ADBI Working Paper Series

International Monetary Transmission and Exchange Rate Regimes: Floaters vs. Non-Floaters in East Asia

Soyoung Kim and

Doo Yong Yang

No. 181
December 2009

Asian Development Bank Institute

Soyoung Kim is a professor of economics at Seoul National University. Doo Yong Yang is a research fellow at ADBI. This paper was prepared for "Global Financial Crisis: A Conference on Macroeconomic Policy Issues," held at ADBI 28–29 July 2009. The authors thank Michael Plummer, Hans Genberg, Shinji Takagi, and Reimund Soto, and other conference participants.

The Working Paper series is a continuation of the formerly named Discussion Paper series; the numbering of the papers continued without interruption or change. ADBI's working papers reflect initial ideas on a topic and are posted online for discussion. ADBI encourages readers to post their comments on the main page for each working paper (given in the citation below). Some working papers may develop into other forms of publication.

Suggested citation:

Kim, S., and D. Y. Yang. 2009. International Monetary Transmission and Exchange Rate Regimes: Floaters vs. Non-Floaters. ADBI Working Paper 181. Tokyo: Asian Development Bank Institute. Available: http://www.adbi.org/working-paper/2009/12/18/3422.intl.money.trans.exchange.rate.regimes/

Asian Development Bank Institute
Kasumigaseki Building 8F
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

Abstract

This paper analyzed the impact of United States (US) monetary shocks on the economies of selected East Asian countries using a structural vector autoregression model. We found that the impacts of the US monetary shocks on domestic interest rates and exchange rates contradict conventional wisdom. The conventional exchange rate channel is unlikely to play much role in the transmission of US monetary policy shocks to floating exchange rate regimes in East Asian countries, excluding Japan. In these countries, the domestic interest rate responds strongly to US interest rate changes, largely by authorities giving up monetary autonomy due to fear of floating. On the other hand, the domestic interest rate does not respond much to changes in US rates in the countries with a fixed exchange rate regime and capital account restrictions, such as the People's Republic of China and Malaysia. This may suggest that the countries with a fixed exchange rate regime enjoy a higher degree of monetary autonomy, probably with the help of capital account restrictions.

JEL Classification: F33, F32

Contents

1. INTRODUCTION

The changes in the United States (US) interest rates have a strong impact on economic conditions in other countries. With the increasing globalization of most countries in the world, the influence of the US monetary shocks has been a major concern in developed as well as developing countries. The international monetary transmission has a long history of debate. The Mundell-Fleming framework shows that a monetary expansion raises domestic production and income, but the monetary expansion induced boom at home is found to be at the expense of the foreign country, through the expenditure-switching mechanism under perfect capital mobility and a floating exchange rate regime. However, empirical evidence shows that the effects of US monetary policy has positive spill-over effects on Non-US Group of Seven countries' output and demand (Kim 2001). In this regard, modern sticky price models can theoretically reproduce the positive spill over effects of US monetary expansion on foreign output (Obstfeld and Rogoff 1995; Betts and Devereux 2001).

However, different transmission channels can be formed in response to external monetary shocks under different exchange rate regimes. A few past studies investigated this issue. Giovanni and Shambaugh (2008) concluded that only in the pegged countries is real gross domestic product (GDP) growth affected by external monetary shocks. Countries with a free floating regime show no relationship between real GDP growth and the base interest rates. They conclude that the main transmission channel is interest rates, in that pegged countries move their interest rates with the base country interest rates while floats do not. Frankel, Schmukler, and Serven (2004) also investigate the transmission of international interest rates to domestic rates depending on the exchange rate regime. They concluded that the full transmission of domestic interest rates occurred in the long run regardless of the exchange rate regime, but that short-run effects differed across different regimes. Moreover, they found that the interest rates of countries with more flexible exchange rate regimes adjust more slowly to changes in international rates, implying some capacity for monetary independence. On the other hand, Miniane and Rogers (2007) found no evidence that countries with more capital controls are less affected by foreign monetary shocks, implying that capital controls do not play a role in international transmission mechanism.

Since the Great Crash of 2008, the question of how a country can mitigate effects from external shocks has been increasingly raised among emerging market economies. East Asian countries have suffered from the shocks that originated with the sub-prime crisis in the US. One interesting area to investigate is how US monetary policy affects East Asia. This is relevant for the choice of exchange rate regime in the region. East Asian countries have various exchange rate regimes, from hard peg to free floating. The question is whether the choice of a different exchange rate regime can result in different spill-over effects from the US monetary shocks. If so, what should Asia take as its desirable exchange rate regime?

To address these questions, this paper examined the effects of US monetary policy shocks on monetary and foreign exchange policy variables and exchange rates. The paper addressed whether interest rates of East Asian countries is unaffected by US interest rate changes, showing monetary policy autonomy, whether US interest rate changes affect the exchange rates of East Asian countries against the dollar, and the foreign exchange reserves changes, reflecting strong foreign exchange intervention, among other issues.

This is an important question in relation to the transmission of US monetary policy shocks, since responses of monetary policy and exchange rates of East Asian countries have crucial implications on the transmission of the US monetary policy changes to East Asian countries. For example, appreciation of East Asian exchange rates following US monetary expansion can make East Asian countries suffer from a negative beggar-thy-neighbor effect. A decrease in East Asian interest rates following US monetary expansion, however, may generate a positive spillover effect to East Asian countries.

In addition, monetary independence has played a central role in the debate over the choice of exchange rate regimes. With capital now being mobile internationally, the policy choice under trilemma remains with either stable exchange rate or monetary independence. Proponents of floaters have argued that floater countries would able to pursue their own independent monetary goals, while advocates of hard peg have questioned the feasibility of such a strategy in a world of highly mobile international capital. On the other hand, even under fixed exchange rate regime, theoretically the monetary independence can be secured with the help of capital account restrictions.

To examine this issue, we employed the structural Block-Exogenous vector autoregression (VAR) model. The structural VAR model is useful to identify the US monetary policy shocks, which is the focus of this paper. On the other hand, the Block-Exogenous VAR model in which the US variables are exogenous to variables of East Asian countries is used since most East Asian countries can be regarded as small, open economies that have a minor effect the US or global economic conditions. The use of block-exogenous VAR modeling also helps to save the degree of freedom.

2. EXCHANGE RATE REGIMES, MONETARY POLICY AND CAPITAL RESTRICTIONS IN ASIA

This section describes exchange rates, monetary policy rules and capital control or restriction in select Asian countries. This is important to understand the monetary transmission mechanism and policy reactions since international monetary policy transmission and most policy options are endogenously determined by the institutional arrangements in each country.

2.1 Exchange Rate Regimes

Before the 1997 Asian financial crisis, most East Asian currencies were pegged to the US dollar with different degrees of fixity. After the crisis, however, affected countries tended to move toward freer-floating exchange rate regimes and to liberalize capital and foreign exchange markets. In addition, other emerging economies that had previously chosen relatively fixed exchange rate regimes also moved toward less fixed regimes.

In the meantime, some have argued that when the crisis subsided, some countries moved toward a less flexible exchange rate system due to difficulties in maintaining a floating exchange rate regime. Indeed, there is growing recognition that the exchange rate regime a country declares often differs from its operational regime (Calvo and Reinhart 2002), Even though crisis-hit countries in East Asia including the Republic of Korea (hereafter Korea), Indonesia, Thailand, as well as non-crisis countries such as Singapore and Taipei,China, officially announce free-floating exchange rate regimes, most of them actually have a substantially less flexible exchange rate than is officially announced, due to a fear of floating.

The International Monetary Fund (IMF) exchange rate classification has had a long history of comprehensive and frequent updating. The original IMF exchange rate regime classification categorized members' exchange rate regimes based on their official announcements. From 1975 to 1998, depending on their own official declaration of the degree of exchange rate flexibility, countries' exchange rate regimes were classified into three basic categories—pegs, limited flexibility (usually within a band or cooperative arrangement), and greater flexibility (managed or free floats)—that were further divided into 15 subcategories. However, the IMF classification did not reflect the true exchange rate regime of a specific country, as exchange rate regimes often differed from what the authorities officially declared them to be.

Recognizing this problem, the IMF moved to a more de facto classification system in January 1999. The new system combines available information on exchange rate and

monetary policies and formal or informal policy intentions with data on actual exchange rate and reserves movements to reach a judgment on the actual exchange rate regime (IMF 1999). The new system classifies exchange rate regimes into eight categories: a regime with no separate legal tender, currency boards, conventional fixed (pegged against a single currency or a basket of currencies), pegged exchange rates within horizontal bands, crawling pegs, crawling bands, managed floating with no predetermined path for the exchange rate, and finally, independent floating. In response, Levy-Yeyati and Sturzenegger (1999) raised a question on the old IMF de jure classification. They constructed a de facto classification based on data on exchange rates and international reserves from all IMF-reporting countries over the period of 1974 to 2000, which they believed provided a meaningful alternative for conducting an empirical analysis of exchange rate regimes. They used three variables related to exchange rate behavior: exchange rate volatility, volatility of exchange rate changes, and volatility of reserves. In line with the de facto classification, Reinhart and Rogoff (2004) attempted to build a non-arbitrary de facto classification, a so-called natural classification. They employed extensive data on market-determined parallel exchange rates, and found that there was a gap between de facto and de jure exchange rate regimes.

Ogawa and Yang (2008) have also investigated the degrees of exchange rate flexibility in Asia. In theory, fixed exchange rate regimes require volatility in reserves, but zero or near-zero volatility in exchange rates. Therefore, the index should be zero or near-zero. On the other hand, free-floating regimes are characterized by substantial volatility in exchange rates with stable reserves. The index for free-floating regimes should be close to 1.

As indicated in Table 1, East Asian exchange rate regimes seem to move toward more flexible exchange rate arrangements both in terms of de jure and de facto classifications after the Asian crisis. However, various exchange arrangements still coexist in the region, from a hard peg (currency board) in Hong Kong, China a fixed regime in the People's Republic of China (PRC) and Malaysia, relatively flexible regimes in Korea, Thailand, and Indonesia, to mostly free-floating in Japan.

Table 1: Exchange Regimes Clarification in Asia

Country	Classification	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
People's Republic of China	IMF	3	3	3	3	3	3	3	3	3	3	3
	Levy	NA	NA	NA	NA	NA	NA	-	-	-		
	RR	4	4	4	4	4	4	4	-	-		
	Flexibility index	-	-	-	-	0.0	0.0	0.0	0.0	0.0		
Indonesia	IMF	7	7	8	8	8	8	7	7	7	7	7
	Levy	Interm*	Interm*	Interm*	Interm	Interm*	Interm*	-	-	-		
	RR	7	7	14/13	14/13	13	13	13				
	Flexibility index	0.015	0.053	0.311	0.652	0.309	0.301	0.593	0.395	0.183		
Japan	IMF	8	8	8	8	8	8	8	8	8	8	8
	Levy	Float	Float	Float	Float	Float	Float	-	-	-		
	RR	13	13	13	13	13	13	13	-	-		
	Flexibility index	0.552	0.283	0.381	0.562	0.363	0.309	0.381	0.272	0.339		
Republic of Korea	IMF	7	7	8	8	8	8	8	8	8	8	8
	Levy	Interm* 2	Fix	Interm*	Interm*	Fix	Fix	-	-	-		
	RR	7	7	14	13	13	13	13	-	-		
	Flexibility index	0.101	0.065	0.408	0.219	0.147	0.107	0.163	0.140	0.100		
Malaysia	IMF	7	7	7	3	3	3	3	3	3	3	3
	Levy	Float2	Interm*2	Float	Interm*	Fix+	Fix+	-	-	-		
	RR	8	8	13	4	4	4	4	-	-		
	Flexibility index	0.193	0.201	0.385	0.351	0.0	0.0	0.0	0.0	0.0		

Philippines	IMF	8	8	8	8	8	8	8	8	8	8	8
	Levy	Float2	Fix2	Float	Float	Float2	Float	-	-	-		
	RR	4	4	14/13	12	12	12	12	-	-		
	Flexibility index	0.323	0.018	0.493	0.591	0.301	0.338	0.288	0.126	0.187		
Singapore	IMF	7	7	7	7	7	7	7	7	7	7	7
	Levy	Fix3	Fix3	Interm*	Float	Float2	Float	-	-	-		
	RR	11	11	11	12	12	12	12	-	-		
	Flexibility index	0.104	0.045	0.268	0.194	0.091	0.078	0.148	0.074	0.086		
Thailand	IMF	3	3	8	8	8	7	7	7	7	7	7
	Levy	Interm* 2	Fix+	Interm*	Intern*	Float	Float	-	-	-		
	RR	4	4	14/13	12	12	12	12	-	-		
	Flexibility index	0.101	0.083	0.278	0.472	0.391	0.371	0.364	0.258	0.272		
Taipei,China	IMF	NA	NA	NA	NA	NA	NA	NA	NA	NA		
	Levy	NA	NA	NA	NA	NA	NA	NA	NA	NA		
	RR	NA	NA	NA	NA	NA	NA	NA	NA	NA		
	Flexibility index	0.284	0.136	0.480	0.517	0.244	0.258	0.243	0.139	0.116		
US (FI)		0.559	0.617	0.246	0.393	0.445	0.490	0.755	0.739	0.840		

Notes: IMF classification (Annual Report on Exchange Arrangements and Exchange Restrictions): Exchange arrangement with no separate legal tender = 1, Currency board arrangement = 2, Conventional pegged arrangement = 3, Pegged exchange rate within horizontal bands = 4, Crawling peg = 5, Crawling band = 6, Managed floating with no pre-announced path = 7, Independently floating = 8.

Levy (Levy-Yeyati and Sturzenegger (1999): NA means that classification variable is not available. Fix+: inconclusive, Fix*: uncontroversial, Interm: dirty, Interm*: dirty/crawling peg, 2: classified in 2nd round, 3: outliers.

RR (Reinhart and Rogoff [2004]): No separate legal tender = 1, Pre-announced peg or currency board arrangement = 2, Pre-announced horizontal band that is narrower than or equal to +/- 2% = 3, De facto peg = 4, Pre-announced crawling peg = 5, Pre-announced crawling band that is narrower than or equal to +/- 2% = 6, De facto crawling peg = 7, De facto crawling peg that is narrower than or equal to +/- 2% = 6, De facto crawling peg = 8, Pre-announced crawling ban that is wide than or equal to +/- 2% = 9, De facto crawling peg that is narrower than or equal to +/- 5% = 10, Moving band that is narrower than or equal to +/- 2% = 11, Managed floating = 12, Free floating = 13, Freely falling = 14.

Flexibility Index (FI): Ogawa and Yang (2008).

2.2 Monetary Policy

Monetary policy is related to exchange rate regimes. As most emerging Asian economies have moved toward more flexible exchange rate regimes, most monetary policies in the region have changed to allow more monetary autonomy, with inflation-targeting policies as an example. According to Stone and Bhundia (2004), after the 1990s, the number of East Asian countries using the fixed exchange rate policy decreased while the number of countries using the inflation-targeting policy increased rapidly. This change has contributed to the stability of prices worldwide and the transition of emerging markets' exchange rate systems from fixed rate to elastic floating rate.

However, East Asian countries still have a variety of monetary policy frameworks. According to Stone and Bhundia (2004), Indonesia, Philippines, Thailand, Korea, and Japan all follow the inflation-targeting framework, even though they differ somewhat in their exchange rate regime. More specifically, based on their IMF classification (IMF various issues) , the Philippines, Korea, and Japan have independently floating exchange rate regimes while Indonesia and Thailand have managed floating exchange rate regimes. Malaysia follows a fixed exchange rate arrangement and does not have an explicitly stated nominal anchor for its monetary policy, but rather monitors various indicators. The PRC targets a monetary aggregate and has a de facto conventional crawling peg exchange rate arrangement. Singapore manages the exchange rate as an intermediate target, a monetary policy framework that has been in place since the early 1980s. Singapore's high import rate and its role as a price-taker in the international markets make Singapore highly susceptible to imported inflation. Thus, Singapore considers the exchange rate to be a more effective tool than the interest rate for stabilizing inflation. This monetary policy framework, however, is considered a variant of inflation targeting (Table 2). Despite having different monetary policy frameworks and exchange rate regimes, countries in the region have generally been able to keep inflation under control even during the crisis years.

Table 2: Monetary Rule Classification in Asia

	1995	1996	1997	1998	1999	2000	2001	2002	2003	most recent (de jure)
People's Republic of China	XRP	XRP	XRP	XRP	XRP	XRP	XRP	XRP	XRP	Monetary aggregate target
Indonesia	ITL	ITL	ITL	ITL	ITL	ITL	ITL	ITL	ITL	Inflation targeting (2005)
Japan	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	Inflation targeting (Price stability)
Republic of Korea	MoA	MoA	ITL	ITL	ITL	ITL	FFIT	FFIT	FFIT	Inflation targeting (2002; CPI)
Malaysia	ITL	ITL	ITL	XRP	XRP	XRP	XRP	XRP	XRP	No explicit nominal anchor
Philippines	XRP	XRP	ITL	ITL	ITL	ITL	ITL	FFIT	FFIT	Inflation targeting (2001; CPI)
Singapore	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	Exchange rate – centered
Thailand	XRP	XRP	ITL	ITL	ITL	FFIT	FFIT	FFIT	FFIT	Inflation targeting (2000;core CPI)

Note: Monetary policy classification : XPR: exchange rate peg; MoA: Monetary Aggregate Anchor; ITL: inflation targeting lite; FFIT: fully fledged inflation targeting; IIT: implicit price stability anchor; CPI: consumer price index.

Source: Stone and Bhundia (2004).

2.3 Capital Restrictions

Capital controls for limiting capital flows are a common tool to mitigate the adverse effects of external shocks in emerging market economies. While capital controls can take a variety of forms, for countries that have substantially liberalized the capital account, more market-

based controls—such as the Chilean unremunerated reserve requirement imposed on capital inflows—have been the predominant option in recent years. Thailand adopted this measure in December 2006, but encountered a severe side effect of rapidly falling stock prices, suggesting that designing and implementing capital inflow control is not an easy task. To these economies, returning to the days of draconian capital controls or recreating a system of extensive administrative controls is no longer an option.

Evidence on the effectiveness of capital inflow controls is mixed. Country experiences suggest that the best market-based controls can be expected to lengthen the maturity of inflows; such controls can have little impact on volume. The effectiveness of capital control measures tends to weaken over time as agents in the markets find ways to circumvent them. At the same time, capital controls can produce adverse effects: they tend to increase domestic financing costs, reduce market discipline, lead to inefficient allocations of financial capital, distort decision-making at the firm level, and can be difficult and costly to enforce. To the extent that capital controls are effective only for relatively short periods of time, such measures might be used at the time of surges of inflows rather than as a permanent measure. But again, effective implementation is not an easy task. Administering capital controls requires highly competent country regulatory authorities as they must constantly look out for unwanted flows—often disguised—entering through other channels.

Countries with significant capital controls have tried easing restrictions on capital outflows in a limited manner to reduce net capital inflows. Easing restrictions on capital outflows is expected to generate some capital outflows, reduce the size of net capital inflows, and hence mitigate the upward pressure on exchange rates. This is the policy that used to be pursued by many emerging market economies in Asia during the capital surges of early 2000s. As these measures are expanded, it must be kept in mind that a more liberal capital outflow policy could invite more capital inflows. Thus, to be effective, these measures need to be combined with other measures, such as strengthening financial sector supervision.

Asia shows a varying degree of capital account openness as the selected Chinn-Ito index in Table 3 illustrates. Kaminsky and Schmukler (2003) also constructed a graded index of financial reforms. This index has three components: domestic financial sector liberalization (DFS), especially of interest rate and credit controls; capital account liberalization (KA); and the openness of the equity market to foreign investment (SM). Table 4 also displays selected the Kaminsky and Schmukler index.

Table 3: Chinn-Ito Index in Asia

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
People's Republic of China	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13
Indonesia	2.54	2.27	2.00	1.05	1.46	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
Japan	2.27	2.27	2.27	2.27	2.27	2.54	2.54	2.54	2.54	2.54	2.27	2.00	1.73
Republic of Korea	-0.09	-1.13	-1.13	-1.13	-1.13	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
Malaysia	1.27	1.00	0.73	0.46	0.19	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
Philippines	1.18	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Singapore	2.54	2.54	1.50	1.50	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54
Taipei,China	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thailand	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-1.13
US	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54

Note: Chinn-Ito Index measures degree of openness of capital account.

Source: Available at http://www.econbrowser.com/archives/2008/05/updated_chinnit.html.

Table 4: Kaminsky and Schmukler Index in Asia

	1995			1999			2000			2001			2005		
	DFS	KA	SM	DFS	KA	SM	DFS	KA	SM	DFS	KA	SM	DFS	KA	SM
Indonesia	1	3	1	1	3	1	1	3	1	1	3	1	1	3	1
Japan	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Republic of Korea	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1
Malaysia	2	1	1	2	3	2	2	3	2	2	3	1	1	2	1
Philippines	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1
Taipei,China	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1
Thailand	1	2	1	2	1	1	2	1	1	2	1	1	1	1	1

Note: The value for each sector (Domestic Financial Sector (DFS), Capital Account (KA), and Stock Market (SM)) is presented for each country, being 1 the most liberalized and 3 the least liberalized.

Source: Kaminsky and Schmukler (2003).

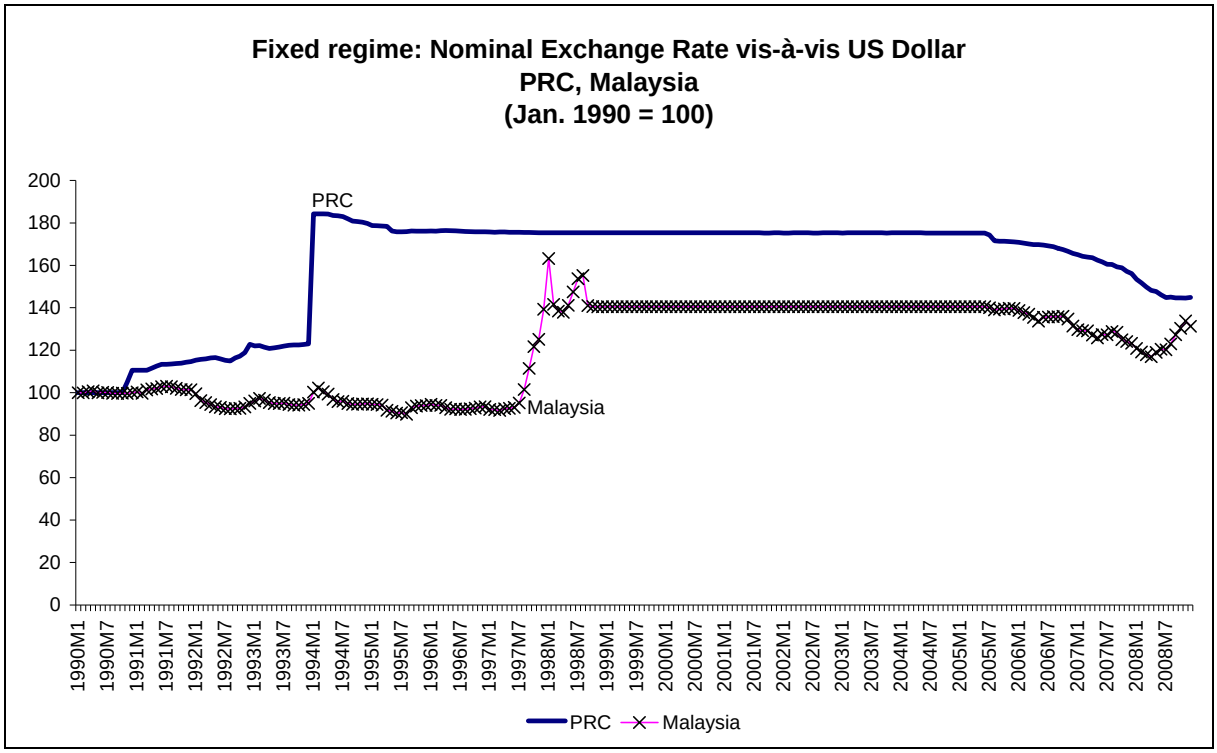
As indicated in both indexes, most Asian countries have shown a gradual liberalization of capital account transactions since the 1990s. One interesting exception is Malaysia, which took serious capital controls after the Asian crisis to mitigate the adverse effects of capital flows. In general it is fair to say that Singapore and Japan as the most liberalized economies in capital account. Indonesia, Philippines, Thailand, and Korea are in the middle in terms of Asian capital restrictions. The PRC is the most restricted in the index.

3. EMPIRICAL REGULARITIES

Figures 1, 2, and 3 show movements in domestic currency value vis-à-vis the US dollar based on their de jure classification. The fixed group of the PRC and Malaysia show steady pegged currencies vis-à-vis the US dollar after the Asian crisis. The PRC has pegged its currency to the US dollar since the depreciation in 1994, while Malaysia has kept its peg since the Asian crisis. However, in recent years, their currencies show frequent deviation from the long-run peg trend (Figure 1).

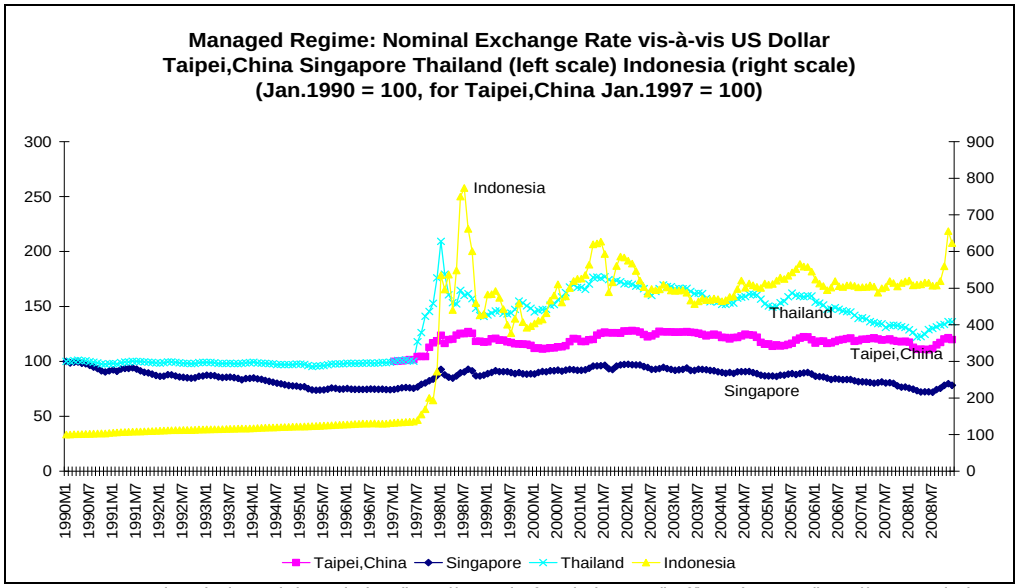
The intermediate group including Thailand, Indonesia, Taipei,China, and Singapore show higher volatilities in their currencies vis-à-vis the US dollar after the Asian crisis. Especially, the Indonesian rupiah had huge depreciation during the tranquil period of 1999 and 2007. It is not easy to distinguish the intermediate group and free-floating group by tracing the movements in domestic currency vis-à-vis the US dollar. Most members of the free-floating group shows similar patterns of movements in exchange rates.

Figure 1: Exchange Rate; Fixed Peg (1990=100)



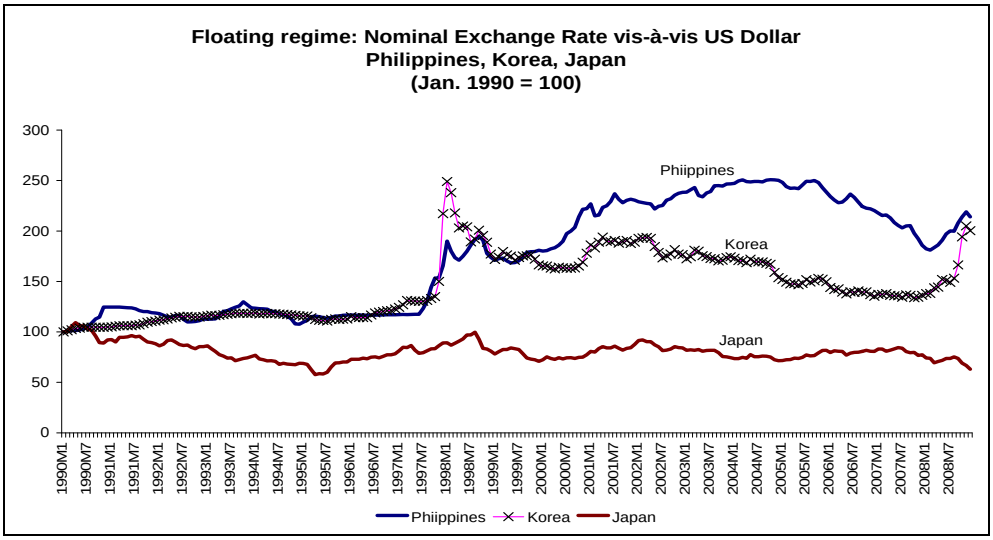
Sources: International Financial Statistics (http://www.imfstatistics.org/imf/) and CEIC (http://www.ceicdata.com/).

Figure 2: Exchange Rate; Managed Floating Regime (1990=100)



Sources: International Financial Statistics (http://www.imfstatistics.org/imf/) and CEIC (http://www.ceicdata.com/).

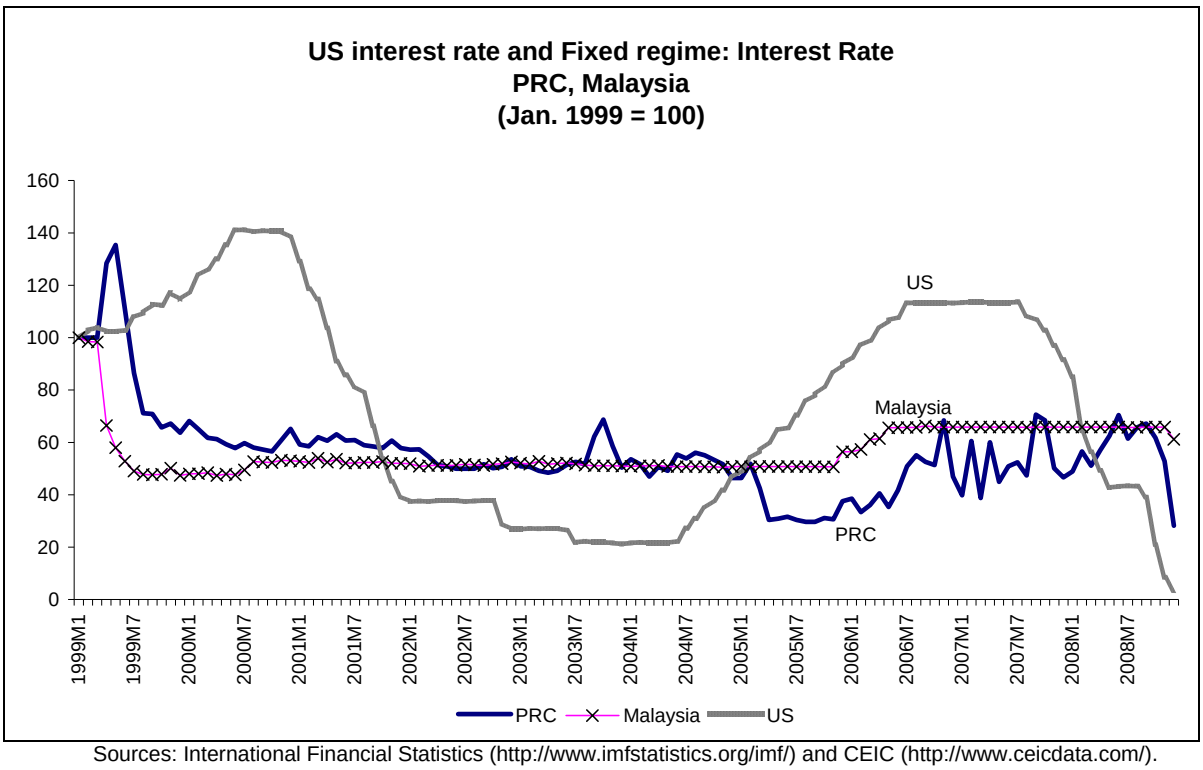
Figure 3: Exchange Rate; Free-Floating Regime (1990=100)



Sources: International Financial Statistics (http://www.imfstatistics.org/imf/) and CEIC (http://www.ceicdata.com/).

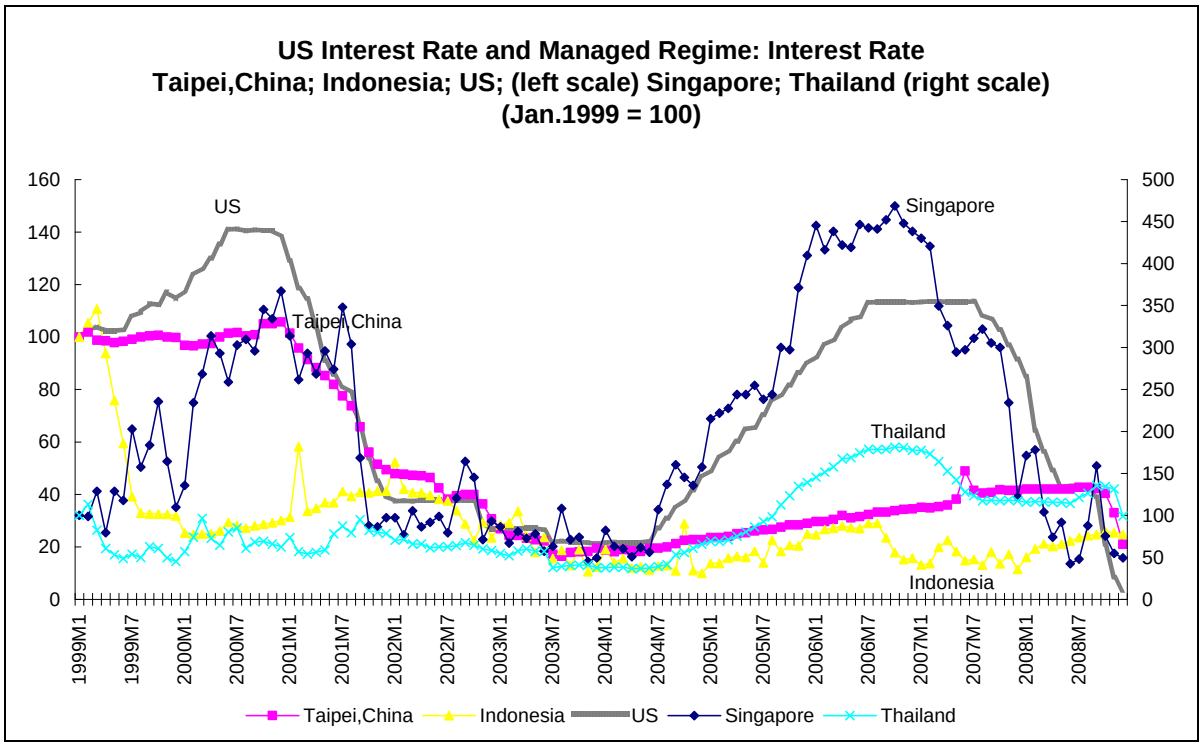
The policy interest rates in Asia also varied as exchange rates did. Interestingly, the fixed group did not respond much to the US interest rates changes. The PRC and Malaysia have maintained relatively stable policy interest rates from the late 1990s to 2008 (Figure 4). On the other hand most managed floaters in Asia show trends similar to US interest rates (Figure 5). In particular, timely responses to a decrease in US interest rates reduce the appreciation pressures in Asian countries. This prevents the expenditure switching effects through exchange rate changes from the interest rate changes between the US and Asian floaters. The free-floating group exhibits less change in interest rates. At the same time, they do not respond much to US interest rate movements in general (Figure 6).

Figure 4: Interest Rates; Fixed Pegged (1999=100)



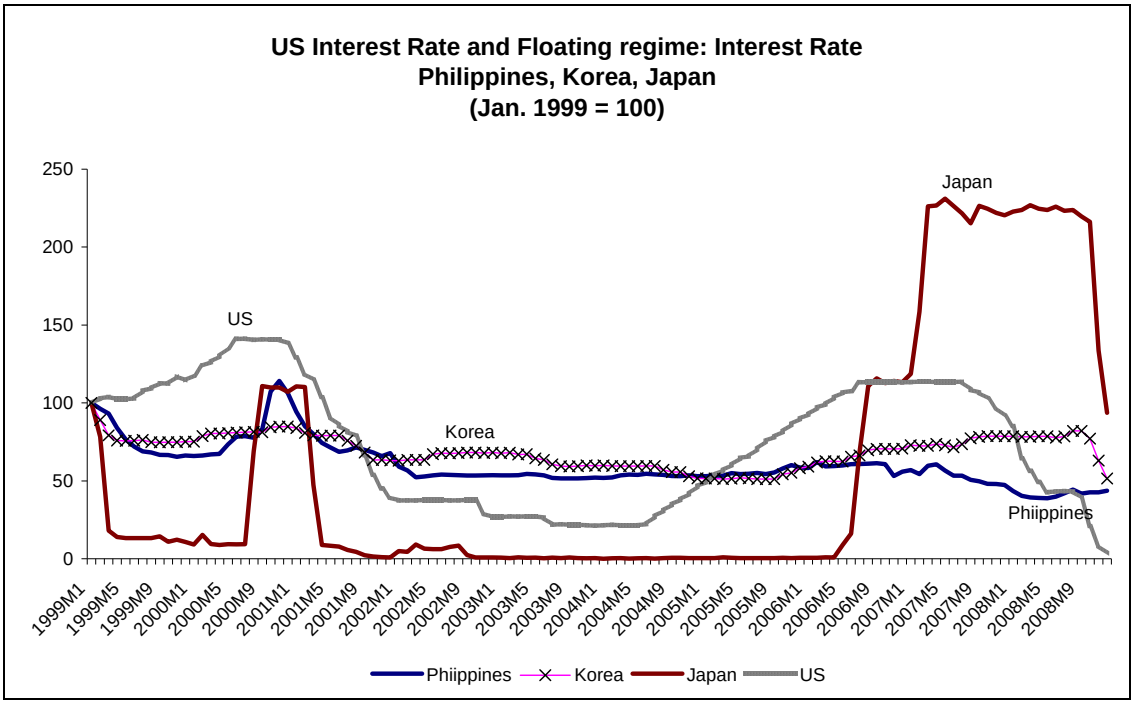
Sources: International Financial Statistics (http://www.imfstatistics.org/imf/) and CEIC (http://www.ceicdata.com/).

Figure 5: Interest Rates; Managed Floaters (1999=100)



Sources: International Financial Statistics (http://www.imfstatistics.org/imf/) and CEIC (http://www.ceicdata.com/).

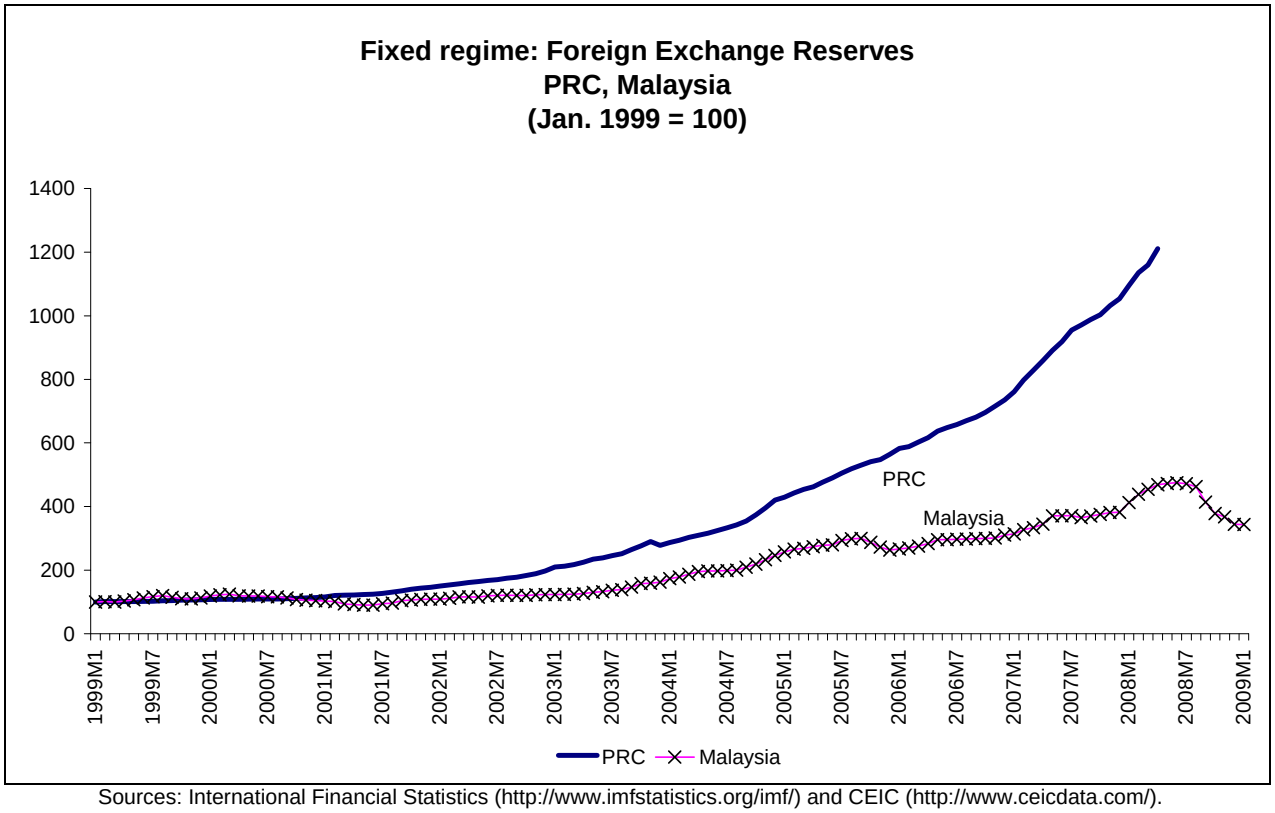
Figure 6: Interest Rates; Free-Floaters (1999=100)



Sources: International Financial Statistics (http://www.imfstatistics.org/imf/) and CEIC (http://www.ceicdata.com/).

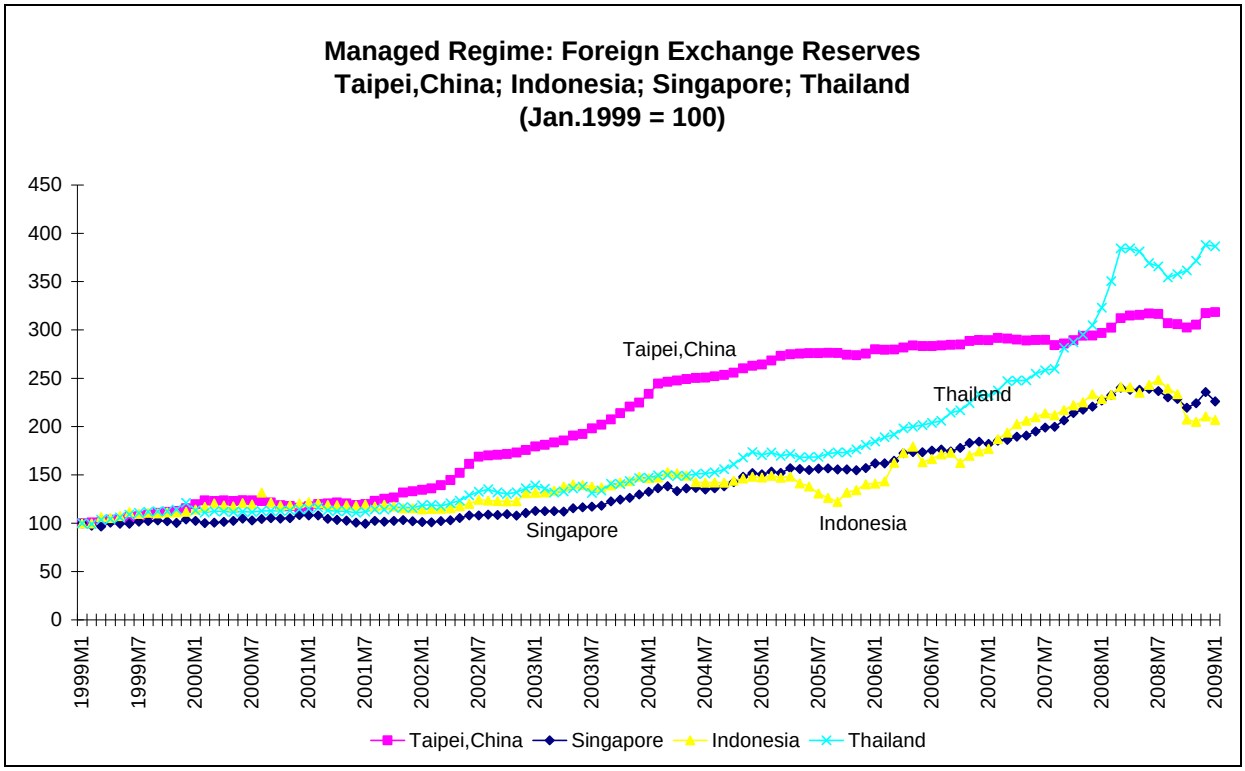
Foreign exchange reserves are also used for reducing appreciation pressures in Asia. There has been a strong upward trend in Asian foreign exchange reserves since 2002. This coincides with the depreciation of the US dollar regardless of exchange regimes in Asia (Figures 7, 8, and 9).

Figure 7: Foreign Exchange Reserves; Fixed Peg (1999=100)



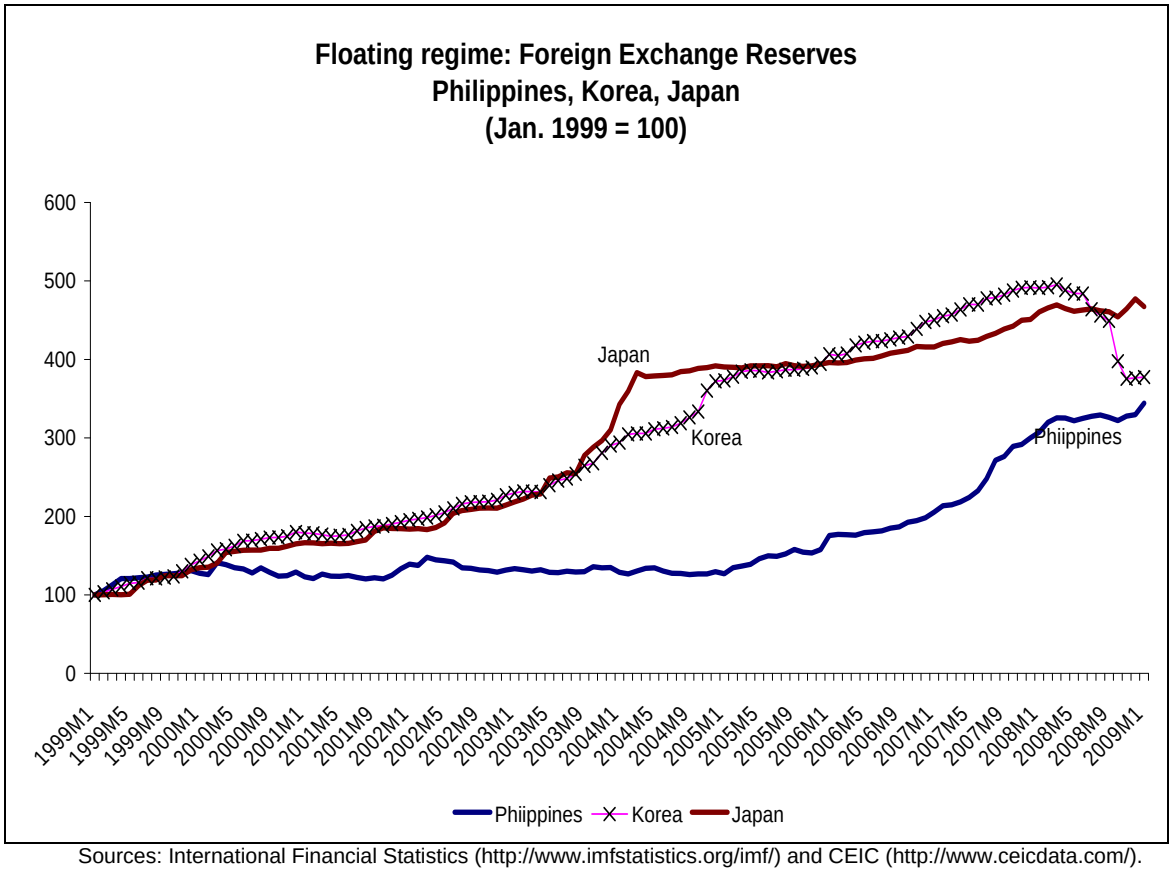
Sources: International Financial Statistics (http://www.imfstatistics.org/imf/) and CEIC (http://www.ceicdata.com/).

Figure 8: Foreign Exchange Reserves; Managed Floaters (1999=100)



Sources: International Financial Statistics (http://www.imfstatistics.org/imf/) and CEIC (http://www.ceicdata.com/).

Figure 9: Foreign Exchange Reserves; Free-Floaters (1999=100)



Sources: International Financial Statistics (http://www.imfstatistics.org/imf/) and CEIC (http://www.ceicdata.com/).

Table 5 displays major Asian macroeconomic variables. For the fixed group, the volatility of exchange rates is smaller than that of the floater group. Korea, the Philippines, and Indonesia show high standard deviations in exchange rates, while the PRC and Malaysia shows lower standard deviations. Interestingly, Japan and Taipei,China show lower volatility in exchange rates. The volatility of foreign reserves varies with the degree of exchange rate flexibility. The countries with rigid exchange rate regimes show higher volatilities in foreign reserves, while floaters display lower volatilities except for Korea and Japan. Policy interest rates are ambiguous in terms of volatilities based on different exchange regimes. In general, non-floaters should show higher volatility in interest rates, but non-floaters such as the PRC and Malaysia have lower interest rate volatility. On the other hand, floaters such as Indonesia, Philippines, Taipei,China, and Thailand show higher interest rate. This could be related to the inflation level in each country. Those that have higher interest rate volatility also display a higher consumer price index. Fluctuations in output are not distinguishable with the choice of exchange rate regime in general.

Table 5: Standard Deviation of Major Macro-variables

	M1	RES	Interest	Exchange	CPI	IP
People's Republic of China	42.83	80.20	0.69	5.57	2.46	41.19
Indonesia	42.70	24.34	6.74	9.60	25.24	11.83
Japan	31.92	48.70	0.19	6.75	1.02	6.19
Republic of Korea	27.26	46.50	0.65	11.57	8.90	20.61
Malaysia	33.31	52.73	0.51	4.89	6.52	16.70
Philippines	30.26	32.47	1.89	11.84	14.61	17.54
Singapore	27.62	29.12	0.93	7.54	3.90	18.79
Taipei,China	23.38	39.57	1.40	3.96	3.12	14.49
Thailand	29.19	38.66	1.15	9.18	8.16	26.46
US	21.03		1.82		7.76	5.07

Note: Data are from International Financial Statistics of IMF from January 1999 to June 2007. M1, RES, interest, Exchange, CPI, IP stand for M1 money supply, foreign reserves, policy interest rates, the domestic currency/US dollar exchange rates, consumer price index, and industrial production for each country, respectively.

Source: authors' calculation.

Table 6 displays the correlation of interest rates, price level and output of Asian countries with those of the US. Interest rates of the floaters such as Korea, Philippines, and Taipei,China show strong correlation with the US interest rate. However, non-floaters such as the PRC and Malaysia have lower correlation. This might look strange since fixed exchange rate regime should display higher correlation with the US interest rates, but these countries have capital account restrictions that may allow them to have monetary autonomy even under a fixed exchange rate regime. The consumer price index (CPI) in Asian countries has a higher correlation with the CPI of the US in general, except for Japan. This implies higher exchange rate pass-through in those economies. Asian countries' output is highly correlated with the US output in general, except for the PRC which has a lower correlation.

Table 6: Correlation of Interest Rates, Price and Output with the US

	Interest	CPI	IP
People's Republic of China	0.22	0.78	0.43
Indonesia	0.21	0.99	0.68
Japan	0.24	-0.44	0.93
Republic of Korea	0.57	0.99	0.88
Malaysia	0.20	0.99	0.89
Philippines	0.62	0.99	0.82
Singapore	0.75	0.92	0.93
Taipei,China	0.68	0.93	0.93
Thailand	0.39	0.99	0.86

Note: Data are from International Financial Statistics of IMF from January 1999 to June 2007. Interest, CPI, and IP stand for interest rates, consumer price index and industrial production respectively.

Source: authors' calculation.

4. EMPIRICAL MODEL

We used the following empirical model to analyze the effects of changes in US monetary policy on East Asian economies. Most East Asian countries can be treated as small, open economies. In order to reflect this structure in the model, we assume a block-exogenous VAR model in which the US variables are treated as exogenous to East Asian variables.[1] In addition, by constructing a block-exogenous VAR model, we can also save the degree of freedom (compared to considering all the interactions between two countries).

US monetary policy and East Asian economies endogenously respond to the US or world structural shocks. As a result, simple analysis on the relation between US monetary policy and East Asian economies can be misleading since the simple timing relation between US monetary policy and East Asian variables can originate from non-monetary structural shocks. Therefore, exogenous US monetary shocks are identified in the following model, by using the Christiano, Eichenbaum, and Evans (1999) method.

The empirical model assumes that the economy is described by the following structural equation system

$$G(L)y(t) = e(t) \quad (1)$$

where *G(L)* is a matrix polynomial in lag operator L, and $y(t)$ is a *m* x 1 data vector with m the number of variables in the model. In addition, $\text{var}(e(t)) = \Lambda$ where Λ is a diagonal matrix and the diagonal elements are variances of structural shocks.

[1] Although we used the same framework for all countries, the US may not be regarded as completely exogenous to Japan and the PRC. In this regard, the empirical results for Japan and the PRC should be interpreted with some caution. On the other hand, while an individual country in East Asia is not likely to affect the US economy, Asia as a whole may affect the US economy (i.e., see Kim, Lee, and Park 2009). We did not model such a possibility explicitly since such a modeling, together with analyzing the effects of US monetary policy shocks, is not easy, especially given our short sample periods.

We assumed that the equation system (1) can be expressed as

$$y(t)=\begin{bmatrix} y_1(t) \\ y_2(t) \end{bmatrix},\ G(L)=\begin{bmatrix} G_{11}(L) & 0 \\ G_{21}(L) & G_{22}(L) \end{bmatrix},\ e(t)=\begin{bmatrix} e_1(t) \\ e_2(t) \end{bmatrix} \quad (2)$$

where $y_1(t)$ and $e_1(t)$ are m_1 x 1 vectors, $y_2(t)$ and $e_2(t)$ are an m_2 x 1 vectors, $G_{11}(L)$ is an m_1 x m_1 matrix, $G_{21}(L)$ is an m_2 x m_1 matrix, and $G_{22}(L)$ is an m_2 x m_2 matrix.

We assumed that $G_{12}(L)=0$. This assumption is the restriction of block-exogeneity, which implies that $y_1(t)$ is not affected by not only current but also lagged $y_2(t)$. In the empirical model, $y_1(t)$ is the US variables and $y_2(t)$ is variables of an East Asian country. Therefore, the US variables are not affected by the variables of a small, open East Asian country.

In the US block, the Christiano, Eichenbaum, and Evans method was applied to identify US monetary policy shocks. $y_1(t)$ is [IP_US, CPI_US, CMP, FFR, NBR, M]′ where IP_US is Industrial Production, CPI_US is Consumer Price Index, CMP is Commodity Price, FFR is the Federal Funds Rate, NBR is Non-Borrowed Reserves, and M is monetary aggregate. Following Christiano, Eichenbaum, and Evans, we identified FFR shocks as monetary policy shocks by imposing restrictions on contemporaneous structural parameter $G_{11}(0)$ that IP, CPI, and CMP don't respond to FFR contemporaneously and FFR does not respond to NBR and M contemporaneously (for contemporaneous structural parameter).[2]

For the variables of a East Asian country ($y_2(t)$), CPI, industrial production (IP), call rate (or interbank rate) (CR), and exchange rate against the US dollar (ERA) are considered. CPI and IP are important economic variables indicating the price level and production level of the country. CR and ERA are included since those variables show monetary policy and foreign exchange policy for each country.[3] The basic model includes these four variables only since the estimation period is relatively short. Then, the basic model is extended to include M1 and foreign exchange reserves (RES) additionally, one by one, in order to infer more detailed effects on foreign exchange policy responses of a East Asian country.

Since the variables on the right hand side are different in the reduced form Block-Exogenous VAR model, Ordinary Least Square provides inconsistent estimates. We estimated the reduced form Block-Exogenous VAR model with seemingly unrelated regression and then transformed to structural VAR model.

Since the estimation period is short, we used monthly data. The estimation period is January 1999– June 2007, derived from the period after the Asian financial crisis. We considered the period before the recent global financial crisis since the US takes unusual monetary policy (i.e., quantitative easing) during such times. A constant and two lags are assumed in the VAR model.

5. EMPIRICAL RESULTS

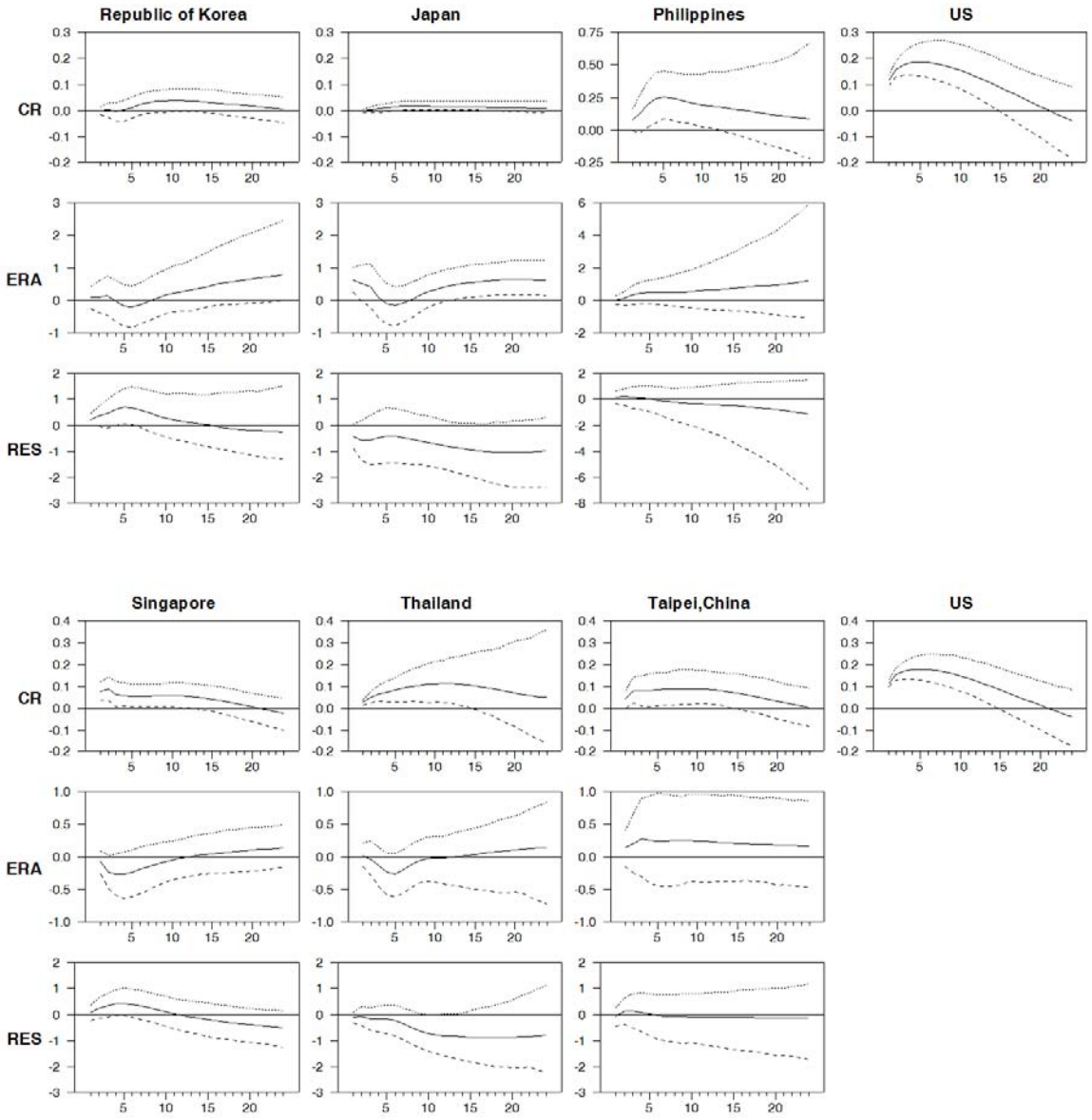
Figure 10 shows the impulse responses of interest rates, exchange rates, and foreign exchange reserves to US monetary policy shocks over 24 months, with 90% probability bands. The country names are noted at the top of each column while the names of responding variables are noted at the far left of each row. To compare the interest rate

[2] The US data is obtained from the database of the Federal Reserve Bank of St. Louis. Intermediate material price is used as commodity price index. M1 is used as the monetary aggregate. We conducted experiments with various measures of commodity price and monetary aggregates. Abnormal responses such as the price puzzle are relatively weaker when we use the intermediate material price and M1. Natural logarithm is taken and multiplied by 100 for all variables except for the interest rate.

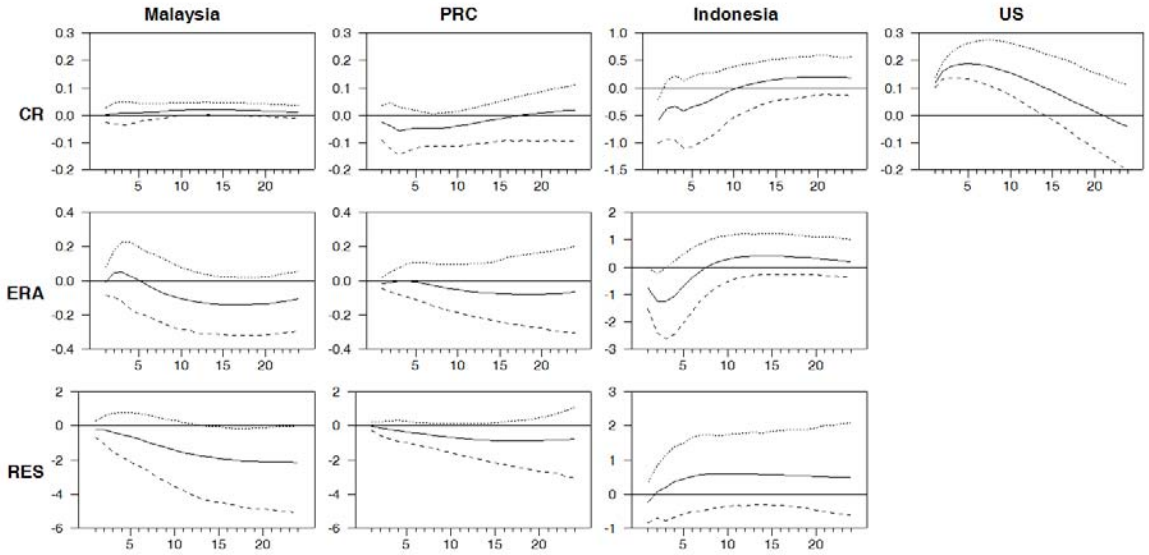
[3] Data for East Asian countries are obtained from International Financial Statistics and Census and Economic Information Center (CEIC). Natural logarithm is taken and multiplied by 100 for all variables except for the interest rate.

changes of each country with those of the US, the interest rate response of the US is also reported at the last column in each figure. In addition, the scale of the graphs in each row is the same, in order to facilitate the comparison across countries.[4]

Figure 10: Impulse Responses of Interest Rates, Exchange Rates, and Foreign Exchange Reserves to US Monetary Policy Shocks



[4] The only exception is Indonesia.



Sources: Authors' calculations.

The US interest rate increases by 0.15% point on impact and increases up to 0.2 % point in approximately 5 months. Then, the US interest rate decreases back to the initial level in about 20 months. Theoretically, such increases in interest rate are likely to depreciate the exchange rate of East Asian currencies against the US dollar when exchange rate flexibility is allowed. However, the exchange rate depreciation is not significant (based on 90% probability bands) in almost all countries, except for Korea in the long horizon and Japan. Even in Korea, the exchange rate appreciation is not significant in the short run and medium run although it is significant in the long run. In Japan, the short-run and medium-run appreciation is different from zero with more than 95% probability.

The exchange rate responses are quite interesting, given that many East Asian countries allowed some exchange rate flexibility during this period. These exchange rate responses are mostly explained by East Asian countries interest rate and foreign exchange policy responses . The interest rates of most East Asian countries strongly respond to the US monetary policy shocks. In the Philippines, Thailand, and Taipei,China, the domestic interest rate tends to increase as much as the US interest rate increases, which can fully nullify the effects of US monetary policy shocks on the exchange rate. Also in Singapore and Korea, the interest rate increases are significant. In other countries, such as Malaysia and the PRC, the interest rate does not respond much, but a significant drop in foreign exchange reserves is observed, which can also contribute to the exchange rate stability in response to the US interest rate increase. These two countries, in fact, adopted the fixed exchange rate regime. In addition, the capital account restrictions of these countries seem to help to fix the exchange rate while keeping the interest rate. On the other hand, the Japanese interest rate does not respond much to the US interest rate changes. Although foreign exchange reserves fall temporarily in the medium run, this does not seem to be enough to fully nullify the exchange rate depreciation. As a result, a significant exchange rate depreciation is found in Japan.[5]

These results suggest that the conventional exchange rate channel is unlikely to play much role in the transmission of the US monetary policy shocks to emerging East Asian countries, excluding Japan. For example, the conventional exchange rate switching effect that can generate the opposite real effects to East Asian economies is not likely to be important. On the other hand, many emerging Asian countries did increase the interest rate in response to the US interest rate increase. This suggests that US monetary policy changes, for example,

[5] Interpreting Indonesian responses is difficult in view of conventional theory.

monetary expansion, are likely to have a positive spill-over effect to Asian real economies, and will help the synchronization of the US and Asian business cycles. However, in countries with capital account restrictions and a fixed exchange rate regime, the PRC neither channels are likely to play any role in the transmission of the US monetary policy shocks. Finally, in a true free floater like Japan, the exchange rate channel is likely to be important.

Some argue that after a financial crisis, East Asian countries tend to adopt more flexible exchange rate arrangements with liberalized capital accounts. Theoretically, even with liberalized capital accounts, monetary autonomy can be obtained under a flexible exchange rate regime. Reflecting these theories, these East Asian countries try to adopt monetary policy framework that may provide stronger monetary autonomy, for example, inflation targeting. However, empirical results show that, at least conditional on US monetary policy shocks, these countries in fact neither allow the exchange rate to move freely nor perform independent interest rate policy. Fear of floating of these countries may prevent these countries from securing monetary autonomy.

On the other hand, the trilemma also suggests that monetary autonomy can be achieved even under a fixed exchange rate regime by restricting capital mobility. Our empirical results show that two East Asian countries with a fixed exchange rate regime and capital account restrictions (the PRC and Malaysia) seem to be at least partly successful in keeping domestic monetary policy independent from US monetary policy.

These results are interesting since past studies, such as Giovanni and Shambaugh (2008) and Frankel, Schmukler, and Serven (2004) suggest that the interest rate responds more strongly in the fixed exchange rate regime, contrary to our empirical results. In our sample, fixed exchange rate regime countries imposed capital account restrictions, which may make the result different. That is, the monetary independence may be achieved under a fixed exchange rate regime with the help of capital account restrictions. On the other hand, at least some of our sample floating exchange rate regime countries were not true floaters, which may explain strong responses to the interest rate in our floater samples.

6. CONCLUSION

The impacts of the US monetary shocks on East Asian exchange rates and domestic interest rates are different depending on the exchange rate regimes. The conventional theory suggests that in the floating exchange rate regime the expenditure-switching effect is the main channel so that expansionary monetary policy in the US increases the real output of the US while decreasing the real output in other countries. This would occur through exchange rate channel in the world of floaters. However, the conventional theory suggests that in the case of a fixed exchange rate regime, expansionary US monetary policy induces increases in real output of other countries as other countries increase their interest rates at the expense of independent monetary policy.

However, the conventional wisdom reverses in Asia. This paper shows that that the conventional exchange rate channel is unlikely to play much role in the transmission of the U.S. monetary policy shocks to floaters in East Asian countries, excluding Japan. These countries turn out to change domestic interest rate strongly to offset the US interest rate changes by giving up monetary autonomy, probably as a result of fear of floating. On the other hand, in the countries with capital account restrictions and fixed exchange rate regime, such as the PRC and Malaysia, neither channel is likely to play any role in the transmission of the US monetary policy shocks. They enjoy independent monetary policy probably with the help of capital account restrictions.

This finding is relevant not only for identifying the international monetary transmission mechanism in Asia, but also for predicting the rebalancing processes from the global financial crisis and global imbalances. The prolonged expansionary monetary policy in the

US will help in Asia, especially for floaters. In the case of floaters, domestic demand and output would increase without the expenditure-switching effects responses to US expansionary monetary shocks. Moreover, non-floaters may enjoy more room for maneuvering domestic interest rates due to lower interest rates in the US. On the other hand, a contradiction persists on the issue of foreign exchange reserves that is quite related to the issue of rebalancing. If Asia has been successful in mitigating the external shocks by holding huge amount of foreign reserves, then Asia will continue to accumulate the foreign reserves regardless of exchange rate regimes. This will not reduce the global imbalances that might be a partial cause of the global crisis in 2008, and furthermore will not facilitate the appropriate rebalancing process.

REFERENCES

Betts, C., and M. B. Devereux. 2001. The International Effects of Money and Fiscal Policy in a Two-Country Model. In *Essays in Honor of Robert A. Mundell,* edited by M. Obstfeld and G. Calvo. Cambridge, MA: MIT press.

Calvo, G., and C. Reinhart. 2002. Fear of Floating. *Quarterly Journal of Economics* 117: 379–408.

Christiano, L. J., M. Eichenbaum, and C. L. Evans. 1999. Monetary Policy Shocks: What Have We Learned and to What End? In *Handbook of Macroeconomics,* edited by J. Taylor and M. Woodford. Amsterdam: Elsevier North-Holland.

Frankel, J., S. Schumkler, and L. Serven. 2004. Global Transmission of Interest Rates: Monetary Independence and Currency Regimes. *Journal of International Money and Finance* 23: 701–734.

di Giovanni, J., and J. C. Shambaugh. 2008. The Impact of Foreign Interest Rates on the Economy: The Role of the Exchange Rate Regime. *Journal of International Economics* 74: 341–361.

IMF. 1999 and various issues. *Annual Report on Exchange Arrangements and Exchange Restrictions.* IMF: Washington, DC.

Kaminsky, G., and S. L. Schmukler. 2003. Short-Run Pain, Long-Run Gain: The Effects of Financial Liberalization. National Bureau of Economic Research (NBER) Working Paper Series 9787. NBER: Cambridge, Massachusetts.

Kim, S. 2001. International Transmission of US Monetary Policy Shocks: Evidence from VAR's. *Journal of Monetary Economics* 48: 339–372.

Kim, S., J. Lee, and C. Y. Park. 2009. Emerging Asia: Decoupling or Recoupling. ADB Working Paper Series on Regional Economic Integration No. 31. Manila: Asian Development Bank.

Levy-Yeyati, E., and F. Sturzenegger. 2002. Classifying Exchange Rate Regimes: Deed Versus Words. Univeridad Torcuato Di Tella. Available at: http://profesores.utdt.edu/~fsturzen/DW2002.pdf.

Miniane, J., and J. H. Rogers. 2007. Capital Controls and the International Transmission of U.S. Money Shocks. *Journal of Money, Credit, and Banking* 39: 1003–1035.

Reinhart, C. M., and K. S. Rogoff. 2004. The Modern History of Exchange Rate Arrangements: A Reinterpretation. *Quarterly Journal of Economic*s 119: 1–48.

Stone, M. R., and A. J. Bhundia. 2004. A New Taxonomy of Monetary Regimes. IMF Working Paper WP/04/191. IMF: Washington, DC.

Obstfeld, M., and K. Rogoff. 1995. Exchange Rate Dynamics Redux. *Journal of Political Economy* 103: 624–660.

Ogawa, E., and D. Y. Yang. 2008. The Dilemma of Exchange Rate Arrangements in East Asia. *Japan and the World Economy* 20: 217–235.