Uruguay, and Venezuela
Central America	ACX	187	Other America, Costa Rica, Cuba, Dominican Republic, Guatemala, Honduras, Haiti, Jamaica, Mexico, Nicaragua, Panama, and El Salvador
Other East Asia	EAO	193	Cambodia, North Korea, Lao PDR Myanmar, Mongolia, Other Oceania, Papua New Guinea, and Vietnam
Other South Asia	ASO	414	Afghanistan, Other South Asia, Bangladesh, Sri Lanka, Nepal, and Pakistan
North Africa	AFN	205	Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Sudan, and Tunisia
Other Africa	AFS	780	Other Africa, Africa small LDCs, Angola, Burkina Faso, Burundi, Benin, DR of the Congo, Central African Republic, Congo, Cote d'Ivoire, Cameroon, Ethiopia, Ghana, Guinea, Kenya, Liberia, Madagascar, Mali, Mauritania, Malawi, Mozambique, Niger, Nigeria, Rwanda, Sierra Leone, Senegal, Somalia, Chad, Togo, United Republic Of Tanzania, Uganda, South Africa, Zambia, and Zimbabwe

CHAPTER V

SIMULATION RESULTS

This chapter aims at answering the research question whether the Asian region can help global current account rebalancing through their exchange rate appreciation. To answer this question, firstly, effects of real exchange rate appreciation are examined in section 5.1. Secondly, section 5.2 is deliberately to examine China's impacts on global trade, in which the real appreciation of Chinese yuan in section 5.2.1 and yuan appreciation along with macroeconomic policy actions in section 5.2.2 are considered. Thirdly, global trade impacts of exchange rate co-realignment in Asia are investigated in section 5.3. Lastly, the key conclusion of this research is elaborated in section 5.4. By means of CAM-based simulations, each objective is accomplished in a similar manner.

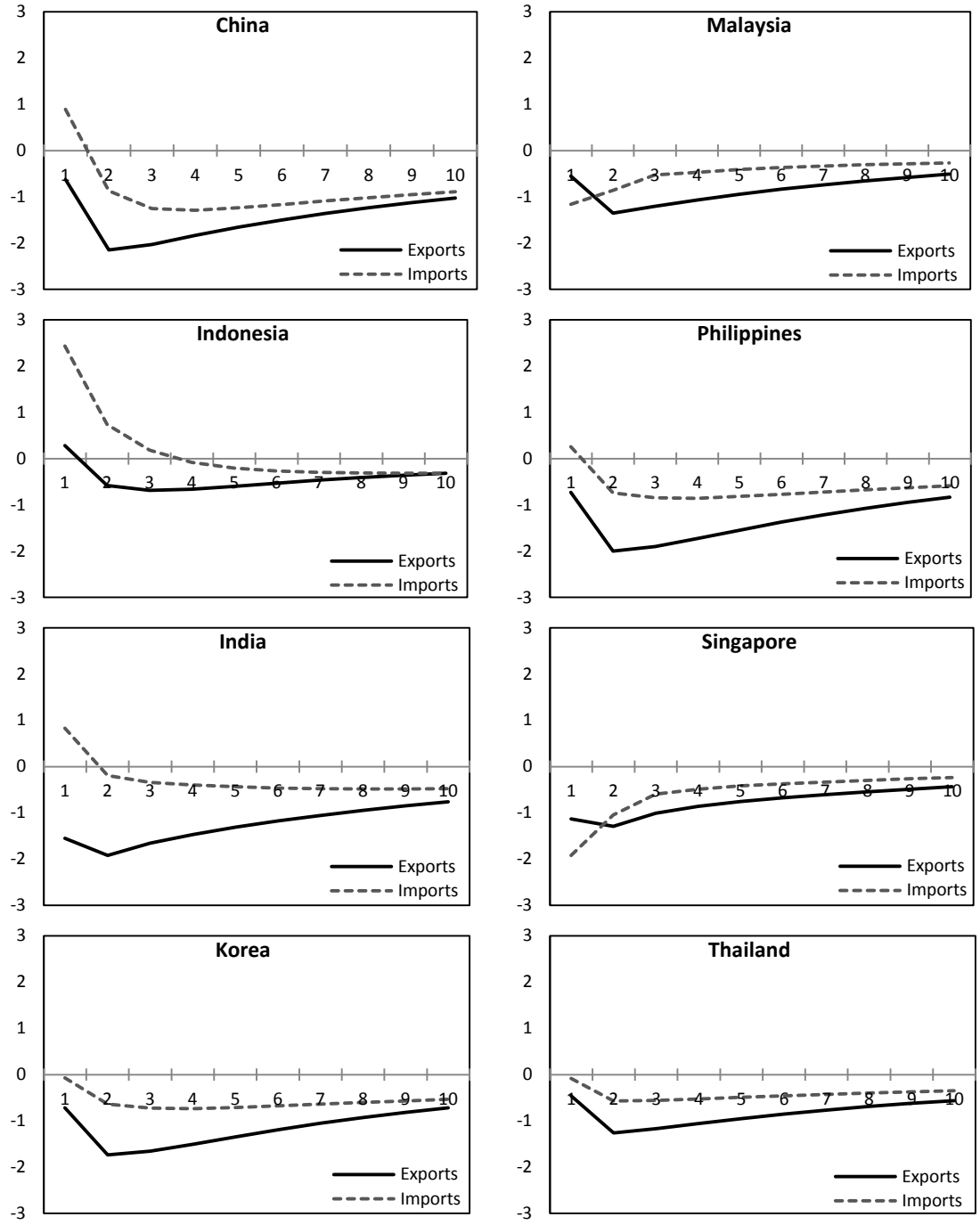
5.1 Effects of Real Exchange Rate Appreciation on Trade

According to a conventional wisdom, appreciation of real exchange rate would bring trade balance deterioration to the economy as it reduced exports and raised imports. This section examines whether the real exchange rate appreciation of the individual Asian countries, including China, Indonesia, India, Korea, Malaysia, Philippines, Singapore, and Thailand worsens its trade balance (objective 1).

It is expected that real exchange rate appreciation of individual countries should decrease their exports but increase their imports which leads to a worsening in the country's trade balance.

In doing so, an alternative scenario, based on the CAM, for each of them is conducted by imposing an exogenous shock on the error term in equation 4.25 (Box 4.10), for example, of China's real exchange rate equation, then the simulation is performed over a 10-period forecast horizon (years), and consequently deviations from the baseline values of export volumes, import volumes, and the trade balance of China are calculated. The same process is independently repeated for the remaining selected Asian countries.

For simplicity and comparability across countries, the shock imposed on each case is to cause the real exchange rate to increase by 10% from its baseline value at first period, implying that the corresponding currency has appreciated against world's currencies by 10% in real values. As a result, responses of trade flows and the trade balance to its own exchange rate shock are reported in Figures 5.1 and 5.2 respectively.



Note that the horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values (%).

Figure 5.1 Impacts of real exchange rate shock on export and import volumes by country

Figure 5.1 shows the response of volumes of total exports and imports for the selected Asia. For the period contemporaneous to the 10% appreciation of real exchange rates, exports fall by 0.63%, 1.55%, 0.72%, 0.55%, 0.73%, 1.13%, and 0.46% in China, India, Korea, Malaysia, Philippines, Singapore, and Thailand respectively, but rise 0.28% in Indonesia. That is, the export volumes negatively and immediately respond to the exchange rate appreciation in all cases, with the exception

of Indonesia where exports positively respond to. The result is somewhat straightforward and in line with expectation as the real exchange rate appreciation would reduce export competitiveness, and shifted foreign demand for goods and services away from the country that experiences exchange rate appreciation, resulting in a decline in exports.

But, in case of Indonesia, the increased exports driven by exports of primary products could be explained by income abroad. Evidence from much work concentrated on elasticity of exports and imports indicates that changes in domestic and foreign income exert greater impact on exports, imports, and the trade balance than changes in exchange rates (Zhang, 1996; Cerra and Dayal-Gulati, 1999; Ahearne, Fernald, and Loungani, 2001; Zhang and Wan, 2007). The higher the income they earn, the greater the demand for goods and services they consume as well as import. Because the appreciation of Indonesia's real exchange rate tended to reinforce income abroad, particularly countries that imported primary commodities, the volumes of Indonesia's total exports then increased to some extent.

Meanwhile, the response of import volumes varies across countries. Imports rise by about 0.89%, 2.43%, 0.83%, and 0.25% in China, Indonesia, India, and Philippines respectively, but fall by 0.07%, 1.16%, 1.92%, and 0.08% in Korea, Malaysia, Singapore, and Thailand respectively in response to the real exchange rate appreciation. The rise in import volumes for China, Indonesia, India, and Philippines is basically interpreted as the real appreciation of exchange rates would make foreign-produced goods and services less expensive relative to domestically-produced ones, and consequently shifted domestic demand toward goods and services produced abroad.

In case of Korea, Malaysia, Singapore, and Thailand where the volume of imports declines, however, it would seem that price effects induced by the exchange rate appreciation have been dominated by income effects. While the appreciation of real exchange rates that made foreign-produced goods cheaper than before tended to increase imports, it worsened net exports through discouraging exports, thereby reducing national income and demand for imports. Accordingly, the decreased imports for these countries could be a result of the decrease in income. The simulation result confirms as such, and also indicates that a sharp fall in manufactured imports mostly contributed to the decrease in total imports in Malaysia and Singapore, while a fall in imports of primary products, energy, and services tended to cancel out a marginal rise in manufactured imports in Korea and Thailand.

Although the real exchange rate appreciation may cause various outcomes of the volume of trade flows, it seems to have a similar conclusion on the trade balance as can be seen in Figure 5.2. The trade balance for China, Indonesia, India, Korea, Malaysia, Philippines, Singapore, and Thailand initially fall by 0.78, 0.50, 0.60, 0.85,

0.56, 0.87, 0.74, and 0.69 percentage points of their own GDP respectively in response to the 10% appreciation of their own real exchange rate.

This result indicates that the appreciation of individual selected Asia's real exchange rates was associated with an immediate deterioration in its own trade balance. Moreover, it is worth noting that the response of trade balances for each case has been undertaken by imposing the same magnitude on real exchange rates, so that an implication for the trade balance could be drawn from exchange rate arrangements. When the exchange rates are fixed, the appreciation of real exchange rates is mostly due to a rise in domestic price levels relative to foreign price levels. Conversely, when the exchange rates are purely flexible such appreciation is totally due to the appreciation of nominal exchange rates indeed.

As mentioned in chapter 2, there is a variety of exchange rate arrangements among these Asian countries, ranging from a crawling peg exchange rate of China to independently floating exchange rates of Korea and Philippines (IMF, 2008). In Figure 5.2, it is noticeable that Philippines and Korea are the most affected countries by the real exchange rate shock, while Indonesia and Malaysia are the least affected countries followed by India, Thailand, Singapore, and China. Therefore, the result somewhat implies that effects of the real exchange rate shock on the trade balance would be larger in the countries characterized as more floater (i.e., Korea and Philippines) than in the countries with a more rigid exchange rate arrangement.

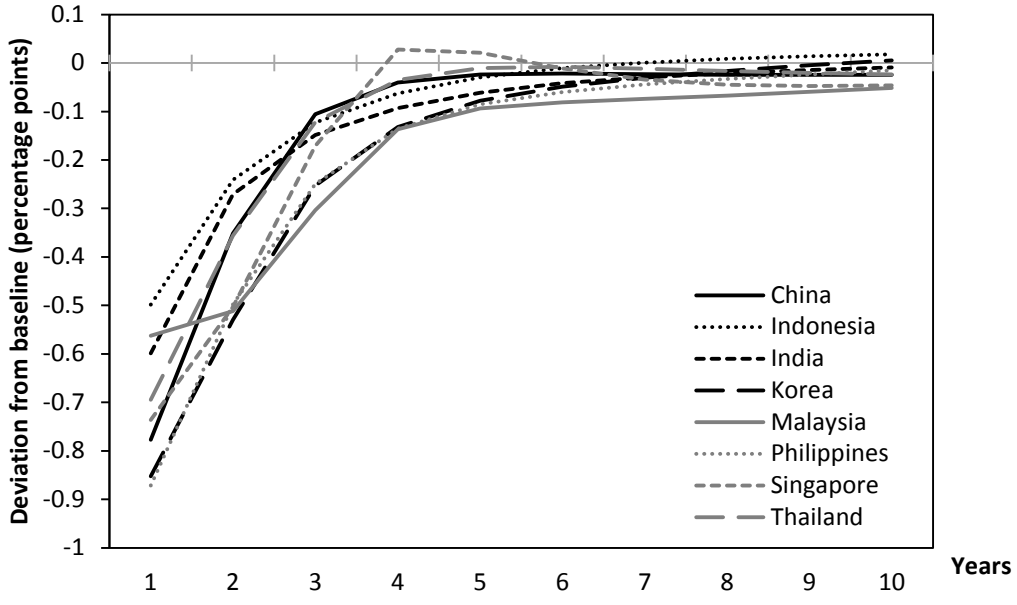


Figure 5.2 Impacts of real exchange rate shock on the trade balance by country

In short, real exchange rate appreciation tended to lead the economy to a worsening in the trade balance as expected although its effects on trade flows varied across Asian countries. While the price effects of the real appreciation substantially reduced the demand for exports of all the Asian countries, the income effects did also reduce the imports of some of the countries, namely Korea, Malaysia, Singapore, and Thailand as well. However, the reduction in import values were less than the reduction of export values, resulting in a worsening in their trade balances.

5.2 China's Impacts on Global Trade

China's exchange rate policy is one of the most controversial issues in the global economy. Due to its progressively large trade surplus with the US and excessive reserve accumulation in China, the US and other western economies have blamed China as a currency manipulator that intervenes in currency markets for the purpose of gaining unfair trade advantage, and called for more appreciation of Chinese yuan or even truly flexible regime. Geithner (2012) insists that the yuan is still undervalued although China has begun to adjust the exchange rate and its regime, and also stresses that the future appreciation of the yuan not only against the dollar, but also against other major world's currencies such as the euro and yen. Thus, this section intentionally examines impacts of China's real exchange rate appreciation against world's currencies on global trade (objective 2).

Imagine that Chinese authorities were willing to let the real exchange rate appreciate against world's currencies in order to deal with mounting international pressures on its currency. As shown in the previous section, such a real appreciation would stimulate imports and undermine exports, thereby worsening China's trade balance. However, a loss of export competitiveness due to the appreciation may also discourage employment, especially in exporting sectors, lowering aggregate demand, output and national income, and resulting in an economic slowdown in China. That is, the more the yuan appreciates, the larger the negative impact takes place on the Chinese economy. For avoiding this potential negative effect, the authorities need some expansionary policies either by fiscal or through monetary policies (Blanchard and Giavazzi, 2006; Willenbockel, 2006; and Zhang, 2006). Accordingly, the alternative 3 scenarios are constructed by imposing shocks on China as follows[27]:

1) A 10% real exchange rate appreciation
2) A 10% real exchange rate appreciation and 10% increase in government expenditure
3) A 10% real exchange rate appreciation and 1 percentage point (pp) cut in interest rate.

[27] An additional exogenous shock is imposed on the error term in equation 4.5 (Box 4.2) for China's fiscal policy shock, and in equation 4.22 (Box 4.8) for China's monetary policy shock.

Since the underlying objective behind these scenarios is to examine how the global trade responded to if such policy actions occurred in China, it is possible to take historical experience for setting the size of shocks. For simplicity, the magnitude of the real exchange rate shock is carried on with 10% as same as the previous section, while both of fiscal and monetary policy shocks are based on their annual average changes.[28] Again, the CAM simulation is separately performed by scenario, and consequently the deviations from baseline values of exports, imports, and the trade balance are calculated as the net effects for each scenario.

5.2.1 Chinese yuan appreciation

Since the total exports for the world as a whole are equal to the world total imports measured in common currency units, changes in China's trade flows, by definition, must be matched with changes in trade flows elsewhere and consequently affect their trade balance. Therefore, this sub-section intends to examine whether yuan appreciation would improve the trade balances of other economies focusing on Asian countries as well as the G-3 economies.

It is expected that yuan appreciation should improve the trade balances of both China's trading partners and trade competitors. In countries which are China's trading partners the appreciation should increase their exports and decrease their imports. In countries which are China's trade competitors the appreciation should increase their exports to the third countries and decrease the imports from China.

Figure 5.3 presents the responses of export and import volumes and the trade balance for China as well as other Asian countries and the G-3 economies to the 10% real appreciation of Chinese yuan.

In China, exports initially decline by 0.63%, and continue to fall by 2.14% after a period of the real appreciation shock, while imports immediately rise by 0.89% in response to the shock. Despite a lagged declined in exports, China's trade balance, falling by 0.78 percentage point of GDP, hits the lowest points in the period contemporaneous to the shock. An explanation is that real appreciation induced a rise in unit cost of China's exports, making export less attractive to foreign countries who imported Chinese goods and services, and thereby lowering demand for its exports. At the same time, China's imports were encouraged because the imported goods became relatively inexpensive, shifting demand toward foreign-produced goods. As a result, China's trade balance would be worse off through the real appreciation of the yuan by decreasing exports and increasing imports.

[28] Over the 1980 to 2008, Chinese government expenditure has grown by an annual average of around 10%, while the annual change of China's short-term interest rate is on average at -0.4pp. Because the average change in the interest rate is quite small, this paper decides to impose the interest rate shock by -1pp.

Among other Asian countries, exports rise by 0.03%, 0.94%, 0.41%, 0.98%, 0.55%, and 0.27% respectively in India, Korea, Malaysia, Philippines, Singapore, and Thailand for the period contemporaneous to the shock, with the exception of Indonesia that has a 0.01% decline in exports. While imports fall in Indonesia and India by 0.22% and 0.12% respectively, the import volumes rise by 0.52%, 0.48%, 0.58%, 0.62%, and 0.19% respectively in Korea, Malaysia, Philippines, Singapore, and Thailand. The result indicates that the 10% real appreciation of Chinese yuan would be beneficial to Asian countries' exports, with the exception of Indonesia and, to a lesser extent, India that experienced relatively small benefits.

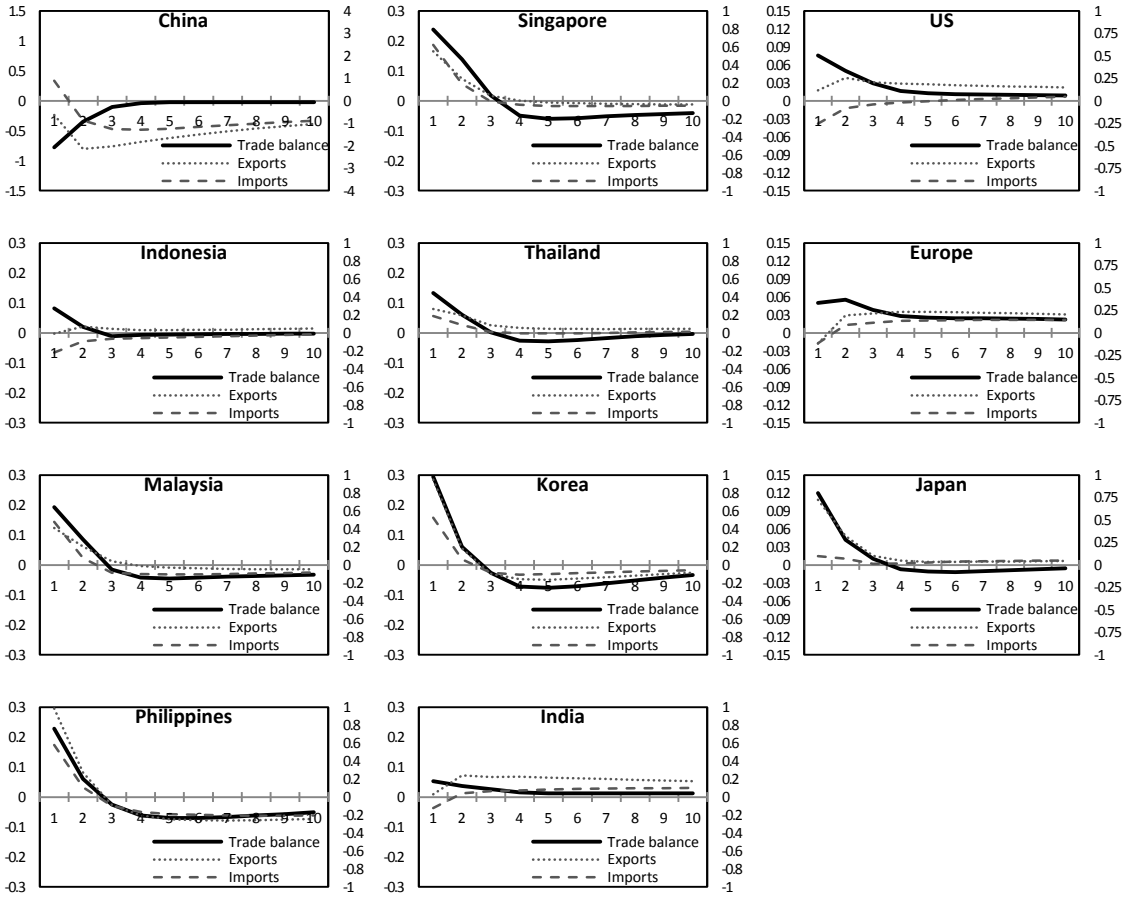
Both manufactured and service sectors seemed to highly contribute to the increase in total exports, in particular for Korea and Philippines where exports of manufactures and services rose above 1%. Due to the surge in exports of manufactures, at the same time, it would stimulate demand for imports of goods and services not only for final consumption, but also for using as inputs in manufacturing, thereby increasing the volumes of manufactured imports in Korea, Malaysia, Philippines, Singapore, and Thailand. Overall, the trade balance for all of them improves by 0.08 (Indonesia), 0.05 (India), 0.29 (Korea), 0.19 (Malaysia), 0.23 (Philippines), 0.24 (Singapore), and 0.13 (Thailand) percentage points of their own GDP.

Among the G-3 economies, the real appreciation of Chinese yuan appears to have impacts on trade flows and the trade balance as follows. US exports rise about 0.11% for the period contemporaneous to the shock, while its imports fall by 0.25%. The result indicates that the real appreciation of Chinese yuan would not only increase US exports, but also decrease US imports as expected. The impact is relatively large on imports, compared with exports because appreciation of the yuan should make Chinese goods and services less attractive to China's major importing countries like the US, rather than tended to enhance the competitiveness of US exports.

In Japan, exports and imports immediately rise by 0.72% and 0.1% respectively in response to the shock. Like many other Asian countries, the surge in Japan's exports which were mostly contributed by manufactured and service sectors tended to go to China, Korea, Malaysia, Philippines, Singapore, and Thailand where demand for imports of manufactures increased. Although the total of Japan's imports would rise in response to yuan appreciation, there was a fall in manufactured imports to some extent which distinguished Japan from other Asian countries. Since Japan as well as the US and Europe were the main markets for China's manufactured goods, the appreciation of the yuan causing the decreased China's exports should be associated with a fall in demand for imports of manufactures in these economies.

Contrary to Japan, both exports and imports in Europe fall approximately by 0.12% in response to the shock. This indicates that the real appreciation of the yuan

would decrease trade volumes of Europe in which the fact that almost 80% of total trade had been undertaken by each other within the region. Even if the share of Europe's manufactured exports was relatively small by China (only 2.6% in 2008), the export volumes expected to rise when a stronger value of the yuan occurred, rather than fall. In this case, the result of Europe's exports might be misled by the aggregate of European countries as a whole such that the increased exports to China were dominated by a larger decline in intra-regional exports.[29] However, appreciation of the yuan brings about a trade balance improvement for the G-3 economies by 0.08 (US), 0.05 (Europe)[30], and 0.12 (Japan) percentage points of their own GDP.



Note that the impacts are the result of China's real exchange rate appreciation by 10%. The horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values where the left axis belongs to the trade balance per GDP (pp) and the right axis belongs to export volumes and import volumes (%).

Figure 5.3 Impacts of the real appreciation of Chinese yuan on trade flows and the trade balance in selected economies

[29] In fact, intra-regional trade flows within Europe have slowed due to the ongoing European recession triggered by the debt crisis in late 2009.

[30] Despite an equal decline in Europe's export and import volumes, the value of imports falls faster than exports in response to yuan appreciation, resulting in trade balance improvement.

In summary, real appreciation of Chinese yuan worsened China's trade balance not only through undermining export performance, but also encouraging demand for imports. As expected, the appreciation of the yuan brought about trade balance improvement in both China's trading partners and trade competitors. In competition with China, exports from Korea, Japan, and ASEAN countries benefited from the loss of China's competitiveness. In addition, the findings confirm that the imports of China's trading partners particularly the US and Europe significantly reduced as a result of the yuan appreciation.

5.2.2 Chinese yuan appreciation with macroeconomic policy actions

As mentioned before, currency appreciation is typically unfavorable in export-dependent economy like China because a loss of export competitiveness implies higher unemployment in exporting sectors, resulting in substantial economic contraction. In this regard, China's policy of expansion, either by fiscal policy or through monetary policy is required to mitigate such adverse effects on Chinese economy. Based on absorption approach, however, expansive policy is expected to increase not only domestic demand, but also imports accelerating a reduction in China's trade surplus. Thus, this sub-section attempts to examine whether yuan appreciation combined with fiscal and monetary policies, respectively would worsen China's trade balance and improve the trade balances of other economies focusing on Asian countries as well as the G-3 economies.

It is expected that expansionary macroeconomic policy in addition to yuan appreciation should worsen China's trade balance through a decrease in exports and a sharp increase in imports. Moreover, a combination of yuan appreciation and policy expansion in China should improve the trade balances of both China's trading partners and trade competitors, for countries which are China's trading partners the combined policies should increase their exports and decrease their imports, for countries which are China's trade competitors the combined policies should increase their exports to the third countries as well as to China and decrease their imports from China.

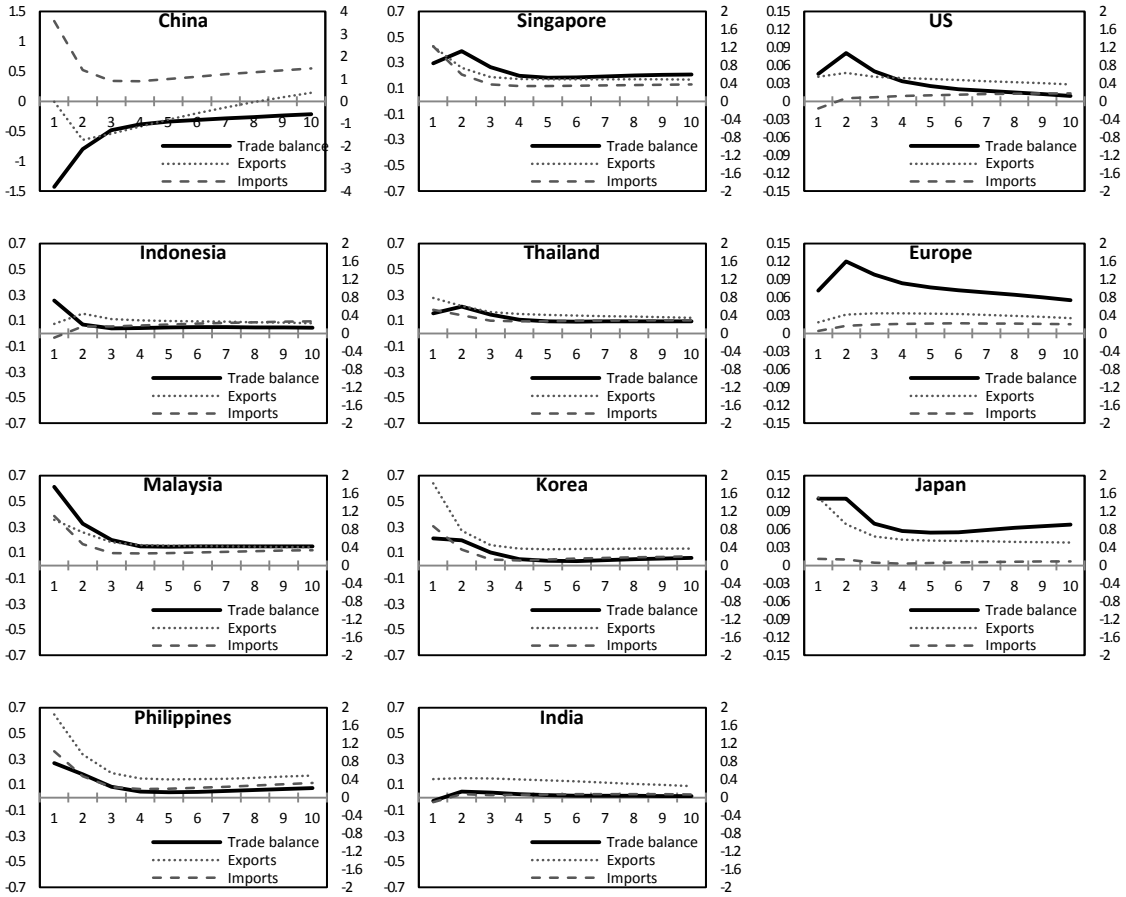
5.2.2.1 Yuan appreciation along with expansionary fiscal policy

Figure 5.4 shows the responses of export and import volumes and the trade balance for China as well as other Asian countries and the G-3 economies to a combination of the 10% real appreciation of the yuan and a 10% increase in China's government expenditure.

In China, exports fall immediately by 0.02%, and undergo a further decline by 1.72%, while imports sharply rise by 3.57% in response to the combined shock between the real exchange rate appreciation and fiscal expansion. Unsurprisingly, China's imports increased dramatically because the rise in output and national income

generated by the expansionary fiscal policy made people richer and consequently stimulated domestic consumption as well as created additional demand for imported goods and services. Such a surge in imports seems to highly contribute to China's trade balance that rapidly falls by 1.43 percentage points of GDP.

The presence of government spending does not crowd out private investment in this scenario. In other words, the joint effect fosters investment and also consumption in China through the fiscal stimulus with a decline in interest rates. This is because an upward pressure on China's interest rates induced by fiscal expansion was dominated by a deflationary pressure due to the appreciation of the yuan that pushed down interest rates. Although the declined interest rate could lead to nominal exchange rate depreciation, its effect seemed not to be large. Overall, the real appreciation of Chinese yuan accompanied by the increase in China's government expenditure would stimulate domestic demand over income resulting in a further reduction in China's trade balance in line with absorption approach.



Note that the impacts are the result of China's real exchange rate appreciation by 10% combined with an increase in China's government spending by 10%. The horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values where the left axis belongs to the trade balance per GDP (pp) and the right axis belongs to export volumes and import volumes (%).

Figure 5.4 Impacts of the real appreciation of Chinese yuan along with China's fiscal expansion on trade flows and the trade balance in selected economies

Within the Asian region, exports rise approximately by 0.21%, 0.41%, 1.83%, 1.01%, 1.85%, 1.22%, and 0.79% respectively in Indonesia, India, Korea, Malaysia, Philippines, Singapore, and Thailand for the period contemporaneous to the combined shock. Imports also rise immediately by 0.87%, 1.10%, 1.03%, 1.22%, and 0.52% respectively in Korea, Malaysia, Philippines, Singapore and Thailand, but fall about 0.09% and 0.1% respectively in Indonesia and India. The result indicates that the real appreciation of Chinese yuan accompanied by the increase in China's government spending would encourage trade volumes among Asian countries in satisfying higher demand for consumption and investment as well as imports in China. Accordingly, the trade balance in these countries improves by 0.26 (Indonesia), 0.21 (Korea), 0.61 (Malaysia), 0.27 (Philippines), 0.30 (Singapore), and 0.15 (Thailand) percentage points of their own GDP, with the exception of India where it slightly deteriorates because of price effects.

Similarly, the real appreciation of Chinese yuan combined with fiscal expansion in China brings an increase in trade flows to the G-3 economies. In the US, exports immediately rise above 0.50%, while imports still fall 0.16% in response to the combined shock. Both exports and imports in Europe, turning initially to positive, rise by 0.25% and 0.05% respectively. In line with other Asian countries, Japan's exports and imports rise considerably about 1.52% and 0.14% respectively for the period contemporaneous to the combined shock. The result implies that the increase in China's government expenditure in addition to the real appreciation of the yuan would be of benefit to G-3 exports since the fiscal stimulus gave rise to a higher domestic consumption and private investment in China and consequently expanded into imports of goods and services abroad. As a result, the corresponding trade balance in the G-3 economies improves 0.05 (US), 0.07 (Europe), and 0.11 (Japan) percentage points of their GDP.

To sum up, real appreciation of Chinese yuan along with fiscal expansion had the effects of stimulating domestic demand as well as imports leading to a considerable reduction in China's trade surplus with moderate adverse impacts on the Chinese growth. On the other hand, the increased aggregate demand in China spurred the exports of China's trading partners and trade competitors, especially Philippines, Korea, and Japan to China, resulting in improving their trade balances.

5.2.2.2 Yuan appreciation along with expansionary monetary policy

Figure 5.5 presents the responses of export and import volumes and the trade balance for China, other Asian countries and the G-3 economies to a combination of the 10% real appreciation of the yuan and a 1pp cut in China's interest rate.

In China, exports fall about 2.13% following the initial decline of 0.62%, while the import volumes rise by 0.92% in response to the real exchange rate shock

combined with the expansionary monetary policy. As such, China's trade balance approximately worsens by 0.78 percentage point of GDP in this scenario. It is noticeable that the result is very close to those resulting from yuan appreciation without policy measure as expected. This is because the expansive effect of 1pp cut in China's short-term interest rate fell partially into nominal depreciation of China's exchange rates and partially into an acceleration of domestic inflation in China, thereby offsetting its own effect on exchange rate on exchange rate adjustments in real values.

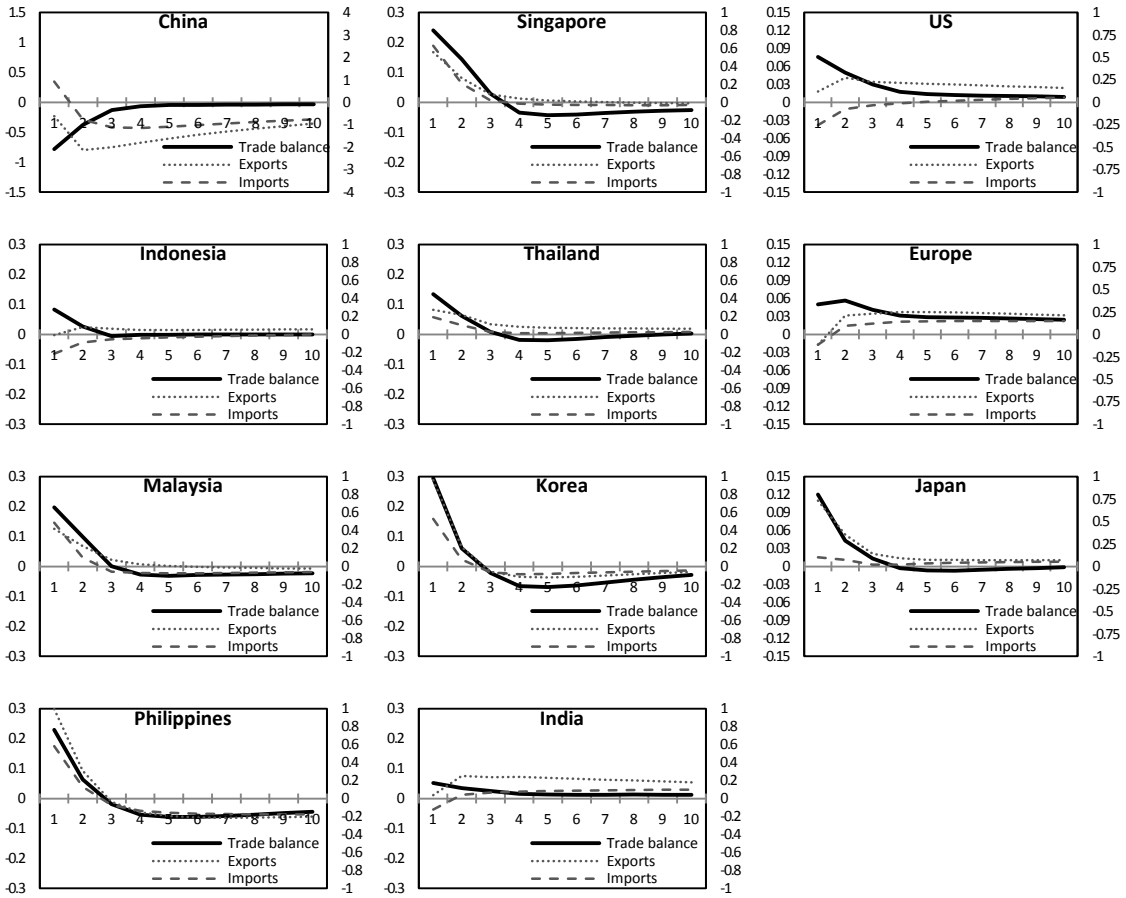
The result implies that the combined effect was supposed to be influenced solely by the adverse impact from China's real exchange rate appreciation. That is, there was relatively small impact on domestic consumption and private investment although the cut in interest rates would be expected in stimulating domestic demand. All in all, the result indicates that China's real exchange rate appreciation along either with or without the 1pp cut in China's interest rate was significantly indifferent on China's trade balance.

Also, such impacts observed in Asian countries and the G-3 economies somewhat mirror the result in China as follows.

For the period contemporaneous to the combined shock, exports rise by 0.04%, 0.96%, 0.42%, 0.99%, 0.56%, and 0.27% respectively in India, Korea, Malaysia, Philippines, Singapore, and Thailand, with the exception of Indonesia that has a 0.01% decline in exports. While imports fall in Indonesia and India by 0.22% and 0.12% respectively, the volumes of imports rise by 0.53%, 0.49%, 0.58%, 0.63%, and 0.19% respectively in Korea, Malaysia, Philippines, Singapore, and Thailand. As a result, the trade balance for all of them improves by 0.08 (Indonesia), 0.05 (India), 0.29 (Korea), 0.20 (Malaysia), 0.23 (Philippines), 0.24 (Singapore), and 0.13 (Thailand) percentage points of their own GDP.

Among the G-3 economies, exports rise 0.12% in the US and 0.73% in Japan, but fall about 0.11% in Europe. Imports in the US and Europe fall by 0.25% and 0.11% while Japan's imports rise by 0.10% in response to the combined shock. Accordingly, the trade balance in the G-3 economies improves by 0.08 (US), 0.05 (Europe), and 0.12 (Japan) percentage points of their GDP.

Obviously, the result of yuan appreciation along with the 1pp cut in China's interest rate is somewhat similar to those without monetary expansion, and appears to be consistent with China's result. This confirms that the impact of yuan appreciation along either with or without the 1pp cut in China's interest rate was significantly indifferent.



Note that the impacts are the result of China's real exchange rate appreciation by 10% combined with a cut in China's short-term interest rate by 1pp. The horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values where the left axis belongs to the trade balance per GDP (pp) and the right axis belongs to export volumes and import volumes (%).

Figure 5.5 Impacts of the real appreciation of Chinese yuan along with China's monetary expansion on trade flows and the trade balance in selected economies

In sum, the real appreciation of Chinese yuan accompanied by monetary expansion worsened China's trade balance to some extent in line with expectation. Although cutting the interest rate was directly regarded as matter of indifference to a reduction in China's trade balance, it could indirectly be expected that the increase in domestic demand induced by expansive policy would come up with higher demand for imports later. However, an improvement in the trade balances of China's trading partners and trade competitors came about as a consequence of yuan appreciation along with expansionary monetary policy.

5.3 Global Trade Impacts of Exchange Rate Co-realignment in Asia

Regional cooperation among Asian economies seeking deeper integration for both trade and capital markets has taken place for decades. Strength of such cooperation grows increasingly after the Asian crisis, especially in financial and monetary frameworks. Although the progress is slightly slow, there have been visible outcomes with the primary objectives of enhancing regional foreign exchange market

stability and preventing any future financial crises. Even an informal form of cooperation in which Asian currencies are loosely coordinated as shown in Figure 2.6 may also be a product of being more interconnected regionally.

Sheng *et al.* (2009) point to the existence of international production networks in Asia that linked these currencies together. Since the development of Asia's production networks arises in constructing optimized specialization between production processes of particular countries, the less volatile and less divergent regional exchange rates are very of concern to them. Diverging regional nominal and real exchange rates quickly distort market confidence and predictability of prices, and as such, endanger intra-regional trade and financial flows (Fernandez-Arias *et al*., 2002). Therefore, this section takes advantages of the CAM to investigate the impact of Asian exchange rate co-realignment on global trade (objective 3).

It is expected that such co-realignment should reduce trade surplus in all Asian emerging markets through a decrease in their exports and an increase in their imports. Furthermore, Asian co-realignment should improve the trade balances of the US and Europe as well as the rest of the Asian countries.

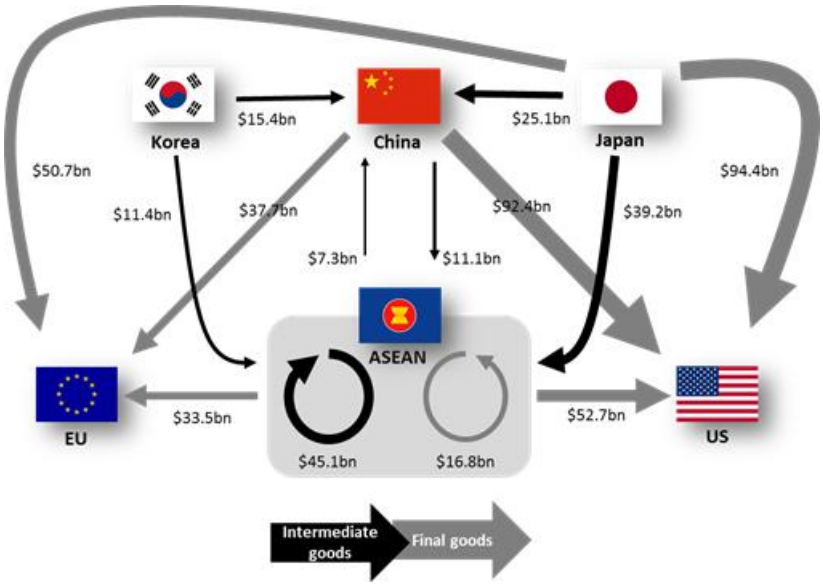
Over the past decade, the Asian region has experienced tremendous changes in China's role not only as the biggest export market for most regional economies, but also as a window to connect the region's production network with demand outside the region. Figures 5.6 and 5.7 show the main trade flows in Asia's international production network in 1999 and 2009 respectively.

An intra-regional trade pattern observed in both figures indicates that Japan and Korea exported intermediate goods comprising processed goods and parts and components to China and ASEAN in assembling and thereby shipping them as final goods outside the region. In other words, Japan and Korea who produced relatively high value added parts and finished goods completed the production process in China and ASEAN as an assembly and export base for final goods.

Between 1999 and 2009, however, China had taken a greater lead in intra-regional trade, becoming the main market for intermediate goods traded within the region. Japan's exports of intermediate goods shifted relatively toward China, increasing from US$25.1 billion in 1999 to US$88.1 billion in 2009, while those from Korea rose from US$15.4 billion to US$74.5 billion. Even ASEAN had come into play a role in supplying intermediate goods to China.

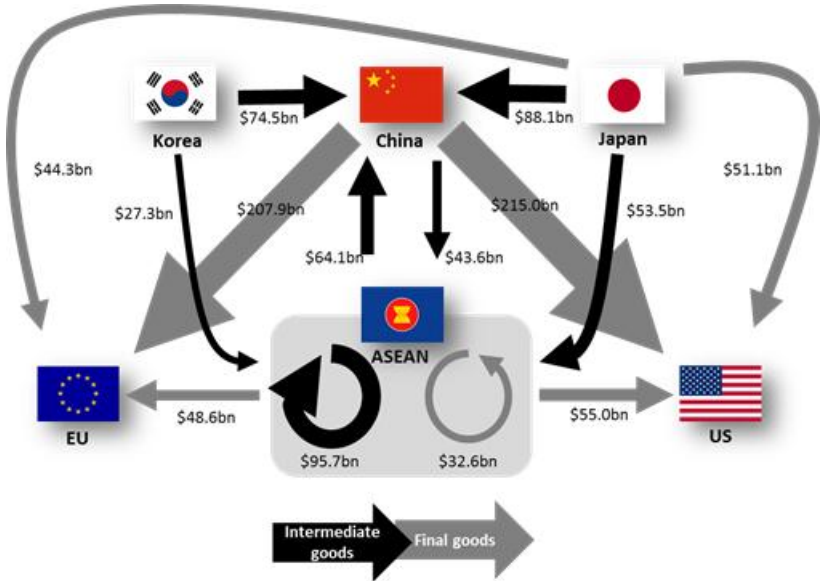
Moreover, the rise of China had dramatically increased in international markets such that its exports of final goods outside the region grew sharply. China's exports to the US rose from US$94.4 billion in 1999 to US$215.0 billion in 2009, while those to the EU surged from US$37.7 billion to US$207.9 billion. By contrast, Japan saw its exports of final goods to the US and the EU rapidly fell from US$94.4

billion and US$50.7 billion to US$51.1 billion and US$44.3 billion respectively whereas ASEAN's exports outside the region relatively remained the same.



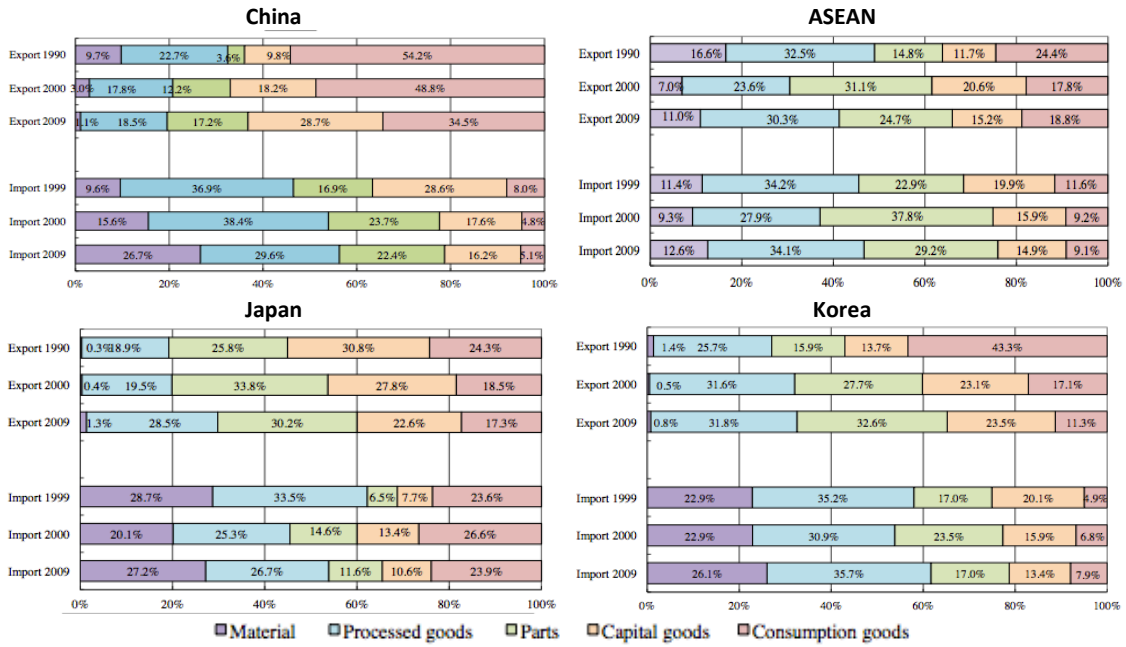
Note that the grey arrow stands for intermediate goods (processed goods and parts and components) and the black arrow stands for final goods (capital goods and consumption goods).
Source: RIETI (2011)

Figure 5.6 East Asia's trade in intermediate and final goods in 1999



Note that the grey arrow stands for intermediate goods (processed goods and parts and components) and the black arrow stands for final goods (capital goods and consumption goods).
Source: RIETI (2011)

Figure 5.7 East Asia's trade in intermediate and final goods in 2009



Source: RIETI (2011)

Figure 5.8 Composition of traded goods in East Asian economies by production process in 1990, 2000, and 2009

Figure 5.8 illustrates the shares of total exports and imports by production process in selected Asian economies. In 2009, China's exports of final goods consisting of capital and consumption goods accounted for 63.2% of total exports of which consumption goods were the largest portion, while China's imports of intermediate goods accounted for 52% of total imports. This is indicative of the recent characteristics of China's trade structure to import of intermediate goods and export of final goods.

In ASEAN, trade in intermediate goods exhibited an increasing trend although both export and import structures were likely to be balanced with materials, processed goods, parts and components, capital goods, and consumption goods during this period. As the major suppliers of intermediate goods, both Japan and Korea exported parts and processed goods approximately 60% of their total exports in 2009. The composition of traded goods in Figure 5.8 confirms Asian trade pattern of the production network mentioned earlier.

Suppose so far that a group of these Asian countries had politically decided to cooperate in their foreign exchange-related policies and unified their currencies regarding a resolution of global current account imbalances. Participating countries totally agreed to keep their trade competitiveness stable within group by letting their real exchange rates move together. Because changes in the real exchange rate of the participants were identical in terms of direction and magnitude, their bilateral competitiveness would remain the same, but adjust simultaneously against those of the rest of the world.

In terms of members, China is mainly supposed to be the case due to its largest trade surplus with the US. Regardless of other issues, ASEAN countries should also be the participants with the following reasons. First, within the region's production network ASEAN is another major assembly bases and exporting platforms, in particular for hard disk drive industry and automotive industry, who exports final goods to the US as well as Japan. Second, there has been a flying-in-unison pattern of Asian currencies such that China's and many of ASEAN exchange rates are moving in concert within a common band over the past decade (Figure 2.6).

Moreover, a number of existing literature on Asian monetary integration conclude the feasibility of forming a monetary union among ASEAN5, China, Korea, and Japan, implying that exchange rate policy coordination would be possible between ASEAN5 and China. In addition, the previous section shows the real appreciation of the yuan would not only reduce a surplus in China's trade balance, but also further enlarge trade surpluses in Asian countries. This can be seen as a transfer of trade surpluses from China to other Asian countries, so that the global current account imbalances may still exist.

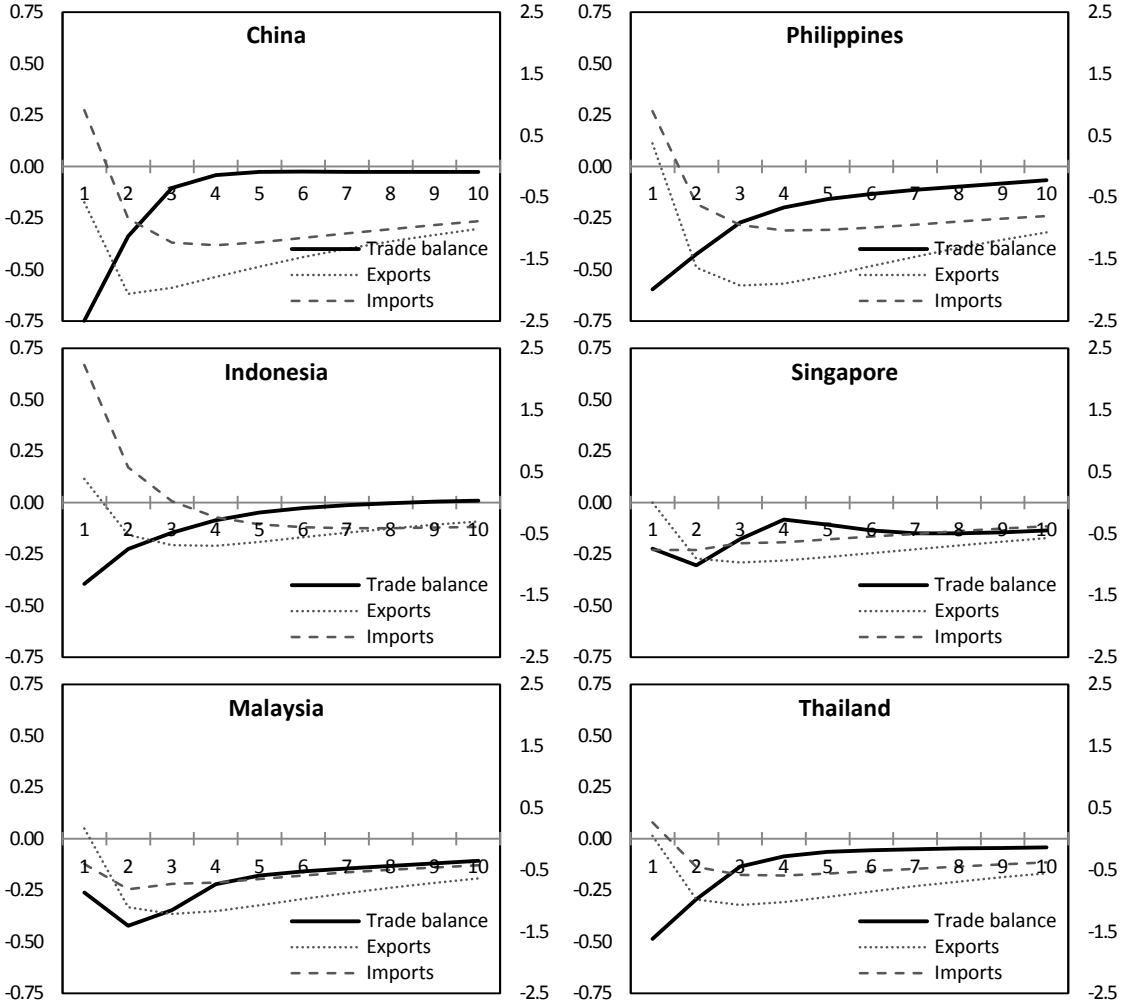
However, India is not considered to be the case due to its persistent trade deficit while Korea is not included because the movements of Korea's exchange rates have been diverging from the region's trend. In fact, the Chinese authorities have traditionally placed greater emphasis on integration with ASEAN instead of either Korea or Japan not only for economic reasons, but also for strategic reasons. Accordingly, 5-leading member states of ASEAN (ASEAN5), comprising Indonesia, Malaysia, Philippines, Singapore, and Thailand, are involved in a scenario of regional exchange rate co-realignment.

Since the exchange rates are co-aligned among member countries, their real exchange rates have to appreciate in concert with each other against world's currencies. Hence, the scenario is constructed by imposing a set of real exchange rate shocks that is equivalent to a 10% appreciation for each member country. Again, the CAM simulation is undertaken and the deviations from baseline values of export volumes, import volumes, and the trade balance are calculated as the net effects for the Asian exchange rate co-realignment scenario.

Figure 5.9 present the member's responses of the volumes of exports and imports and the trade balance to which China's and ASEAN5's real exchange rates appreciate simultaneously by 10% against world's currencies. In response to the combined shock, exports immediately fall by 0.58% in China, but rise 0.39%, 0.17%, 0.38% and 0.05% in Indonesia, Malaysia, Philippines, and Thailand respectively, while Singapore's exports remain unchanged. Imports rise by 0.92%, 2.23%, 0.90%, and 0.27% in China, Indonesia, Philippines, and Thailand respectively for the period

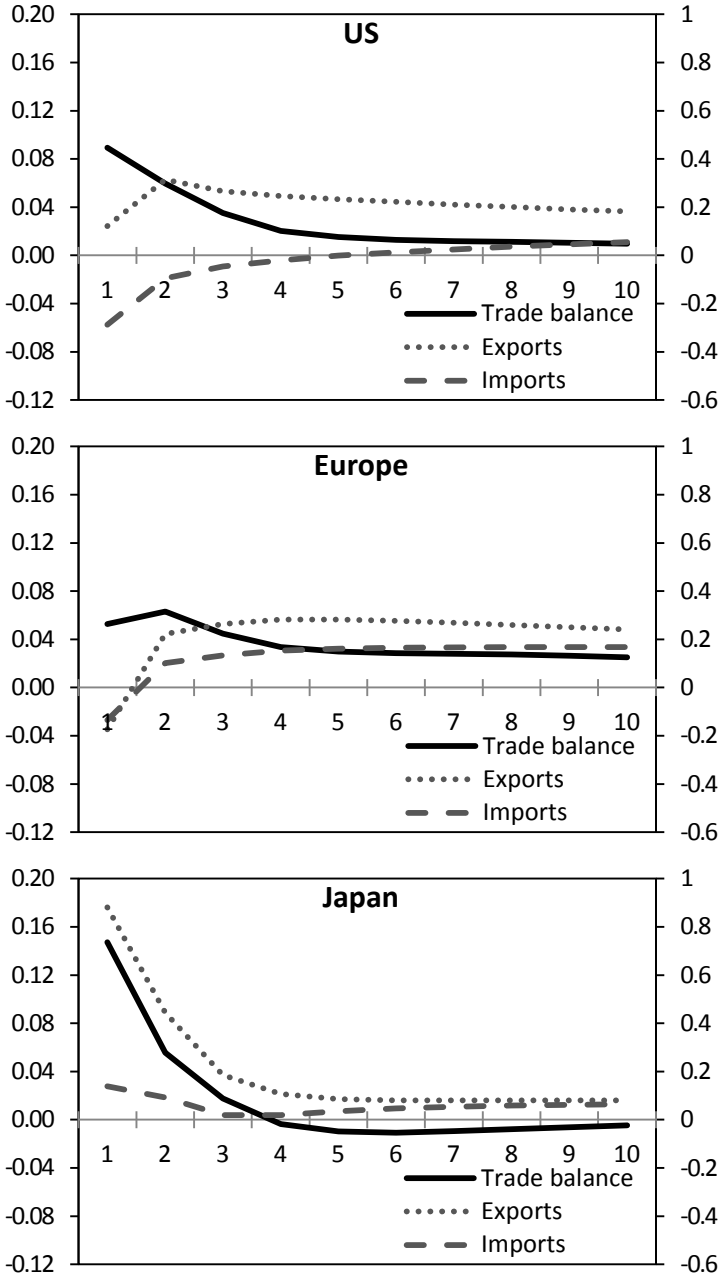
contemporaneous to the shock, but fall in both Malaysia and Singapore by 0.41% and 0.77% respectively.

For China, the result is in line with expectations such that the real exchange rate appreciation would cause a decrease in exports and an increase in imports. Interestingly, there is an increase in export volumes for Indonesia, Malaysia, Philippines, and Thailand although the real values of their currencies increase. This could be partially because the co-realignment of real exchange rates made regional exchange rate stability, facilitating intra-regional trade in manufactured products especially intermediate goods. All in all, the trade balance deteriorates by 0.75 (China), 0.39 (Indonesia), 0.26 (Malaysia), 0.60 (Philippines), 0.22 (Singapore), and 0.49 (Thailand) percentage points of their own GDP.



Note that the horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values where the left axis belongs to the trade balance per GDP (pp) and the right axis belongs to export volumes and import volumes (%).

Figure 5.9 Impacts of Asian co-realignment of real exchange rates on trade flows and the trade balance by participating country



Note that the horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values where the left axis belongs to the trade balance per GDP (pp) and the right axis belongs to export volumes and import volumes (%).

Figure 5.10 Impacts of Asian co-realignment of real exchange rates on trade flows and the trade balance by G-3 economy

Figure 5.10 present the responses of export and import volumes and the trade balance to the Asian exchange rate co-realignment among the G-3 economies. For the period contemporaneous to the shock, exports rise by 0.12% in the US and 0.88% in Japan, but fall by 0.17% in Europe. Imports fall in the US and Europe by 0.29% and 0.13% respectively in response to the shock. Accordingly, the trade balance improves by 0.09 (US), 0.05 (Europe), and 0.15 (Japan) percentage points of their GDP. As expected, the joint appreciation of Asian exchange rates would improve the trade

balance in the US and Europe mostly by discouraging demand for imports because the overall Asian goods became more expensive relative to their locally-produced goods. By contrast, the trade balance improvement in Japan was largely driven by a surge in exports of manufactures.

In short, regional exchange rate co-realignment of China together with ASEAN5 ended up with trade balance deterioration in these countries. Furthermore, the co-realignment improved trade balances of the US and Europe as well as Japan.

5.4 Findings and Summary

This section attempts to address the research question whether the Asian region can help global current account rebalancing through their exchange rate appreciation, so that the results of regional co-realignment of real exchange rates in Asia are compared with those of unilateral exchange rate appreciation and those of yuan appreciation respectively, and consequently the following hypotheses are tested.

Hypothesis I: Asian exchange rate co-realignment is superior to unilateral exchange rate appreciation for the individual participating countries.

H_0: its own trade balance $_{\text{co-realignment}} \leq$ its own trade balance $_{\text{unilateral appreciation}}$
H_1: its own trade balance $_{\text{co-realignment}} >$ its own trade balance $_{\text{unilateral appreciation}}$

Hypothesis II: Asian exchange rate co-realignment is superior to Chinese yuan appreciation for the individual G-3 economies, in particular the US.

H_0: G-3 trade balance $_{\text{co-realignment}} \leq$ G-3 trade balance $_{\text{yuan appreciation}}$
H_1: G-3 trade balance $_{\text{co-realignment}} >$ G-3 trade balance $_{\text{yuan appreciation}}$

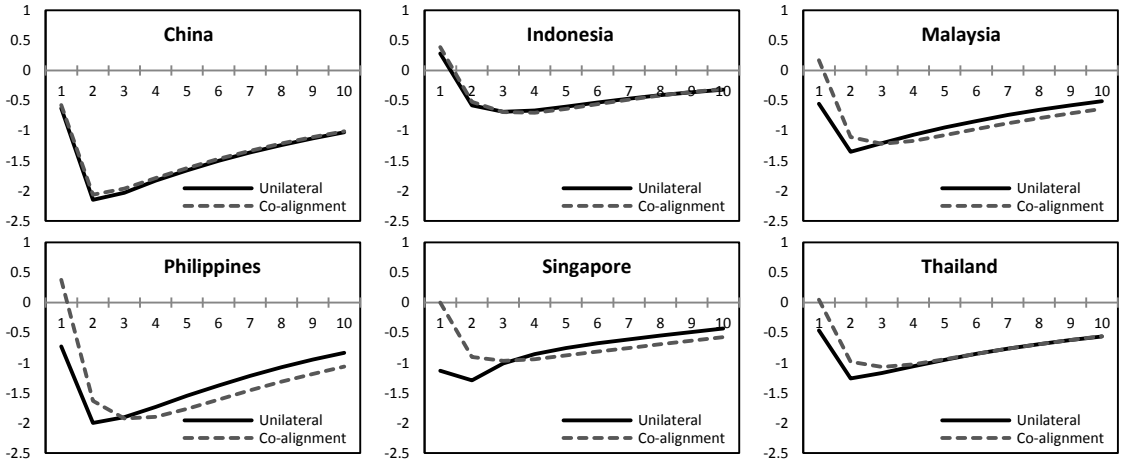
5.4.1 Does the regional co-realignment benefit China and ASEAN5?

Cooperation, in reality, would not take place easily unless participants enjoy benefits of being a member. The regional co-realignment scenario so far would make non-sense if the cooperation does not generate mutual benefits to the participating countries. Given a situation that ASEAN countries were experiencing an upward pressure on values of their currencies, should they join up with China to coordinate their real exchange rates and let them appreciate together?

To test the first hypothesis, a comparison of the impacts on participating countries as a result between of the unilateral exchange rate appreciation scenario (obtained from section 5.1) and of the regional co-realignment scenario (obtained from section 5.3) is shown in Figures 5.11 through 5.13.

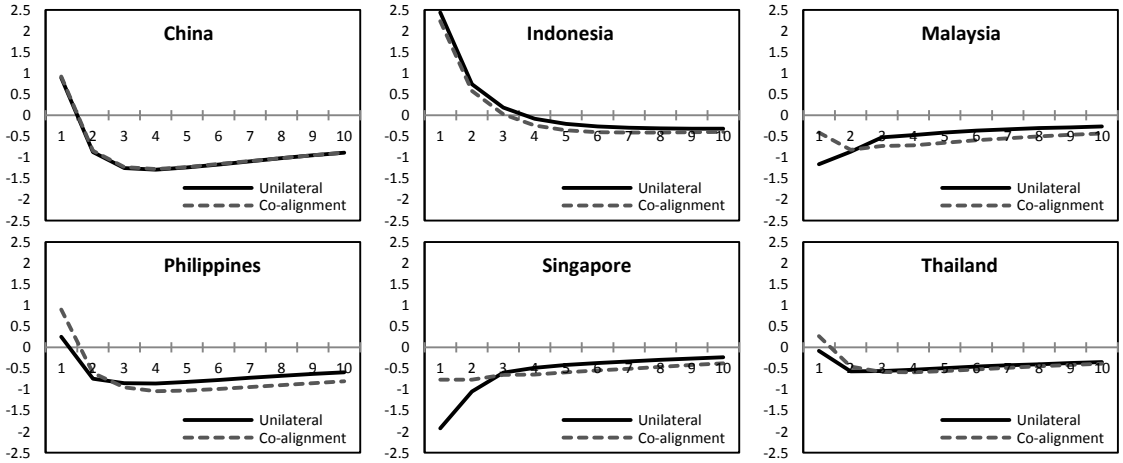
Figure 5.11 illustrates that exports for all of them increase further in comparison with those in the case of unilateral appreciation. This improvement in

exports, especially for Malaysia, Philippines, Singapore, and Thailand where the responses of export volumes are no longer negative, implies a benefit of being a member. Figure 5.12 shows that the volumes of imports also expand relative to those without cooperation, with the exception of Indonesia that slightly decrease. As apparent, the co-realignment scenario exhibits a moderate tendency towards growing trade flows for member countries, probably because the beneficial effect stemming from making stability of real exchange rates within group would create a stable atmosphere for trade in the region.



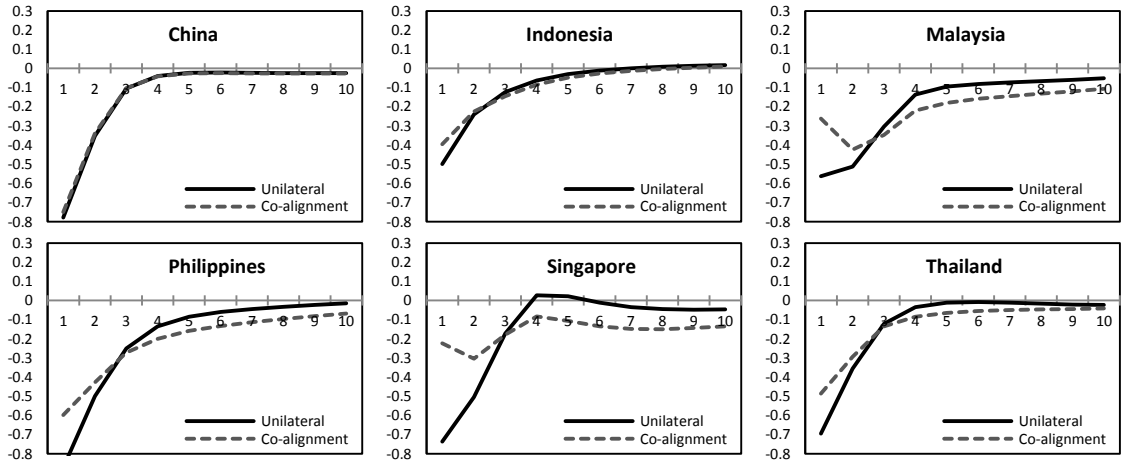
Note that the horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values (%).

Figure 5.11 Comparison of impacts between unilateral appreciation and regional co-realignment of real exchange rates on Asian exports by country



Note that the horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values (%).

Figure 5.12 Comparison of impacts between unilateral appreciation and regional co-realignment of real exchange rates on Asian imports by country



Note that the horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values (pp).

Figure 5.13 Comparison of impacts between unilateral appreciation and regional co-realignment of real exchange rates on Asian trade balances by country

In addition, Figure 5.13 reveals trade balance deterioration still exists among participating countries, yet by a notably less amount of GDP. As can be seen, the burden of unilateral exchange rate appreciation on the trade balance would be mitigated more or less when these Asian countries begin to cooperate together in unifying their currencies. The improvement in trade balance deterioration supports such cooperation.

The comparison results between these 2 scenarios are summarized in Table 5.1 with the arrow sign. Directions of the arrow capture the adjustment of the variables while the suffixes measure the degree of the variable's adjustments relative to that of the corresponding variable. As apparent, under the Asian co-realignment scenario the impact on trade balance in all participating countries is denoted by a downward-pointing arrow with minus sign, interpreting that the trade balance worsens by less degree in comparison with that under the unilateral scenario. In other words, it means that each participant's trade balance in case of the co-realignment is greater than that in case of unilateral appreciation.

Given the results in Table 5.1, the first null hypothesis is absolutely rejected, implying that Asian exchange rate co-realignment is superior to unilateral exchange rate appreciation for the individual participating countries. To conclude, both China and ASEAN5 would benefit from cooperation.

Table 5.1 Comparison of the results between unilateral exchange rate appreciation and Asian exchange rate co-realignment by participating country

	Scenario					
	Unilateral appreciation			Asian co-realignment		
Economy	*Exports*	*Imports*	*Trade balance*	*Exports*	*Imports*	*Trade balance*
China	↓	↑	↓	↓-	↑+	↓-
Indonesia	↑	↑	↓	↑+	↑+	↓-
Malaysia	↓	↓	↓	↑	↓-	↓-
Philippines	↓	↑	↓	↑	↑+	↓-
Singapore	↓	↓	↓	↑	↓-	↓-
Thailand	↓	↓	↓	↑	↑	↓-

Note that the results are taken from the initial response of the corresponding variables in each scenario.

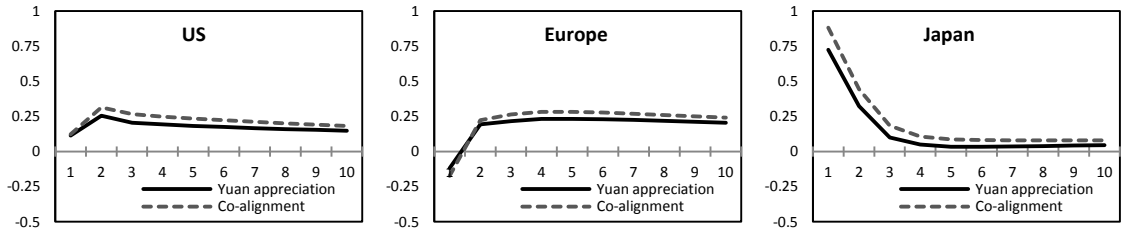
↑+ Greater increase ↑ Increase ↓ Decrease ↓- Less decrease

5.4.2 Does the regional co-realignment in Asia help global rebalancing?

It can be said that appreciation of Chinese yuan is widely believed to be a significant resolution of global imbalances. Hence, in question of rebalancing the scenario of yuan appreciation will serve as a good benchmark for the scenario of regional co-realignment, involving China and ASEAN5. To test the second hypothesis, a comparison of the impacts on the G-3 economies as a result between of the Chinese yuan appreciation scenario (obtained from section 5.2) and of the Asian co-realignment scenario (obtained from section 5.3) is shown in Figures 5.14 through 5.16.

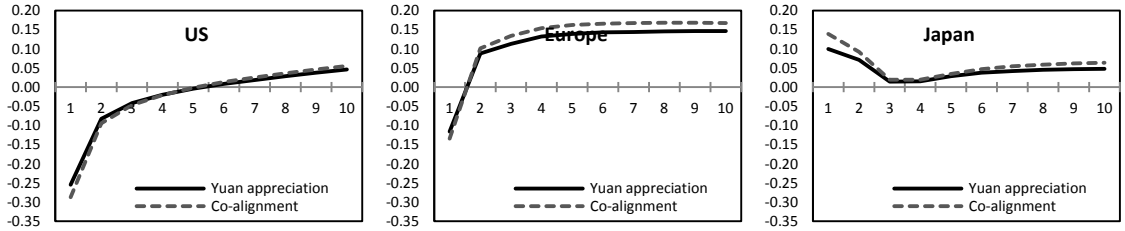
Figure 5.14 indicates that Japan's exports increase to a greater degree in the Asian co-realignment scenario, while those of Europe slightly decrease and those of US are significantly indifferent. This confirms that the adjustment of China's exchange rate, even including other Asian exchange rates, could not help stimulate US exports of goods.

On the other hand, Figure 5.15 shows a further decline in US and Europe's imports suggesting that the Asian exchange rate co-realignment was relatively effective in reducing imports in the US as well as Europe. This should not be surprising, given that a huge trade deficit in the US is the counterpart surpluses in China as well as some Asian countries. When Asia allowed its real exchange rates to appreciate against the world's currencies, its own traded goods became less attractive to its trading partners such as the US, so that the joint appreciation could end up with a fall in foreign demand for imports.



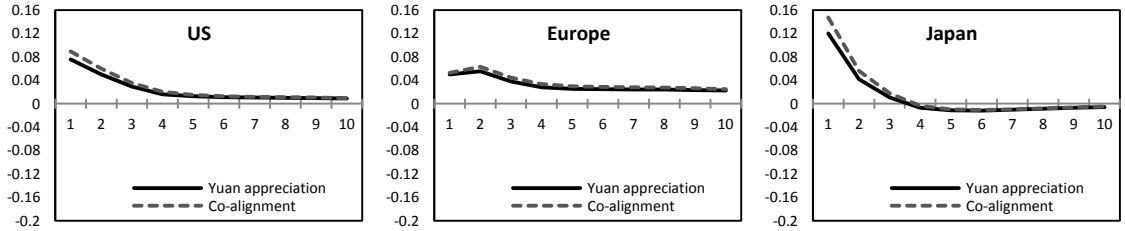
Note that the horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values (%).

Figure 5.14 Comparison of impacts between Chinese yuan appreciation and Asian co-realignment of real exchange rates on G-3 exports by economy



Note that the horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values (%).

Figure 5.15 Comparison of impacts between Chinese yuan appreciation and Asian co-realignment of real exchange rates on G-3 imports by economy



Note that the horizontal axis represents the forecast horizon (years) and the vertical axis represents the deviation from baseline values (pp).

Figure 5.16 Comparison of impacts between Chinese yuan appreciation and Asian co-realignment of real exchange rates on G-3 trade balances by economy

Figure 5.16 shows that the improvement in the trade balance for the G-3 economies under the Asian co-realignment scenario is larger than that under the yuan appreciation scenario. However, it is noticeable that the positive effect is relatively large on Japan's trade balance. This is perhaps due to a production network implicitly embedded in the Asian region. As can be seen earlier, the Asian exchange rate co-realignment could also encourage the participant's imports contributing to a further worsening trade balance in the participating countries. It would be of benefit to Japan as a major supplier of intermediate goods in this region when there was an increase in demand for its exports driven by Asian developing countries. Accordingly, the regional co-realignment tended to contribute more benefits towards Japan's exports instead of the US and Europe's, thereby highly improving the trade balance.

The comparison results between these 2 scenarios are summarized in Table 5.2 with the arrow sign. Again, directions of the arrow capture the adjustment of the variables while the suffixes measure the degree of the variable's adjustments relative to that of the corresponding variable. Obviously, under the Asian co-realignment scenario the impact on trade balance in all G-3 economies is symbolized by an

upward-pointing arrow with plus sign, interpreting that the trade balance improves by large degree in comparison with that under the yuan appreciation scenario. That is, it means that each G-3 trade balance in case of the co-realignment is greater than that in case of yuan appreciation.

Table 5.2 Comparison of the results between Chinese yuan appreciation and Asian exchange rate co-realignment by G-3 economy

	Scenario					
	Yuan appreciation			Asian co-realignment		
Economy	*Exports*	*Imports*	*Trade balance*	*Exports*	*Imports*	*Trade balance*
the US	↑	↓	↑	↑+	↓-	↑+
Europe	↓	↓	↑	↓-	↓-	↑+
Japan	↑	↑	↑	↑+	↑+	↑+

Note that the results are taken from the initial response of the corresponding variables in each scenario.

↑+ Greater increase ↑ Increase ↓ Decrease ↓- Less decrease

Given the results in Table 5.2, the second null hypothesis is definitely rejected, implying that Asian exchange rate co-realignment is superior to Chinese yuan appreciation for the individual G-3 economies. In addition, yuan appreciation along with macroeconomic policy is tested and rejected because it would not only reduce trade balance improvement in the US, but also enlarge trade surpluses in Asian countries (Table 5.3). To conclude, such cooperation between China and ASEAN5 could also help global current account rebalancing.

Table 5.3 Comparison of the results between Chinese yuan appreciation and Chinese yuan appreciation with expansionary macroeconomic policy

	Scenario 1			Scenario 2			Scenario 3		
	Yuan appreciation			Yuan appreciation and fiscal policy expansion			Yuan appreciation and monetary policy expansion		
Economy	*Exports*	*Imports*	*Trade balance*	*Exports*	*Imports*	*Trade balance*	*Exports*	*Imports*	*Trade balance*
China	↓	↑	↓	↓-	↑+	↓+	↓-	↑+	–
G-3:									
the US	↑	↓	↑	↑+	↓-	↑-	↑+	–	–
Europe	↓	↓	↑	↑	↑	↑+	↓-	↓-	–
Japan	↑	↑	↑	↑+	↑+	↑-	↑+	–	–
Other Asia:									
Korea	↑	↑	↑	↑+	↑+	↑-	↑+	↑+	–
India	↑	↓	↑	↑+	↓-	↓	↑+	–	–
Indonesia	↓	↓	↑	↑	↓-	↑+	–	–	–
Malaysia	↑	↑	↑	↑+	↑+	↑+	↑+	↑+	↑+
Philippines	↑	↑	↑	↑+	↑+	↑+	↑+	–	–
Singapore	↑	↑	↑	↑+	↑+	↑+	↑+	↑+	–
Thailand	↑	↑	↑	↑+	↑+	↑+	–	–	–

Note that the results are taken from the initial response of the corresponding variables in each scenario.

↑+ Greater increase ↑ Increase ↑- Less increase – No change ↓+ Greater decrease ↓ Decrease ↓- Less decrease

5.4.3 Summary

This chapter intentionally addresses the research question of Asia's role in global current account rebalancing through the following objectives: 1) to examine effects of real exchange rate appreciation on exports, imports, and the trade balance for each of individual Asian countries, 2) to examine effects of Chinese yuan appreciation and of yuan appreciation combined with China's macroeconomic policies on Asian countries and the G-3 economies, and 3) to investigate effects of regional foreign exchange rate realignment on Asian countries and the G-3 economies, by section respectively.

By using the CAM the objectives are reached, and their results serve as useful information in analyzing and answering the research question as follows.

In section 5.1, it is strongly evident such that individual Asia's current account position would deteriorate in the trade balance account as a consequence of its real exchange rate appreciation. A decline in exports was the main contributor to the trade balance reduction.

Section 5.2 pays more attention to China's impacts on trade regarding global rebalancing. There is evidence of a reduction in China's trade surplus and a US trade balance improvement in relation to Chinese yuan appreciation in section 5.2.1. The improvement in US trade balance was largely subject to a fall in demand for imports. Moreover, real appreciation of the yuan did improve not only the US current account, but also other economies in Asia as well as outside the region. In section 5.2.2, it is indicative of a further reduction in China's trade balance when appreciating values of the yuan were accompanied by expansionary macroeconomic policy in China. Fiscal policy seemed to be effective relative to monetary policy in this regard.

In section 5.3, Asian cooperation in foreign exchange-related policies is introduced and investigated with respect to global rebalancing. It is evident to the extent that the regional exchange rate co-realignment between China and ASEAN5 would not only reduce their trade balance, but also improve the trade balance in the US, Europe, and Japan. However, such cooperation could stimulate exports in participating countries to some extent.

Finally, results obtained from section 5.3 are compared with those from section 5.1 and 5.2 in order to answer the research question. The comparisons find evidence of a potential incentive for China and ASEAN5 to coordinate their exchange rate policy as well as their ability to narrow the gap between China's trade surplus and US trade deficit. Therefore, an appropriate exchange rate policy in both China and other major Asian countries could significantly help global current account rebalancing.

CHAPTER VI

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The research was undertaken with a main purpose of examining the effects of Asian real exchange rate appreciation on trade flows and the trade balance in order to assess effectiveness of currency revaluation in rebalancing the current account. This analysis was motivated by accusations of artificially undervaluing Asian currencies, in particular Chinese yuan such that their currency appreciation could help global current account rebalancing, and attempted to examine a validity of the theoretical proposition of absorption approach in case of China whether the increase in domestic absorption over income induced by expansionary macroeconomic policy led to a reduction in current account. In addition, progressive regional financial and monetary cooperation in Asia and the growing intra-regional trade attracted this research to investigating the effects of regional exchange rate coordination, in which a group of Asian currencies was involved.

An overview of global imbalances and Asian countries, including China, Indonesia, Malaysia, Philippines, Singapore, Thailand, Korea and India was discussed in chapter 2. Asia's large and prolonged current account surpluses, driven by its increasing dependence on exports, had been consistent with the US current account deficits after the Asian crisis. It was indicative of an essential role of the region in contributing to the imbalances during the past decade. A combination of heavy reliance on exports in relation to GDP and an exceptional stockpile of international reserves in Asian countries was a potential incentive to keep currencies undervalued. In the recent decade, either managed floating or freely floating exchange rate arrangement had widely been undertaken in Asian countries, but there was evidence that most of these currencies had been managed strongly and persistently in order to maintain competitiveness in line with each other despite the adoption of greater exchange rate flexibility. As such, a prolonged period of undervalued currencies in some countries might form part of the huge and sustained US deficits since other countries were unwilling to allow too much appreciation of their own currencies. However, path of Asian exchange rates tended to be a result of the closer trade integration and more regional financial and monetary cooperative efforts.

Cambridge-Alphametrics Model (CAM) of the world economy, originated by Cripps and Godley (1978), was used to provide estimation and simulation results in order to address each of the research objectives. The current version of the CAM was modified by a few specifications as follows. First, the standard bloc aggregation of the model was rearranged by separating Asian countries of particular interest from the rest of Asia. China, Indonesia, Malaysia, Philippines, Singapore, Thailand, Korea, and

India were taken individually among Asian countries apart from Japan that was treated as one of the world's leading economies like the US and Europe. Second, the base year was changed from year 2000 to year 2005 in order to capture the latest changes in exchange rate regimes in China and Malaysia. In this regard, the structural parameters were then re-estimated; however, there was no significant divergence from the original model.

By using the CAM each objective was reached in chapter 5, and its results served as useful information in analyzing the impacts of exchange rate appreciation, focusing on trade flows and the trade balance, and in answering the research question as follows.

For the first objective, the effects of real exchange rate appreciation on exports, imports, and the trade balance for particular countries in Asia were examined in section 5.1. From the theoretical perspective, elasticity approach, widely adopted by many studies in analyzing the balance of payments adjustment to an effective devaluation, was applied inversely and considered to have an opposite conclusion in case of revaluation. The CAM-based simulation strongly confirmed the expectation to the extent that the real exchange rate appreciation of the selected Asian currencies worsens their net exports, thereby resulting in a reduction in the trade balance and the current account. Nevertheless, such effects on trade flows varied across countries depending whether on the price effect or the income effect was dominant. In most cases, the price effect played a major role in demand for exports while the income effect relatively shared in demand for imports especially in case of Korea, Malaysia, Singapore, and Thailand.

For the second objective, section 5.2 was fully dedicated to analyzing global trade impacts of China's actions. Firstly, the effects of Chinese yuan appreciation on China as well as other economies were examined in section 5.2.1. Secondly, such effects of yuan appreciation companied by expansionary policy, either fiscal or monetary, were also examined in section 5.2.2. In this regard, there were 3 scenarios under this objective consisting of (i) yuan appreciation, (ii) yuan appreciation along with an increase in China's government spending, and (iii) yuan appreciation along with a cut in China's interest rate.

In the review, although the size of impacts differed across studies depending on methods and variables they used, a number of earlier studies on yuan revaluation found that Chinese economy would experience an economic contraction through substantial trade balance deterioration as a consequence of yuan appreciation, and recommended the use of fiscal or monetary policy in eliminating adverse effects on growth. From theoretical aspect of absorption approach, however, the expansive macroeconomic policy did not only mitigate such negative effects, but also contribute to a reduction in the current account more or less. The net effect from an expansionary

fiscal policy tended to reinforce the effect of real exchange rate appreciation on the trade balance while the effects of monetary expansion tended to offset each other, and then would have relatively small net effect on the trade balance. Regarding global imbalances, the existing literature also studied such effects on China's major trading partners, in particular the US, and found that the stronger yuan would discourage US imports from China, but seemed not to encourage US exports. Moreover, there was some evidence of an improvement in US trade balance or in the current account, even in other economies with respect to yuan appreciation.

Again, based on the CAM simulation, the results confirmed such an aspect of absorption approach and the main finding were as follows: 1) real appreciation of Chinese yuan brought about trade balance improvement both in Asian countries and in the world's major leading economies, including the US, Europe, and Japan, but with different sources. A surge in exports was the main contributor to trade balance improvement among most Asian countries as well as Japan, while a decline in imports played a crucial role in the improvement between the US and Europe. 2) Real appreciation of the yuan along with an expansionary fiscal policy further amplified the worsening of China's trade balance in comparison with no policy action, or even with monetary policy expansion, but did the reverse in the US. 3) The presence of China's expansionary fiscal policy stimulated total trade volumes for the world as whole.

For the third objective, the effects of Asian exchange rate co-realignment on global trade were investigated in section 5.3, and then section 5.4 compared such effects with those from section 5.1 and 5.2. The rationale behind this objective was the fact that regional cooperative efforts in financial and monetary frameworks as well as intra-regional and international trade in the Asian region had increasingly grown over the past decade. There had been evidence of an informal form of monetary cooperation in which Asian currencies were loosely coordinated in order to maintain competitiveness in line with each other. In other words, the exchange rates of these currencies were moving in concert with each other within a common band.

In the review, empirical studies on Asian monetary integration found many obstacles pointing to infeasibility of integration in Asia. However, a smaller group of the region's countries was possible, especially ASEAN5, China, Korea, and Japan. In a sense, the presence of intra-regional trade pattern with the rise of China supporting Asia's production networks could be a possible explanation for this phenomenon.

Regarding a resolution of global current account imbalances, China and ASEAN5 were explicit chosen because of their role in the production networks as exporting platforms, and then their real exchange rate were assumed to appreciate equally. By using the CAM, the result was simulated and found that region co-realignment of real exchange rates worsened their own trade balance to a lesser

degree compared with their unilateral appreciation. Last but not least, another interesting finding was that Asian co-realignment further improved the trade balance in the US as well as Europe in comparison with real appreciation of Chinese yuan as it tended to generalize an increase in prices of Asian goods and services relative to those abroad.

6.2 Policy Implications

The Asian region in which many countries are highly independent on exports is considered to be vulnerable to external shocks. In the recent years, not only a slump in global demand itself, but the region has also been dampened further by an upward trend in exchange rate appreciation of many Asian currencies amid concerns over the ongoing global economic slowdown. The increasing value of Asian currencies could be a major factor undermining their economic growth as it tended to discourage exports and stimulate imports, thereby worsening their trade balance. It would be of great importance to policymakers in the region taking care of their impacts.

This research has investigated the effects of a kind of regional exchange rate coordination in Asia, and has established that joint appreciation of exchange rates would be not only relieve such negative impacts on net exports and growth for the participants, but also contribute to a desirable improvement in the US trade deficits.

For Asia, hence, the Asian authorities should deliberate on a common agreement for their foreign exchange-related policies in the region because the similar exchange rate movements through exchange rate coordination would become an automatic protection to their bilateral competitiveness, facilitating intra-regional trade and thereby leading to welfare improvement for these economies. Moreover, the authorities should take this opportunity to rebalance their economic policies from relying significantly on export towards domestic sources if they would like to reduce their heavy dependence on external sectors and enhance long-term growth stability. In addition, expansionary macroeconomic policies, especially fiscal policy, should be used to supplement the rebalancing process.

However, such cooperation comes along with relevant adjustment costs, in particular unless the existence of regional asymmetries has been eliminated; conflicts of interest among countries would potentially deter them from gaining welfare improvement.

For the US, if the government would like to reduce the large and persistent trade deficits, they should facilitate such cooperative efforts in Asia and should also enhance their own export performance as well as saving behavior simultaneously because the co-realignment of Asian currencies would bring the trade balance improvement for the US through reducing US demand for imports but having small effect on US export improvement.

6.3 Limitations and Recommendations for Further Study

In this research, the result of the studies regarding the impact of Asian foreign exchange rate policies on the global trade highly relies on the CAM-based simulation model. Although the CAM has served well as a tool for dealing with a large dataset for the entire world, global linkages, reliable estimation and plausible simulation results, and so on, it is noteworthy that there are a few drawbacks of using this model constrained by its assumptions, data, and estimation method as follows.

First, the CAM assumes an identical economic structure for all economies representing that they are part of the same world economy. In fact, the structure of economy is clearly different in a particular country, so that the outcomes may differ in real world. Second, the core structure of the CAM relies on somewhat demand-driven approach to macroeconomic behavior that is strongly influenced by extensions of Keynesian analysis. Hence, monetary policy measures may affect real demand; however, such effects are weak as compared with the effects of fiscal policy. Third, the lack of available data and inconsistent data are usually inevitable and considered to be a serious problem for econometric modeling, especially in multi-country models; however, in the CAM the missing data are estimated and inconsistencies are reconciled by customarily accepted methods for large accounting models.[31] Lastly, there is an imposed value for a certain coefficient in a few cases because coefficients estimated using historical panel data yield unsatisfactory theoretical explanations or have unacceptable implications for dynamic behavior of dependent variable or the model as a whole. As such, interpretation of the results and the use of policy implications need to keep the model's assumptions and these cautions in mind.

For further research, therefore, it would be of great importance to suggesting that the impacts of regional exchange rate coordination in Asia should go deep in exporting and importing industry, in particular automotive industry and/or hard disk drive industry that tends to benefit from regional exchange rate stability.

[31] Adjustments are made using an algorithm that minimizes changes to the original data.

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APPENDICES

APPENDIX A VARIABLES AND IDENTITIES (FULL MODEL)

Symbol	*Definition of variables*	*Units*	*Measurements*
AGF	Bank deposits and capital held by government at end year	$m	AGF = NGI + max(NGF, 0)
AX$	External assets at end year	$m	AX$ = R$ + AXO$
AXO$	Other external assets at end year (adjusted)	$m	AXO$ = AXOU$.AXOW$ / AXOUW$
AXOU$	Other external assets at end year (unadjusted)	$m	AXOU$ = NXI$ + max(NXFU$, 0)
BA$	Net exports of primary commodities	$m	BA$ = XA$ - MA$
BA0	Net exports of primary commodities at base-year prices (adjusted)	$m	BA0 = XA0 - MA0
BAU0	Net exports of primary commodities at base-year prices (unadjusted)	$m	behavioral [structural policy]
BE$	Net exports of energy products	$m	BE$ = XE$ - ME$
BE0	Net exports of energy products at base-year prices	$m	BE0 = XE0 - ME0
BIT$	Net income and transfers from abroad	$m	BIT$ = XIT$ - MIT$
BITU$	Net income and transfers from abroad (unadjusted)	$m	behavioral [structural policy]
BM$	Net exports of manufactures	$m	BM$ = XM$ - MM$
BM0	Net exports of manufactures at base-year prices	$m	BM0 = XM0 - MM0
BS$	Net exports of services (adjusted)	$m	BS$ = XS$ - MS$
BS0	Net exports of services at base-year prices	$m	BS0 = XS0 - MS0
BSU$	Net exports of services (unadjusted)	$m	behavioral [structural policy]
C	Consumers expenditure	$m	C = YP – SP
CA$	Current account balance of payments	$m	CA$ = TB$ + BIT$
CO2	CO2 emissions	m tons	behavioral [structural policy]
CO2W	Global CO2 emissions	m tons	CO2W = sum(CO2)
DNN	Natural increase in population	millions	exogenous
DP	Bank deposits at end-year	$m	DP = NFI + max(NFF, 0)
EB	Energy balance	mtoe	EB = EX - EM
ED	Energy demand	mtoe	behavioral [structural policy]
EDW	World energy demand	mtoe	EDW = sum(ED)
EM	Primary energy imports	mtoe	behavioral [structural policy]
EP	Primary energy production	mtoe	EP = EPC + EPN

Symbol	*Definition of variables*	*Units*	*Measurements*
EPC	Primary energy production from solids, liquids and gases (carbon-based energy products)	mtoe	behavioral [structural policy]
EPN	Primary electricity production (non-carbon energy)	mtoe	behavioral [fiscal policy]
EPW	World energy production	mtoe	EPW = sum(EP)
EX	Primary energy exports	mtoe	EX = EP + EM - ED
G	Government expenditure	$m	behavioral [fiscal policy]
H	Domestic expenditure	$m	H = C + IP + IV + G
HAGF	Holding gain or loss on government investment in banks	$m	HAGF = R(-1) .rpr$/rx + (LN(-1)+ LGF(-1)–DP(-1)) .rpfa – AGF(-1) - lnbail .LN(-1) .wln.rpfa
HAXO	Holding gain on other external assets	$m	HAXO = AXO$/rx - AXO$(-1)/rx(-1) - IAXO$/rx
HDP	Holding gain or loss on other sectors' investment and deposits with banks	$m	HDP = DP - DP(-1) - IDP
HKP	Holding gain or loss on capital stock at end year	$m	HKP = KP - KP(-1) - IP - IV
HLGO	Holding gain or loss on other government debt	$m	HLGO = LGO - LGO(-1) - ILGO
HLN	Holding gain or loss on bank lending	$m	HLN = LN - LN(-1) - ILN
HLX	Holding gain or loss on external liabilities	$m	HLX = LX$/rx - LX$(-1)/rx(-1) - ILX$/rx
HWP	Holding gain or loss on private wealth	$m	HWP = HKP + HDP - HLN + HLGO + HAXO - HLX
IAG	Government asset transactions	$m	IAG = IAGF + IAGO
IAGF	Government injections to banks	$m	IAGF = AGF - AGF(-1) - HAGF
IAGO	Other government asset transactions	$m	behavioral [financial policy]
IAXO$	Other external capital outflow	$m	IAXO$ = ILX$ - IR$ + CA$
IDP	Acquisition of bank deposits	$m	IDP = IR$/rx - IN + ILGF - IAGF
ILG	Net issues of government debt	$m	ILG = IAG – NLG
ILGF	Acquisition of government debt by banks	$m	ILGF = ILG – ILGO
ILGO	Non-bank acquisition of government debt	$m	ILGO = LGO - LGO(-1) .rpfa
ILN	Net borrowing from banks	$m	ILN = LN - LN(-1) .rpfa. (1-wln)
ILX$	Other external borrowing	$m	ILX$ = LX$ - LX$(-1) .rplx$
im	Bond rate	% p.a.	behavioral [confidence]
IP	Private investment	$m	behavioral [confidence]
IR$	Net acquisition of exchange reserves	$m	IR$ = R$ - R$(-1) .rpr$
irm	Real bond rate	% p.a.	irm = 100((1+im/100) / (1+pi/100)-1)
irs	Real short-term interest rate	% p.a.	irs = 100((1+is/100) / (1+pi/100)-1)
is	Short-term interest rate	% p.a.	behavioral [monetary policy]

Symbol	*Definition of variables*	*Units*	*Measurements*
IV	Change in inventories	$m	behavioral [confidence]
KI	Produced capital stock at end year	$m	KI = KI(-1) - KID + IP + IV
KID	Capital consumption	$m	rdp.KI(-1)
KP	Value of capital at end year	$m	KP = pkp.KI
LG	Government debt at end year	$m	LG = AGF – NGF
LGF	Government debt held by banks at end year	$m	LGF = LG - LGO
LGO	Non-bank holdings of government debt at end year	$m	behavioral [monetary policy]
LN	Bank loans outstanding at end year	$m	LN = DP - NFF
lnbail	Government bail-out losses as proportion of abnormal loan write-offs by banks	ratio	constant [assumption]
lpa	Domestic impact of world price of primary commodities	log	lpa = 0.3log(paw/rx) + 0.7lpa(-1)
lped	Demand impact of world price of oil	log	lped = 0.3log(pew/(rx(pewmax-pew))) + 0.7lped(-1)
lpep	Production impact of world price of oil	log	lpep = 0.15log(pew/(rx(pewmax-pew))) + 0.85lped(-1)
LX$	External liabilities at end year	$m	LX$ = AXOU$ - NXFU$
M$	Imports of goods and services	$m	M$ = MA$ + ME$ + MM$ + MS$
M0	Import of goods and services at base-year prices	$m	M0 = MA0 + ME0 + MM0 + MS0
MA$	Imports of primary commodities	$m	behavioral [price behavior]
MA0	Imports of primary commodities at base-year prices (adjusted)	$m	MA0 = MAU0.XAW0/MAUW0
MAU0	Imports of primary commodities at base-year prices (unadjusted)	$m	MAU0 = XA0 - BAU0
ME$	Imports of energy products	$m	behavioral [price behavior]
ME0	Imports of energy products at base-year	$m	behavioral [product mix]
mh	Import content of domestic expenditure	ratio	mh = M0/(pp0.H + vx.X0)
MIT$	Income paid abroad	$m	MIT$ = XITU$ - BITU$
MM$	Imports of manufactures	$m	behavioral [trade policy]
MM0	Imports of manufactures at year prices (adjusted)	$m	MM0 = MMU0.XMW0/MMUW0
MMU0	Imports of manufactures at year prices (unadjusted)	$m	behavioral [price behavior]
MS$	Imports of services	$m	behavioral [trade policy]
MS0	Imports of services at base-year prices (adjusted)	$m	MS0 = MSU0.XSW0/MSUW0

Symbol	*Definition of variables*	*Units*	*Measurements*
MSU0	Imports of services at base-year prices (unadjusted)	$m	behavioral [price behavior]
N	Total population	millions	N = N(-1) + DNN + NIM
NCP	Child population	millions	exogenous
NE	Employment (full-time equivalent)	millions	behavioral [labour market]
NFF	Bank deposits less loans at end year	$m	NFF = R$/rx + LGF + - AGF
NFI	Covered bank lending	$m	behavioral [confidence]
NGF	Government investment and deposits with banks less outstanding debt at end year	$m	NGF = NLG + AGF(-1) + HAGF – IAGO – LG(-1).rpfa
NGI	Covered government debt	$m	behavioral [monetary policy]
NIM	Net migration (adjusted)	millions	NIM = NIMU + NIMUW*(NIMU - abs(NIMU))/(sum(abs(NIMU)) - NIMUW)
NIMU	Net migration (unadjusted)	millions	behavioral [labour market]
NIT$	Net income and transfers (adjusted)	$m	NIT$ = min(XIT$, MIT$)
NITU$	Net income and transfers (unadjusted)	$m	behavioral [external policy]
NLG	Government net lending	$m	NLG = YG – G
NLP	Private net lending	$m	NLP = SP - IP - IV
NOP	Elderly population	millions	exogenous
NUR	Urban population	millions	behavioral [trend]
NWP	Working age population	millions	NWP = N - NCP - NOP
NX$	External position	$m	NX$ = R$ + NXF$
NXF$	External position at end year excluding exchange reserves (adjusted)	$m	NXF$ = AXO$ - LX$
NXFU$	External position at end year excluding exchange reserves (unadjusted)	$m	NXFU$ = CA$ - IR$ + AXO$(-1) .rpaxou$ - LX$(-1).rplx$
NXI$	Covered external position excluding exchange reserve transactions	$m	behavioral [confidence]
NXN$	Covered external position including exchange reserve transactions	$m	NXN$ = min(R$ + AXO$, LX$)
paw	World price of primary commodities	index	behavioral [global markets]
paw$	World dollar price of primary commodities	index	paw$ = paw.phw
pewmax	Oil price ceiling	index	constant (assumed level at which demand and supply elasticities become infinite)
pew	World price of oil	index	market-clearing price (equalizes EDW and EPW)

Symbol	*Definition of variables*	*Units*	*Measurements*
pew$	World dollar price of oil	index	pew$ = pew.phw
ph	Dollar price of domestic expenditure	ratio	ph = rx.phw
phd	Domestic price index	index	phd = phd(-1)(1+pi/100)
phw	World dollar price of expenditure	ratio	phw = phw(-1).(1+pi_us/100).rx_us(-1)/rx_us
pi	Domestic currency price inflation	% p.a.	pi = 100((1+pvi/100).(tt(-1)/tt)-1)
piw	World average domestic currency price inflation	% p.a.	piw = sum(pi.H)/HW
piw$	World dollar price inflation	% p.a.	piw$ = 100 (phw/phw(-1) - 1)
pkp	Price of capital (ratio of value of capital including land to produced capital stock)	deflator	behavioral [confidence]
pmm$	Price of imports of manufactures	deflator	ppm$ = MM$/MM0
pmm0	Average supplier price for imports of manufactures	deflator	ppm0 = sum(sxm*(XM$/XM0)*(XM0(-1)/XM$(-1))
pp0	Base-year ppp adjustment	ratio	constant
pp0w	World base-year ppp adjustment	ratio	constant
pvd	Domestic cost index	index	pvd = pvd(-1)(1+pvi/100)
pvi	Domestic cost inflation	% p.a.	behavioral [supply, incomes policy]
pxm$	Price of exports of manufactures	index	pxm$ = XM$ / XM0
R$	Exchange reserves at end year	$m	behavioral (monetary policy)
rmlx$	Ratio of exchange reserves to imports and external liabilities	%	rmlx$ = 100 R$/(M$ + LX$)
rpax$	Valuation ratio for external assets brought forward	$m	rpax$ = rpr$.r$(-1) + rpaxo$.axo$(-1))/(r$(-1)+ AXO$(-1))
rpaxo$	Valuation ratio for other external assets brought forward (adjusted)	$m	(AXO$-IAXO$)/AXO$(-1)
rpaxou$	Valuation ratio for other external assets brought forward (unadjusted)	$m	behavioral [price movements]
rpfa	Valuation ratio for domestic financial assets brought forward	ratio	rpfa = 1/(1+spvi) [assumption]
rpkp	Valuation ratio for capital stock brought forward	ratio	rpkp = pkp/pkp(-1)
rplgo	Valuation ratio for non-bank holdings of government debt brought forward	ratio	rplgo = slgx.ph(-1)/ph + (1- slgx).rpfa
rplx$	Valuation ratio for external liabilities brought forward	ratio	behavioral [price movements]
rpr$	Valuation ratio for exchange reserves brought forward	ratio	behavioral [price movements]
rrf	Bank reserves as percent of lending	%	rrf = 100 LGF/LN

Symbol	*Definition of variables*	*Units*	*Measurements*
rx	Real exchange rate (adjusted)	ratio	rx = rxu pp0w.HW/sum(H.rxu)
rxd	Nominal exchange rate	index	rxd = rxd(-1)(1+rxna/100)
rxna	Nominal exchange rate appreciation	% p.a.	rxna = 100((ph/ph(-1))/(1+pi/100)-1)
rxu	Real exchange rate (unadjusted)	ratio	behavioral [monetary policy, confidence]
slgx	Proportion of government debt financed in foreign currency	ratio	slgx = 1 - log(1+YR)/2 [assumption]
SP	Private saving	$m	behavioral [confidence]
spvi	Inflation indicator	log	spvi = log(-0.718 + 3.436(1+pvi/100) /(2+pvi/100))
sxm	Market share of exports of manufactures in imports of each destination bloc (adjusted)	ratio	sxm = sxmu / sum(sxmu)
sxmm	Percent share of world exports of manufactures	%	sxmm = 100.XM$/MMW$
sxmu	Market share of exports of manufactures in imports of each destination bloc (unadjusted)	ratio	behavioral [trade policy]
TB$	Trade balance	$m	TB$ = X$ - M$
TB0	Trade balance at base year prices	$m	TB0 = X0 - M0
tt	Terms of trade effect	ratio	tt = (H+TB$/rx) /(H+TB0/pp0)
ucx	Unit cost of exports	ratio	ucx = 2.mh.M$/M0 + (rx.H + X$-M$)(1-2.mh) / (pp0.V)
ucx$	Unit cost of exports (international purchasing power)	ratio	ucx$ = mh.vx.M$/M0 + (1-mh.vx).rx/pp0
V0	GDP at base-year exchange rates	$m	V0 = V.pp0
V	GDP volume	$m	V = H + TB0/pp0
VN	GDP per capita	$	VN = V / N
VNE	GDP per employed person	$	VNE = V / NE
VT	Productive capacity	$m	VT = 1.05 movav(V,6) .(V/V(-6))^0.3
VV	Domestic purchasing power of GDP	$m	VV = H + TB$/rx
VV$	External purchasing power of GDP	$m	VV$ = H.rx + TB$
vx	Import content of exports relative to import content of domestic expenditure	ratio	vx = 2 + (X0-M0)/(pp0.V) [assumption]
wln	Write-off rate for bank loans	% p.a.	exogenous [confidence]
WLNA	Lagged loan write-offs	$m	WLNA = 0.8 LN(-1).wln.rpfa + 0.2 WLNA(-1)
WP	Private wealth at end-year	ratio	WP = KP + LGO–AGO + DP–LN + (AXO$-LX$)/rx
X$	Exports of goods and services	$m	X$ = XA$ + XE$ + XM$ + XS$
X0	Exports of goods and services at base-year prices	$m	X0 = XA0 + XE0 + XM0 + XS0

Symbol	*Definition of variables*	*Units*	*Measurements*
XA$	Exports of primary commodities (adjusted)	$m	XA$ = XAU$.MAW$/XAUW$
XA0	Exports of primary commodities at base-year prices	$m	behavioral [trade policy]
XAU$	Exports of primary commodities (unadjusted)	$m	behavioral [price behavior]
XE$	Exports of energy products	$m	XE$ = XEU$.MEW$/XEUW$
XE0	Exports of energy products at base-year prices (adjusted)	$m	XE0 = XEU0.MEW0/XEUW0
XEU$	Exports of energy products (unadjusted)	$m	behavioral [price behavior]
XEU0	Exports of energy products at base- year prices (unadjusted)	$m	behavioral [product mix]
XIT$	Income and transfers from abroad (adjusted)	$m	XIT$ = XITU$.MITW$/XITUW$
XITU$	Income and transfers from abroad (unadjusted)	$m	XITU$ = NITU$ + max(BITU$, 0)
XM$	Exports of manufactures	$m	XM$ = sum(sxm.MM$)
XM0	Exports of manufactures at base-year prices	$m	behavioral [price behavior]
XS$	Exports of services (adjusted)	$m	XS$ = XSU$.MSW$/XSUW$
XS0	Exports of services at base-year prices	$m	behavioral [price behavior]
XSU$	Exports of services (unadjusted)	$m	XSU$ = BSU$ + MS$
Y	National income (domestic purchasing power)	$m	Y = H + CA$/rx
Y$	National income (international purchasing power)	$m	Y$ = Y / rx
YG	Government net income	$m	behavioral [fiscal policy]
YN	Income per capita	$m	YN = Y / N
YP	Private disposable income	$m	YP = Y - YG
YR	Relative income per capita	$m	YR = YN / YNW

APPENDIX B ESTIMATION RESULTS

By taking the full sample data from 1980 to 2008 with the four models of estimation, although some are not, most of coefficients on these explanatory variables are statistically significant at 5% as the calculated t-value exceeds the critical t-value. However, it is worth nothing that for theoretical and empirical reasons there are some restrictions on the coefficients in a few cases, for example, imposing a specific and appropriate value on some coefficient, re-estimating some coefficient by using more recent sample data. The following estimated equations demonstrate the selected model for each behavioral equation eventually applied to the simulation. Figures written with asterisk (*), double asterisk (**) and in bold indicate statistically significant coefficients at 5%, 10%, and imposed coefficients, respectively.

Income and expenditure

Private sector: *1) private saving; 2) private investment; 3) changes in inventory;*

$$\Delta\frac{\boldsymbol{SP_{it}}}{\boldsymbol{YP_{it-1}}} = 0.026^{*}{}_{i} + (\boldsymbol{-0.2})\frac{SP_{it-1}}{YP_{it-2}} + (0.661^{*})\frac{\Delta YP_{it}}{YP_{it-1}} + (\boldsymbol{-0.008})\frac{\Delta WP_{it-1}}{WP_{it-2}} + (0.081^{*})spvi_{it} + (\boldsymbol{0.07})irs_{it-1} + (0.043)AR(1) \quad (1)$$

$$\Delta\log\frac{IP_{it}}{V_{it-1}} = -0.146^{*} + (-0.069^{*})\log\frac{IP_{it-1}}{V_{it-2}} + (\boldsymbol{0.5})\Delta\log V_{it} + (0.058)\frac{ILN_{it-1}}{V_{it-1}} + (\boldsymbol{-0.2})irm_{it} + (0.207^{*})AR(1) \quad (2)$$

$$\Delta\frac{\boldsymbol{IV_{it}}}{\boldsymbol{V_{it-1}}} = -0.003^{*}{}_{i} + (-0.774^{*})\frac{IV_{it-1}}{V_{it-2}} + (0.156)\Delta\log V_{it} + (\boldsymbol{0.05})\Delta\frac{ILN_{it}}{V_{it-1}} + (\boldsymbol{0.05})\frac{ILN_{it-1}}{V_{it-1}} + (\boldsymbol{-0.013})irs_{it} + (0.035)AR(1) \quad (3)$$

Government sector: 4) government income; 5) government expenditure

$$\frac{\Delta\boldsymbol{YG_{it}}}{\boldsymbol{Y_{it-1}}} = 0.02^{*}{}_{i} + (-0.168^{*})\frac{YG_{it-1}}{Y_{it-1}} + (0.204^{*})\frac{\Delta Y_{it}}{Y_{it-1}} + (0.041^{*})\frac{\Delta Y_{it-1}}{Y_{it-1}} + (0.016^{*})\frac{LG_{it-1}}{Y_{it-1}} + (\boldsymbol{-0.2})irm_{it-1} \cdot \frac{LG_{it-1}}{Y_{it-1}} + (-0.001)AR(1) \quad (4)$$

$$\Delta\boldsymbol{\log G_{it}} = -0.187_{i} + (-0.033^{*})\log G_{it-1} + (0.069^{*})\Delta\log YG_{it} + (0.321^{*})\frac{YG_{it-1}}{Y_{it-1}} + (0.108^{*})\log N_{it-1} + (-0.026^{*})\log\frac{LG_{it-1}}{Y_{it-1}} + (0.179^{*})\frac{CA\$_{it-1}}{Y\$_{it-1}} + (-0.033^{*})AR(1) \quad (5)$$

The current account

Trade in primary commodities: *6) net exports of primary commodities (vol.); 7) exports of primary commodities (vol.); 8) exports of primary commodities (val.); 9) imports of primary commodities (val.); 10) world price of primary commodities;*

$$\frac{\Delta\boldsymbol{BAU0_{it}}}{\boldsymbol{V_{it-1}}} = 0.002^{*}{}_{i} + (\boldsymbol{-0.05})\frac{\Delta V_{it}}{V_{it-1}} + (0.002)\Delta lpa_{it-1} + (0.044)AR(1) \quad (6)$$

$$\frac{\Delta XA0_{it}}{V_{it-1}} = 0.0002^{*} + (0.932^{*})\frac{\Delta(\max\{BAU0_{it}, 0\})}{V_{it-1}} + (0.104)AR(1) \quad (7)$$

$$\Delta\log\frac{XAU\$_{it}}{XA0_{it}} = -0.012^{*} + (0.907^{*})\Delta\log(paw_{t}) + (0.444^{*})\Delta\log\frac{rx_{it}}{pp0_{i}} + (-0.08)AR(1) \quad (8)$$

$$\Delta\log\frac{MA\$_{it}}{MA0_{it}} = -0.009^{*} + (0.825^{*})\Delta\log(paw_{t}) + (0.317^{*})\Delta\log\frac{rx_{it}}{pp0_{i}} + (-0.078)AR(1) \quad (9)$$

$$\Delta\log(paw_t) = 0.151^{*} + (-0.172^{*})\log(paw_{t-1}) + (2.465^{*})\Delta\log VW_t + (-0.012^{*})logVW_{t-1} + (0.447)AR(1) \quad (10)$$

Trade in energy: *11) exports of energy (vol.); 12) imports of energy (vol.); 13) exports of energy (val.); 14) imports of energy (val.);*

$$\Delta\log\frac{\boldsymbol{XEU0_{it}}}{\boldsymbol{EX_{it}}} = 1.721^{*}{}_{i} + (-0.296^{*})\log\frac{XE0_{it-1}}{EX_{it-1}} + (-0.022)AR(1) \quad (11)$$

$$\Delta\log\frac{\boldsymbol{ME0_{it}}}{\boldsymbol{EM_{it}}} = 1.36^{*}{}_{i} + (-0.232^{*})\log\frac{ME0_{it-1}}{EM_{it-1}} + (-0.063)AR(1) \quad (12)$$

$$\Delta\log\frac{XE\$_{it}}{XE0_{it}} = -0.015^{*} + (1.066^{*})\Delta\log(pew_t) + (-0.089)AR(1) \quad (13)$$

$$\Delta\log\frac{ME\$_{it}}{ME0_{it}} = -0.005 + (0.941^{*})\Delta\log(pew_t) + (0.016)AR(1) \quad (14)$$

Energy demand and supply: *15) energy demand; 16) carbon-based energy production; 17) non-carbon energy production; 18) energy imports; 19) CO2 emissions;*

$$\Delta\log\frac{\boldsymbol{ED_{it}}}{\boldsymbol{N_{it}}} = -0.067^{*}{}_{i} + (-0.034^{*})\log\frac{ED_{it-1}}{N_{it-1}} + (0.385^{*})\Delta\log\frac{V_{it}}{N_{it}} + (-0.032^{*})\Delta lped_{it} + (0.144)\Delta\log(tt_{it}) + (0.056^{*})\Delta\log X0_{it} + (0.188)\frac{IV_{it}}{V_{it-1}} + (0.118^{*})\log(1 + YR_{it-1}) + (0.006)AR(1) \quad (15)$$

$$\Delta\log\boldsymbol{EPC_{it}} = -0.005^{*}{}_{i} + (1.038^{*})\Delta\log(ED_{it} - EPN_{it}) \cdot min\left\{\frac{ED_{it-1} - EPN_{it-1}}{EP_{it-1}}, 1\right\} + (0.019^{*})\Delta(lpep_{it}) + (0.285^{*})AR(1) \quad (16)$$

$$\Delta\log\frac{\boldsymbol{EPN_{it}}}{\boldsymbol{mavg\{ED_{it-1}, 4\}}} = -0.335^{*}{}_{i} + (-0.147^{*})\log\frac{EPN_{it-1}}{mavg\{ED_{it-2}, 4\}} + (0.184^{*})\Delta\log(ED_{it}) + (0.036^{*})(lpep_{it-1}) + (-0.027)\Delta(lpep_{it-1}) + (0.078)AR(1) \quad (17)$$

$$\Delta\log\boldsymbol{EM'_{it}} = 0.147^{*}{}_{i} + (-0.029^{*})\log EM'_{it-1} + (0.449)\Delta\log EPW_t + (0.057)AR(1)$$

where $EM'_{it} = \begin{cases} EM_{it} - (ED_t - EP_{it}) & ; ED_{it} > EP_{it} \\ EM_{it} & ; otherwise \end{cases}$ (18)

$$\Delta\frac{\boldsymbol{CO2_{it}}}{\boldsymbol{V_{it}}} = 0.00002^{*}{}_{i} + (-0.066^{*})\Delta\frac{CO2_{it-1}}{V_{it-1}} + (0.986^{*})\Delta\frac{ED_{it} - EPN_{it}}{V_{it}} + (0.056^{*})\frac{ED_{it-1} - EPN_{it-1}}{V_{it-1}} + (-0.00005)\frac{\Delta V_{it}}{V_{it-1}} + (0.038)AR(1) \quad (19)$$

Trade in manufactures: *20) exports of manufactures (vol.); 21) imports of manufactures (vol.); 22) imports of manufactures (val.); 23) market shares of exports of manufactures;*

$$\Delta\log\frac{\boldsymbol{XM0_{it}}}{\boldsymbol{XM\$_{it}}} = -0.016^{**}{}_{i} + (-0.136^{*})\log\frac{XM0_{it-1}}{XM\$_{it-1}} + (-0.074^{*})\log(ucx\$_{it-1}) + (-0.043)AR(1) \quad (20)$$

$$\Delta\log\frac{\boldsymbol{MMU0_{it} \cdot pmm0_{it}}}{\boldsymbol{MM\$_{it}}} = 0.0008_i + (-0.132^{*})\log\frac{MM0_{it-1} \cdot pmm0_{it-1}}{MM\$_{it-1}} + (0.058)\Delta\log(pmm0_{it}) + (-0.244^{*})\Delta\log(rx_{it}) + (0.05)AR(1) \quad (21)$$

$$\Delta\log \boldsymbol{MM\$_{it}} = 0.111_i + (-0.147^*)\log MM\$_{it-1} + (0.004^*)trend + (\mathbf{1})\Delta\log MH\$_{it} + (-0.125^*)\Delta\log(rx_{it}) + (0.106^*)\log MH\$_{it-1} + (-0.005)\log(pmm0_{it-1}) + (0.189^*)AR(1) \quad (22)$$

$$\Delta\log(\boldsymbol{sxm_{it}}) = -0.123^*{}_i + (-0.064^*)\log(sxm_{it-1}) + (-0.176^*)\log(ucx\$_{it-1}) + (-0.075^{**})\Delta\log(ucx\$_{it-1}) + (0.079)AR(1) \quad (23)$$

Trade in services: *24) exports of services (vol.); 25) imports of services (vol.); 26) net exports of services (val.); 27) imports of services (val.);*

$$\Delta\log\frac{\boldsymbol{XS0_{it}}}{\boldsymbol{XS\$_{it}}} = -0.005_i + (-0.029)\log\frac{XS0_{it-1}}{XS\$_{it-1}} + (-0.539^*)\Delta\log(rx_{it}) + (-0.1)AR(1) \quad (24)$$

$$\Delta\log\frac{\boldsymbol{MSU0_{it}}}{\boldsymbol{MS\$_{it}}} = -0.002_i + (-0.041)\log\frac{MS0_{it-1}}{MS\$_{it-1}} + (-0.312^*)\Delta\log(rx_{it}) + (-0.052)AR(1) \quad (25)$$

$$\frac{\Delta BSU\$_{it}}{V_{it-1}} = (-0.003^*)\Delta\log(rx_{it}) + (0.021)\frac{\Delta BA\$_{it}}{V_{it-1}} + (-0.043^*)\frac{\Delta BE\$_{it}}{V_{it-1}} + (0.077^*)\frac{\Delta BM\$_{it}}{V_{it-1}} + (0.107^*)AR(1) \quad (26)$$

$$\frac{\Delta MS\$_{it}}{V_{it-1}} = 0.0005^* + (0.003^*)\Delta\log(rx_{it}) + (0.657^*)\frac{\Delta\min\{BSU\$_{it}, 0\}}{V_{it-1}} + (0.089^{**})\frac{\Delta MA\$_{it}}{V_{it-1}} + (0.036^*)\frac{\Delta XE\$_{it}}{V_{it-1}} + (0.12^*)\frac{\Delta MM\$_{it}}{V_{it-1}} + (0.208^*)AR(1) \quad (27)$$

External income and transfers: *28) net income and transfers from abroad; 29) net income and transfers;*

$$\frac{\Delta\boldsymbol{BITU\$_{it}}}{\boldsymbol{Y\$_{it-1}}} = -0.0008^*{}_i + (-0.049)\frac{BIT\$_{it-1}}{Y\$_{it-1}} + (0.008^{**})\frac{\Delta NX\$_{it}}{Y\$_{it-1}} + (-0.018)\frac{NX\$_{it-1}}{Y\$_{it-1}}\cdot im_{t-1}^{US} + (0.019)AR(1) \quad (28)$$

$$\Delta\log\boldsymbol{NITU\$_{it}} = 0.279_i + (-0.127)\log NIT\$_{it-1} + (1.083)\Delta\log XW\$_t + (0.078)\log NXN\$_{it-1} + (0.174)AR(1)$$

$$\text{where} \quad NIT\$_{it} = \begin{cases} XIT\$_{it} & ; XIT\$_{it} \le MIT\$_{it} \\ MIT\$_{it} & ; XIT\$_{it} > MIT\$_{it} \end{cases} \quad (29)$$

The financial sectors: flows of fund, holding gains and balances

Government debt and asset transactions: *30) covered government debt; 31) non-bank holdings of government debt; 32) other government asset transactions;*

$$\Delta\log\boldsymbol{NGI_{it}} = 0.252_i + (-0.141^*)\log NGI_{it-1} + (0.942^*)\Delta\log Y_{it} + (0.109^*)\log\frac{R\$_{it-1}}{rx_{it-1}} + (0.039)AR(1)$$

$$\text{where} \quad NGI_{it} = \begin{cases} AGF_{it} & ; AGF_{it} \le LG_{it} \\ LG_{it} & ; AGF_{it} > LG_{it} \end{cases} \quad (30)$$

$$\Delta\log\frac{\boldsymbol{LGO_{it}}}{\boldsymbol{LG_{it}}} = 0.0003_i + (-0.009)\Delta\log\frac{DP_{it-1}}{Y_{it-1}} + (0.108^*)AR(1) \quad (31)$$

$$\frac{\boldsymbol{IAGO_{it}}}{\boldsymbol{Y_{it-1}}} = 0.037^*{}_i + (-0.028^*)\frac{LG_{it-1}}{Y_{it-1}} + (\mathbf{0.2})\frac{NLG_{it}}{Y_{it-1}} + (0.352^*)AR(1) \quad (32)$$

The external position: *33) exchange reserves; 34) covered external position (excl. exchange reserves);*

$$\Delta\log\frac{\boldsymbol{R\$_{it}}}{\boldsymbol{rx_{it}\cdot Y_{it-1}}} = -0.628^*{}_i + (0.925^*)\log(rpr\$_{it}) + (1.579^*)\frac{CA\$_{it}}{Y\$_{it-1}} + (-1.076^*)\frac{CA\$_{it-1}}{Y\$_{it-1}} + (0.175^*)AR(1) \quad (33)$$

$$\Delta\log\frac{\boldsymbol{NXI\$_{it}}}{\boldsymbol{rx_{it}\cdot Y_{it-1}}} = 0.238_i + (-0.015)\log Y_{it-1} + (-0.242)\Delta\log Y_{it-1} + (-0.031)\Delta\log R\$_{it-1} + (-0.766)\Delta\log(1+YR_{it-1}) + (0.004)AR(1) \quad (34)$$

where $NXI\$_{it} = \begin{cases} AXO\$_{it} & ; AXO\$_{it} \le LX\$_{it} \\ LX\$_{it} & ; AXO\$_{it} > LX\$_{it} \end{cases}$

The real exchange rate: *35) real exchange rate;*

$$\Delta\log(\boldsymbol{rxu_{it}}) = -0.307^*_i + (-0.546^*)\log(rx_{it-1}) + (\mathbf{0.3})\frac{CA\$_{it-1}}{NXI\$_{it-1}+M\$_{it-1}} + (\mathbf{0.1})\frac{NX\$_{it-1}}{Y\$_{it-1}} + (0.082^*)\Delta spvi_{it-1} + (-0.506^*)\Delta\log(phw_t) + (0.645^*)AR(1) \quad (35)$$

Valuation of external position: *36) valuation for exchange reserves; 37) valuation for other external assets; 38) valuation for external liabilities;*

$$\log(rpr\$_{it}) = 0.703^* + (-0.389^*)\Delta\log(phw_t) + (0.481^*)AR(1) \quad (36)$$

$$\log(rpaxou\$_{it}) = 0.4^* + (-0.36^*)\Delta\log(phw_t) + (0.371^*)AR(1) \quad (37)$$

$$\log(rplx\$_{it}) = 0.405^* + (-0.36^*)\Delta\log(phw_t) + (0.109)\Delta\log(pkp_{it}) + (0.434^*)AR(1) \quad (38)$$

The domestic banking system: *39) covered bank lending;*

$$\Delta\log\frac{\boldsymbol{NFI_{it}}}{\boldsymbol{Y_{it-1}}} = -0.64^{**}_i + (-0.081^*)\log\frac{NFI_{it-1}}{Y_{it-1}} + (0.771)\frac{\Delta LGF_{it}}{Y_{it-1}} + (0.256^*)\frac{\Delta NFF_{it}}{NFI_{it-1}} + (\mathbf{0.3})\Delta\log Y_{it} + (0.063)\frac{NFF_{it}}{NFI_{it-1}} + (0.035)\log Y_{it-1} + (0.068^*)\frac{R\$_{it-1}+NXI\$_{it-1}}{Y\$_{it-1}} + (-\mathbf{4})\frac{WLNA}{LN_{it-1}} + (0.088)AR(1) \quad (39)$$

where $NFI_{it} = \begin{cases} DP_{it} & ; DP_{it} \le LN_{it} \\ LN_{it} & ; DP_{it} > LN_{it} \end{cases}$

Interest rates, capacity utilization, and inflation

Interest rates: *41) short-term interest rate; 42) bond rate;*

$$\Delta\log(\boldsymbol{is_{it}}) = -0.08^*_i + (-0.28^*)\log(is_{it-1}) + (0.275^*)\Delta\log(pvi_{it}) + (0.175^*)\log(pvi_{it-1}) + (0.292^*)\log\frac{V_{it}}{VT_{it}} + (0.065)AR(1) \quad (41)$$

$$\log(\boldsymbol{im_{it}}) = 0.089^*_i + (0.105^*)\log(is_{it-1}) + (0.109^*)\Delta\log(is_{it}) + (0.86^*)\Delta\log(pvi_{it}) + (0.89^*)\log(pvi_{it-1}) + (0.578^*)AR(1) \quad (42)$$

Cost inflation: *43) domestic cost inflation;*

$$\Delta\log(\boldsymbol{pvi_{it}}) = -0.72^*_i + (-0.181^*)\log(pvi_{it-1}) + (0.146^*)\Delta\frac{V_{it}}{VT_{it}} + (-0.226^*)\Delta\log(rx_{it}) + (\mathbf{0.05})\Delta\log\frac{pew_t}{rx_{it}} + (-0.167^*)AR(1) \quad (43)$$

where $VT_{it} = (1+\sigma)\cdot \text{mavg}\{V_{it}, 6\}\cdot e^{\left\{\delta\cdot\log\frac{V_{it}}{V_{it-6}}\right\}}$

Employment, urbanization, and migration: *44) employment; 45) urban population; and 46) net migration*

$$\Delta\mathbf{log}\frac{\boldsymbol{NE_{it}}}{\boldsymbol{LS_{it}}} = -0.036^{*}{}_{i} + (0.505^{*})YR_{it-1}\cdot\Delta\log V_{it} + (0.196^{*})YR_{it-1}\cdot\Delta\log V_{it-1} + (0.143)\Delta\log\frac{NUR_{it-1}}{N_{it-1}} + (-0.044)AR(1) \quad (44)$$

$$\Delta\mathbf{log}\frac{\boldsymbol{NUR_{it}}}{\boldsymbol{N_{it}}} = 0.031^{*}{}_{i} + (-0.001)\log\frac{V_{it-1}}{N_{it-1}} + (0.75^{*})AR(1) \quad (45)$$

$$\Delta\mathbf{log}\left(\mathbf{1}+\frac{\boldsymbol{NIMU_{it}}}{\boldsymbol{NE_{it-1}}}\right) = -0.001^{*}{}_{i} + (\mathbf{0.02})\Delta\log NWP_{it-1} + (\mathbf{0.04})\Delta\log NE_{it} + (0.5^{*})AR(1) \quad (46)$$

BIOGRAPHY

Nuchit Pruektanakul was born on 11 February 1987 in Songkhla, Thailand. He achieved a Bachelor's Degree in Statistics, specializing in Applied Statistics at the Faculty of Commerce and Accountancy of Chulalongkorn University, Thailand in 2008. During academic breaks he got chances to do an internship at Kim Eng Securities (Thailand) PLC. and United Overseas Bank Asset Management (Thai) Co., Ltd. After graduated, he immediately registered to undertake a Master's Degree in International Economics and Finance at the Faculty of Economics of Chulalongkorn University, Thailand. (E-mail: nuchit.pr@gmail.com)