

Capital Flows, Macroeconomic Management and Regional Cooperation in Asia

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Introduction

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The Korea Institute for International Economic Policy (KIEP) organized and sponsored an international workshop entitled “Capital Flows, Macroeconomic Management and Regional Cooperation in Asia” on November 30, 2007 in Washington, DC.¹⁾ The rationale behind the theme of the workshop is self-evident. While the Asian economies have recovered well from the financial and economic crisis of 1997-98 and have seen a resurgence in international capital flows, they continue to face enormous challenges in macroeconomic management. The regional economies have also taken a number of modest steps to enhance regional economic cooperation as a means of fortifying themselves against future financial crises as well as reducing prisoners’ dilemmas that might exist in their exchange rate and monetary policies (Cavoli and Rajan 2008).

The workshop consisted of four sessions on various monetary and financial issues in Asia. A common theme across most papers related to exchange rate management in Asia, an issue that is of paramount interest to the region specifically, but also to an unbalanced global macroeconomy.

Session 1 was on Capital Account Liberalization and Capital Flows in Asia. Paper 1 by Eswar Prasad on “Liberalizing China’s Capital Account” examines the complex interactions between various structural and macroeconomic policies in China. While these policies have ensured

1) The workshop was hosted by the Korea Economic Institute (KEI) with particularly able assistance from Julia Cunico. Thanks are also due to Jim Lister of KEI and Jung Woon Kim of KIEP for assistance in organization of the workshop. The usual disclaimer applies.

rapid growth over a sustained period, the author stresses that the rapid growth may have hidden and possibly even worsened deeper structural problems. In particular, he notes that a weak financial sector has distorted domestic demand and the particular pattern of investment financing might lead (and in some cases, already have led) to a buildup of excess capacity in some sectors and engender deflationary risks over the medium term, eventually leading to rising non-performing loans (NPLs) and consequently an even weaker financial sector. The policies of financial repression pursued by the Chinese authorities have, according to the author, contributed to inefficient intermediation of domestic capital and left the economy potentially vulnerable to large shocks. Given the rigid peg operated by China, monetary policy may be of limited use in guarding against such shocks. The author notes that, going forward, the authorities must make the financial system more robust, market-driven and diversified (away from the banking sector to alternative sources of funding), while simultaneously allow for further capital account liberalization and a more flexible exchange rate along with an inflation targeting framework.

Paper 2 in Session 1 by Carmen M. Reinhart and Vincent Reinhart is entitled "What Tools are Available to Policymakers in Emerging Market Economies to Deal with Capital Inflows?". The authors recognize that policymakers in many emerging economies have chosen to restrict fluctuations in their US dollar bilateral exchange rates (particularly in the case of appreciation). Using the simple uncovered interest parity (UIP) framework, the authors outline various sources of upward pressure on a currency. They then go on to document the tools used by policy makers to limit exchange rate appreciations using large dataset of developing economies over the period 1990 to 2006. The authors pay particular emphasis to the use of reserve requirements as a liquidity instrument in the presence of persistent reserve accumulations.

Session 2 continues with the focus on the issue of liquidity management by Asian economies in the presence of persistent balance of payments surpluses and consequent reserve accumulations. In particular, both papers focus on monetary sterilization. Paper 1 in the session by Hali Edison, Roberto Guimarães Filho, Charles Kramer, and Jacques Miniane (all IMF economists from the Asia-Pacific Department) is entitled "Sterilized Intervention in Emerging Asia: Is It Effective?" The paper investigates the extent of sterilization and its impact on exchange

rates for a five Asian countries (India, Indonesia, Korea, Philippines and Thailand) using monthly data between the period 2000 and 2007. While the authorities find monetary sterilization to be very high in most of the selected Asian economies, they find limited evidence of any systematic links between exchange rates and intervention. The authors find that the authorities have generally intervened extensively to prevent both appreciations and depreciations. However, while there has been considerable “leaning against the wind” by regional monetary authorities, the authors find that intervention appears to be more associated with lower exchange rate volatility than with controlling the value of the nominal currency per se.

Paper 2 in Session 2 by Alice Ouyang, Ramkishen S. Rajan and Tom Willett on “China as a Reserve Sink” focuses on liquidity management in the particular case of China using monthly data between 1999 and early 2007. China has become the world’s largest foreign exchange reserve holder, having amassed over US\$ 1,200 billion of international reserves by end 2006. The rapid accumulation of reserves has generated several controversies. One concern is whether this continuing balance of payments surplus signals the need for a substantial revaluation or appreciation of the Chinese yuan (CNY) to protect China both from the inflationary consequences of the liquidity buildup. To investigate the central bank’s ability to control domestic monetary aggregates, it is necessary to estimate the extent to which international flows undercut its control. This in turn requires the estimation of the counterfactual of the desired rate of monetary growth, i.e. estimation of the central bank’s monetary reaction function. There is no one correct theoretical specification for central bank reaction function, but the literature has developed a standard set of variables to be considered within this function. This allows the authors, at least in principle, to break down the interrelationship between international reserve changes and the monetary base into those relating to autonomous changes in the monetary base (the offset coefficient) and those relating to autonomous changes in international reserve flows (the sterilization coefficient). The empirical results suggest that China’s effective degree of capital mobility has risen substantially in recent years with offset coefficients rising from around 0.1 to 0.2 in 2003 to above 0.6 for the most recent data. This is consistent with the judgments of a number of economists that China’s capital controls have been becoming increasingly less binding. To date, however, this increased effective capital

mobility has *not* undermined the PBC's ability to effectively sterilize its huge reserve accumulation.²⁾ The authors estimate that the PBC has typically sterilized around 90 percent of the reserve inflows. This in turn explains how China has been able to maintain relatively low rates of money growth and inflation despite the surge of capital inflows. Overall the estimates of high sterilization over the period of China's recent huge buildup in reserves support the view that China has operated as a reserve sink, much as Germany and Japan did during the later stages of the Bretton Woods system.

Session 3 moved the discussion forward to the issue of Policy Coordination Issues in East Asia and impact of Exchange Rate Regimes. Paper 1 in the session by Deok Ryong Yoon and Jung Sik Kim on "Exchange Rate Regimes and Macroeconomic Stability in East Asia" investigates the impact of exchange rate regime on growth and inflation in East Asia (ASEAN plus Three) using annual data for the period 1990-2005. While the authors are unable to find conclusive results regarding the impact of exchange rate volatility on inflation, its impact on growth is significant during the post-crisis period (1998-2005) but insignificant for the pre-crisis period (1990-1997). More generally, the authors argue that impact of exchange rate regime and exchange rate volatility on inflation and economic growth depends strongly on the type of exchange rate classification, sample periods and sub-set of countries considered.

Paper 2 in Session 3 by Woosik Moon and Yeongseop Rhee is entitled "Price Convergence in East Asia and Its Implication for Regional Monetary Integration" The paper measures the degree of price differences among East Asian economies between 1990 and 2004, and in particular, analyzes whether there has been any price-convergence among regional economies. Using raw price data of 63 goods compiled by the Economist Intelligence Unit (EIU), the authors find that there does not appear to be any noticeable trend of price-convergence among East Asian economies as whole when compared to the European Union (EU). However, the authors note that some price level convergence is apparent for a subset of Northeast Asian countries (Korea-Japan-China). They suggest that such persistent price differences might be explained primarily by exchange

2) Eswar Prasad also discusses some of these issues at a broader leveling his paper on China.

rate fluctuations among East Asian currencies as well as large income disparities among regional economies. Given that the attaining income convergence is a much longer-term objective, the authors stress the important of monetary cooperation and exchange rate coordination.

The theme of Regional Monetary Cooperation Asia was the specific focus of a panel of distinguished economists in Session 4 with a background paper on "Asian Monetary Cooperation" by Thomas Willett, Orawan Permpoon and Lalana Srisorn.³⁾ In a broad-ranging paper the authors discuss the literature on optimum currency area (OCA) analysis and its applications to Asia. The authors note in particular that it would be dangerous to assume that OCA criteria are endogenous; i.e. they will be met "ex post than ex ante." Accordingly the OCA criteria remain relevant to analyzing whether Asia is suitable and ready for monetary integration. The authors emphasize that a great deal of analysis - especially empirical analysis - of OCA is partial and misleading as it excludes a number of important criteria that are potentially important. However, a challenge for researchers is to operationalize the large number of OCA criteria listed by the authors. The authors go on to explore lessons for Asian cooperation from the European experience, with particular focus on the role of dynamic spillovers among regional economies and possible creation of a composite currency unit (Asian Currency Unit or ACU) along the lines of the European Currency Unit (ECU). The authors emphasize that it would be a fallacy for Asia to attempt to emulate Europe by creating an Asian exchange rate mechanism as a transition step toward monetary union. Apart from the lack of strong institutional development in Asia, the extent of capital mobility in Asia today is far higher than in Europe in the 1980s and 1990s, thus making any narrow adjustable bands likely to fail. The authors further note that policy attention should focus not just on direct intervention to limit intraregional exchange rate fluctuations, but also on greater monetary policy coordination among Asian economies.⁴⁾

The paper authors, panellists, discussants and participants contributed to an intellectually stimulating workshop. The editors of the proceedings

3) The panel consisted of Richard N. Cooper, C. Randall Henning and Masahiro Kawai.

4) The paper also has an extensive reference list for readers interested in the topic of Asian monetary and financial cooperation.

hope that the papers will further contribute to the ongoing important dialogue on the issue of macroeconomic policy management in Asia.

Reference

Cavoli, T. and R.S. Rajan. 2008. *Exchange Rate Regimes and Macroeconomic Management in Asia?*, Chapter 1. Hong Kong: Hong Kong University Press. (forthcoming)

Chapter 1

Capital Account Liberalization and Capital Flows in Asia

Liberalizing China's Capital Account*

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1. Introduction

The Chinese economy has delivered a remarkable performance over the last two decades, with annual GDP growth averaging nearly 10 percent. The particular combination of macroeconomic and structural policies that has generated this growth has clearly “worked” well. But rapid growth can hide, or in some cases even exacerbate, a number of deeper problems. For instance, the financial sector is in poor shape and has distorted domestic demand; the patterns of investment financing could lead to a resurgence of nonperforming loans (NPLs) in the future and, by fueling a buildup of excess capacity in some sectors, could generate deflationary risks in the medium term. Meanwhile, in the short term, some of the pressures are becoming evident in other forms such as asset price booms (in the equity markets, in particular).

The sustainability of growth—while an important concern—may not even be the key problem. There are indirect and subtle costs to the current growth model that deserve attention. For instance, tight management of the exchange rate has been facilitated by financial repression and a relatively closed capital account. This has, among other things, meant very low real rates of return for households, who save a lot and have few investment opportunities other than domestic bank deposits. These policies have also curtailed financial sector development, leading to inefficient intermediation of domestic capital. There are clearly large welfare costs associated with these constraints.

The growth strategy has involved a number of policy distortions and constraints that have greatly reduced the room for policy maneuver in

* This is a revised and condensed version of a paper forthcoming in the *China Economic Review*.

case any big shocks should hit. Such shocks could come from internal sources—e.g., loss of confidence in the banking system, social instability generated by rising inequality—or external sources—e.g., international capital market crises, a collapse of external demand, U.S. trade sanctions, flaring-up of tensions over Taiwan etc.

Monetary policy is typically the first line of defense against such shocks but, with monetary policy constrained by the objective of maintaining a tightly managed exchange rate, it can at best play a very limited role. There appears to be room for fiscal maneuver since the explicit levels of the fiscal deficit and government debt are quite low, but this may be deceptive as there are large contingent liabilities in the state-owned banking system and huge unfunded pension liabilities. The financial system is still dysfunctional in many ways and may not be deep or robust enough to withstand a significant shock.

So what should China do to prepare itself to deal with shocks, and make growth more balanced and sustainable? The banking system should be made more robust and driven by market principles, and the financial system should be broadened to create alternative sources of funding for firms and alternative investment opportunities for households and firms. The state-owned enterprise sector needs to be further corporatized by hardening budget constraints. There is a need for a better social safety net and a better system for delivery of social services.

Many of these reforms are inter-related and trying to implement these reforms in isolation is not an effective way to proceed. For instance, stable macroeconomic policies and a well-developed and efficient financial sector are essential ingredients for balanced and sustainable growth. In turn, these two intermediate objectives would be helped by effective monetary policy and further capital account liberalization. And a flexible exchange rate is a prerequisite for both of these.

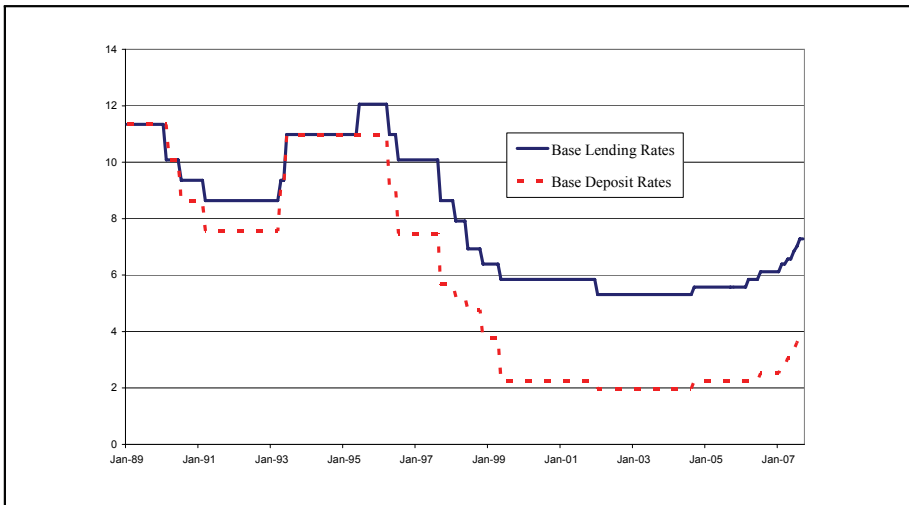
Ignoring these linkages—for instance, trying to push forward with banking reforms while holding monetary policy hostage to an exchange rate objective—makes an already difficult reform process even harder. Similarly, financial repression has kept the real price of capital cheap and, along with subsidized energy and land prices, shifted production towards capital-intensive methods. This works at cross-purposes with the authorities' goal of boosting employment growth and facilitating the transition of rural unemployed and underemployed to employment in manufacturing and services.

Ultimately, the essence of the policy debate can be framed in terms of the pace and sequencing of reforms required to turn these strengths into forces that allow the growth miracle to be sustained and to reduce the risks of its being derailed by shocks.

2. Investment-Led Growth

One dimension of the Chinese growth story that is of particular relevance in the context of the arguments in this paper is the composition of growth. Investment in physical capital has been a major contributor to growth during this decade, in some recent years accounting for nearly two-thirds of nominal GDP growth. Private consumption, by contrast, has made a much smaller contribution to growth (see Aziz 2006, and Lardy 2006, for details on the composition of growth). One consequence of the investment-heavy expansion has been the relatively slow employment growth.¹⁾ Indeed, during the period

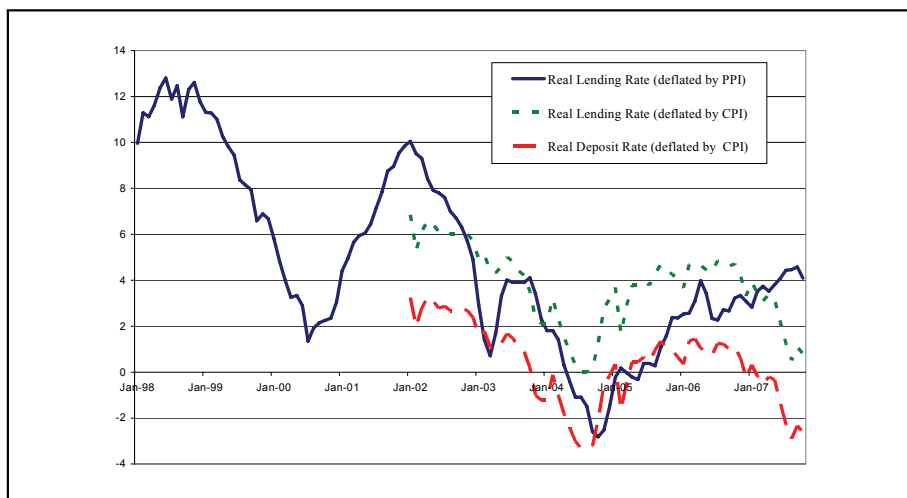
**Figure 1a. Base Lending and Deposit Rates
(1-year rates, in percent)**



Source: CEIC

1) See the chapter by Brooks in Prasad (ed., 2004) for some detailed calculations.

**Figure 1b. Real Lending and Deposit Rates
(1-year rates, in percent)**



Source: CEIC and author's calculations

Notes: Real rates calculated by deflating the nominal rates by twelve-month trailing CPI or PPI inflation.

2000-05, growth of total non-agricultural employment averaged only 3 percent per annum, compared to average non-agricultural GDP growth of about 9.5 percent.

Why has investment growth been so strong? A substantial fraction of this investment in China has been financed by credit provided by state-owned banks at low interest rates. Indeed, cheap capital has played a big part in skewing the capital-labor ratio and holding down employment growth (Aziz 2006). Recent increases in the base lending rate have been far too small to raise the real price of capital to a meaningful level for an economy that is experiencing annual real growth of over 10 percent (Figures 1a,b). In addition, local governments provide subsidized land in order to encourage investment. And energy prices continue to be administered and made available to enterprises at prices below international levels.

A lot of the recent investment has also been financed through retained earnings of profitable firms, which ought to be more defensible

on the basis of economic criteria. However, even here the picture is not clear. Profitable state enterprises were not, until very recently, required to pay dividends to the state. This suggests that such investment may have been spurred by the minimal rates of return on bank deposits which made even marginal investment projects seem in the money. The risk, of course, is that such high rates of investment in industries with favorable demand conditions may be leading to a buildup of excess capacity in those very industries; this could become evident if there were to be adverse demand shocks in the future (Goldstein and Lardy 2006).

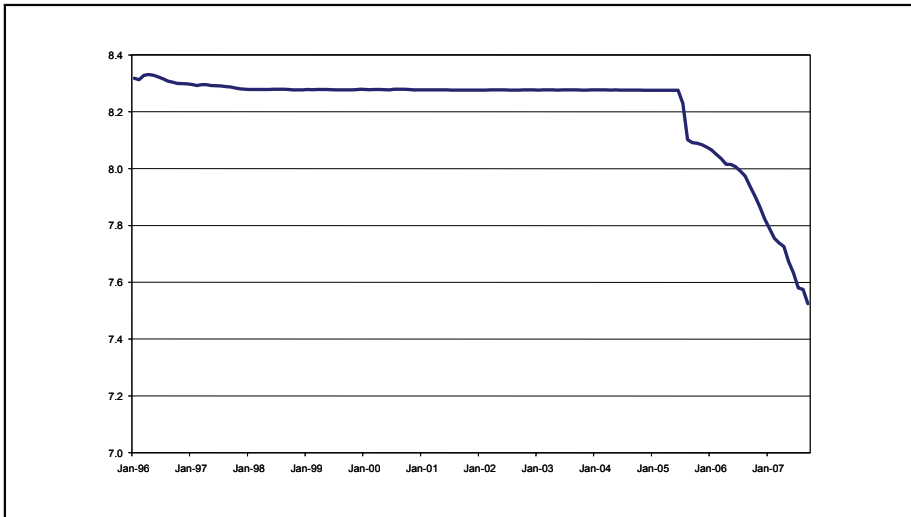
While investment has been high, national savings have been even higher, with both household and corporate savings rising in recent years. The uncertainties engendered by the transition to a market economy, the limited availability of instruments to borrow against future income to finance purchases (major durable goods, housing etc.), and the lack of international portfolio diversification opportunities have all contributed to high household savings (Chamon and Prasad 2007). Financial system repression has meant that there are few alternatives to funneling these savings into deposits in the state-owned banking system.

Households willingly hold bank deposits despite the weaknesses of the banking system because of implicit deposit insurance provided by the government. This provides abundant liquidity for banks to expand credit which, because of the distorted incentives faced by lenders, largely finances investment by state enterprises. State enterprises that do make profits are not required to pay dividends, encouraging them to plow retained earnings (which are counted as enterprise savings) back into investment. Thus, the investment boom in recent years has been fueled by cheap credit and overoptimistic expectations of future demand growth in sectors that are doing well at present.

3. Macroeconomic Policies

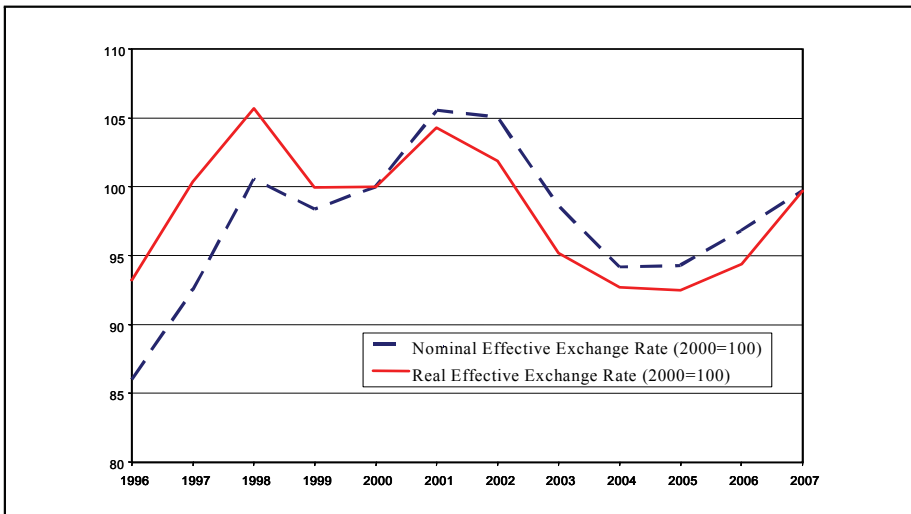
China has had a relatively stable exchange rate relative to the U.S. dollar since 1995. Since 2001, the exchange rate has been kept from appreciating only by massive intervention in the exchange market. In tandem with sustained high export growth and a burgeoning current account surplus that is likely to hit 12 percent of GDP in 2007, this is indicative of a substantially undervalued currency. Figures 2a,b show

Figure 2a. RMB- USD Exchange Rate



Source: IFS

Figure 2b. Real and Nominal Effective Exchange Rates



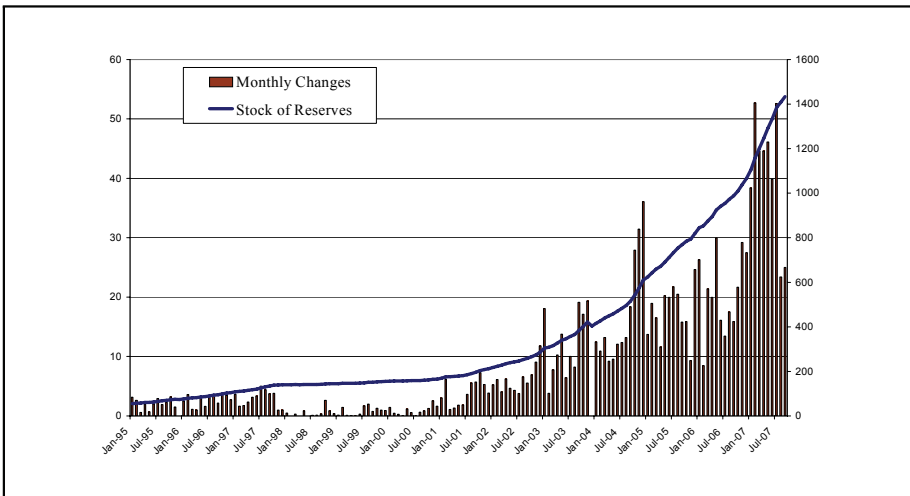
Source: IFS

Note: Data for 2007 are for end-July

that, despite an appreciation of the renminbi versus the U.S. dollar since June 2005, the real effective exchange rate of the renminbi is now *below* its recent peak in 2002 (largely due to the U.S. dollar's depreciation against other major currencies).

Resisting pressures for exchange rate appreciation has fueled a surge in the accumulation of international reserves since 2001 (Figure 3). During the period 2001-04, inflows of speculative capital (in anticipation of eventual renminbi appreciation) accounted for most of the pickup in the pace of reserve accumulation relative to the period 1998-00. During 2005-06, speculative inflows shrank but the slack was more than taken up by a dramatic surge in the trade balance, which doubled the rate of reserve accumulation that had been seen during 2001-04. The inflows resulting from these factors have added to the liquidity in the banking system and further complicated the control of credit growth.

Figure 3. Foreign Exchange Reserves: Flows and Stocks (in billions of USD)



Source: CEIC and author's calculations

Why have these inflows not led to rampant inflation? The answer lies in the ability of the People's Bank of China (PBC) to sterilize these inflows. Such sterilization usually quickly runs into limits in most

emerging market economies. Government bonds that are used to soak up liquidity have to offer increasingly high yields to convince domestic economic agents to hold them, leading to ever-increasing costs to the budget.

In China, private saving rates (both household and corporate) continue to be very high; most of these savings invariably flow into the banking system since there are few alternatives. This has made the banks flush with liquidity, particularly at a time when they are under pressure to hold down growth in credit. Moreover, banks have an incentive to hold PBC bills rather than increase their lending since corporate lending, for instance, carries a capital requirement of 100 percent while no capital needs to be put aside for lending to the government. So there is a great deal of demand for PBC bills even at relatively low interest rates. This means that, at the margin, sterilization is essentially a moneymaking operation for the PBC (abstracting from the effects of changes in the exchange rate). In other words, the present configuration of interest rates in China and the U.S. generates “profits” for the PBC from its sterilization operations.

But such a cost-benefit calculation can be deceptive. The lack of exchange rate flexibility not only reduces monetary policy independence, it also hampers banking sector reforms. The inability of the PBC to use interest rates as a primary tool of monetary policy implies that credit growth has to be controlled by blunter and non-market-oriented tools, including targets/ceilings for credit growth as well as “non-prudential administrative measures” (which effectively amount to moral suasion). This vitiates the process of banking reform by keeping banks’ lending growth under the administrative guidance of the PBC rather than letting it be guided by market signals. This constraint has also perpetuated large efficiency costs via provision of cheap credit to inefficient state enterprises (Dollar and Wei, 2007). The incidence of these and other costs of banking system inefficiency are not obvious, but they may ultimately be borne by depositors in the form of low (or negative) real returns on their saving.²⁾

The management of capital flows has been another crucial component

2) In July 2007, the benchmark one-year deposit rate was raised to 3.33 percent and the tax rate on bank interest income was cut from 20 percent to 5 percent. The effective after-tax deposit rate is now 3.16 percent, which is still below the current rate of CPI inflation.

of macroeconomic policy. Extensive capital controls, along with tax benefits and other incentives, have been used to promote inward FDI while other forms of inflows, especially portfolio debt, have been discouraged (Prasad and Wei 2007). Capital controls have also played an important role in protecting the banking system from external competition by restricting the entry of foreign banks and by making it harder to take capital out of the country. The limited development of debt and equity markets means that the state-owned banking system is effectively the only major game in town, for both borrowers and savers.

China's approach to exchange rate policy and capital account liberalization may be indicative of a desire to maintain stability on the domestic and external. And the large stock of foreign exchange reserves resulting from these policies may serve as insurance against vulnerabilities arising from a weak banking system. But the policy distortions needed to maintain this approach could generate imbalances, impose potentially large welfare costs, and themselves become a source of instability.

4. Path to Reforms

It is not easy to isolate specific policies to deal with particular problems identified above. Indeed, the reform process appears to have reached a stage where the traditional approach of undertaking incremental reforms in isolation from others may not work well anymore.³⁾ Given the prominence of China's exchange rate regime in discussions about China-U.S. bilateral relations as well as the issue of global current account imbalances, currency policy provides a good illustration about the inter-connectedness of various reforms.

What are the costs of an inflexible exchange rate? An inflexible exchange rate, while not the root cause of imbalances in the economy, requires a large set of distortionary policies for its maintenance over long periods. It is these distortions that—through multiple channels—hurt economic welfare and could, over time, shift the balance of risks in the economy.

It is then easy to see why exchange rate flexibility matters for China.

3) See Blanchard and Giavazzi (2006) and Prasad and Rajan (2006) for more on this point.

It is not necessarily because it will directly have a large or lasting impact on problems such as the U.S.-China trade imbalance.⁴⁾ Rather, the case for a flexible exchange rate rests on a deeper set of policy priorities, with the ultimate objective being balanced and sustainable growth in the longer term.

An independent interest rate policy is a key tool for improving domestic macroeconomic management and promoting stable growth and low inflation. Monetary policy independence is, however, a mirage if the central bank is mandated to attain an exchange rate objective. Capital controls do insulate monetary policy to some extent, but they are notoriously leaky and tend to become increasingly less effective over time.⁵⁾ Thus, a flexible exchange rate is a prerequisite for an independent monetary policy.

Independent interest rate policy, in turn, is a key input into financial sector reforms. Using interest rate policy, rather than government directives, to guide credit expansion is essential to encourage banks to become more robust financial institutions. Trying to foster the commercial orientation of the banking sector in the absence of monetary policy tools to guide credit and money growth vitiates banking reforms.

The argument that the financial system needs to be fully modernized before allowing currency flexibility therefore has it backwards. Indeed, durable banking reforms are likely to be stymied if the PBC's ability to manage interest rates is constrained by the exchange rate objective. The PBC then has to revert to its old practice of telling state banks how much to lend and to whom, which hardly gives banks the right incentives to assess and price risk carefully in their loan portfolios. This

4) While Chinese currency appreciation by itself may not have much of an impact on global current account imbalances, it would be an important step towards resolving those imbalances since other Asian economies may be emboldened to allow their currencies to appreciate as well if China made the first move.

5) A crude way of measuring *net* flows through unofficial channels is to look at the errors and payments category of the balance of payments. Prasad and Wei (2007) document that, during periods of downward (depreciation) pressures on the renminbi – e.g., the Asian crisis period – errors and omissions were negative and large, suggesting significant capital flight. During 2003-05, the errors and omissions turned into large positive numbers, reflecting speculative inflows in anticipation of renminbi appreciation. *Gross* unofficial flows could of course be much larger.

makes banking reforms even more complicated than they already are.

Another requirement for broader financial development is a stable macroeconomic environment, for which again good macroeconomic policies, including effective monetary policy, are necessary. On the flip side, the lack of effective macroeconomic management could generate risks via the financial sector. In the absence of room for maneuver on interest rates, liquidity flows into the economy could result in asset price bubbles, including in the real estate and stock markets. These markets could become vulnerable to sudden and unpredictable shifts in investor sentiment that could send them tumbling at the slightest provocation, with broader ripple effects through the economy.

For developing the domestic financial sector, opening up of the capital account—to inflows as well as to outflows—could also serve as an important catalyst.⁶⁾ Inflows can bring in technical expertise on developing new financial instruments, creating and managing risk assessment systems, and improving corporate governance. Indeed, the approach of using foreign strategic investors to improve the efficiency of domestic banks is a strategy the Chinese authorities see as playing a useful role in their overall reform effort. Allowing outflows would help increase efficiency by creating competition for the domestic banking system and limiting the captive source of funds (bank deposits) that now keep domestic banks flush with liquidity. However, opening the capital account ahead of introducing greater flexibility in the exchange rate could pose serious problems in the future.⁷⁾

Ultimately, stable macroeconomic policies and a well-developed and efficient financial sector are crucial ingredients for balanced and sustainable growth. Exchange rate policy is clearly not an end in itself but, as shown by the connections depicted above, has an important role to play in achieving these deeper policy reforms and also the ultimate objectives in terms of growth and welfare.

5. An Alternative Monetary Policy Framework

What could serve as a suitable alternative anchor for inflation

6) See Kose, Prasad, Rogoff and Wei (2006).

7) See Eichengreen (2004), Prasad, Rumbaugh, and Wang (2005), and Yu (2007).

expectations in place of a tightly managed exchange rate? Marvin Goodfriend and I have argued that China should adopt an explicit inflation objective—a long-run range for the inflation rate and an explicit acknowledgement that low inflation is the priority for monetary policy—as a new anchor for monetary policy (Goodfriend and Prasad, 2007). An inflation objective, coupled with exchange rate flexibility, would work best to stabilize domestic demand in response to internal and external macroeconomic shocks. Indeed, focusing on inflation stability is the best way for monetary policy to achieve broader objectives such as financial stability and high employment growth. Over time, the inflation objective would provide a basis for currency flexibility. Thus, exchange rate reform will be seen as a key component of an overall reform strategy that is in China's short- and long-term interests.

The time is right for making the switch—economic growth is strong and headline inflation is low. At an operational level, the PBC could continue its current approach to monetary policy, which includes setting targets for money and credit growth. The crucial difference would be to switch the strategic focus from the exchange rate to the inflation objective, which means that the currency could appreciate or depreciate in response to more fundamental economic forces such as productivity growth. This framework would subsume monitoring of monetary aggregates such as M2 and private credit, but directly targeting these aggregates is increasingly inappropriate for an economy that is undergoing rapid structural transformation and changes in the structure of its financial markets.

A full-fledged inflation targeting regime could serve as a useful long-term goal, but the approach I have outlined above is more practical for the foreseeable future and should deliver most of the benefits of formal inflation targeting.

Two related points are worth noting. Independent interest rate policy requires a flexible exchange rate, not a one-off revaluation or a sequence of revaluations. A flexible exchange rate buffers some of the effects of interest rate changes, especially in terms of offsetting the temptation for capital to flow in or out in response to such changes. A one-off revaluation can solve this problem temporarily, but could create even more problems subsequently if interest rate actions in a different direction become necessary, or if investor sentiment and the pressures for capital inflows or outflows shift.

Another crucial point is that exchange rate flexibility should not be confused with full opening of the capital account. An open capital account would allow the currency to float freely and be market-determined. But the exchange rate can be made flexible and the objective of monetary policy independence achieved even if the capital account is not fully open.

A concern often expressed by Chinese policymakers is that, given the fragility of the domestic banking system, exchange rate flexibility could be disastrous. There are two possible factors behind this concern. One is that sharp changes in the value of the currency could destroy bank balance sheets. There is little evidence, however, that Chinese banks have large exposures to foreign currency assets (and/or external liabilities denominated in renminbi) that would hurt their balance sheets greatly if the renminbi were to appreciate in the short run.

A more serious concern is that outflows of capital could starve the domestic banking system of liquidity by allowing domestic savers to take their money abroad. This is where the difference between exchange rate flexibility and capital account liberalization becomes especially important. There is no reason why, with even the moderately effective capital controls that are in place now, China could not allow for more exchange rate flexibility. A flexible exchange rate, even if it does not yield a "true" market equilibrium rate because capital flows are constrained, can allow for an independent monetary policy. And this flexibility does not by itself generate channels for evading controls on capital flows. In short, as a reason for not moving more quickly towards a flexible exchange rate, banking system weaknesses constitute a red herring.

6. Conclusions

China has achieved remarkable economic progress in the last three decades. But a great deal of work remains to be done to make the economy resilient to large shocks, to ensure the sustainability of its growth, and to translate this growth into corresponding improvements in the economic welfare of its citizens. This is a good time for pushing forward with some of those essential reforms.

External pressure can play a helpful role in this reform process, but only if it is placed in the right context. For instance, the debate in the

U.S. about the Chinese exchange rate regime has been distorted in some ways and made political rather than substantive by placing it in the narrow context of the U.S.-China trade balance. There is an important strategic (and educational) element related to reframing the exchange rate issue in a broader context. This is where external pressure from the international community can be helpful, not in the form of threats but by reorienting the discussion in a fashion that brings into sharper focus the linkages between currency reform and other core reforms on which there is broad consensus within China.

Furthermore, working with the Chinese to develop deadlines for achieving specific policy goals would be useful if done in a collaborative rather than confrontational manner. These intermediate steps could serve as concrete guideposts for the reform process and help break down internal resistance to the reforms. Commitments that the Chinese made in the context of accession to the World Trade Organization, for instance, have helped to galvanize internal reforms. In China—as in any other country—there are some groups that stand to lose disproportionately from certain reforms, even if those reforms may be hugely beneficial overall. This is precisely where external pressure, if applied judiciously, can be helpful in generating enough momentum to help the forces that are predisposed towards undertaking reforms. A confrontational approach, on the other hand, could well prove counterproductive by bolstering the forces opposed to reform and allowing them to paint certain reforms as being detrimental to China and in the interests only of other countries.

Ultimately, as far as Chinese reforms are concerned, there is a set of shared interests between policymakers in China, the U.S. and elsewhere. For it is deep and enduring reforms that promote sustained and balanced growth in China that are in the best interests of both China and the world economy.

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What Tools are Available to Policymakers in Emerging Market Economies to Deal with Capital Inflows?*

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Introduction

Over the past decade, policymakers in many emerging market economies have opted to limit fluctuations of the value of their domestic currencies relative to the currency of some key trading partners, quite often the U.S. dollar. Two notable features have emerged from this experience. First, the ability to limit fluctuations in the exchange rate is decidedly asymmetric: Authorities have a variety of tools to blunt pressures that would otherwise lead to an appreciation of the home currency. Efforts to stem a depreciation of the home currency, in contrast, typically run aground against a strong tide of investor unwillingness to hold an asset expected to decline in value. This asymmetry requires a different analytic emphasis in addressing policy choices to counter appreciation versus depreciation. Second, policymakers seldom rely on a

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single means to control the exchange rate. This follows because most authorities are loathe to undertake the surest mechanism to eliminate bilateral exchange rate fluctuations—surrendering monetary autonomy to the anchor country. Instead, they make do with a combination of taxes and fees, outright controls, and partial exchange market intervention.

In this paper, we apply these two observations to ask: What are the tools available to authorities in emerging market economies to counter pressure on the exchange rate to appreciate? As is evident from some of our earlier work, one of the most interesting manifestations of this exchange-rate pressure comes in the form of capital inflows (as in Calvo, Leiderman, and Reinhart, 1996, and Reinhart and Reinhart, 1998). So we could have also posed the question as: How can authorities stem the tide of large capital inflows?

We will use a simple interest-parity relationship to identify the potential sources of upward pressure on the value of a foreign exchange rate in the next section. The section also updates some of the analysis in Calvo and Reinhart (2002) to establish that exchange rates, even though they are subject to a variety of pressures, vary very little in practice, thereby providing some circumstantial evidence that authorities work to smooth them. But how?

In Section 3, the parity condition will be applied to explain the various policy options to damp exchange rates in principle. The section that follows turns to practice by considering the extent to which the accumulation of foreign exchange has effectively been sterilized and then details major policy initiatives related to stemming forces to appreciate the exchange rate in scores of countries over the past two decades. This has proved to be the most daunting aspect of this project, in that so many different countries have moved at so many different margins. Consider, for instance, China: In the past year, authorities on several occasions have raised deposit and lending rates, widened the acceptable range of variation in the yuan, raised reserve requirements, and taken efforts to encourage outflows. The fifth section offers concluding comments.

2. Varieties of Upward Pressure on the Exchange Value of a Currency

Although economists' ability to explain, let alone predict, movements in foreign exchange values has been shown to be dreadful, the profession retains a touching faith in a simple relationship's ability to do so. That is, uncovered interest parity remains the workhorse of exchange-rate determination in theoretical models despite its consistently poor showing in empirical derbies. By dint of necessity, we will also ride that horse to explain forces tending to put upward pressure on the exchange value of the currency of the sort associated with large capital inflows.

Adopt, for the moment, the perspective of an investor in an emerging market economy who faces two alternatives—an investment at home with a stated nominal return of i in the home currency and an investment abroad with a stated return of i^* in the foreign currency. Let s be the foreign currency value of one unit of the home currency. The domestic asset is taxed at the rate t^D and subject to expropriation risk of δ per annum.¹⁾ Thus, the relevant return on the domestic asset is:

$$i - t^D - \delta.$$

If the domestic investor opts for holding the foreign asset, the nominal return must be translated into domestic currency, which might be expected to change over the relevant at the rate \dot{s}/s , and a tax t^F is levied by the home or foreign government.²⁾ Thus, the all-in return from the foreign asset will be:

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- 1) See Reinhart (2000) for a discussion of the distinction between a tax on holding an asset and on acquiring an asset. The former is akin to a reserve requirement (without remuneration) and the latter is a Tobin tax.
 - 2) Either rule out default by the foreign sovereign or interpret δ as differential default risk. The “•” Operator denotes the forward derivative with respect to time and, to keep the notation simple, we abstract from uncertainty.

$$i^* - \frac{S}{s} - t^F.$$

The return from these two investment strategies should equal, adjusted for differences in their riskiness. This risk premium, ρ , is essentially defined by the difference in these all-in returns, or

$$i - t^D - \delta = \rho + i^* - t^F - \frac{S}{s}.$$

This identity can be useful in describing pressures on the exchange rate, with the equal sign serving as the fulcrum to balance relative asset demands if we move from treating this equation as an identity to treating it as a behavioral relationship. That is, think of the risk premium as parametric instead of as a residual. Upward impetus to the exchange value of the currency might materialize for three key reasons:

2. 1. *The foreign interest rate falls*

All else equal, a reduction in the foreign interest rate would tend to increase relative demands for the home asset, inducing home-exchange rate appreciation. This force came prominently to the fore in two recent episodes when the U.S. Federal Reserve cut its policy interest rate to unusually low levels, to 3 percent in nominal terms in 1992 and to 1 percent from 2003. These low returns encouraged investors to seek alternatives, often riskier and sometimes off the shores of the United States. Calvo, Leiderman, and Reinhart (1996) identified the low levels of U.S. interest rates as instrumental in explaining capital flows. In updating this approach, Reinhart and Reinhart (2002) found systematically that real private capital flows, direct investment, and portfolio investment to emerging market economies did indeed vary inversely with the nominal short-term U.S. interest rate over the last thirty years of the twentieth century.

2. 2. *Default risk declines*

An improvement in economic conditions and fiscal consolidation are often associated with upward pressures on the value of an emerging market economy's currency. Within the framework provided by the parity condition, this can be explained as a reduction in differential default risk. This has been evident in episodes in countries where the exchange rate rallied on news of improvement in the fiscal accounts, on the announcement of structural reform, and when outside assessors—i.e., the rating agencies—release an improved evaluation. Indeed, the association between rising commodity prices and an appreciating currency in emerging market economies that has sometimes been noted might be thought of as reflecting the more complicated causal chain in which gains in commodity prices improve fiscal conditions and thereby trim default risk.³⁾

2. 3. *Risk appetites increase*

Instances of increased tolerance and/or perception of lessened risk on the part of global investors tend to be associated with the search for return by global investors and capital inflows to emerging markets. In the United States, for instance, narrow domestic corporate yield spreads in the early and mid 1990s, elevated stock prices in the late 1990s, and low financial market volatilities of 2005 and 2006 all apparently served to encourage private capital inflows. In terms of the parity condition, such increased enthusiasm for emerging market assets maps into a reduction in the risk premium. And all else equal, such a decline would be associated with the expectation of an appreciation of the exchange rate.

We have pushed and pulled the interest parity condition to identify reasons why the exchange rate might change. In the event, many exchange rates do not move much. The joint observations that there seem to be many sources of potential pressures on the exchange rate in principle and the lack of exchange rate volatility in practice creates the strong presumption that authorities often take steps to limit exchange rate fluctuations. In other work, one of us has dubbed this “the fear of floating” (Calvo and Reinhart 2002). This reluctance to allow market

3) Chen and Rogoff (2002), for instance, found robust empirical relationships linking the exchange rates of Australia, Canada, and New Zealand and country-specific indexes of commodity prices.

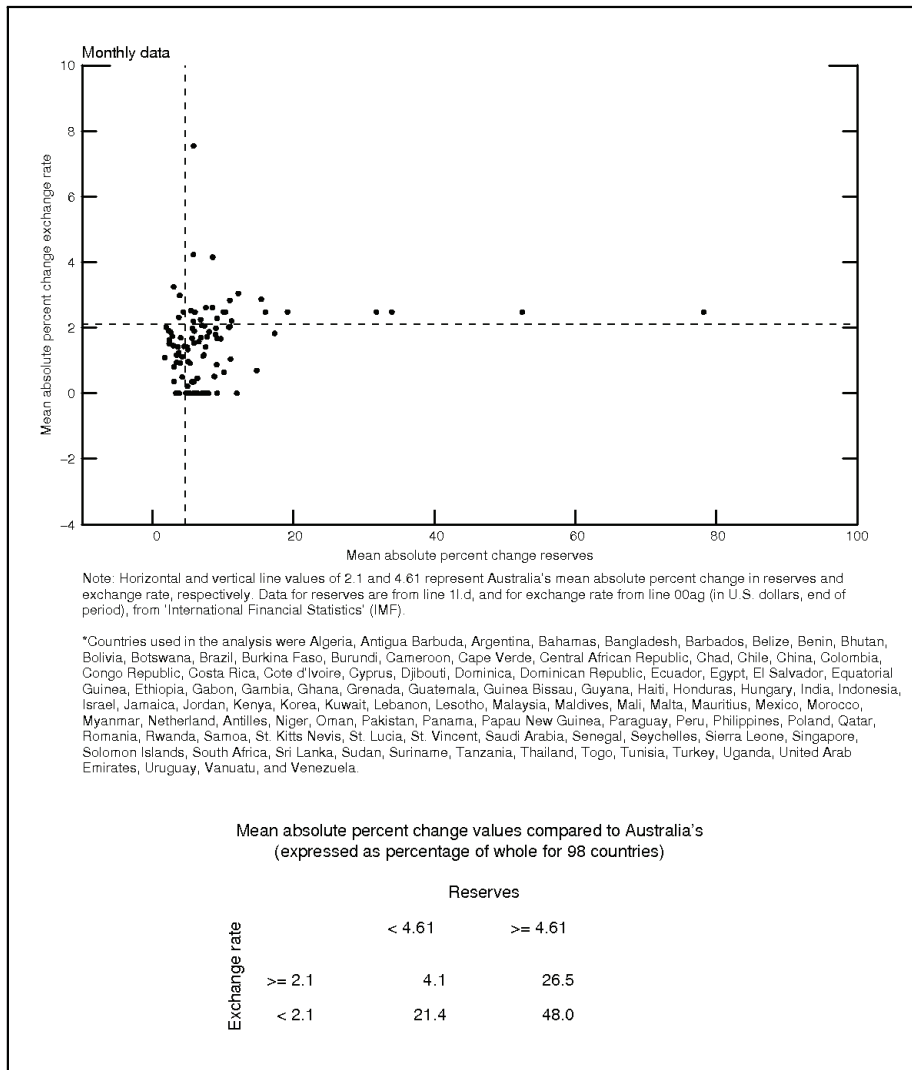
forces to take their course has had various rationales, including the concerns that a surge in capital flows may distort relative prices, exacerbate weaknesses in the financial sector, and feed asset price bubbles. Such concerns tend to be especially acute if authorities view the favor of financial markets to be fleeting. Deterring such “hot money” may be seen as a means of smoothing through volatile foreign appetites for risk. But not all money is hot, and deterring foreign capital inflows presumably limits additions to the domestic capital stock, thereby reducing the resources available for production.

The evidence, at least as amassed by Calvo and Reinhart, suggests that many authorities see the balance as tilted against capital inflows. Among their calculations, the authors compute the month-to-month percent change in the exchange rate and reserves for a large set of countries. They then compared the likelihood that the exchange rate fluctuated by less and reserves by more than their chosen benchmarks (Australia, Japan, and the United States). Actual policies tended to be consistent with more muted swings in the exchange rate in most countries than in the benchmarks. And one of the instruments to achieve that outcome appears to be reserves, in that reserves generally vary by more than in any of the benchmark countries.

Figure 1 updates this analysis using the monthly percent changes in exchange rates (relative to the U.S. dollar) and international reserves (in U.S. dollars) for ninety-seven developing countries from 1990 to 2006. The chart in the upper panel compares the mean absolute percent change in the exchange rate (along the vertical axis) with the mean absolute percent change in reserves (along the horizontal axis). The horizontal and vertical lines (at 2.1 and 4.6, respectively) represent the sample averages for Australia, a country noted for its commitment to floating exchange rates. As is evident from the chart and the contingency table in the bottom panel, seven out of ten countries in the sample had exchange rates that were less variable and reserves that were more variable than the benchmark experience.

What is probably most instructive is the upper left quadrant of the graph and the contingency table. Few countries (4 percent) were willing to tolerate exchange rates that were more variable than the benchmark while varying their reserves by less than the benchmark. Thus, policymakers in emerging market economies appear to have made the effort to limit fluctuations in exchange rates. However, if the interest rate

Figure 1.



parity condition purports to explain the determination of exchange rates, then the steps authorities take to damp currency fluctuations must leave

footprints there. But that is the subject of Section 3.

3. Tools to Limit Exchange Rate Fluctuations

The interest parity condition offered multiple margins for authorities to offset forces that would otherwise produce an appreciation of the exchange rate. We will detail four in particular.⁴⁾

3. 1. *Shadow foreign financial conditions*

In principle, the domestic monetary authority could adjust the home interest rate point for point with any change in foreign financial conditions. If, for instance, the foreign monetary authority lowers its policy rate, the domestic interest rate could be moved down in tandem, thereby never allowing an incipient wedge to open up between the left and right hand sides of the parity condition that would otherwise be filled with the expectation of an exchange rate change.

This, of course, is the classic recipe for an open economy to stabilize its exchange rate by surrendering its monetary autonomy.⁵⁾ But in a world of potentially volatile financial flows, the issue is more complicated. Authorities in the emerging market economy must tether their policy rate to overall financial conditions, not the foreign policy rate alone. Thus, the domestic rate may have to change with changes in the perceived default rate and the risk premium, two variables that must be inferred, not observed. Also note that the change in the domestic interest rate can be put in place either through domestic open market operations or unsterilized foreign exchange intervention, which may have different effects on other elements of the parity condition.

3. 2. *Increase taxes on the home asset*

Home authorities could always attempt to dampen the ardor of global investors for emerging market assets by raising the tax on them.⁶⁾

4) Reinhart and Reinhart (1998) provide a longer list of tools.

5) Notice that, for the anchor country, the effects of its monetary policy are amplified to the extent that other countries follow its lead. The decision of N countries to follow the N+1st entails different dynamics than when N+1 countries fix their exchange rate.

Again, in principle, such variations could counter changes in any of the other elements of the parity condition without recourse to changes in the exchange rate. Or could they? Bartolini and Drazen (1997) caution that changes in capital controls may serve as a signal to foreign investors. Presumably, the same may be said about tax policy. Foreign investors might interpret an increase in the tax on foreigners as an attempt to preserve an attractive asset for local investors. If that is the case, then foreign investors may just pile more capital into the country. In effect, the increase in the tax rate would be offset to some extent by a reduction in perceived default risk.

3. 3. *Lower the tax on foreign assets*

If capital inflows from foreigners cannot be deterred, perhaps the authorities can encourage capital outflows by domestic residents, thereby keeping net inflows unchanged (Labán and Larraín, 1993). Aside from signaling aspects just mentioned, this mechanism of lowering the tax on foreign assets is available only if there was a tax to start with, as it is unlikely authorities would go so far as subsidizing investments in their industrial country anchor.

3. 4. *Conduct sterilized intervention*

If domestic and foreign assets are imperfect substitutes in investors' portfolios, then changes in relative asset shares could affect the foreign exchange risk premium, blunting pressures on the exchange rate to change. International economists have long struggled with the issue of whether this theoretical result holds in practice. Schadler et al. (1993) conclude that, in most of the developing countries that they examine, there is some scope for sterilization policies in the short run—i.e., changes in domestic credit are not instantly offset by changes in net foreign assets. Frankel and Okungwu (1996), however, find stronger evidence of perfect capital mobility in many of the developing countries that have experienced heavy capital inflows—casting greater doubt on any ability to influence exchange rates through sterilization.

Another line of work has argued that even if assets were perfect substitutes, sterilized intervention might serve an important role in

6) Edwards (1999) reviews the experience of capital controls in emerging market economies.

signaling policy intentions. In effect, foreign exchange intervention might be viewed as the first step in a sequence of policy actions. In pricing foreign exchange, market participants would look past those essentially irrelevant operations to the changes in the domestic policy interest rate that they foreshadow, leading to an association between intervention and changes in currency value (Mussa, 1981). The evidence on this issue is mixed: Kaminsky and Lewis (1996) find little empirical support for the signaling hypothesis in the United States, while Dominguez and Frankel (1993) do.

It is important to realize that, given the uncertainties surrounding the efficacy of all these policies, risk-averse authorities tend not to rely on any one alone. Also, a combination of these policies may help when international and domestic considerations are both significant. For instance and as already mentioned, domestic authorities may be reluctant to surrender monetary autonomy by shadowing foreign financial conditions exactly. In many cases, they may rely on unsterilized intervention to smooth the exchange rate but raise reserve requirements to cushion the net effect on the domestic money stock (Reinhart and Reinhart, 1999). As long as required reserves do not pay a competitive interest rate, however, reserve requirements are a tax on the banking system. Changes in that tax can have real effects, including on the exchange rate, depending on the incidence of the tax.

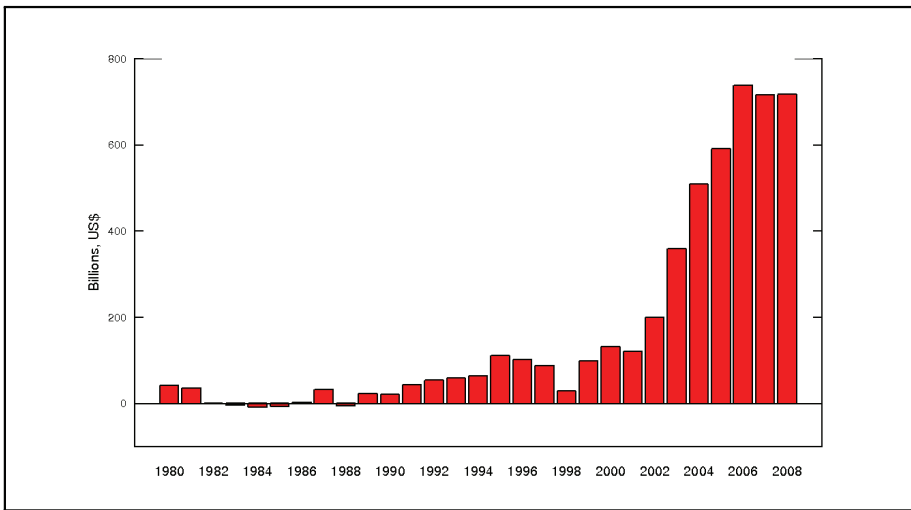
4. Some Evidence on the Actions of Emerging Market Authorities

We read theory as suggesting that authorities in emerging market economies have tools at their disposal to trim an appreciation of their currency. We read the evident smoothness of many exchange rates as suggestive of them using at least some of those tools. In this section, we present evidence that they use those tools in part to insulate the domestic economy from some of the consequences of these actions regarding the exchange rate.

As can be seen in Figure 2, emerging market economies have been accumulating reserves on a massive scale. According to the International Monetary Fund, international reserves of the group "Other Emerging Market Economies," which includes China and India, are set to increase \$3/4 trillion in each of the next few years. Those reserves could be

increasing through sterilized intervention attempting to hold up the risk premium by changing relative asset stocks or unsterilized intervention that keeps the nominal interest rate low by allowing foreign reserves to bloat the domestic money stock. If it were the latter, we would expect to see an association between the domestic money stock and foreign exchange reserves.

Figure 2. Annual Accumulation of Foreign Exchange Reserves, Other Emerging Market and Developing Economies



Source: IMF World Economic Outlook Database(Apr. 2007)

To investigate the matter, we gathered annual data on international reserves and the domestic money stock for thirty nonindustrial economies. The upper panel of Figure 3 plots the pairwise observations of the percent changes in the narrow domestic money stock along the vertical axis and the percent change in international reserves along the horizontal axis. Ordinary-least-squares regression lines are drawn through each year’s worth of observations. Quite clearly, international reserves did not leave a material imprint on the domestic money stock in the early years of this decade. More recently, though, those regression lines point more distinctly upward.

Figure 3. Changes in Reserves and Money, 2000-2006, Emerging Market Countries

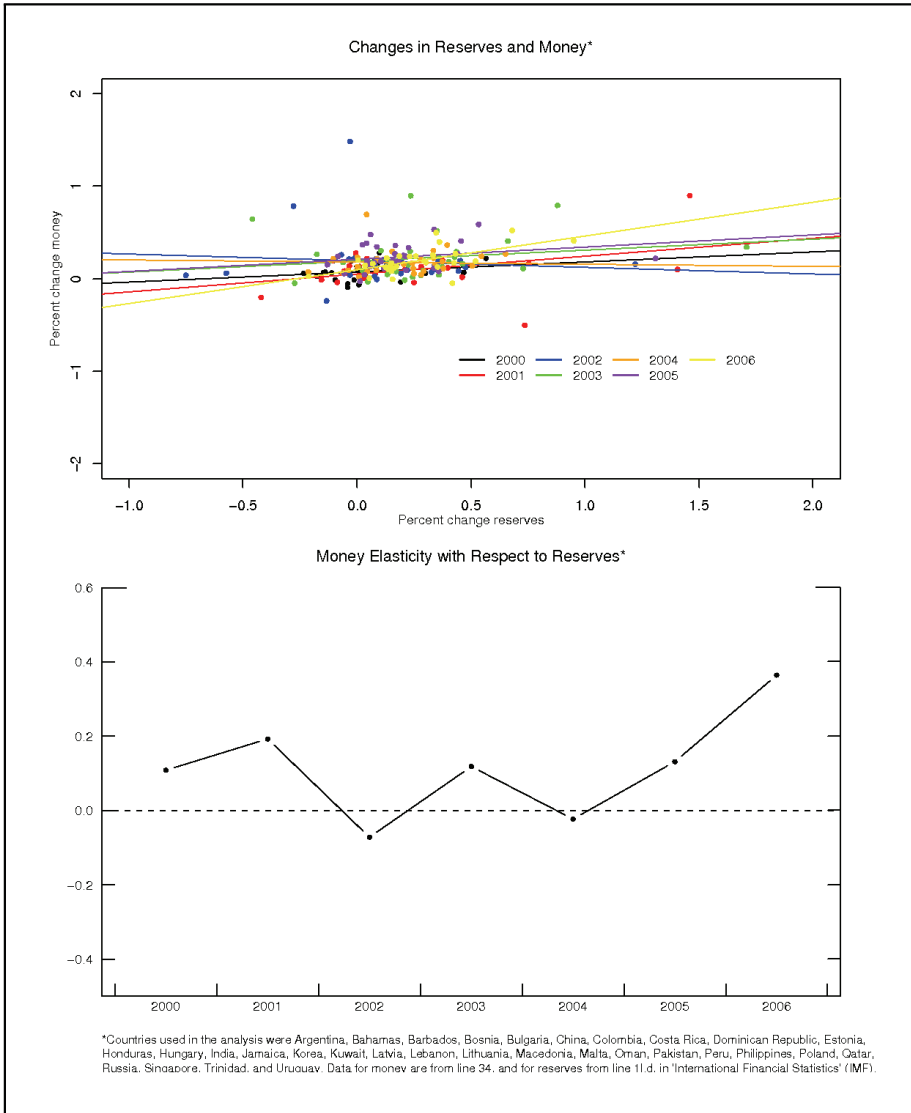


Figure 4. Countries and Economic Unions in the Sample

Afghanistan	Czech Republic
Albania	Denmark
Algeria	Djibouti
Andorra	Dominica
Angola	Dominican Republic
Anguilla	ECOWAS (Economic Community of West African States)
Antigua and Barbuda	ECCB (East Caribbean Central Bank)
Argentina	East Timor
Armenia	Ecuador
Aruba	Egypt
Australia	El Salvador
Austria	Equatorial Guinea
Azerbaijan	Eritrea
BCEAO (Central Bank of the West African States)	Estonia
BEAC (Bank of Central African States)	Ethiopia
Bahamas	European Union
Bahrain	Fiji
Bangladesh	Finland
Barbados	France
Belarus	Gabon
Belgium	Gambia
Belize	Georgia
Benin	Germany
Bermuda	Germany, East
Bhutan	Ghana
Bolivia	Gibraltar
Bosnia and Herzegovina	Greece
Botswana	Grenada
Brazil	Guatemala
British Virgin Islands	Guernsey
Brunei	Guinea
Bulgaria	Guinea-Bissau
Burkina Faso	Guyana
Burundi	Honduras
CEMAC (Economic and Monetary Community of Central Africa)	Hong Kong
CMA (Common Monetary Area)	Hungary
Cambodia	Iceland
Cameroon	India
Canada	Indonesia
Cape Verde	Iran
Cayman Islands	Iraq
Central African Republic	Ireland
Chad	Isle of Man
Chile	Israel
China	Italy
Colombia	Jamaica
Comoros	Japan
Congo, Democratic Republic of the Congo-Kinshasa	Jersey
Congo, Republic of the Congo-Brazzaville	Jordan
Cook Islands	Kazakhstan
Costa Rica	Kenya
Cote D'Ivoire	Kiribati
Croatia	Korea
Cuba	Kosovo
Cyprus	Kuwait

This tendency can be seen more sharply in the bottom panel, which plots the slope coefficient from these regressions over time, which can be interpreted as the elasticity of the domestic money supply to international reserves. This elasticity has often been close to zero. In the most recent years, though, authorities apparently have found it difficult to offset their massive purchases and the coefficient has drifted up.

Figure 4. Continue

Kyrgyzstan	St. Lucia
Lao	St. Vincent
Latvia	Samoa
Lebanon	San Marino
Lesotho	Sao Tome e Principe
Liberia	Saudia Arabia
Liechtenstein	Senegal
Libya	Serbia and Montenegro
Lithuania	Seychelles
Luxembourg	Sierra Leone
Macao	Singapore
Macedonia	Slovak Republic
Madagascar	Slovenia
Malawi	Solomon Islands
Malaysia	Somalia
Maldives	South Africa
Mali	Spain
Malta	Sri Lanka
Mauritania	Sudan
Mauritius	Suriname
Mexico	Swaziland
Micronesia	Sweden
Moldova	Switzerland
Monaco	Syria
Mongolia	Taiwan
Montenegro	Tajikistan
Montserrat	Tanzania
Morocco	Thailand
Mozambique	Togo
Namibia	Tonga
Nepal	Trinidad and Tobago
Netherlands	Tunisia
Netherlands Antilles	Turkey
New Zealand	Turkmenistan
Nicaragua	UEMOA (West African Economic and Monetary Union)
Niger	Uganda
Nigeria	Ukraine
Norway	United Arab Emirates
Oman	United Kingdom
Pakistan	United States
Panama	Uruguay
Papua New Guinea	Uzbekistan
Paraguay	Vanuatu
Peru	Venezuela
Philippines	Vietnam
Poland	WAEMU (West African Economic and Monetary Union)
Portugal	WAMA (West African Monetary Agency)
Qatar	West African States
Romania	Yemen
Russia	Yugoslavia
Rwanda	Zambia
SADC (South African Development Community)	Zimbabwe
St. Kitts	

Why does the direct policy tool that so often occupies center stage in theoretical models—changes in reserves—seem to have so little

domestic consequence? The shallowness of some of these domestic financial markets cast doubt on the explanation that this is evidence of sterilization. Rather, it may signal that authorities use some of the other tools at hand, importantly including reserve requirements, to offset the effects of their unsterilized intervention. To shed light on the issue, we amassed information on official actions directed toward the exchange rate in more than one-hundred countries over the past decade from a variety of sources, paying particular, but not exclusive, attention to reserve requirements. The list of countries for which some information is available is given in Figure 4. The detailed results are relegated to on-line worksheet, but certain regularities are worth highlighting.⁷⁾ <http://www.wam.umd.edu/~creinhar/Links.html>

The range of experience is considerable and changes in policy can be quite nuanced. Countries as varied as Croatia, South Korea, and Vietnam raised reserve requirements in the past few years to restrain the expansion of domestic credit. At the head of the league table, though, is the People's Bank of China, which upped the required reserve ratio six times in the first seven months of 2007 to blunt the effects of swelling international reserves on the domestic money stock. In many countries, more nuanced policy adjustments are also possible, in that reserve requirements often differ by the type, maturity, and currency composition of deposits.

The apparatus of reserve requirements also apparently has an options value to authorities even if actual requirements have gone untouched for some time. For example, a recent report of the Reserve Bank of India held that "... it is necessary to retain the flexibility of using reserve requirements as and when necessary."⁸⁾ In recent years, international financial institutions have also come to the recognition that such tools may prove useful. As one example, among the preliminary conclusions in the International Monetary Fund's Article IV consultation with Kazakh officials in 2006 was

... the National Bank of Kazakhstan (NBK) will need to move quickly to soak up liquidity to slow the pace of credit expansion.

7) The worksheet and accompanying explanatory information prepared by April Gifford are available at <http://www.wam.umd.edu/~creinhar/Links.html>.

8) Original sources for this and what follows are provided in the worksheet.

This can be achieved by increasing the interest rate paid on bank deposits to at least international levels and by broadening the coverage of reserve requirements to include all liabilities, which should also help slow external borrowing. In addition, consideration should also be given to a moderate and temporary increase in reserve requirements to aid in mopping up liquidity.

Some national authorities, however, have eschewed the use of reserve requirements, including Australia, Denmark, El Salvador, Hong Kong, Sweden, and Switzerland. Even less interventionist are the handful of economies that have given up independent monetary policy, including those that have adopted a currency board, such as Brunei and Hong Kong, and the completely dollarized Ecuador.

While the list stresses changes in reserve requirements, also included are controls on capital inflows, on capital outflows, and changes in official exchange rate bands. The variety of experience eludes simple summary, suggesting that researchers should reflect the range of alternative policies in modeling.

5. Conclusion

The experience of emerging market economies over the past decade offers many governmental experiments with influencing the foreign exchange market, but unfortunately few of them are controlled experiments. We can trace associations among variables—say, low foreign interest rates occur in tandem with capital inflows and increased taxes on those inflows. The extent to which one produced the other, however, is difficult to ascertain.

We take the variety of official actions to be evidence of:

- Distaste for exchange rate appreciation when capital flows in;
- Belief that policy tools can be effective; and
- Recognition that no single tool is completely effective.

In addition, authorities seem reluctant to be bound by the iron triangle of international finance that holds only two of the following three can be achieved: freely mobile capital, fixed exchange rates, and

monetary autonomy. Even as investors direct capital internationally with increasing vigor, authorities look for ways to train some measure of monetary control while delivering a stable exchange rate. When global capital flows in, the preference for relatively stable exchange rates often necessitates accumulating reserves. Important among the tools to blunt the consequences on domestic liquidity of that reserve build-up are reserve requirements, which are often seen as having the advantage of potentially being tailored to an instrument's type, maturity, and currency denomination, but other tools are also in the arsenal.

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Chapter 2

Monetary Sterilization in Asia: Magnitude and Effectiveness

Sterilized Intervention in Emerging Asia: Is It Effective?*

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1. Introduction

Has sterilized intervention in emerging Asia been effective in influencing the level, change, or volatility in exchange rates? The question arises because it is hard to rationalize the rapid buildup of foreign exchange reserves in the region as solely aimed at ensuring sufficient reserves (Table 1). Certainly, some of the reserve accumulation has been precautionary in nature, and in some countries intervention reflects the operation of a fixed exchange-rate regime (Table 2). But for countries that operate flexible regimes, reserve accumulation may reflect a desire to influence the level, change in, or volatility of the exchange rate. Indeed, since mid2005 intervention has occurred in the context of upward pressure on currencies, suggestive of a “leaning against the wind” approach. This paper concentrates on five managed-floating countries that have conducted intervention—India, Indonesia, Korea, the Philippines, and Thailand—over the period 2000-07.

* This paper is based on Chapter 3 of the IMF’s *Asia Pacific Regional Economic Outlook*.

Table 1. Cumulative Foreign Exchange Flows and Reserve Accumulation¹
(In millions of U.S. dollars)

	2000-07	2000-02	2003-04	2005-07
Indonesia				
Current account and FDI	40,962	15,332	7,559	18,071
Net capital inflows	-17,275	-9,233	-1,209	-6,834
Reserve accumulation	20,171	4,521	4,749	10,901
India				
Current account and FDI	30,903	14,969	16,622	-687
Net capital inflows	112,729	17,661	32,538	62,530
Reserve accumulation	163,622	35,553	60,068	68,001
Korea				
Current account and FDI	93,283	30,845	44,819	17,619
Net capital inflows	71,710	17,860	20,202	33,648
Reserve accumulation	164,902	47,358	77,654	39,890
Philippines				
Current account and FDI	14,230	-321	2,213	12,338
Net capital inflows	-6,452	60	-1,396	-5,116
Reserve accumulation	17,103	464	1,254	15,384
Thailand				
Current account and FDI	44,643	26,912	10,620	7,111
Net capital inflows	-32,585	-24,764	-10,939	3,119
Reserve accumulation	41,889	6,402	15,993	19,494

Source: IMF staff estimates.

¹The reserve accumulation is from the central bank balance sheet (it is not derived from the BOP data).

The data excludes net errors and omissions and current transfers.

Net capital inflows excludes FDI.

Table 2. Reserve Adequacy Ratios (Asofend-2006)

	India	Indonesia	Korea	Philippines	Thailand
Gross reserve					
In months of imports of goods and services	8.2	9.4	7.7	4.4	6.0
As ratio of short-term external debt 1/	9.4	1.5	2.1	1.6	2.0

Source: IMF staff estimates.

1/ Residual maturity.

An important goal of this paper is to ascertain the impact of intervention on exchange rates. While the theoretical literature on its effects has advanced, and central bankers indicate that they view intervention as an effective policy tool (Neely 2007), inferring its effects remains complicated. This study, like many in the literature, faces data limitations and methodological challenges. In particular, it is hampered by the use of monthly reserve data as a proxy for intervention and standard problems such as the simultaneity of exchange rates and intervention. Furthermore, the lack of a counterfactual also makes assessing the effectiveness of intervention difficult.

Recognizing such difficulties, this paper finds limited evidence of systematic links between exchange rates and intervention. The data show that the authorities have intervened on both sides of the market. Early in the sample period, some authorities were “leaning against the wind” by selling foreign exchange, while later in the sample they bought foreign exchange during periods of protracted appreciation pressures on their currencies. Overall, the empirical results speak loudest on volatility, suggesting that intervention may be associated with lower exchange rate volatility.

2. What Is Sterilized Intervention?

Foreign exchange intervention is the purchase or sale of foreign exchange by a monetary authority, either sterilized or unsterilized (Box 1). *Unsterilized intervention* involves the purchase of foreign currency with domestic currency, which changes the monetary liabilities of the monetary authorities, and thus the monetary stance. *Sterilized intervention* includes both this exchange of currencies and monetary operations (such as open-market sales or purchases of securities) to undo the effects of that exchange on monetary liabilities. Sterilized intervention is thus equivalent to a swap of securities denominated in home currency for those denominated in foreign currency, with a corresponding change in the currency composition of the private sector’s securities holdings. The distinction between unsterilized and sterilized intervention is important: changes in the monetary stance would naturally affect the exchange rate, so it would not be surprising to find that unsterilized intervention is effective. By contrast, sterilized intervention acts through subtler channels

(as discussed later), which may not always work.

The distinction between sterilized and unsterilized intervention is also important in relation to the monetary framework. For example, four of the five countries studied here – Indonesia, Korea, the Philippines, and Thailand – have adopted inflation-targeting frameworks, which may constrain intervention. For instance, if an inflation-targeting country wished to resist exchange rate pressures, it could adjust its monetary policy stance through intervention. But protracted onesided intervention could, in principle, raise inconsistencies with inflation targeting. For example, unsterilized intervention could create a surge of domestic liquidity that led to an undue loosening in the domestic monetary stance, or could keep the exchange rate from adjusting to a level consistent with achieving the inflation target. It is thus not surprising that the countries in the sample generally sterilize (as discussed below).

3. Motives for Intervention, Channels for Effectiveness, and Evidence from the Literature

3. 1. Typically, intervention aims at

- *Influencing the level of the exchange rate.* The authorities may be concerned that the exchange rate has moved away from its equilibrium level, unduly affecting competitiveness (note that none of the five countries examined targets a specific exchange rate level).
- *Dampening exchange rate changes.* The authorities may also intervene to slow the speed of exchange rate changes. For example, this “leaning against the wind” may buy the export sector time to adjust to an appreciating exchange rate trend.
- *Smoothing exchange rate volatility.* The authorities may intervene to prevent exchange markets from becoming disorderly. In particular, excessive volatility may impede the orderly functioning of the market, leading to a widening of bidask spreads and loss of liquidity.
- *Accumulating reserves.* The authorities may intervene to build an inventory of foreign currency assets. Following the financial crises of the 1990s, many countries, including those in this study, embarked on intervention partly as a self-insurance policy aimed

at reducing external vulnerabilities and sovereign risk.

3. 2. *Sterilized intervention can work through two main channels:*¹⁾

- *Portfolio balance channel.* Sterilized intervention may affect the exchange rate if it changes the risk premium, which arises when home and foreign bonds are imperfect substitutes.²⁾ That is, the risk premium may change to induce the private sector to adjust its holdings of foreign and domestic bonds. If so, the exchange rate would move to equalize risk-adjusted returns on domestic and foreign currency assets.³⁾
- *Signaling channel.* Sterilized intervention may have effects through the signaling channel if it changes expected future values of the exchange rate or its fundamentals. In particular, this channel would imply a systematic relationship between intervention and future policies.

Prior research on the effectiveness of these channels focuses mainly on advanced countries, and finds weak evidence that sterilized intervention affects exchange rates.⁴⁾ The empirical literature uncovers effects that are statistically significant but economically small.⁵⁾ Some research finds effectiveness when the exchange rate is away from

1) Edison (1993) is an early survey of the intervention literature; Sarno and Taylor (2001) provides a more recent survey of theory and empirical evidence. Truman (2004) concludes "Intervention has definite limits as a policy instrument. Its effectiveness is uncertain and imprecise, and therefore it is at best blunt or a blunted instrument."

2) The risk premium is the differential between home and foreign interest rates, adjusted for the expected depreciation of the foreign currency.

3) The wellknown empirical violations of uncovered interest parity, surveyed in Engel (1996), and more recently Chinn (2006), are consistent with the assumptions underpinning the portfolio balance channel.

4) Typically, the literature focuses on the effects of intervention on the nominal bilateral exchange rate visàvis the U.S. dollar, since most countries intervene against the dollar.

5) Edison (1993) surveys the literature from the 1980s through early 1990s. Dominguez and Frankel (1993) found some evidence in favor of the portfolio and signaling channels while Obstfeld (1990) found that portfolio balance effects are statistically significant but small. For Japan, Ito (2002) found that large and infrequent intervention had quantitatively small but statistically significant effects on the dollar-yen nominal exchange rate.

fundamentals, but such effects are very short lived and at times tend to increase volatility. In addition, for the major currencies, evidence that sterilized intervention *dampens* volatility is weak.⁶⁾

The literature on the effectiveness of intervention in emerging markets is still in its infancy, owing in part to limited availability of data. Existing studies generally find weak evidence of effectiveness.⁷⁾ In contrast, a study on India finds that intervention dampens volatility (but does not affect the level of the rupee). A recent cross-country study, using a sample of emerging markets and small advanced countries, finds that resisting nominal exchange rate appreciation through sterilized intervention is likely to be ineffective when capital flows are persistent (IMF 2007).

In principle, intervention could be more effective in emerging markets countries than in advanced countries:

- *Emerging markets assets may be less perfect substitutes internationally than advanced country assets.* Indeed, Chinn and Ito (2007) show that countries in our sample are less financially open to international transactions than advanced economies. In addition, emerging market currencies may be riskier than major currencies, especially during periods of financial market volatility, and investors typically demand a risk premium for holding emerging market bonds.
- *In emerging markets, intervention is larger relative to foreign exchange turnover.*⁸⁾ Despite its rapid growth in recent years, foreign exchange turnover is still relatively small compared with advanced economies (Table 3). For example, average *daily* turnover represented about 5½ percent of GDP in Japan and the United States in 2007, while it averaged only 2½ percent of GDP in the five countries examined here.

6) Dominguez (2006) and Edison, Cashin, and Liang (2006) have found that intervention increases exchange rate volatility, in contrast with claims by central banks that intervention does not increase (or is not associated with an increase in) volatility (Neely 2007)

7) Guimarães and Karacadag (2004), using daily data for Mexico and Turkey, find that intervention tends to increase exchange rate volatility. Disyatat and Galati (2005) find weak evidence that intervention is effective in the Czech Republic. On India, see Pattanaik and Sahoo (2003).

8) See Neely (2007) and Fatum and Hutchinson (2006) for evidence supporting this view.

Table 3. Foreign Exchange Turnover

(Daily average net of inter-dealer double-counting, in millions of U.S. dollars)

	India	Indonesia	Japan	Korea	Malaysia	Philippines	Thailand	United States
2001	3,416	3,857	146,780	9,597	1,248	1,061	1,896	253,654
2004	6,642	2,301	198,870	19,808	1,612	671	2,869	461,291
2007	34,085	2,809	238,425	33,396	3,417	2,320	6,171	663,611
	(In percent of reserves)							
2001	7.4	14.2	37.1	9.3	4.2	7.9	5.9	440.1
2004	5.2	6.6	23.8	10.0	2.4	5.1	5.9	607.8
2007	20.0	6.8	27.1	14.0	4.2	11.6	9.5	1,209.8
	(In percent of GDP)							
2001	0.7	2.4	3.6	2.0	1.4	1.5	1.6	2.5
2004	1.0	0.9	4.3	2.9	1.4	0.8	1.8	3.9
2007	3.5	0.7	5.5	3.5	2.1	1.7	2.8	4.8

Sources: Bank for International Settlements; and IMF staff estimates.

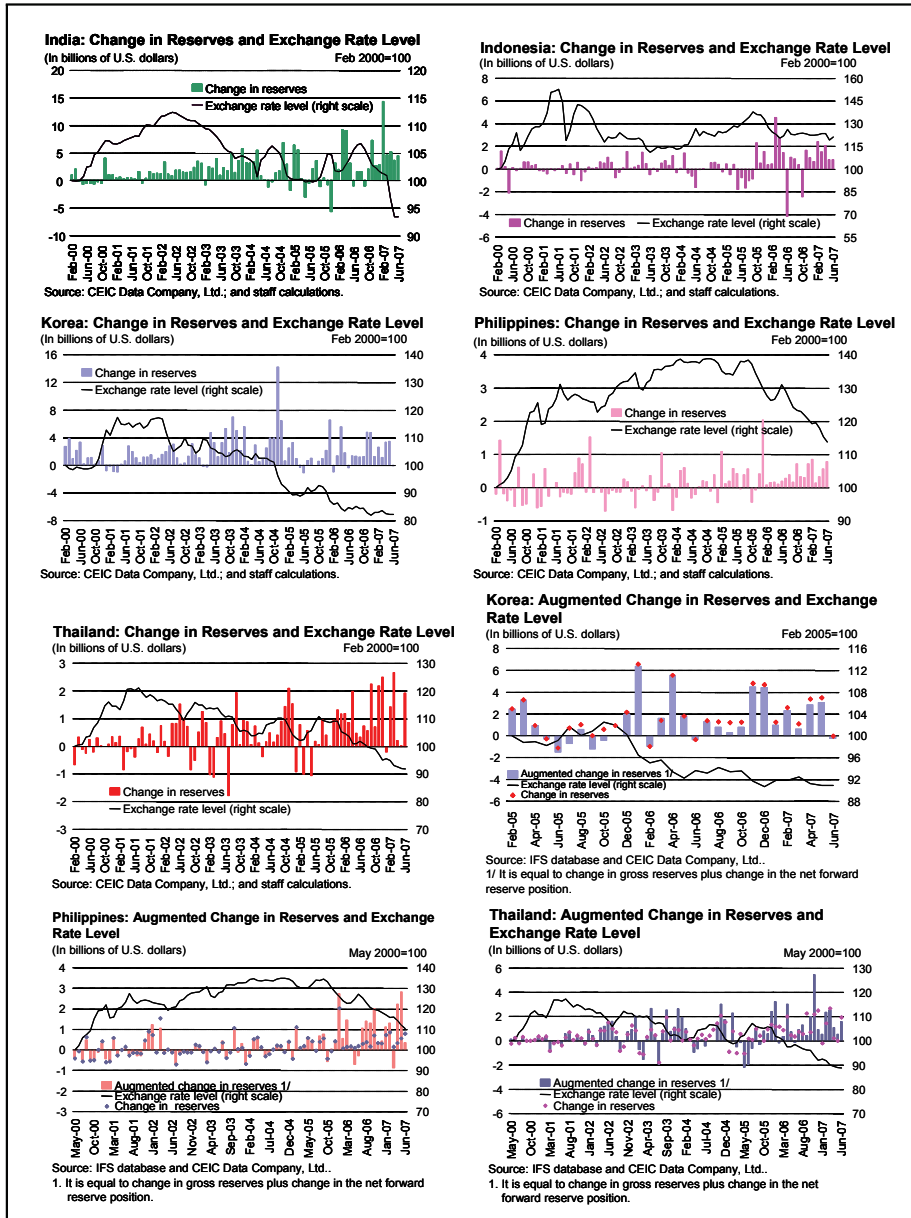
4. Has Intervention Been Effective in Emerging Asia?

4. 1. Data Issues

Measuring intervention is a key hurdle for properly assessing its effectiveness. Our sample of countries lack high-frequency, publicly available data on intervention, requiring the use of a proxy series. Given this constraint, this study proxies intervention with monthly changes in gross reserves. Actual intervention and the change in gross reserves differ owing to valuation changes and income flows from reserves, but for the countries studied here, the proxy tracks intervention reasonably well. In particular, for countries in this study, the correlation between changes in gross reserves and actual intervention data generally ranges around 0.8-0.9 (for countries in the sample, intervention data are confidential, except for India, which publishes monthly data). The main drawback of the data is its monthly frequency, which makes it difficult to disentangle the simultaneity of the exchange rate and intervention, and impossible to detect short-lived effects.⁹⁾

9) Ideally, intervention should also be adjusted for passive intervention, for example, when the monetary authorities accumulate reserves for the purpose of treasury operations and not to affect the exchange rate. However, such adjustments are not possible in our sample given lack of data.

Figure 1. Foreign Exchange Intervention



The proxy data show common patterns for intervention across countries, albeit with the magnitude varying substantially. Figure 1 shows that countries in the region have leaned more heavily toward purchases of foreign currency than sales, particularly in India and Korea. Similarly, countries appear to have stepped up intervention recently, particularly in India, Indonesia, Thailand, and the Philippines. However, the size of intervention relative to foreign exchange turnover has varied substantially across the sample countries. For instance, over the period 2005-07 absolute monthly intervention averaged 11 percent of *daily* foreign exchange market turnover in India, 50 percent in Indonesia, 5 percent in Korea, 38 percent in the Philippines, and 22 percent in Thailand.¹⁰⁾

Intervention in the region has often followed a “leaning against the wind” pattern. As Figure 1 shows, countries have often stepped up foreign exchange purchases during periods of protracted appreciation pressures on their currencies. For example, this occurred in India between June 2002 and April 2004 and between August 2006 and June 2007. It also took place in Korea between April 2002 and June 2007 and in the Philippines between September 2005 and June 2007.¹¹⁾ Such “leaning against the wind” complicates inference on the effectiveness of intervention since the simultaneous observation of foreign exchange purchases and domestic currency appreciation cannot be interpreted as evidence that intervention was ineffective. For instance, in the absence of intervention the exchange rate might have followed a more appreciated path.

Countries in the sample appear to have increasingly intervened through forwards and swaps (Box 1). India and Indonesia have reportedly intervened in spot markets only, but the Philippines and Thailand have increasingly used forwards and swaps for both outright intervention and sterilization (Figure 1).¹²⁾ Since there is no *a priori* reason to believe that forward or swap intervention would have a qualitatively different effect

10) Daily turnover data is for 2007, kindly provided by the BIS. Note that it is common in the literature to measure monthly intervention relative to daily turnover.

11) Note that June 2007 marks the end of our sample period, not necessarily the end of these “leaning against the wind” episodes.

12) Data for Korea starts in January 2005; most of its activity in forwards and swaps since then has reflected a slow unwinding of a US\$34 billion long forward position, which was mostly built over 2003 and 2004.

on the exchange rate than spot intervention, excluding such operations would underestimate actual intervention. Accordingly, an expanded measure of intervention was computed as the change in gross reserves plus the change in the net forward position (including the forward leg of swaps).

4. 2. *Extent of Sterilization*

In our sample, intervention has been mainly sterilized. To assess the degree of sterilization, the contribution of net domestic assets to reserve money growth is regressed on the contribution of net foreign assets to reserve money growth.¹³⁾ Under full sterilization, the coefficient would be -1, indicating that when the monetary authority purchases foreign

Table 4. Sterilization Coefficient^{1,2}

	2000-2007	2000-2002	2003-2004	2005-2007
India	-0.79	-0.72*	-1*	-0.72
Indonesia	-0.82*	-0.85*	-0.79*	-0.77*
Korea	-1*	-0.93*	-1.02*	-1.06*
Philippines	-0.85*	-0.72	-0.92*	-1.15*
Thailand	-0.87	-0.91*	-0.69	-0.9*

Source: IMF staff calculations.

¹The sterilization coefficient is the coefficient from a regression on the contribution of net domestic assets to reserve money growth on the contribution of net foreign assets to reserve money growth.

Net domestic assets in the regression are defined as reserve money minus net foreign assets.

²A star denotes that the null hypothesis of full sterilization (a coefficient equal to or smaller than minus one) cannot be rejected at 95 percent confidence.

13) This is an imperfect estimate of sterilization, since reserve money may be changing owing to (for example) shifts in money demand. Also, open market operations of domestic assets are not the only way to sterilize intervention; for example, swaps can be used as well. Further, note that net domestic assets are defined here as reserve money minus net foreign assets, which includes the central bank's net worth.

currency assets, it sells an equivalent amount of net domestic assets to neutralize the effect on reserve money.¹⁴⁾ This appears to be the case: the null hypothesis of full sterilization cannot be rejected in most cases, and even when it can, the coefficient is close to -1 (Table 4). This is unsurprising; with the exception of India, all countries in our sample follow inflation targeting, which implies—in the absence of changes in monetary policy stance—routine sterilization of the effects of intervention. In effect, then, the data for reserve changes can be treated as measuring sterilized intervention.

4. 3. Has Sterilized Intervention Been Effective?

As a first step to gauge the effectiveness of intervention, this paper employs simple correlation analysis. Most of the results are based on contemporaneous correlations between intervention and the level, the change, and the volatility of the exchange rate. The exchange rate used is the bilateral rate against the U.S. dollar, as this is the key exchange rate that authorities focus on when intervening.¹⁵⁾ Because the exchange rate is expressed in units of domestic currency per U.S. dollar, a positive correlation between intervention and the level of the exchange rate would indicate that higher intervention is associated with a more depreciated domestic currency, providing evidence of effectiveness.¹⁶⁾ Similarly, a positive correlation between intervention and the change in the exchange rate would indicate that higher intervention is associated with a weaker appreciation (or stronger depreciation), which also provides evidence that intervention may slow the speed of appreciation. Finally, one would also expect to find a negative correlation between intervention and volatility if intervention dampens exchange rate volatility.

14) If (narrow) money demand is constant or stable in the very short term, the regressions correctly test for sterilization even for countries that target a short-term interest rate.

15) For Korea, calculations were recomputed using the bilateral rate against the yen, but the results were very similar to those using the U.S. dollar. Further work could investigate whether intervention in the region has affected the level or volatility of the real exchange rate.

16) Note that leaning against the wind policies may generate negative correlations.

These simple correlations were buttressed with regression and vector auto-regression (VAR) analysis. Some of the regressions partially account for the simultaneity of intervention at the monthly frequency and are consistent with “leaning against the wind” and the protracted nature of intervention in our sample. In addition, the VAR analysis attempts to uncover lagged effects of intervention on the level or volatility of the exchange rate, as well as to differentiate between anticipated and unanticipated intervention. Because the regressions did not uncover significant information beyond what our correlation analysis shows, we concentrate on the correlations in the main text (see Box 2 for more details on the regression and VAR analysis).

5. Results

5. 1. Level of the exchange rate

The correlation between intervention (measured by the change in gross reserves) and the level of the exchange rate is weak. For most countries and subperiods, the sign of the correlation indicates that foreign currency purchases are associated with an *appreciation* of the domestic currency, the opposite of what one would expect, although the

Table 5. Change in Reserves and Level of the Exchange Rate^{1,2}

Contemporaneous	2000-2007	2000-2002	2003-2004	2005-2007
India	-0.21*	0.46*	-0.35	-0.22
Indonesia	-0.15	-0.21	-0.24	-0.30
Korea	-0.15	-0.33	-0.59*	-0.36
Philippines	-0.03	0.00	0.06	-0.27
Thailand	-0.33*	0.06	-0.29	-0.34

Source: IMF staff calculations.

¹The table displays the contemporaneous correlation between changes in gross reserves and the level of the exchange rate against the U.S. dollar.

²A negative correlation indicates that foreign reserve acquisitions are associated with an appreciation of the domestic currency, and a star denotes that the correlation is significantly different from zero at the 95 percent confidence level.

correlation coefficients are generally insignificant (Table 5). Such correlations could simply indicate that the authorities lean against the wind, purchasing foreign exchange when the domestic currency appreciates. However, computing correlations between intervention today and the level of the exchange rate with a lag, or attempting to control for the endogeneity of intervention in regressions, yields no further evidence of effectiveness (Box 2).¹⁷

5. 2. *Changes in the exchange rate*

The correlations between changes in gross reserves and the change in the exchange rate are also negative, and hence provide no evidence that intervention has slowed the speed of appreciation (Table 6).

Table 6. Change in Reserves and Change in the Exchange Rate^{1,2}

Contemporaneous	2000-2007	2000-2002	2003-2004	2005-2007
India	-0.31*	-0.48*	-0.45*	-0.17
Indonesia	-0.19	-0.09	-0.35	-0.48*
Korea	-0.47*	-0.34*	-0.51*	-0.64*
Philippines	-0.31*	-0.19	-0.25	-0.28
Thailand	-0.49*	-0.49*	-0.47*	0.50*

Source: IMF staff calculations.

¹The table displays the contemporaneous correlation between changes in gross reserves and changes in the exchange rate against the U.S. dollar.

²A star denotes that the correlation is significantly different from zero at the 95 percent confidence level.

5. 3. *Volatility of the exchange rate*

There is some modest evidence that intervention affects the volatility of the exchange rate.¹⁸) While the correlations are generally small and

17) Using the expanded measure of intervention (including the change in the net forward position) for Korea and the Philippines does not qualitatively affect the results.

18) Volatility was estimated with daily exchange rate data and then aggregated at the monthly frequency, based on two measures: a fitted GARCH (1,1) process

statistically insignificant, their sign is mainly negative, suggesting that intervention has been associated with lower volatility (Table 7). This result is robust to adjustments for delayed effects of intervention, the endogeneity of intervention, and the measure of volatility.¹⁹⁾

Table 7. Change in Reserves and Volatility of the Exchange Rate^{1,2}

Contemporaneous	2000-2007	2000-2002	2003-2004	2005-2007
India	0.05	-0.39*	-0.11	-0.09
Indonesia	-0.18	-0.15	-0.34	-0.2
Korea	-0.09	-0.19	-0.04	-0.01
Philippines	-0.22*	-0.3	-0.12	0.16
Thailand	-0.07	-0.13	0.05	0.02

Source: IMF staff calculations.

¹The table displays the contemporaneous correlation between changes in gross reserves and the realized volatility of the exchange rate against the U.S. dollar.

²A star denotes that the correlation is significantly different from zero at the 95 percent confidence level.

6. Concluding Remarks

This paper finds limited evidence of systematic links between sterilized intervention and exchange rates. The limited evidence for effectiveness may be surprising to some. The low degree of substitutability of emerging market assets and the large size of interventions relative to currency market turnover in emerging markets would suggest that intervention could have a sizeable effect on exchange rates. However, there is some modest evidence that intervention dampens volatility, which is consistent with the stated objectives of some monetary authorities.

There are several factors that could weaken the effectiveness of

on the daily log difference of the exchange rate, and realized volatility based on the rolling 20day moving average of the square of the log difference of the exchange rate.

- 19) When controlling for the endogeneity of intervention using twostage least squares, only in the Philippines was intervention associated with lower volatility in a statistically significant way.

intervention in emerging Asia. First, persistent structural factors may be driving the appreciation of the currency, obscuring any effect of intervention beyond a short period. Second, to the extent that sterilized intervention prevents the domestic interest rate from adjusting (especially downward), it would have limited effects on capital flows driven by interest differentials, thereby failing to alleviate upward pressure on the currency. In addition, intervention aimed at building reserves would not necessarily signal future policy changes and hence might not be expected to exert any effect on the exchange rate.

Finally, the results need to be interpreted with a grain of salt. Data limitations and methodological challenges hamper the assessment of the effectiveness of intervention. While the results in this paper suggest that there is limited evidence of effectiveness, the fact that the monetary authorities have actively intervened suggests that they believe the intervention has been effective. This is also consistent with the views of central banks in emerging markets (Neely 2007) and with the findings that intervention may work over a very short time horizon in advanced economies. Better data availability and continued research into the channels and motives for intervention in emerging markets countries could lead to a fuller understanding of the effectiveness of intervention in the region.

Box 1. The Mechanics of Intervention

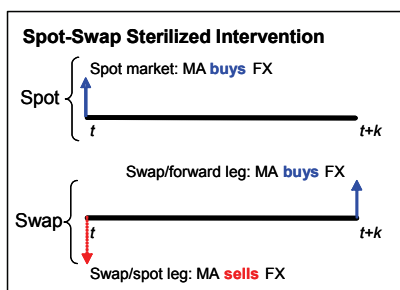
The balance sheet of the monetary authority helps illustrate the important distinction between sterilized and unsterilized intervention. Like any other balance sheet, it is organized according to the principles of double-entry bookkeeping. The acquisition of an asset by the monetary authority appears on the asset side of the ledger. Similarly, any addition to the authorities' obligations appears on the liabilities side.

An *unsterilized intervention* consists of a purchase (or sale) of foreign exchange from the private sector (commercial banks), with a purchase increasing the monetary authority's net foreign assets holdings (upwardpointing arrow). At the same time, the monetary authority credits the reserve accounts of commercial banks, corresponding to an automatic increase in the monetary base. This action is consistent with a traditional open market operation, in which the

Central Bank: Stylized Balance Sheet	
Assets	Liabilities
Net foreign assets	Monetary base
Foreign currency	Currency in circulation
Foreign bonds ↑	Reserve accounts of commercial banks ↑ ↓
Gold	
Net domestic assets	Net worth
Domestic bonds ↓	Accumulated surpluses and net interest and capital gains
Loans to commercial banks	

monetary authority affects the money supply and interest rates through a change in its holdings of foreign assets (unsterilized intervention). If the monetary authority sterilizes this intervention, it would sell domestic bonds to commercial banks (downwardpointing red arrow), mopping up the liquidity associated with the initial operation. The result of these operations is that the monetary base remains constant while the composition of the monetary authority's assets changes (higher NFA, lower NDA). Similarly, the composition of private sector holdings of foreign and domestic assets also changes, which may affect the exchange rate through the portfolio balance channel.

Sterilized intervention may be conducted through *swap and forward* operations. For instance, in an outright forward intervention, the monetary authority purchases or sells foreign exchange in the forward market. Initially, this transaction is equivalent to sterilized intervention: it has no immediate impact



on the monetary authority's monetary liabilities, as it is settled at a future date. However, when the transaction is settled, it affects the monetary authority's balance sheet (as in the case of unsterilized intervention), unless there is another offsetting transaction (e.g., if the forward contract is rolled over). Swaps can also be used to sterilize intervention. For example, if the monetary authority purchases foreign exchange in the spot market, it can immediately mop up the effects on liquidity by selling foreign exchange (first leg of the spotforward swap) and simultaneously reverse the first leg of the swap with a forward purchase of foreign exchange (second leg of the swap). This swap intervention also gives rise to a net forward position, which if left unsterilized would have a delayed impact on reserves and the monetary base. However, as in the case of the outright forward, the monetary authority has the option of rolling over its swaps to leave the monetary base unchanged.

Box 2. The Effectiveness of Intervention: Additional Tests

In addition to estimating contemporaneous and lagged correlations between intervention and the level, change, and volatility of the exchange rate, simple regressions were also estimated. These regressions should not be seen as structural models of the exchange rate. Two issues need to be kept in mind when interpreting the results: (i) there is substantial academic evidence that floating exchange rates (admittedly not a perfect description of the currencies examined here) cannot be distinguished from a random walk at horizons of two years or less (Engel, Mark, and West, 2007); and (ii) given the monthly frequency of the data, there is substantial simultaneity between the exchange rate and intervention.

Twostage least-squares were applied to adjust for simultaneity. In the first stage, intervention was regressed on the lagged change in the exchange rate and lagged intervention. In the second stage, the exchange rate change is regressed on the predicted value of the intervention from the first-stage regression. The first-stage regression specification is consistent with the leaning against the wind and the protracted nature of intervention in our sample. Specifically,

$$\text{First stage: } I_t = a + b * I_{t-1} + c * \Delta S_{t-1} + u_t$$

$$\text{Second stage: } \Delta S_t = d + e * I_t^p + v_t,$$

where I denotes intervention, ΔS denotes the change in the exchange rate (expressed in log differences, with a negative change signifying appreciation), a , b , c , d , and e denote parameters to be estimated, and u and v denote regression errors. The second-stage regression was also estimated with the volatility of the exchange rate on the left-hand side.

In most of the first-stage regressions, the instruments worked well in explaining intervention. However, in most cases the coefficient of interest (e) was statistically insignificant at 95 percent confidence, and/or of the wrong sign (negative in the case of the exchange rate change regressions; positive in the case of the volatility regressions), whether using the change in the exchange rate or the volatility of the exchange rate in the second-stage regression. Only in a handful of cases (such as the volatility regression for the Philippines) was the coefficient significant and of the expected sign.

In an additional exercise, vector auto-regressions (VAR) were applied for each country. The specification of the VAR included the exchange rate (in either level terms or first differences), intervention, and interest rate differentials (measured as the difference between the domestic 3-month money market or treasury bill rate and the 3-month U.S. treasury rate). The results indicate that the exchange rate does not respond to intervention shocks. The impulse response functions show that the effect of intervention on the exchange rate is generally statistically insignificant and of the wrong sign. This result is robust to the ordering used to identify the shocks and to the VAR specification. In one case, India, some of the responses of the exchange rate to intervention were of the correct sign (higher intervention leads to a more depreciated exchange rate) but statistically insignificant.

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China as a Reserve Sink: The Evidence from Offset and Sterilization Coefficients*

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1. Introduction

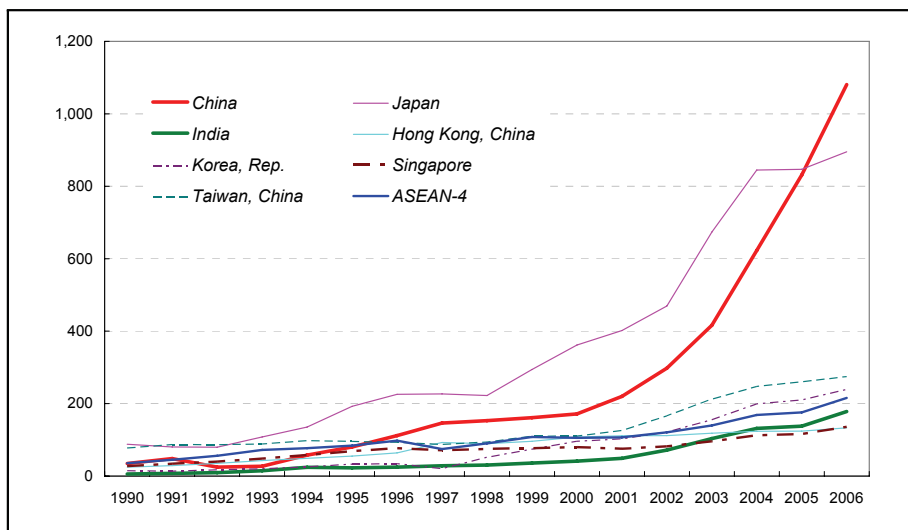
China has become the world's largest foreign exchange reserve holder, having amassed over US\$ 1,200 billion of international reserves by end 2006 (Figure 1).¹⁾ The rapid accumulation of reserves has generated several controversies. One concern is whether this continuing balance of payments surplus signals the need for a substantial revaluation or appreciation of the Chinese Yuan (CNY) to protect China both from the inflationary consequences of the liquidity buildup and a misallocation of resources²⁾ as well as to help ease global economic imbalances. An

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1) China overtook Japan to become the world's largest reserve holder in February 2006.
2) Rodrik (2006) discusses the issue of opportunity costs of stockpiling reserves. The

alternative view, particularly associated with McKinnon (2003a,b, 2004), argues that a fixed exchange rate is an optimal policy for China and the larger Asian region both on the grounds of macroeconomic stability and rapid economic development. The global monetarist approach of McKinnon is based on the assumption of little or no sterilization of international reserves, so that any payments imbalance is temporary. However, many other commentators have suggested that the Chinese government’s concern with inflation has led the People’s Bank of China (PBC) to heavily sterilize these reserve inflows.

**Figure 1. International Reserve Holdings in Asia (including gold)
(in US\$ Billions)**



Source: All the data are from International Financial Statistics (IFS), except Taiwan. The data for Taiwan is from AREMOS Economic Statistical Databanks, which published by Taiwan Economic Data Center (TEDC).

World Bank (2005) and Mohanty and Turner (2005) discuss the quasi fiscal costs of sterilization and capital losses on reserve assets arising from exchange rate fluctuations. We return to the issue of fiscal costs of sterilization specifically for China in Section 5.

Contrary to the wide spread concerns among many economists about the huge size of current global economic imbalance, Dooley et al. (2004) famously argued that mainstream economists have failed to recognize that we are now in a new informal version of the Bretton Woods system (BW2) and the global economy is therefore not in genuine disequilibrium. While there are clearly important analogies between the current international monetary system and Bretton Woods (BW1), the question is still open to whether we are currently closer to the early or late days of BW1. In the later days of BW1 much attention was given to the concept of countries as *reserve sinks* into which reserves flowed. Instead of stimulating adjustments, as assumed in global monetarist models (i.e. the price-specie flow mechanism), the reserves effectively disappear from the system (down the sink) and hence contributed to continuing disequilibrium. Germany was seen as the prototype of the reserves sink during the BW1 days.³⁾ Today China appears to be playing that role. Thus investigating how China has reacted to its reserve increases is of international as well as national importance.

An intermediate view is that while China has sterilized most of its past reserve increases, continuing to do so is becoming increasingly difficult for China as its reserves continue to rise and capital controls become more porous (for instance, see Prasad, 2005, Prasad and Wei, 2005, and Xie, 2006). One of the reasons why there is so much disagreement is because, as Goodfriend and Prasad (2006) have noted, “(t)he fraction of reserves sterilized by the central bank has varied over the last few years and it is not straightforward to assess exactly how much sterilization has taken place.”

This paper estimates the degree of recent sterilization in China, as well as the degree of capital mobility as measured by offset coefficients, i.e. the fraction of an autonomous change in the domestic monetary base that is offset by international capital flows. In one sense, the level of sterilization can be observed from the degree to which the central bank takes action to offset the effects of increases in international reserves on the domestic base or other monetary aggregates. However, this can offer a misleading picture of the effectiveness of sterilization since if the central bank wants the base to increase anyway, then it would decide not to neutralize the reserve increases; this would not imply that it had

3) See Willett (1980) for references to this literature.

lost control of the domestic monetary process. China's large balance of payments surplus in 2003 was accompanied by rapid domestic money and credit expansion which is consistent with an inability to effectively sterilize. It appears, however, that the primary cause of the rapid expansion of money and credit was the Chinese government's concern with maintaining rapid economic growth and not the inability of the PBC to control the domestic monetary base.⁴ Thus, the PBC did not try to fully neutralize the domestic monetary effects of the reserve increases under government direction. One therefore has to control for other factors that may impact monetary policy.

To investigate the central bank's ability to control domestic monetary aggregates, it is necessary to estimate the extent to which international flows undercut its control. This in turn requires the estimation of the counterfactual of the desired rate of monetary growth, i.e. estimation of the central bank's monetary reaction function. There is no one correct theoretical specification for central bank reaction function but the literature has developed a standard set of variables to be considered within this function. This allows us, at least in principle, to breakdown the interrelationship between international reserve changes and the monetary base into those relating to autonomous changes in the monetary base (the offset coefficient) and those relating to autonomous changes in international reserve flows (the sterilization coefficient). We also make use of recursive estimation to investigate changes in offset coefficients and sterilization over time. While we find no evidence of the inability of the government to sterilize a high proportion of reserve accumulations, we do find substantial increases over time in our estimates of the offset coefficients, suggesting that sterilization is becoming increasingly difficult.

The next section briefly explores the evolution of the balance of payments flows in China since the late 1990s, focusing on the magnitude and sources of reserve buildup as well as the reserve buildup's monetary consequences. It also briefly discusses the sterilization policy measures used in China (*de jure* sterilization). Section 3 offers a summary of the main empirical methodologies commonly used to estimate the *de facto*

4) Lardy (2005) argues that the money expansion in 2003 was the government's mistaken overreaction to the potential adverse effect of severe acute respiratory syndrome (SARS) on economic growth.

extent of sterilization. As will be discussed, the estimation procedure used in this paper is based on a set of simultaneous equations to estimate both the “sterilization coefficient” (i.e. how much domestic money creation responds to a change in international reserves) and the “offset coefficient” (i.e. how much the balance of payments changes in response to a change in domestic money creation). Since the foreign exchange and the domestic monetary markets are interrelated, ignoring such interrelationships can lead to biased results. Section 4 discusses the data and definitions of variables to be used in the empirics. This section also discusses the empirical results of the sterilization and offset coefficients based on monthly data for the period from mid 1999 to late 2007. The final section concludes with a brief discussion of the macroeconomic policy implications and tradeoffs facing China in the future.

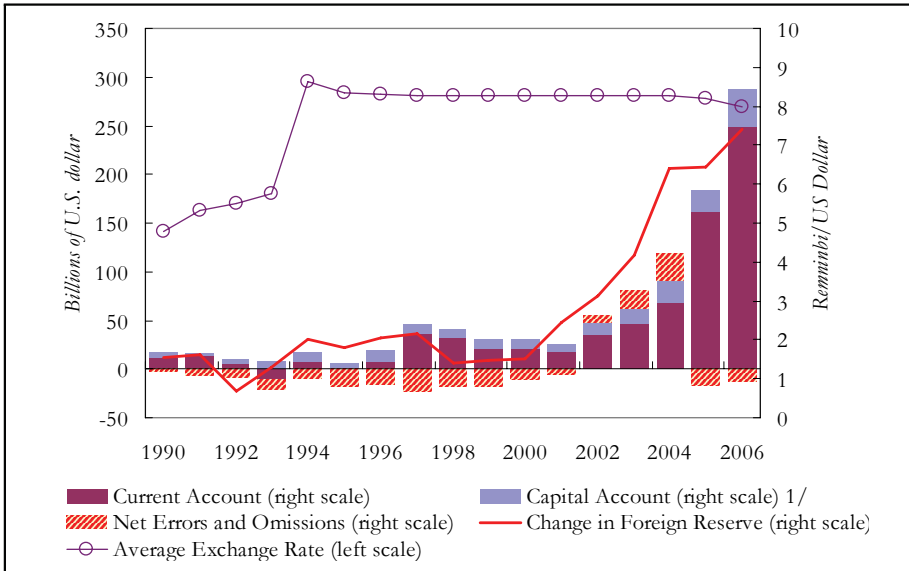
2. Reserve Growth and Sterilization Policy Measures in China since 1990

2.1. *Evolution of China's Balance of Payments*⁵⁾

Our empirical analysis begins with 1999 since relevant monthly data are not available for earlier years. China's large reserve accumulation began in earnest in 2001 (Figure 2). China has experienced large and growing surpluses on both the capital and current accounts between 2002 and 2006, while even the errors and omissions balance (a broad proxy for capital flight by residents) turned positive between 2002 and 2004, presumably in anticipation of impending exchange rate appreciation. Thus, China's reserves increased markedly during this period.

5) The evolution of capital inflows to China throughout the 1990s is explored in more detail by Prasad and Wei (2005) and Prasad (2005). Also see He et al. (2005), and Ma and McCauley (2005).

Figure 2. Trends in China’s Balance of Payments Transactions (Billions of US\$), 1990 - 2006



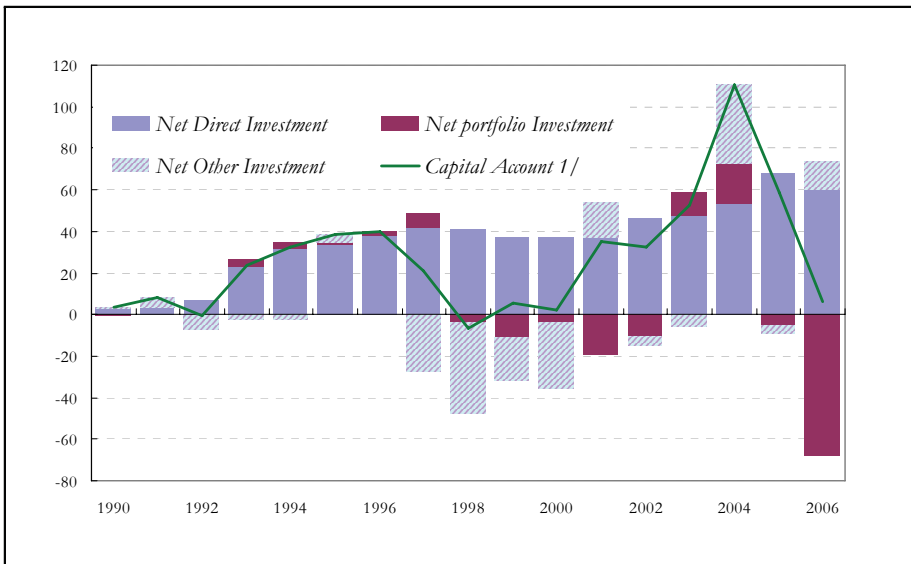
Source: IMF International Finance Statistics Yearbook.

From Figure 3 it is apparent that the swelling of China’s capital account surplus in 2004 was largely because of a surge in portfolio capital flows as well as “other investments” (i.e. short-term debt flows), again most likely a reflection of mounting market expectations of an impending revaluation of the Chinese currency. As noted by Prasad and Wei (2005), “much of the recent increase in the pace of reserve accumulation is potentially related to ‘hot money’ rather than a rising trade surplus or capital flows such as FDI that are viewed as being driven by fundamentals” (p. 8).⁶ However, Goldstein and Lardy (2006)

6) Three caveats should be noted. First of all, part of the change in reserves is also because of a valuation effect as a portion of reserves that was invested in non-US dollars (gold, euros, etc) has changed in US dollar terms (while most central banks including the PBC do not disclose the composition of assets in which reserves are being invested, it is generally suggested that a large part has been invested into dollar-denominated assets like Treasury securities). Prasad and Wei (2005) offer some “guess-timates” on the possible valuation effects. Secondly,

conclude that even with hot money flows excluded, China has been faced with a substantial payments disequilibrium. This is observation is validated in the data in Figures 1 and 2 which show sustained inflows of FDI into China and growing current account surpluses.

Figure 3. Capital Account Components (Billions of US\$), 1990 - 2006



Source: IMF International Finance Statistics Yearbook.

1/ Capital Account is defined as Financial Account.

there was a one-off fall in reserves in China in 2004. This was because since 2003 the government transferred US\$ 60 billion to three state-owned banks, Bank of China (US\$ 22.5 billion), China Construction Bank (US\$ 22.5 billion), and Industrial and Commercial Bank of China (US\$ 15 billion) to aid in their recapitalization (see Ma, 2004 for details). And lastly, while China has not yet become fully convertible on the capital account, a large number of so-called “qualified foreign investment institutions” or QFIIs received approval by the China Securities Regulatory Commission to increase their investments to China which in turn has fuelled large-scale portfolio capital inflows (see Hu, 2004 for details).

The Chinese government finally loosened its strict US dollar peg and allowed for a small revaluation from 8.28 to 8.11 CNY per US dollar in July 21, 2005 and simultaneously announced that the currency would be pegged to a basket of currencies.⁷⁾ Interestingly, China has since experienced a sharp increase in the current surplus relative to the capital account despite expectations of continued upward pressure on the CNY⁸⁾ (i.e. one logically would have expected to see an intensification of speculative inflows).

On the one hand, the relative decline in the capital account surplus was partly policy-induced. The government has been promoting outward investments by Chinese corporates and domestic institutional investors and has loosened a number of restrictions on capital outflows to ease some appreciation pressures from huge reserves accumulation, while simultaneously tightening some restrictions on capital inflows such as imposing a quota in July 2004 on offshore borrowing by foreign banks operating in China.⁹⁾ On the other hand, the sharp increase in the country's current account balance is somewhat harder to fathom. While part of the rise is due to the sharp depreciation of RMB vis-à-vis the Euro and most other Asian currencies (i.e. China's real effective exchange rate has not changed much since July 2005), it has also been suggested by some observers that the current account surplus has been partly driven by over-invoicing of exports and under-invoicing of imports. As noted by one market commentator:

The massive flip-over between the financial account and trade account... in 2005...raises the possibility that capital flow for...(CNY) ..speculation masqueraded as a trade surplus last year due to improving capital account control. This is important in understanding the nature of China's BoP surplus. 2005 BoP data suggest that capital account flows accounted for one-third of the BoP surplus, while 2004 data suggest that this was three-quarters. If 2004 data are more accurate, the appreciating

7) The CNY has been on a very gradual appreciating path since July 2005. See Ogawa and Sakane (2005) and Shah et al. (2005) for discussions of the currency weights in China's basket.

8) This expectation is apparent by examining the Non Deliverable Forward (NDF) market on the CNY.

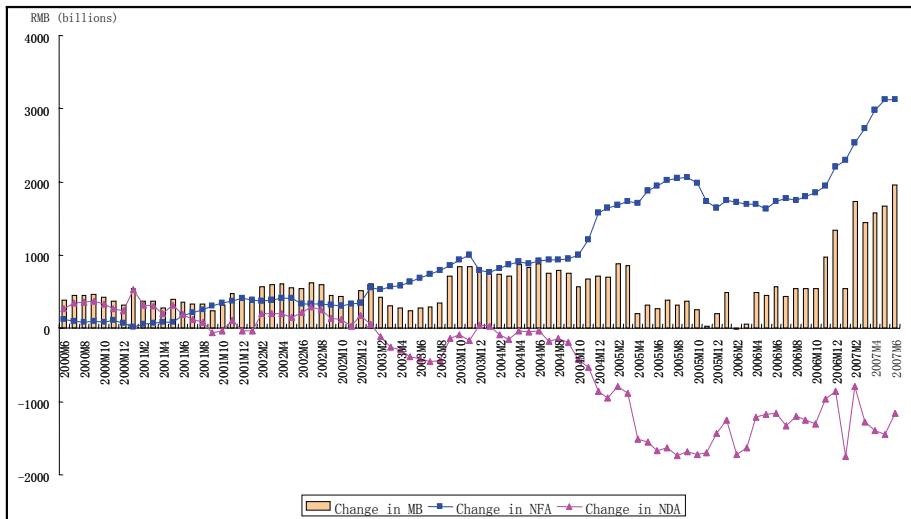
9) Prasad and Wei (2005) and Liu and Otani (2005) detail the steps taken to deregulate China's capital account transactions.

pressure appears to be mainly a speculative phenomenon (Xie, 2006).¹⁰⁾

2.2. Sterilization Policy Measures in China

What are the monetary consequences of this huge reserve buildup in China? Figure 4 shows that since December 2002 domestic high-powered money creation – proxied by the growth in broadly defined net domestic assets (NDA)¹¹⁾ – has remained rather low if not negative. This helped

Figure 4. Monthly Annual Change in NFAs, NDAs, and Reserve Money in China, 2000: M6 - 2007: M6



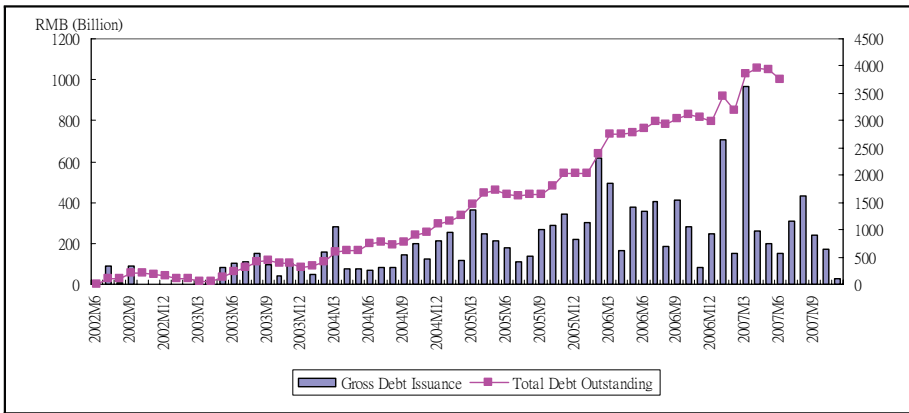
Source: IFS and the PBC's website.

10) Also see Ma and McCauley (2005) who state that a large part of the overall current account surplus in China (40 percent) was also due to net income transfers. They further note that the Chinese government required banks to report “unusually large” (US\$ 10,000) remittance inflows and related dollar sales. From a national income accounting perspective, while China’s investment rate remains extremely high, the rise in the current account surplus has been driven largely by a marked rise in national savings rate.

11) Broadly defined net domestic assets (NDAs) equals monetary base (MB) minus net foreign assets (NFAs).

moderate the increase in the domestic monetary base (*MB*), suggesting that the PBC was actively neutralizing the impact of the reserves buildup using various policies and instruments. The PBC has made intensive use of contractionary open market operations (*OMOs*). In early 1998, the PBC used treasury bonds or securities in its *OMOs*. But since September 2002, the PBC has replaced all outstanding securities with central bank bills (*CBCs*) for use in the *OMOs*. Figure 5 reveals the sharp growth in PBC issuances in recent years.

Figure 5. Issuance of Central Bank Bills and Total PBC Debt Outstanding, 2002: M6 - 2007: M9



Source: PBC’s website.

The PBC has also repeatedly raised the reserve requirement for banks so as to control overall broad monetary growth. Reserve requirements were raised from a low of 6% in early 2000 to 13.5% by November 2007. The PBC has also adjusted the benchmark interest rate upwards to curb liquidity growth. In addition it has undertaken a series of market-based interest rate reforms, such as broadening the floating band of financial institution lending rates at the beginning of 2004.¹²⁾ These monetary policy actions have been accompanied by a slew of administrative measures,

12) In addition, commercial banks have been allowed a greater degree of autonomy in deciding medium and long-term RMB loan interest rates.

including window guidance to halt the nongovernment-approved construction loans and cool down specific sectors. Other measures, such as moral suasion and risk warnings have also been conveyed to commercial banks to try to maintain “reasonable” credit growth. At various times, the government has also introduced measures to curb the rapid escalation of property prices and has also required banks to hold more reserves in foreign currency so as to reduce the balance of payments surplus.

3. Estimating the Extent of Sterilization: Methodological and Empirical Issues

3.1. Empirical Methodologies Commonly Used

Most current studies which estimate the extent of sterilization can be classified into three groups. The first group assumes that capital flows are exogenously determined and typically estimate sterilization coefficients by running simple *OLS* on the monetary reaction function such as the one below:

$$\Delta NDA_t = c_0 + c_1 \Delta NFA_t + X' \beta + u_t \quad (1)$$

where ΔNDA_t and ΔNFA_t represent the change in net domestic assets (a proxy for domestic money creation) and net foreign assets (a proxy for international reserves), respectively, and X represents other explanatory variables that might influence a monetary authority’s reaction. The coefficient of $c_1 = -1$ represents full monetary sterilization, while $c_1 = 0$ implies no sterilization.

The second group uses a VAR model to estimate the lagged effects of NDAs and NFAs. The standard form of a VAR model is as follows:

$$\Delta NDA_t = \alpha_{10} + \sum_{i=1}^k \alpha_{1i} \Delta NDA_{t-i} + \sum_{i=1}^k \beta_{1i} \Delta NFA_{t-i} + e_{1t} \quad (2a)$$

$$\Delta NFA_t = \alpha_{20} + \sum_{i=1}^k \alpha_{2i} \Delta NFA_{t-i} + \sum_{i=1}^k \beta_{2i} \Delta NDA_{t-i} + e_{2t} \quad (2b)$$

Some papers within this group include additional variables in the model such as domestic interest rate, price level, or exchange rate (for

instance, see Cavoli and Rajan, 2006, Christensen, 2004, He et al., 2005 and Moreno 1996). The advantage of a VAR approach is that it allows one to trace out the time path of the various shocks on the variables contained in the VAR system (i.e. the impulse response function). If a shock from foreign assets (say an unexpected increase in foreign assets) is associated with an offsetting decrease in domestic money creation, it can be concluded that the sterilization is significant. An important limitation of the simple VAR approach is that it tends to treat all variables as symmetrically endogenous. As equations 2a and 2b show, a standard form of the VAR model only yields the estimated values of lagged NDAs and NFAs due to the issue of identification. Consequently, the model cannot estimate the contemporaneous effects of variables without restrictions.

The third group of studies—including this paper—estimates the contemporaneous relationship between NDAs and NFAs using a set of simultaneous equations. Although the studies in the first group ignore the simultaneous bias by assuming capital flows are exogenously determined,¹³ it is important to note that domestic monetary conditions are affected by changes in international capital flows and foreign reserves. Concurrently, international capital flows respond to a change in domestic monetary conditions (e.g. higher domestic interest rates would, *ceteris paribus*, lead to greater capital inflows).¹⁴ Some early studies, such as Argy and Korui (1974) and Herring and Marston (1977), have suggested using a simultaneous system to overcome the problem of simultaneity.

The typical model specification for a set of simultaneous equations is:

$$\Delta NFA_t = \alpha_{10} + \alpha_{11} \Delta NDA_t + X_1' \beta_1 + u_{1t} \quad (3a)$$

$$\Delta NDA_t = \alpha_{20} + \alpha_{21} \Delta NFA_t + X_2' \beta_2 + u_{2t} \quad (3b)$$

where X_1 and X_2 are the vectors of controls in the balance of payment function and monetary reaction function, respectively. Eqs. (3a) and (3b) are the balance of payments and the monetary reaction functions, respectively. The former estimates the “offset coefficient”. The expected

13) See Kwack (2001).

14) Indeed, this is the basic dilemma involved in sterilization (Calvo, 1991), a point we return to in Section 5.

value of the offset coefficient is bound by 0 in the event of no capital mobility and -1 in the event of perfect capital mobility.¹⁵⁾ The latter measures the sterilization coefficient. The expected value of the sterilization coefficient is -1 if reserve buildup is perfectly sterilized and 0 if the central bank does not sterilize at all. In general, the greater the degree of capital mobility the less effective is monetary sterilization; a small offset coefficient and a large sterilization coefficient generally imply that the central bank has a fairly high degree of monetary policy independence to neutralize the impact of capital flows effectively on a sustained basis.

3.2. Specification of the Simultaneous Equation Model

One concern with all the above approaches is the lack of explicit micro foundations for inclusion or exclusion of control variables. There is of course a large literature on the determinants of monetary reaction function, but to our knowledge Brissimis-Gibson-Tsakalotos (BGT) (2002) is the only instance in which the simultaneous equations used to estimate the NFAs and NDAs are explicitly derived from a theoretical framework (minimization of a simple loss function of the monetary authority subject to a number of constraints that reflect the workings of the economy). Ouyang et al. (2006) modify the BGT framework in a number of ways and apply it to several Asian economies. However, the modified framework cannot be applied directly to China which maintained a fixed peg to the US dollar until July 2005. Nevertheless, the vector of controls we use in the simultaneous model is informed by the modified BGT model and from existing empirical work in this area (for instance, see Celasun et al., 1999, Fry, 1993, Kim, 1995, Nyatepe and Coo, 1995, Sarjito, 1996 and Rooskareni 1998). We specify a set of simultaneous equations as follows:

$$\begin{aligned} \Delta NFA_t^* = & \alpha_0 + \sum_{i=0}^n \alpha_{1i} \Delta NDA_{t-i}^* + \sum_{i=0}^n \alpha_{2i} \Delta mm_{t-i} + \sum_{i=1}^n \alpha_{3i} \Delta p_{t-i} + \sum_{i=1}^n \alpha_{4i} y_{c,t-i} \\ & + \sum_{i=0}^n \alpha_{5i} \Delta REER_{t-i} + \sum_{i=0}^n \alpha_{6i} \Delta (r_{t-i}^* + E_t e_{t+1-i}) + \varepsilon_t \end{aligned} \quad (4)$$

15) Obstfeld (1982) argues that an estimated offset coefficient may be seriously biased if we ignore the problem of endogeneity between domestic and foreign components of the monetary base.

$$\begin{aligned} \Delta NDA_t^* = & \beta_0 + \sum_{i=0}^n \beta_{1i} \Delta NFA_{t-i}^* + \sum_{i=0}^n \beta_{2i} \Delta mm_{t-i} + \sum_{i=1}^n \beta_{3i} \Delta p_{t-i} + \sum_{i=1}^n \beta_{4i} y_{c,t-i} \\ & + \sum_{i=0}^n \beta_{5i} \Delta G_{t-i} + \sum_{i=0}^n \beta_{6i} \Delta (r_{t-i}^* + E_t e_{t+1-i}) + v_t \end{aligned} \quad (5)$$

where

- ΔNFA_t^* = The change in the adjusted net foreign assets scaled by the GDP (adjustments to be discussed in Section 4.2).
- ΔNDA_t^* = The change in the adjusted net domestic asset scaled by the GDP (adjustments to be discussed in Section 4.2).
- Δmm_t = The change in money multiplier for M2.¹⁶⁾
- Δp_t = The change in consumer price index.
- $y_{c,t}$ = Cyclical income.¹⁷⁾
- ΔG_t = The change in government expenditure scaled by the GDP.
- $\Delta REER_t$ = The change in the real effective exchange rate (REER).
- $\Delta (r_t^* + E_t e_{t+1})$ = The change in foreign interest rate plus the expected nominal exchange rate (CNY/US\$).¹⁸⁾
- e_t = Nominal exchange rate (CNY per US\$).

As can be seen from equations (4) and (5), the balance of payments function (Eq. 4) consists of five control variables encompassing both “push” and “pull” factors as well as monetary policy responses, i.e. factors that motivate capital flows into specific recipient countries. We expect these variables to influence the balance of payments function in the following ways: First, a rise in the M2 money multiplier increases

16) We also tried the M1 money multiplier but the results were not substantially changed.

17) Gerlach and Peng (2006) discuss various ways of measuring the output gap in a fast-growing and developing country, like China, that is undergoing significant structural changes. They find that various output gap measures, including estimates derived from the HP-filter rule, are quite highly correlated.

18) The exchange rate is in logarithms. As discussed in Section 4, we use three different assumptions for expected nominal exchange rate: perfect foresight, static expectations, and forward rates based on the NDF market for CNY.

broad money and pushes the interest rate down, hence reducing capital inflows. In addition, a rising multiplier might be capturing an overall tightening credit policy, including a more restrictive policy towards capital inflows.¹⁹⁾ Second, higher inflation perpetuates concerns about exchange rate depreciation, interest rate hikes and capital losses thereof, hence causing a reduction of capital inflows.²⁰⁾ Third, higher lagged real output could worsen the current account (due to the income effect), reducing foreign reserve accumulation. However, this variable is a double-edged sword in the sense that a domestic boom could perpetuate capital inflows directly (i.e. pull factor). Fourth, foreign reserves will be decumulated due to a decrease in the current account if the REER is positive (price effect).²¹⁾ The use of one period lags in the REER, cyclical output as well as inflation also reduces the possible endogeneity problems.²²⁾ Fifth, a fall in either the change in foreign interest rates or in the expected exchange rate depreciation could lead to increased capital inflows from the country.²³⁾

The monetary policy function (Eq. 5) also consists of five control variables that are considered important factors influencing monetary policy actions. The monetary authority generally implements a contractionary

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- 19) It is plausible that a change in capital flows causes a concomitant change in the money multiplier (for instance, see Rajan, 2007). More generally, one might think about specifying a separate equation endogenizing the money multiplier (Jha and Rath, 2001).
- 20) Additionally, higher inflation could engender greater uncertainty, leading to reduced capital flows.
- 21) Ideally one needs to use a measure of real exchange rate misalignment rather than its change. Short of estimating the “equilibrium” REER we tried the deviation of the REER from its trend, but the results did not improve.
- 22) For instance, it could be argued that greater capital inflows and reserve buildup can lead to a real exchange rate appreciation and a domestic economic boom.
- 23) Two caveats should be noted. First of all, we use only foreign interest rates rather than interest rate differentials as the domestic interest rates are already captured in the ΔNDA_t term. Secondly, there are two other potentially important push factors causing increased capital flows into China, viz. a fall in risk premium and rise in foreign wealth. The other push factor, viz. industrial country growth, is likely highly correlated with domestic country cyclical growth which is already included in the equation. Dasgupta and Ratha (2000) and Montiel and Reinhart (2000) discuss the determinants of capital flows into developing countries.

monetary policy in response to a rise in inflation (for obvious reasons), an increase in the money multiplier (to curb overall money supply growth), or an expected exchange rate depreciation (either for its own sake or because of pass-through concerns). The expected coefficient for each of these variables should therefore be negative. In addition, the monetary authority tends to adopt a countercyclical monetary policy to contract domestic money creation when there is a rise in real GDP growth rate above the trend (i.e. a domestic economic boom) or a more expansionary fiscal deficit, implying a negative expected coefficient again.²⁴⁾

4. Empirics

4.1. Data and Definitions

Our estimations are based on monthly observations over the sample period from 1999:m6 to 2007:m1. All the data are from the *IMF-IFS* or *TEJ Great China* database²⁵⁾ (except the three month CNY non-deliverable forward rate (NDF) which is from *Bloomberg*). Table 1 summarizes the definitions and sources of the various data used in the estimating equations. The relevant variables, such as the change in the “adjusted” ΔNFA_t^* , ΔNDA_t^* and ΔG_t , fiscal deficit are scaled by GDP.²⁶⁾ To check for stationarity we applied the standard ADF unit root test to each of the variables and found all variables to be stationary at the 10 percent significant levels with the exception of the exchange rate adjusted foreign interest rates (see Table 2).^{27),28)}

24) More precisely, one would want to use a measure of broader fiscal stance, viz. full employment primary fiscal balance.

25) See <http://www.tei.com.tw/greatdb/greatDB.html>.

26) Three caveats should be noted. One, the manner of “adjustment” of the NFAs for revaluation effects is discussed in Section 4.2. Two, for the monthly data, the variables are scaled by “monthly GDP”, which is measured by distributing quarterly GDP into corresponding three months weighted by the industrial production ratio. Three, we tried the regressions without scaling by GDP (since we are using first differences), but the coefficient on some variables, like the money multiplier, turned out to be far too large to make any economic sense.

27) The ADF results were confirmed by the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. See Table 2.

Table 1. Definitions and Measurement of the Variables Used in Empirical Study

Variables	Definitions	Measured as	Data (Source)
NFA_t^*	Foreign reserves denominated in domestic currency minus foreign liabilities	$Reserve(\$) \times e_t^{CNY/\$} - Foreign\ Liabilities(CNY)$	IFS
ΔNFA_t^*	The change in NFA_t^* excluding revaluation effect	$NFA_t^* - NFA_{t-1}^* (\frac{e_t}{e_{t-1}})$	
ΔNDA_t^*	The change in (net domestic assets + net other assets - capital item) + revaluation effect scaled by the GDP.	$\Delta NDA_t + \Delta NOA_t - \Delta K_t + NFA_{t-1}^* (\frac{e_t}{e_{t-1}} - 1)$	IFS
mm_t	Money Multiplier for M2	$M2/Monetary\ Base$	IFS
Δmm_t	The change in money multiplier for M2	$Log(mm_t) - Log(mm_{t-1})$	
$\Delta REER_t$	The change in Real Effective Exchange Rate.	$Log(REER_t) - Log(REER_{t-1})$	IFS
$y_{c,t}$	Cyclical Income. The real output deviated from its trend scaled by the trend. The trend is measured by HP-filter.	$[Log(Real\ GDP) - HP-filter\ trend] / HP\ filter\ trend$	IFS and TEJ Great China Database
Δp_t	Inflation Rate	$Log(cpi_t) - Log(cpi_{t-1})$	TEJ Great China Database
$\Delta(r_t^* + E_t e_{t+1})$	The change in exchanged adjusted foreign interest rate. The foreign interest rate is the interest rate for US 3-month treasury bill. $F_{3-month}$ is the 3-month non-deliverable CNY forward rate.	$\Delta[r_t^* + \ln(e_{t+1})]$ if perfect foresight. $\Delta[r_t^* + \ln(F_{3-month})]$ if forward-looking $\Delta[r_t^* + \ln(e_t)]$ if Static expectation	IFS and Bloomberg
ΔG_t	The change in government fiscal deficit scaled GDP	$\Delta G_t / GDP_t$	IFS and Quarterly Monetary Reports Issued by the PBC

28) Siklos (2000) pointed out a similar problem with the Hungarian-German interest rate differential and has argued that interest rates should not be difference stationary.

Table 2. ADF Unit Roots Test for China Data, 1999: M6 - 2007: M1

Variables	ADF Test Statistic (P-value) H_0 : Variable has a unit root	KPSS Test Statistic H_0 : Variable is stationary
ΔNDA_t^*	-9.617***(0.000) (Intercept)	0.042 (Intercept with trend)
ΔNFA_t^*	-2.852*(0.055) (Intercept)	0.086 (Intercept with trend)
Δmm_t	-10.850***(0.000) (Intercept)	0.061 (Intercept)
$\Delta REER_t$	-8.203***(0.000) (Intercept)	0.110 (Intercept)
$y_{c,t}$	-1.462 (0.548) (Intercept)	0.025 (Intercept)
Δp_t	-2.181 (0.215) (Intercept)	0.082 (Intercept)
$\Delta(r_t^* + E_t e_{t+1})$ (Perfect foresight)	-4.571***(0.000) (Intercept)	0.142* (Intercept with trend)
$\Delta(r_t^* + E_t e_{t+1})$ (Forward-looking expectations)	-4.592***(0.000) (Intercept)	0.142* (Intercept with trend)
$\Delta(r_t^* + E_t e_{t+1})$ (Static Expectations)	-4.566***(0.000) (Intercept)	0.142* (Intercept with trend)
ΔG_t	-3.598***(0.007) (Intercept)	0.012 (Intercept)

Note: (*) Significant at more than 10 percent; (**) Significant at more than 5 percent; (***) Significant at more than 1 percent.

We used the Hodrick-Prescott (HP) method to measure the trend of real output. We assume that economic agents have three different ways of forming their expectations about the exchange rate. If economic agents have perfect foresight then the difference between the actual nominal exchange rate at the next period and the current nominal exchange rate is the appropriate proxy for the expected exchange rate depreciation for

Table 3. Summary Statistics of Variables Used in Empirical Study, 1999:M6 - 2007:M1

Variables	N	Mean	Std. Dev.	Maximum	Minimum
ΔNFA_t^*	75	0.066	0.056	0.196	-0.109
ΔNDA_t^*	75	-0.022	0.140	0.345	-0.556
Δmm_t	75	0.003	0.025	0.091	-0.060
$\Delta REER_t$	75	-0.001	0.012	0.035	-0.024
$y_{c,t}$	76	0.000	0.065	0.135	-0.150
Δp_t	75	0.000	0.006	0.019	-0.014
$\Delta(r_t^* + E_t e_{t+1})$ (Perfect foresight)	75	-0.0005	0.003	0.003	-0.014
$\Delta(r_t^* + E_t e_{t+1})$ (Forward-looking expectations)	75	-0.0007	0.0039	0.0133	-0.0103
$\Delta(r_t^* + E_t e_{t+1})$ (Static Expectations)	75	-0.0005	0.003	0.003	-0.013
ΔG_t	75	-0.009	0.136	0.255	-0.615

the next period. If agents have static expectations then the exchange rate change at the current period is used as the proxy. Finally, the three month CNY NDF rate is also used as a proxy for the expected exchange rate for the next period. Table 3 provides the summary statistics of the various variables used in the model.

4.2. Adjustments to the NDAs and NFAs

A typical balance sheet of the monetary authority is as follows:

Table 4. Balance Sheet of Monetary Authority

Assets	Liabilities and Equity
Foreign Assets (FA)	Currency in Circulation and Deposits (MB)
Domestic Assets (DA)	Foreign Liabilities (FL)
Other Assets (OA)	Domestic Liabilities (DL)
	Other Liabilities (OL)
	Equity (K)

Note: The format is taken from the *International Financial Statistics (IFS)* report.

Since both of the changes of *NDA* and *NFA* are based on the monetary authority's balance sheet, care must be taken in accounting for non-policy related changes in the variables such as the revaluation effects due to gold value and exchange rate fluctuations. In order to exclude monetary gold from the foreign assets we use the product of foreign reserves denominated in US dollars and exchange rates (domestic currency/US\$) to proxy foreign assets. The net foreign assets without the revaluation effect are as follows:

$$NFA_t = (R_t \times e_t) - FL_t \quad (6)$$

where R_t is the foreign reserves denominated in US\$ and e_t is the exchange rate against US\$.

We use $(R \times e)$ rather than the actual *FA*. However, the problem with using $(R \times e)$ is that reserve values could change because of currency fluctuations. However, these valuation effects will not change the domestic currency value of the money base and we therefore need to exclude these effects from the book value of *NFA* before estimation. Ideally if we had the currency composition of reserves we could adjust for the valuation changes. Given that such data is not available, the best we can do is assume that all reserves are held in US\$ and adjust the reserves for changes in the CNY/US\$ bilateral rate.²⁹⁾

Since the revaluation effect is the change of NFAs due to exchange

rate fluctuation, it can be measured as follows. In general, the monetary authority recognizes the end-year revaluation of foreign currency liabilities and assets in the Profit and Loss account of the income statement. Since the end-year income statement balance will be included in the equity (K) account of the balance sheet, the change of net foreign assets due to the revaluation effect can be offset by the change of equity so that the domestic monetary base will be the same. In other words, if NFAs rises because of an increase in e_t , then $\overline{MB} = NFA \uparrow + NDA + NOA - K \uparrow$.

$$\text{Revaluation effect} = NFA_{t-1} \left(\frac{e_t}{e_{t-1}} - 1 \right) \quad (7)$$

Therefore, the revised change of net foreign assets = $\Delta NFA_t^* = NFA_t - NFA_{t-1} \left(\frac{e_t}{e_{t-1}} \right)$. The adjusted variable excludes the price or valuation effect, which as noted, should have no direct impact on liquidity.

The adjusted NFA_t^* is derived as a residual component:

$$\Delta NDA_t^* = \Delta MB_t - \Delta NFA_t^*$$

NFA_t^* and ΔNDA_t^* will be used as the dependent variables in eqs. (4) and (5) respectively.

4.3. Empirical Results

We use two-stage least squares (2SLS) to estimate the simultaneous equations 4 and 5. We apply autocorrelation and heteroskedasticity tests to the residuals from the estimated equations³⁰ Newey-West heteroskedasticity and autocorrelation consistent (HAC) covariance estimates are used if there is a problem.³¹ Table 4 summarizes the results of the estimating

29) However we also tried different currency composition of reserves holdings as do Prasad and Wei (2005). Results are fairly robust.

30) The serial correlation Lagrange multiplier (LM) test is used to check for the autocorrelation, while White's heteroskedasticity test is used to test the heteroskedasticity in the residuals.

31) Newey and West (1987) have derived a consistent covariance matrix estimator in the presence of both heteroskedasticity and autocorrelation. Since we use the Newey-West HAC estimates we do not need to include lagged dependent terms as done by Brissimis, Gibson and Tsakalotos (2002) and others.

equations applying two-stage least squares on monthly data. We have three sets of estimations depending on whether we assume perfect foresight (Regression 1), forward-looking expectations (Regression 2) and static expectations (Regression 3). Forward-looking expectations are captured using the three-month forward rate (the one-month forward

Table 5. China - Estimated Simultaneous Equations, 1999: M6 - 2007: M1

China: 2SLS	<u>Regression 1</u>		<u>Regression 2</u>		<u>Regression 3</u>	
	Perfect Foresight: $E_t e_{t+1} = \ln(e_{t+1})$		Forward Exchange Rate: $E_t e_{t+1} = \ln(F_{3M,t})$		Static Expectation: $E_t e_{t+1} = \ln(e_t)$	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
<i>Intercept</i>	0.058*** (0.015)	0.050*** (0.017)	0.058*** (0.014)	0.050*** (0.017)	0.058*** (0.015)	0.050*** (0.017)
ΔNDA_t^* (Offset)	-0.780* (0.403)		-0.781** (0.387)		-0.782* (0.406)	
ΔNFA_t^* (Sterilization)		-0.871** (0.363)		-0.872** (0.373)		-0.871** (0.363)
Δmm_t	-3.138* (1.692)	-4.333*** (0.319)	-3.143* (1.627)	-4.333*** (0.319)	-3.148* (1.704)	-4.333*** (0.319)
$\Delta REER_{t-1}$	0.081 (0.543)		0.082 (0.532)		0.083 (0.544)	
$y_{c,t-1}$	0.123** (0.061)	0.020 (0.177)	0.123** (0.061)	0.019 (0.177)	0.123** (0.061)	0.020 (0.177)
Δp_{t-1}	-0.275 (1.851)	-0.838 (1.446)	-0.278 (1.776)	-0.839 (1.502)	-0.278 (1.861)	-0.838 (1.446)
$\Delta(r_t^* + E_t e_{t+1})$	-0.019 (0.032)	-0.049* (0.029)	-0.019 (0.032)	-0.049* (0.029)	-0.020 (0.032)	-0.049* (0.029)
ΔG_t		-0.093* (0.054)		-0.093* (0.054)		-0.093* (0.054)
<i>R-square</i>	-0.031	0.823	-0.033	0.823	-0.035	0.823
<i>Adj. R-square</i>	-0.107	0.810	-0.109	0.810	-0.111	0.810

Note: (*) Significant at more than 10 percent; (**) Significant at more than 5 percent; (***) Significant at more than 1 percent.

Figure 6a. Recursive Estimated Offset and Sterilization Coefficients, 2003:M1 - 2005:M9 (Perfect Foresight)

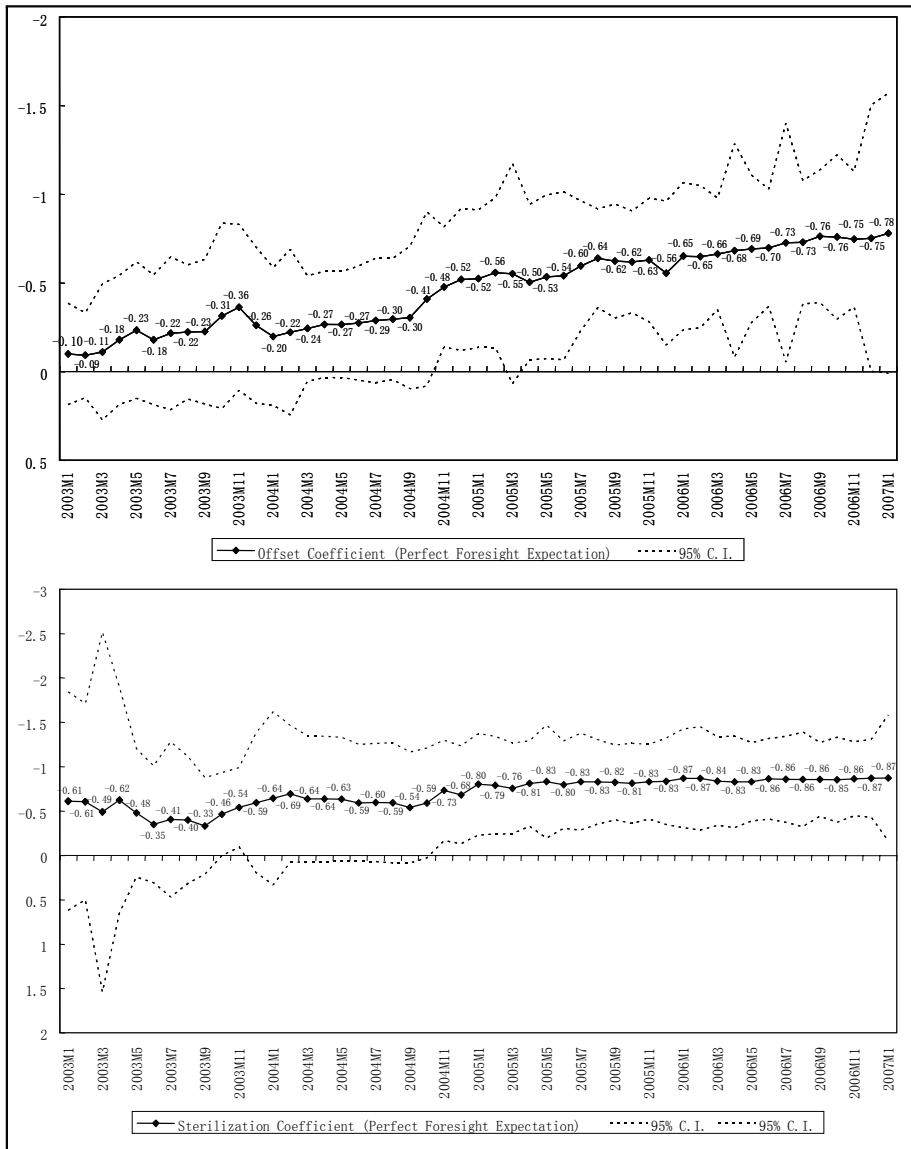


Figure 6b. Recursive Estimated Offset and Sterilization Coefficients, 2003:M1 - 2005:M9 (Forward-looking expectations)

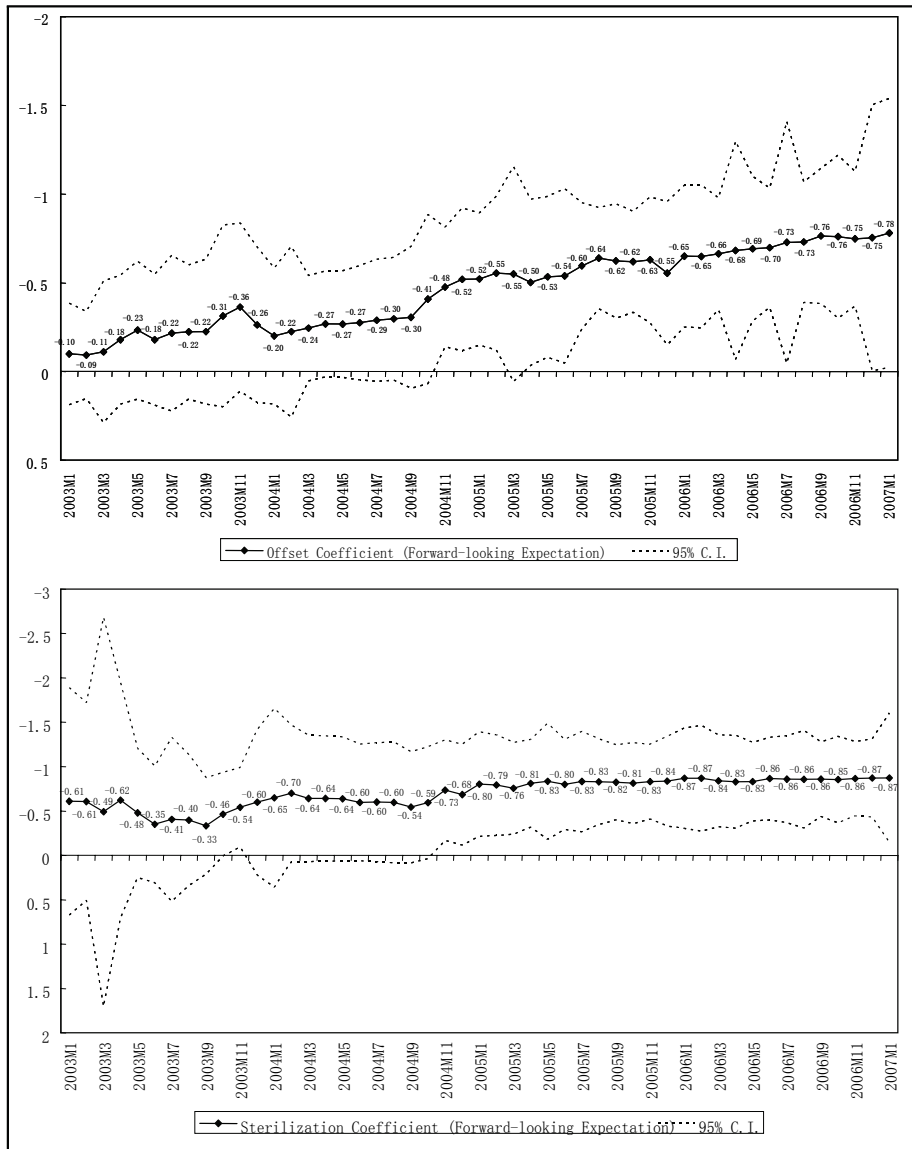
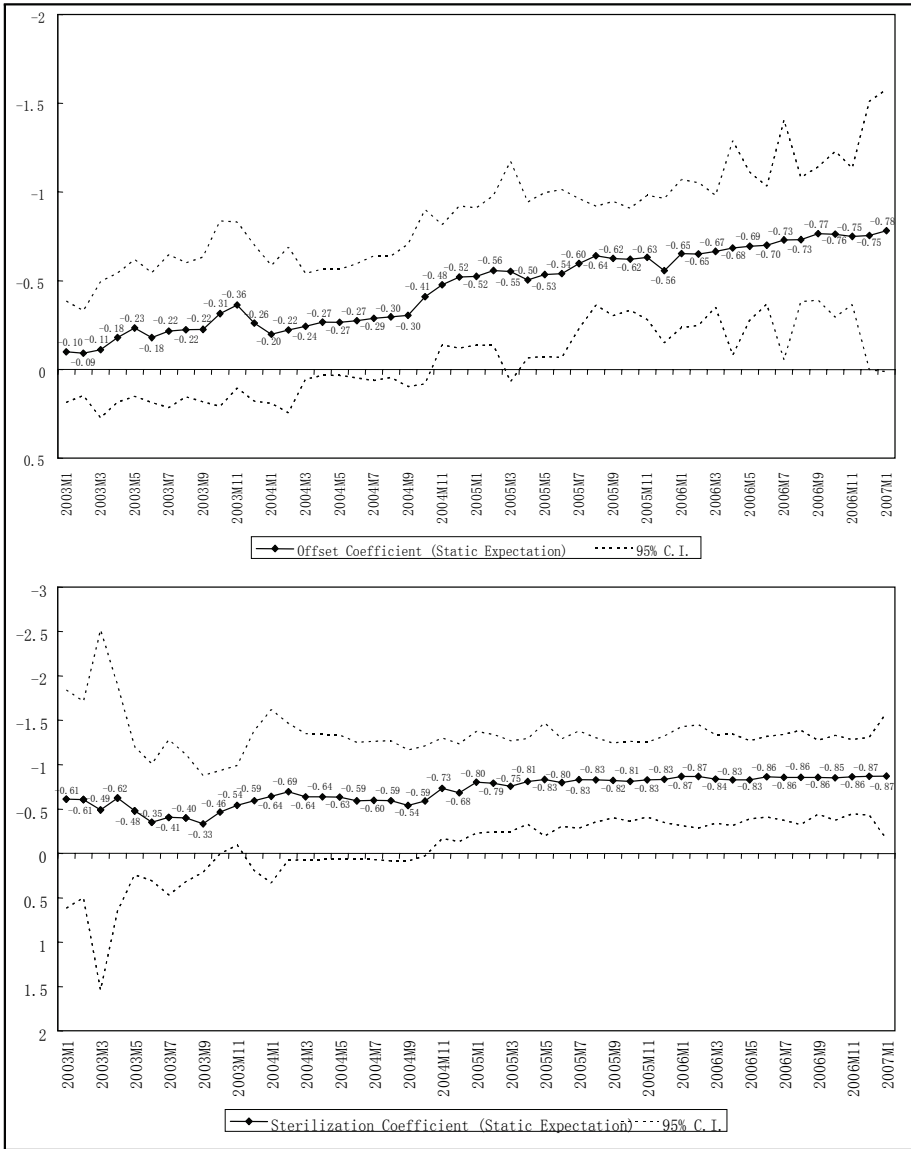


Figure 6c. Recursive Estimated Offset and Sterilization Coefficients, 2003:M1 - 2005:M9 (Static Expectations)



rate unfortunately being unavailable).

The estimated offset coefficients in all regressions are 0.78 and are statistically significant, indicating a substantial degree of capital mobility despite China's capital controls. The estimated sterilization coefficients are also highly statistically significant, averaging 0.87. This suggests that the PBC has heavily sterilized its reserve accumulation in the last eight years. The money multiplier is statistically and economically significant across all the estimations with the correct sign.³²⁾ Cyclical output is statistically significant and positive in the case of the balance of payments function, which suggests that the income effect leading to a worsening of the current account may be outweighed by a direct impact that positive cyclical income has on attracting capital inflows. The positive coefficient in the monetary reaction function is harder to fathom but it is statistically and economically insignificant. The exchange rate adjusted foreign interest rate coefficients have the correct signs though they are only weakly statistically insignificant in the monetary policy reaction function and insignificant in the balance of payments function. In the case of the balance of payments function, the lagged REER is the incorrect sign but not statistically significant in any of the regressions. In the case of the monetary reaction function, government expenditure is weakly statistically significant with a negative sign as would be expected. The lagged inflation term is negative across all regressions as expected, but statistically insignificant. Overall, the lack of either statistical or economic significance of the inflation coefficient in most if not all the regressions (pooled and country-specific) may be due to the fact that while the dependent variables are fairly volatile, the inflation series is quite stable (also see Brissimis, Gibson and Tsakalotos, 2002).

We also applied the recursive estimation on monthly data to estimate the dynamic changes in the offset and sterilization coefficients (see Figures 6a - 6c).³³⁾ The recursive offset coefficient has been rising sharply from around 0.2 in 2004:m1 to 0.8 by 2007:m1, indicating that *de facto* capital mobility increased quite substantially during this period. The

32) We replaced the money multiplier and the net domestic assets in both equations with M2 but the regressions were much poorer. Results are available on request.

33) Forward recursive estimation is applied. The first estimate is derived by using the sample from 1999: M6 to 2002: M12 and then adding one more observation each time to re-estimate the offset and sterilization coefficients.

sterilization coefficient which were around 0.4 and 0.5 between 2003:m11 to 2004:m9, jumped to about 0.8 in 2005:m1 and has remained in that range since.

5. Concluding Remarks

Our empirical results suggest that China's effective degree of capital mobility has risen substantially in recent years.³⁴⁾ This is consistent with the judgments of a number of economists that China's capital controls have been becoming increasingly less binding.³⁵⁾ To date, however, this increased effective capital mobility has not undermined the PBC's ability to effectively sterilize its huge reserve accumulation. We estimate that the PBC has typically sterilized around 80 to 90 percent of the reserve inflows. This broadly concurs with other studies by Burdekin and Siklos (2005) and He et al. (2005). While Burdekin and Siklos (2005) suggest the PBC has over-sterilized the foreign reserves, they find the PBC has not done so sufficiently to prevent M2 (broader money supply) from increasing. He et al. (2005) find that the PBC has fully sterilized the capital inflows, and most of the responses finish in a month.

Our estimates of high sterilization over the period of China's recent huge buildup in reserves support the view that China has operated as a reserve sink, much as Germany and Japan did during the later stages of the Bretton Wood system. While Dooley et al. (2004) have suggested the current global economic imbalances are much less worrisome than most economists have suggested, the chaotic end of the Bretton Woods exchange rate regime in the early 1970s is but one of many examples that large prolonged international payments imbalances seldom lead to happy endings.

Finally, the high level of sterilization raises questions about arguments that China's pegged exchange rate has been an important source of discipline over domestic inflation (see, McKinnon 2003a, 2003b, and 2004). Indeed, in recent years with the absence of sterilization,

34) This conclusion is consistent with Liu and Otani (2005) and Ma and McCauley (2005), both of which undertake a battery of tests on various interest parity conditions.

35) See for example Lardy (2005) and Prasad and Wei (2005).

China's peg would have been a source of substantial inflationary pressure. There are signs that this is happening recently (Figure 6) with a sharp spike in food prices in late 2007 (Goldman Sachs 2007). Going forward, the Chinese authorities would do well to continue to relax the management of the exchange rate, in addition to taking further steps towards deregulation of capital outflows in a judicious manner. Less management of the exchange rate in turn should provide the PBC greater opportunities to use interest rate policy to manage domestic liquidity conditions and pressures.

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Chapter 3

Policy Coordination Issues in East Asia

Exchange Rate Regime and Macroeconomic Stability in East Asia

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1. Introduction

Since the Asian Financial Crisis in 1997 there have been many concerns about the choice of exchange rate regime.¹⁾ The choice of exchange rate regime could affect both the national and regional economies in terms of international trade, inflation, and other macroeconomic variables. Especially on the issue of the macroeconomic stability there have been many arguments about whether a fixed exchange rate regime stabilizes the country's macro economy. Several studies have examined the cases of European countries; however, there has been no study to our knowledge for Asian countries.

In this paper we examine the relationship between exchange rate regime and macroeconomic stability, such as inflation and economic growth, in East Asia. Previous studies have found some contradictory results for the different time periods and country groups; thus, we examined the case of two country groups—ASEAN 5+3 and ASEAN 10+3—for the pre- and post-crisis periods. To do so we used alternative measures of exchange rate stability, such as de jure classification by the IMF and two de facto classifications measures: z-score²⁾ and Nitithanprapas

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1) In fact, several Asian countries have changed their regime from intermediate to more flexible or fixed systems since the crisis.

and Willett (N-W).³⁾

The rest of the paper is organized as follows. In the next section, we present the relationship between exchange rate regime and macroeconomic stability. In Section 3, the measures of exchange rate stability are described. In Section 4, the model and estimation methods are introduced and the impacts of exchange rate regime on inflation and economic growth in East Asia are examined empirically. The robustness of the evidence is also investigated. Finally, the results are summarized and the policy implications are suggested in section V.

2. Exchange Rate Regime and Macroeconomic Stability

In the case for the fixed regime, the predominant view is that, under the fixed regime, inflation will be lower because of the low monetary growth by the rule of the game. Alternative views, however, such as Calvo and Mishkin (2003) and others, are that the strong institutional framework such as central bank independence, the credibility of monetary policy, and the openness or the size of the country that could affect the imported inflation are more important factors than the exchange rate regime choice.

The positive view on economic growth is that a stable exchange rate stimulates investment and increases economic growth. Furthermore, a stable exchange rate lowers the exchange rate risk and increases the economic growth by promoting international trade. Alternatively, the negative view is that, under the fixed regime, when the country is exposed to a real shock, the real exchange rate is adjusted slowly by price and nominal exchange rigidity, and it results in low economic growth. Under free capital movement and low credibility under the pegging system, a speculative attack also could result in low economic growth.

Many studies have attempted to investigate the relationship between exchange rate regime and international trade empirically. However, fewer studies have examined the issue of macroeconomic stability. Recently Ghosh, Gulde, and Wolf (2003) and De Grauwe and Schnabl

2) Ghosh, Gulde and Wolf (2003).

3) Nitithanprapas and Willett (2000).

(2003) examined the effect on the inflation and economic growth. For inflation, Ghosh, Gulde, and Wolf (2003) examined 147 countries for the period of 1970-1999. They find a significant correlation between fixed regime and low inflation in the high-inflation countries, and a weak correlation in the low-inflation countries.

De Grauwe and Schnabl (2003) also examined the effect on inflation in Central and Eastern Europe for 1994-2002, and find insignificant coefficient via *de jure* classification. They find asymmetrical results by *de facto* classification, including a significant correlation between fixed regime and low inflation for the pre-EU accession period (1994-1997), and an insignificant correlation for the post-EU accession period (1998-2004).

On economic growth, Mundell (1995) finds that exchange rate stability increases economic growth. Lafrance and Perrault (2003) argue that a flexible system results in low economic growth. De Grauwe and Schnabl (2003) find high economic growth under the fixed system in the high income group. Ghosh, Gulde, and Wolf (2003), however, find weak correlation between exchange rate regime and GDP growth rate, and Edwards and Levy-Yeyati (2003) argue that a flexible regime increases economic growth. Furthermore, Eichengreen, and Leblang (2003) find that the results depend on the sample time periods.

3. Measures of Exchange Rate Instability

When we examine the impact of exchange rate regime on macroeconomic stability, one of the most important issues is the classification of the exchange rate regime. Exchange rate regime could be classified by *de jure*, official announcement of exchange arrangement by the country's financial authorities, and *de facto*, the actual exchange rate regime.

The IMF published the data on *de jure* regime arrangements in the IMF Annual Reports on Exchange Rate Arrangements and Exchange Rate Restriction. The IMF classifies *de jure* exchange rate arrangements into eight groups: exchange arrangements with no separate legal lender; currency board arrangements; other conventional fixed-peg arrangements (within a band of most $\pm 1\%$); pegged exchange arrangements within horizontal bands (at least $\pm 1\%$); crawling pegs (with small pre-announced adjustment); exchange rates with crawling bands; managed

floating with no pre-announced path for the exchange rate; and independent floating (market-determined exchange rate and independent monetary policy).

The methodology to identify a de facto exchange rate arrangement uses several alternative measures, such as observed exchange rate volatility and exchange market pressure models, in addition to others.

Ghosh, Gulde, and Wolf (2003) propose the z-score as an indicator of exchange rate volatility in which there are exchange rate fluctuations around a constant level and exchange rate fluctuations around a gradual depreciation path. Z-score is estimated in equation (1). A lower z-score is the indicator of exchange rate stabilization.

$$z_t = \sqrt{u_t^2 + g_t^2} \quad (1)$$

where u_t is the arithmetic average of month-to-month percent exchange rate change of the year t , while g_t is the standard deviation of the month-to-month percent exchange rate change of the year t .

Nitithanprapas and Willett (2000) introduce the N-W indicator (N-W Index) as an alternative measure of de facto exchange rate regime classification. In equation (2), the N-W index is estimated by the absolute value of the change of international reserve (R) over the sum of absolute value of the change of international reserve (R) and absolute value of the change of the exchange rate (E). When the N-W index approaches zero, the regime could be classified as floating, while the regime is identified as a fixed system when the index closes to one.

$$\text{N-W index} = |\Delta R| / (|\Delta R| + |\Delta E|) \quad (2)$$

In addition to these, Calvo and Reinhart (2002) and Levy-Yeyati and Sturzenegger (2002) suggest the percentage changes in foreign reserves and absolute changes in nominal interest rate as indicators of observed exchange rate volatility.

4. Empirical Results

4.1. Macroeconomic Stability and Regime Choice in East Asia

a) Macroeconomic Stability

Table 1 shows the country's macroeconomic performance in East Asia. The CPI inflation rate is lower than 5% in Japan, Korea, Thailand, Singapore, Vietnam, Cambodia, and Brunei, whereas it is higher in China, Indonesia, Philippine, Myanmar, and Lao PDR. The GDP growth rate is higher than 7% in China, Vietnam, Myanmar, and Cambodia, and it is lower in other countries.

Table 1. Macroeconomic Performance in East Asia (1990-2006)

	MONEY	WPI	CPI	EXP	GDP
KOREA	11.62	3.06	4.82	10.75	5.85
JAPAN	8.24	-0.54	0.68	5.36	1.40
CHINA	20.11	n.a	6.05	20.03	9.34
THAILAND	11.20	4.03	4.01	11.21	5.17
INDONESIA	17.77	14.12	11.90	9.56	4.47
PHILIPPINES	13.91	7.72	7.73	9.80	3.47
SINGAPORE	8.02	0.65	1.55	10.94	6.67
MALAYSIA	12.35	3.39	2.92	12.15	6.49
AVERAGE1	12.90	4.63	4.96	11.23	5.36
VIETNAM	25.41	n.a	4.11	15.99	7.55
MYANMAR	32.90	n.a	24.97	19.60	7.47
CAMBODIA	17.67	n.a	4.16	23.98	7.40
LAO PDR	31.18	n.a	28.79	18.09	6.33
BRUNEI	4.29	n.a	1.42	n.a	1.90
AVERAGE2	16.26	4.63	7.72	13.75	5.63

Note: Period average growth rate (annual data), EXP is export growth rate.

Source: IMF, International Financial Statistics, various Issues.

In Tables 2 and 3, the volatilities are summarized during pre- and post-crisis periods. The countries which have CPI inflation rates lower than 5% has been reduced from six countries—Japan, Singapore, Malaysia, Vietnam, Cambodia, and Brunei—to 3 countries—Indonesia, Myanmar, and Lao PDR.

In the case of GDP growth rate, there are six countries higher than 7%: Korea, China, Thailand, Singapore, Malaysia, and Vietnam during the pre-crisis period of 1990-1997. This list decreased to four countries—China, Vietnam, Myanmar, and Cambodia—during the post-crisis period of 1998-2005.

Table 2. Macroeconomic Performance in East Asia (1990-1997)

	MONEY	WPI	CPI	EXP	GDP
KOREA	12.60	3.40	6.08	11.49	7.49
JAPAN	7.55	-0.42	1.56	5.64	1.65
CHINA	25.12	n.a	10.90	20.34	10.06
THAILAND	11.46	3.64	5.20	14.35	7.35
INDONESIA	14.91	7.21	8.11	12.44	6.93
PHILIPPINES	16.08	3.99	9.49	17.94	3.13
SINGAPORE	9.25	-1.57	2.44	17.34	8.90
MALAYSIA	18.09	2.84	3.49	16.66	9.21
AVERAGE1	14.38	2.73	5.91	14.53	6.84
VIETNAM	24.50	n.a	4.45	23.37	8.35
MYANMAR	34.01	n.a	25.12	26.39	5.55
CAMBODIA	18.03	n.a	4.77	28.62	5.83
LAO PDR	16.34	n.a	21.49	25.58	6.57
BRUNEI	n.a	n.a	2.68	n.a	1.96
AVERAGE2	17.33	2.73	8.14	18.35	6.38

Note: Period average (annual data).

Source: IMF, International Financial Statistics, various issues.

Table 3. Macroeconomic Performance in East Asia (1998-2006)

	MONEY	WPI	CPI	EXP	GDP
KOREA	10.65	2.72	3.41	10.02	4.21
JAPAN	8.92	-0.66	-0.32	5.08	1.14
CHINA	15.10	n.a	0.58	19.73	8.51
THAILAND	10.94	4.43	2.66	8.07	2.98
INDONESIA	19.99	21.03	16.16	6.68	2.02
PHILIPPINES	11.74	9.59	5.75	1.67	3.81
SINGAPORE	6.80	2.86	0.55	5.34	4.44
MALAYSIA	6.60	3.94	2.28	6.98	3.77
AVERAGE1	11.34	6.27	3.88	7.95	3.86
VIETNAM	25.76	n.a	4.03	14.94	7.55
MYANMAR	31.78	n.a	24.81	11.84	10.02
CAMBODIA	17.49	n.a	3.93	21.08	8.97
LAO PDR	46.01	n.a	37.01	3.13	6.09
BRUNEI	4.29	n.a	0.16	n.a	1.83
AVERAGE2	16.62	6.27	7.77	9.55	5.03

Note: Period average (annual data).

Source: IMF, International Financial Statistics, various issues.

Table 4 indicates the country group's macroeconomic performance during two sub-periods. In the case of ASEAN 10+3, the average inflation rate decreased from 8.14% during the pre-crisis period to 7.77% in the post-crisis period. Also, the GDP growth rate decreased from

Table 4. Macroeconomic Stability in ASEAN 10+3

	Money	WPI	CPI	Export	GDP
1990-1997	17.33	2.73 (ASEAN 5+3)	8.14	18.35	6.38
1998-2006	16.62	6.27 (ASEAN 5+3)	7.77	9.55	5.03

Note: Period average (annual data).

Source: IMF, International Financial Statistics, various issues.

6.38% to 5.03% in these periods, respectively. In the case of ASEAN 5+3, the trend is similar to the case of ASEAN 10+3, shown in Table 5.

Table 5. Macroeconomic Stability in ASEAN 5+3

	Money	WPI	CPI	Export	GDP
1990-1997	14.38	2.73	5.91	14.53	6.84
1998-2006	11.34	6.27	3.88	7.95	3.86

Note: Period average (annual data).

Source: IMF, International Financial Statistics, various issues.

b) Regime Choice in East Asia

In Appendix Tables 3-1 and 3-2, Brunei and Myanmar have chosen fixed or pegged regimes, and China, Malaysia, and Vietnam have changed their regimes from managed floating to pegged or fixed since the crisis. Other countries have chosen managed floating or flexible regimes.

In most of the previous studies, Asian countries' exchange rate regimes have been changed from intermediate regimes to the corner solution, fixed or flexible systems since the crisis. However, when we classify the regime by de jure classification of the IMF in Table 6, the regimes have been changed from flexible to intermediate or fixed regimes since the crisis.

**Table 6. Exchange Rate Regime in East Asia⁴⁾
(De Jure Classification by IMF)**

	1990	1994	1998	2006
Fixed System	0	0	0	1
Intermediate Reg.	3	2	2	4
Flexible Regime	8	10	11	8
Total	11	12	13	13

Note: ASEAN 10+3

Source: IMF, IFS, Annual Report of Exchange Rate Arrangements and Restrictions.

4) See Appendix Table 4-1.

It is assumed that, among the eight groups of IMF classifications, groups 1 and 2 are classified as fixed regimes, and the groups from 3 to 6 are identified as

In Table 7, by z-score of de facto classification, China, Singapore, Malaysia, Vietnam, Myanmar, and Brunei have maintained low exchange rate volatility during the whole period. Similarly, the volatility has decreased during the post-crisis period in China, Malaysia, Vietnam, and Cambodia, which means these countries' regimes have been changed to more fixed or pegged regimes by the de facto classification.

**Table 7. Exchange Rate Regime in East Asia⁵⁾
(Z-Score by De Facto Classification)**

	KOR	JAP	CHN	THA	IND	PHI	SIN	VIE	MYA	CAM	LAO	BRU	MAL
1990-2006	0.0227	0.0274	0.0114	0.0191	0.0432	0.0193	0.0128	0.0133	0.0134	0.0453	0.0304	0.0128	0.0126
1990-1997	0.0204	0.0285	0.0233	0.0135	0.0189	0.0190	0.0113	0.0204	0.0137	0.0870	0.0191	0.0114	0.0160
1998-2006	0.0247	0.0264	0.0008	0.0241	0.0648	0.0196	0.0141	0.0069	0.0132	0.0082	0.0404	0.0141	0.0095

Table 8 shows the change of regime choice in East Asia by the N-W index of de facto classification. During the whole period, exchange rate market pressure has been increased in China, the Philippines, and Malaysia, which means that more fixed regimes have been chosen in

**Table 8. Exchange Rate Regime in East Asia⁶⁾
(N-W index by De Facto Classification)**

	KOR	JAP	CHN	THA	IND	PHI	SIN	VIE	MYA	CAM	LAO	BRU	MAL
1990-2006	0.6510	0.4193	0.9422	0.6703	0.5628	0.7232	0.6350	0.5315	0.6788	0.5565	0.4188 (1997)	n.a	0.8361
1990-1997	0.7633	0.4204	0.8915	0.7928	0.7221	0.8125	0.6703	0.3261	0.6861	0.4523	0.4416	n.a	0.7598
1998-2006	0.5387	0.4181	0.9929	0.5478	0.4035	0.6340	0.6358	0.6599	0.6714	0.6216	0.4160	n.a	0.9125

intermediate regimes. Finally, groups 7 and 8 are treated as flexible regimes in Table 6.

5) See Appendix Table 1-1 and 1-2.

6) See Appendix Tables 2-1 and 2-2.

these countries. During the sub-periods, the pressures have been increased in China, Malaysia, Vietnam, and Myanmar, whereas they have been decreased in Korea, Thailand, Indonesia, and the Philippines. These results are consistent with the evidence of z-score.

4.2. Model and Data

a) Model

To identify the effect of exchange rate regime on inflation, we employ a monetary model of inflation, in which inflation is determined by growth of money and output. We include in this model the indicator of exchange rate regime variable. Exchange rate regime measures by de jure classification and de facto classifications (z-score and N-W index).

$$y_{it} = a_t + x_{it}b_t + e_{it} \quad (3)$$

where y_{it} is the vector of cross-country inflation rate over the period of 1990-2005. The explanatory variables are denoted by x_{it} , which include the domestic variables and exchange rate regime, and e_{it} is the error term.

One of the problems in the estimation of equation (3) is that of endogeneity. The causality could run from the exchange rate regime to the inflation. To solve the problem, we employed the generalized method of moments (GMM) estimation using the valid lags of all endogenous and exogenous variables as the instruments.⁷⁾

To identify the effect of the GDP growth rate on exchange rate regime, the following model is constructed. GDP growth rate is determined by investment ratio over GDP, export growth rate, export plus import over GDP (openness), and exchange rate stability.

$$G_{it} = c_t + F_{it}d_t + e_{it} \quad (4)$$

where G_{it} is GDP growth rate, F_{it} is explanatory variables including exchange rate regime, and e_{it} is the error term.

7) Dynamic panel estimation, which is panel GMM model, is proposed by Arellano and Bond (1991). The GMM model uses the full set of valid lags of all endogenous and exogenous variables as instruments.

b) Data

The sample data used are annual data from 1990 to 2005. In 1997, Asian countries experienced the financial crisis, and the economic environments changed. Thus, in order to test the asymmetry of estimation results, we examine for two sub-periods: the pre-crisis period (1990-1997) and the post-crisis period (1998-2005).

The country groups covered are ASEAN 10+3, which includes Thailand, Indonesia, the Philippines, Singapore, Malaysia, Vietnam, Myanmar, Cambodia, Lao PDR, Brunei, Korea, China, and Japan. Also, we examine the case of ASEAN 5+3, in which Vietnam, Myanmar, Cambodia, Lao PDR, and Brunei are excluded from ASEAN 10+3.

4.3. Estimation Results

To identify the effect of exchange rate regime on inflation and economic growth, the cross-country panel model is used, and to capture the country-specific effect, the fixed-effect model is employed. In the inflation model, the panel GMM estimation technique is introduced for the existence of possible endogeneity bias, such that the causality runs from exchange rate regime to the rate of inflation. There is, however, also a potential reverse causality, that is, countries with low inflation are more likely to adopt a pegged exchange rate regime.⁸⁾

a) Inflation

In estimating equation (3), the GMM technique, which is proposed by Arellano and Bond (1991) is used to solve the endogeneity problem. In the estimation process, z-score and N-W index are used for the de facto exchange rate classifications. The z-score variable indicates exchange rate stability against the dollar. Positive coefficients indicate that the pegged or intermediate regime is associated with less inflation.

The results are reported in Tables 9 and 10. For the whole period, the z-score variables are significant, with positive signs in both ASEAN 10+3 and ASEAN 5+3. When we check the structural break, however, there is an insignificant impact of exchange rate stability on inflation during the sub-period of 1990-1997.

8) De Grauwe and Schnabl (2003).

Table 9. GMM Panel Estimation for Inflation in ASEAN 10+3 (z-Score)

	1990-2005	1990-1997	1998-2005
DLCPI(-1)	0.3001**(10.7945)	0.2161(1.0000)	0.2726**(13.7576)
Z-SCORE	2.4499**(2.4274)	0.5219(1.3992)	2.9654**(2.1273)
%GDP	0.3387(0.8408)	0.1654(0.2962)	0.5707(0.8269)
%MON	0.2193**(3.8705)	-0.0671(-0.8815)	0.2391**(3.1849)
Sargan	149.19	36.44	105.29

Table 10. GMM Panel Estimation for Inflation in ASEAN 5+3 (z-Score)

	1990 - 2005
DLCPI(-1)	0.2807**(2.2806)
Z-SCORE	1.1583**(2.9933)
%GDP	0.3884**(2.4519)
%MON	-0.0177(-0.6348)
Sargan	94.44

As an alternative de facto measure of exchange rate stability, the N-W index is used. The negative coefficient of the N-W index variable suggests the pegged regime is associated with lower inflation. In Tables 11 and 12, the N-W indexes are insignificant, with a negative sign during the whole period in both ASEAN 10+3, and ASEAN 5+3. In the two-period models, there is no significant impact of exchange rate stability on inflation during both sub-periods in Table 11.

Table 11. GMM Panel Estimation for Inflation in ASEAN 10+3 (N-W index)

	1990-2005	1990-1997	1998-2005
DLCPL(-1)	0.3359**(6.4275)	-0.0738(-0.2116)	0.3288**(6.3816)
N-W	-0.0913(-0.8707)	-0.0655(-0.0670)	-0.0826(-0.6331)
%GDP	-0.5167(-1.3588)	-0.0290(-0.0896)	-0.7815*(-1.6962)
%MON	0.2412**(2.8239)	0.0676(1.3400)	0.2397**(2.6942)
Sargan	162.31	48.92	102.40

Table 12. GMM Panel Estimation for Inflation in ASEAN 5+3 (N-W index)

	1990-2005
DLCPI(-1)	0.3246**(1.9962)
N-W	- 0.0434(-0.8016)
%GDP	0.3985**(2.2212)
%MON	-0.0647**(-2.0741)
Sargan	103.16

For the de jure classification, the dummy variable is used during the pegged or intermediate exchange rate regime. In this specification, the negative coefficient of the dummy variable indicates lower inflation in comparison to flexible regimes. The results are reported in Tables 13 and 14. For the whole, the coefficients are insignificant even though the signs are negative in both ASEAN 10+3 and ASEAN 5+3. During two sub-periods, the dummy variable is insignificant, which suggests that the pegged exchange rate regime does not contribute to lower inflation. Other variables have expected signs with significance in most cases.

Table 13. GMM Panel Estimation for Inflation in ASEAN 10+3 (de jure by IMF)

	1990-2005	1990-1997	1998-2005
DLCPI(-1)	0.3853**(5.6481)	0.1524(0.7470)	0.3526**(5.2105)
INTER	-0.0299(-1.4177)	0.0365(1.2385)	0.0160(0.4137)
%GDP	-0.7139*(-1.9671)	0.0628(0.1200)	-0.9692*(-2.2013)
%MON	0.2430**(3.5784)	-0.1585(-1.4676)	0.2382**(3.2252)
Sargan	163.59	38.64	102.01

Table 14. GMM Panel Estimation for Inflation in ASEAN 5+3 (de jure by IMF)

	1990-2005
DLCPI(-1)	0.2992**(2.1399)
INTER	-0.0221(-1.4000)
%GDP	0.3526**(2.1944)
%MON	-0.0698**(-2.9643)
Sargan	104.71

b) Economic Growth

The results of the growth in equation (4) are reported in Tables 15 and 16. The negative coefficients of the z-score variable suggest that exchange rate stability contributes high economic growth. The z-score variables have significant negative coefficients during the whole period in both ASEAN 10+3 and ASEAN 5+3. In the two sub-periods, the results are consistent to those of the whole period.

Table 15. Panel Estimation for GDP Growth in ASEAN 10+3 (z-score)

	1990-2005	1990-1997	1998-2005
C	0.0275(1.414)	-0.0137(-0.4772)	0.0251(0.6887)
Z-SCORE	-0.7779**(-8.173)	-0.4290**(-3.7842)	-1.0531**(-7.3559)
%EXP	0.0651*(1.9649)	0.06553*(1.8536)	0.0635(1.0514)
INVEST/GDP	0.1765**(3.9918)	0.2736**(2.6613)	-0.0226(-0.1618)
(EXP+IMP)/GDP	-0.0087(-0.6265)	-0.0026(-0.0819)	0.0512*(1.7267)
adjusted R-squared	0.5904	0.6477	0.7108

Table 16. Panel Estimation for GDP Growth in ASEAN 5+3 (z-score)

	1990-2005	1990-1997	1998-2005
C	-0.0503(-1.0703)	-0.0621(-1.4789)	-0.0567(-0.5839)
Z-SCORE	-0.6695**(-3.7764)	-0.3815**(-5.4941)	-1.1869**(-14.3786)
%EXP	-0.6695(-3.7764)	0.1796**(2.1527)	0.1763**(2.2666)
INVEST/GDP	0.3059**(3.3368)	0.3857**(2.3326)	-0.0017(-0.01372)
(EXP+IMP)/GDP	0.0279(1.1008)	-0.0169(-0.5725)	0.1128(1.6252)
adjusted R-squared	0.6555	0.7474	0.6947

In the case of N-W index, the positive coefficients of the N-W index indicate that exchange rate stability promotes economic growth. In Tables 17 and 18, the N-W index has significant positive coefficients during the whole period for ASEAN 10+3. In the two sub-period models, N-W

indices have significant positive coefficients for the post-crisis period in ASEAN 10+3 and ASEAN 5+3, whereas they are insignificant during the pre-crisis periods in both country groups.

Table 17. Panel Estimation for GDP Growth in ASEAN 10+3 (N-W index)

	1990-2005	1990-1997	1998-2005
C	-0.0098(-0.4056)	-0.0326(-0.9177)	-0.0626(-1.3911)
N-W	0.0248(1.5547)	0.0137(0.7963)	0.0719**(2.6764)
%EXP	-0.0738**(-2.0983)	-0.004(-0.1123)	-0.2341**(-3.7701)
INVEST/GDP	0.2491**(4.172)	0.3617**(2.7703)	0.3536**(2.0969)
(EXP+IMP)/GDP	-0.015(-0.8445)	-0.0343(-0.9484)	-0.0017(-0.0418)
adjusted R-squared	0.3843	0.5512	0.4959

Table 18. Panel Estimation for GDP Growth in ASEAN 5+3 (N-W index)

	1990-2005	1990-1997	1998-2005
C	-0.1176*(-1.7405)	-0.0997(-1.4006)	-0.2083(-1.5631)
N-W	0.0631**(1.8483)	0.0229(0.6443)	0.1560**(4.9506)
%EXP	-0.2381**(-2.7306)	0.0362(0.3991)	-0.267**(-4.9544)
INVEST/GDP	0.3723**(3.6545)	0.5028**(2.5402)	0.5235**(2.256)
(EXP+IMP)/GDP	0.0321(1.1733)	-0.0397(-1.142)	0.0373(0.4898)
adjusted R-squared	0.5418	0.6743	0.5054

The results by de jure classification are reported in Table 13. The positive coefficients of the dummy variable suggest that pegged or intermediate regimes promote high economic growth. In Table 13, the INTER⁹⁾ dummy variable is insignificant during the whole period. They have significant positive coefficients for the post-crisis period in ASEAN

9) INTER dummy variable is used for both the fixed and intermediate regimes.

10+3, and for both pre- and post-crisis periods in ASEAN 5+3. Other variables have expected signs with significance in most of the equations.

Table 19. Panel Estimation for GDP Growth in ASEAN 10+3 (de jure by IMF)

	1990-2005	1990-1997	1998-2005
C	-0.0012(-0.0503)	-0.0601(-1.3928)	-0.0672(-1.4688)
INTER	0.0006(0.0673)	0.0251(1.2866)	0.0632**(2.2302)
%EXP	-0.0764**(-2.1785)	0.0087(0.2452)	-0.2263**(-3.5917)
INVEST/GDP	0.2721**(4.9609)	0.4041**(3.5753)	0.4683**(2.7425)
(EXP+IMP)/GDP	-0.013(-0.75)	-0.0075(-0.1842)	0.001(0.0254)
adjusted R-squared	0.3699	0.569	0.4778

Table 20. Panel Estimation for GDP Growth in ASEAN 5+3 (de jure by IMF)

	1990-2005	1990-1997	1998-2005
C	-0.0992*(-1.6689)	-0.1641**(-2.3813)	-0.1173(-0.8811)
INTER	0.0193(1.1288)	0.0415**(2.6847)	0.1374**(5.7667)
%EXP	-0.234**(-2.3136)	0.0385(0.3186)	-0.2677**(-3.9017)
INVEST/GDP	0.4222**(3.3919)	0.6175**(2.4759)	0.6379**(2.7494)
(EXP+IMP)/GDP	0.0368(1.2244)	0.0029(0.0838)	-0.0097(-0.1113)
adjusted R-squared	0.5038	0.7063	0.4208

5. Conclusion

The choice of exchange rate regime affects various economic sectors. Specifically, the impact on macroeconomic stability is one of the major concerns for policymakers. In this paper, we examined the regimes' impact on macroeconomic stability in East Asia. We used alternative measures of exchange rate regime by de facto and de jure classifications, and investigate the asymmetry of the effects or robustness of the

evidence.

Our results for the impact of exchange stability on inflation, based on the z-score measures, suggest that pegged exchange rate regimes reduce inflation in East Asia. In the two sub-periods model, however, the pegged regime reduced inflation only during the post-crisis period. In contrast with the results of z-score, we find that exchange rate stability does not reduce the inflation based on the N-W index. These results are consistent for two sub-periods in ASEAN 10+3 and ASEAN 5+3. In the case of de jure classification, it is found that the pegged regime does not reduce inflation.

In the economic growth equation, the evidence shows that exchange rate stability promotes economic growth in both de jure and de facto classifications during the post-crisis period in East Asia. During the pre-crisis period, however, the results show that a pegged regime does not stimulate economic growth.

Finally, we conclude that the impact of exchange rate regime choice on inflation and economic growth in East Asia depends on the alternative measures of exchange rate regime, sample time periods, and country groups.

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Appendix

Table 1-1. z-score for Monthly Exchange Rate Changes against the Dollar

	KOR	JAP	CHN	THA	INN	PHI
1990	0.0073	0.0373	0.0385	0.0058	0.0062	0.0305
1991	0.0062	0.0226	0.0045	0.0051	0.0045	0.0063
1992	0.0057	0.0225	0.0121	0.0044	0.0033	0.0157
1993	0.0041	0.0255	0.0039	0.0037	0.0027	0.0206
1994	0.0034	0.0225	0.1214	0.0036	0.0036	0.0175
1995	0.0087	0.0475	0.0041	0.0054	0.0040	0.0136
1996	0.0120	0.0179	0.0010	0.0029	0.0053	0.0011
1997	0.1159	0.0322	0.0007	0.0767	0.1213	0.0467
1998	0.0654	0.0440	0.0000	0.0856	0.2641	0.0547
1999	0.0219	0.0304	0.0000	0.0198	0.0788	0.0139
2000	0.0180	0.0217	0.0000	0.0196	0.0501	0.0237
2001	0.0212	0.0269	0.0000	0.0164	0.0761	0.0251
2002	0.0226	0.0253	0.0000	0.0143	0.0275	0.0121
2003	0.0174	0.0216	0.0000	0.0127	0.0177	0.0143
2004	0.0205	0.0223	0.0000	0.0158	0.0253	0.0046
2005	0.0142	0.0184	0.0051	0.0141	0.0159	0.0123
2006	0.0208	0.0267	0.0019	0.0189	0.0281	0.0159
1990-2006	0.0227	0.0274	0.0114	0.0191	0.0432	0.0193
1990-1997	0.0204	0.0285	0.0233	0.0135	0.0189	0.0190
1998-2006	0.0247	0.0264	0.0008	0.0241	0.0648	0.0196

Table 1-2. z-score for Monthly Exchange Rate Changes against the Dollar

	MAL	VIE	MYA	CAM	LAO	BRU
1990	0.0047	0.0715	0.0163	0.1298	0.0054	0.0140
1991	0.0068	0.0551	0.0182	0.1782	0.0039	0.0139
1992	0.0143	0.0123	0.0162	0.1324	0.0023	0.0092
1993	0.0074	0.0068	0.0109	0.1458	0.0009	0.0100
1994	0.0202	0.0020	0.0102	0.0257	0.0009	0.0083
1995	0.0140	0.0006	0.0187	0.0385	0.0523	0.0107
1996	0.0062	0.0017	0.0072	0.0102	0.0009	0.0048
1997	0.0545	0.0133	0.0118	0.0354	0.0857	0.0200
1998	0.0731	0.0216	0.0134	0.0349	0.1036	0.0337
1999	0.0000	0.0011	0.0102	0.0077	0.1185	0.0113
2000	0.0000	0.0046	0.0233	0.0058	0.0299	0.0094
2001	0.0000	0.0269	0.0094	0.0036	0.0499	0.0172
2002	0.0000	0.0027	0.0113	0.0023	0.0179	0.0105
2003	0.0000	0.0019	0.0152	0.0047	0.0062	0.0126
2004	0.0000	0.0017	0.0123	0.0032	0.0147	0.0099
2005	0.0028	0.0012	0.0113	0.0065	0.0087	0.0097
2006	0.0098	0.0008	0.0121	0.0050	0.0145	0.0126
1990-2006	0.0126	0.0133	0.0134	0.0453	0.0304	0.0128
1990-1997	0.0160	0.0204	0.0137	0.0870	0.0191	0.0114
1998-2006	0.0095	0.0069	0.0132	0.0082	0.0404	0.0141

Table 2-1. N-W Index in East Asia

	KOR	JAP	CHN	THA	INN	PHI
1990	0.7860	0.4064	0.8476	0.7417	0.9472	0.8542
1991	0.7985	0.4635	0.8734	0.8761	0.7192	0.9523
1992	0.8225	0.2904	0.8169	0.8706	0.8930	0.7764
1993	0.7877	0.3911	0.8309	0.7993	0.7671	0.7515
1994	0.7965	0.5851	0.8938	0.8030	0.7938	0.6460
1995	0.6786	0.4958	0.9148	0.8108	0.6312	0.7482
1996	0.7387	0.4841	0.9734	0.7663	0.5625	0.9658
1997	0.6976	0.2471	0.9809	0.6747	0.4628	0.8057
1998	0.6210	0.3597	1.0000	0.4388	0.3256	0.4491
1999	0.6095	0.4070	1.0000	0.5528	0.2685	0.6511
2000	0.6444	0.4062	1.0000	0.4032	0.4247	0.6546
2001	0.4224	0.2979	1.0000	0.5150	0.2349	0.5334
2002	0.4853	0.4103	1.0000	0.6548	0.3331	0.6641
2003	0.5913	0.6641	1.0000	0.7084	0.5729	0.6116
2004	0.6152	0.4851	1.0000	0.5773	0.4060	0.8105
2005	0.3200	0.3146	0.9430	0.5317	0.6626	0.6974
1990-2005	0.6510	0.4193	0.9422	0.6703	0.5628	0.7232
1990-1997	0.7633	0.4204	0.8915	0.7928	0.7221	0.8125
1998-2005	0.5387	0.4181	0.9929	0.5478	0.4035	0.6340

Table 2-2. N-W index in East Asia

	SIN	MAL	VIE	MYA	CAM	LAO	BRU
1990	0.6241	0.9161	n.a	0.7787	n.a	n.a	n.a
1991	0.6501	0.7737	n.a	0.5242	n.a	n.a	n.a
1992	0.6696	0.7983	0.0000	0.6457	n.a	n.a	n.a
1993	0.6984	0.8873	0.0000	0.3705	0.0000	n.a	n.a
1994	0.6853	0.7290	0.0000	0.7463	0.7035	n.a	n.a
1995	0.6995	0.6655	n.a	0.7373	0.5230	n.a	n.a
1996	0.8370	0.7836	0.9643	0.8973	0.6526	n.a	n.a
1997	0.4982	0.5246	0.6661	0.7891	0.3824	0.4416	n.a
1998	0.5384	0.3673	0.4222	0.4016	0.2817	0.3545	n.a
1999	0.6367	1.0000	0.4920	0.5658	0.5213	0.1826	n.a
2000	0.6576	1.0000	0.0000	0.6163	0.6305	0.3873	n.a
2001	0.6867	1.0000	0.8361	0.9330	0.6120	0.3551	n.a
2002	0.6487	1.0000	0.8562	0.7183	0.8609	0.5694	n.a
2003	0.6275	1.0000	0.8880	0.7358	0.6820	0.6149	n.a
2004	0.7884	1.0000	0.9177	0.6865	0.8041	0.4319	n.a
2005	0.5022	0.9325	0.8672	0.7143	0.5804	0.4320	n.a
1990-2005	0.6530	0.8361	0.5315	0.6788	0.5565	0.4188	n.a
1990-1997	0.6703	0.7598	0.3261	0.6861	0.4523	0.4416	n.a
1998-2005	0.6358	0.9125	0.6599	0.6714	0.6216	0.4160	n.a

Table 3-1. De Jure (IMF) Classifications of Exchange Rate Regime in East Asia

	KOREA	JAPAN	CHINA	THAILAND	INDONESIA	PHILIPPINES	SINGAPORE
1990	7	8	7	3	7	8	7
1991	7	8	7	3	7	8	7
1992	7	8	7	3	7	8	7
1993	7	8	7	3	7	8	7
1994	7	8	7	3	7	8	7
1995	7	8	7	3	7	8	7
1996	7	8	7	3	7	8	7
1997	7	8	7	3	7	8	7
1998	8	8	7	7	8	8	7
1999	8	8	3	8	8	8	7
2000	8	8	3	8	8	8	7
2001	8	8	3	8	8	8	7
2002	8	8	3	8	8	8	7
2003	8	8	3	8	8	8	7
2004	8	8	3	8	8	8	7
2005	8	8	3	8	8	8	7
2006	8	8	3	8	8	8	7

Source: IMF

- 1: exchange rate arrangements with no separate legal tender
- 2: currency board arrangements
- 3: other conventional fixed peg arrangements (within a band of most $\pm 1\%$)
- 4: pegged exchange rate arrangements within horizontal bands (at least $\pm 1\%$)
- 5: crawling pegs (with small, pre-announced adjustment)
- 6: exchange rates with crawling bands
- 7: managed floating with no pre announced path for the exchange rate
- 8: independent floating (market-determined exchange rate and independent monetary policy)

Table 3-2. De Jure (IMF) Classifications of Exchange Rate Regime in East Asia

	MALAYSIA	VIETNAM	MYANMAR	CAMBODIA	LAO PDR	BRUNEI
1990	3	7	3	n.a	7	n.a
1991	3	7	3	n.a	7	n.a
1992	3	7	3	n.a	7	n.a
1993	3	7	3	n.a	7	n.a
1994	7	7	3	7	7	n.a
1995	7	7	3	7	7	n.a
1996	7	7	3	7	8	3
1997	7	7	3	7	7	n.a
1998	7	7	3	7	7	3
1999	3	4	3	7	7	2
2000	3	4	3	7	7	2
2001	3	4	3	7	7	2
2002	3	4	3	7	7	2
2003	3	4	3	7	7	2
2004	3	4	3	7	7	2
2005	3	4	3	7	7	2
2006	3	4	3	7	7	2

Table 4-1. Exchange Rate Regime Choice in East Asia

	1: exchange rate arrangements with no separate legal tender	2: currency board arrangements	3: other conventional fixed peg arrangements (within a band of most $\pm 1\%$)	4: pegged exchange rate arrangements within horizontal bands (at least $\pm 1\%$)	5: crawling pegs (with small, pre-announced adjustment)	6: exchange rates with crawling bands	7: managed floating with no pre-announced path for the exchange rate	8: independent floating (market-determined exchange rate and independent monetary policy)
1990	0	0	3	0	0	0	6	2
1991	0	0	3	0	0	0	6	2
1992	0	0	3	0	0	0	6	2
1993	0	0	3	0	0	0	6	2
1994	0	0	2	0	0	0	8	2
1995	0	0	2	0	0	0	8	2
1996	0	0	3	0	0	0	7	3
1997	0	0	2	0	0	0	8	2
1998	0	0	2	0	0	0	7	4
1999	0	1	3	1	0	0	3	5
2000	0	1	3	1	0	0	3	5
2001	0	1	3	1	0	0	3	5
2002	0	1	3	1	0	0	3	5
2003	0	1	3	1	0	0	3	5
2004	0	1	3	1	0	0	3	5
2005	0	1	3	1	0	0	3	5
2006	n.a	1	3	1	0	0	3	5

Price Convergence in East Asia and its Implication for Regional Monetary Integration

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I. Introduction

Following the global trend of regionalism, East Asian countries have been endeavoring to introduce regional trade arrangements. Multilateral as well as bilateral trade arrangements among East Asian countries stand at the top of the agenda for regional cooperation. Regional trade arrangements usually lead to regional monetary cooperation. The typical example is of course the case of Europe which introduced a single currency, Euro, to solidify the single market program. Monetary and financial integration is indeed becoming one of the most important issues for economists as well as policymakers in East Asia. Given the emerging regionalism and market integration in East Asia, it is expected that some price convergence will occur in East Asia. The extent of intra-regional trade among East Asian countries has become higher and the openness of some East Asian countries is even greater than EMU countries.

This paper intends to measure the extent of the price differences among East Asian countries and examine whether some kinds of price-convergence could be ascertained in East Asia (as it is the case for the EU). Then this paper tries to examine the factors that can explain price differences in East Asia and draw some implications for monetary integration in the region. Certainly intra-regional exchange rate stability in East Asia will help to ease price comparison and thereby create more competitive regional commodities market. The increase in price transparency will bring about the price convergence through the increased pressure

for arbitrage transactions.

Most studies on the extent of market integration have adopted a quantity-based approach and were carried out using trade volumes and a gravity model (McCallum 1995; Wei 1996; Rose 2000; Wang et al. 2003). Rose is the first that studied the effect of a common currency on goods market integration. According to his study, for instance, the existence of a common currency increases bilateral trade by as much as 300%. There are other studies to adopt a price-based approach. To examine market integration, these studies tried to test the validity of the purchasing power parity and the law of one price. They are however of limited value because they do not measure the extent of market integration directly. They are just measuring whether markets are integrated or not.

In contrast, Engel and Rogers (1995), Parsley and Wei (2001), Haffner (2002) tried to measure the extent of market integration by examining the differences in price levels. In particular, Parsley and Wei examined the effect of instrumental and institutional stabilization of exchange rate on the integration of goods market and concluded that goods market integration was increasing over time and was inversely related to distance, exchange variability and tariff barriers.

This paper partly follows Parsley and Wei but complements them in three respects. First, unlike Parsley and Wei, this study focuses on the market integration in East Asia. Parsley and Wei shows how much market integration could be achieved on a global scale but not in East Asian region. It is in this regard especially important to examine the effect of intra regional exchange rate volatility between East Asian currencies on the East Asian market integration. Second, the price catch-up effect is considered. East Asia is characterized by wide differences in income and these differences may explain some of the cross-country price differences. For instance, due to the lagging productivity in the non-tradable sector, especially in services, countries with a relatively higher income tend to have a relatively higher price level. Indeed, Rogers (2000), on the basis of so called Balassa-Samuelson effect, found such evidence of price convergence. Third, in addition to the standard deviation of log price difference for a pair of countries (over all commodities), which was used by Parsley and Wei, this paper considers the mean of the log price differences. Strictly speaking, the study of Parsley and Wei is not examining the convergence of price differences but rather investigating the reduction in volatilities of price differences.

This paper shows that compared with the EU, there does not arise any noticeable trend of price convergence among East Asian countries in general. However, some price convergence is observed for Northeast Asia (NEA), especially for Korea-Japan-China. Moreover this paper shows that the exchange rate variability and income disparity are two of the most important barriers preventing further integration. It suggests that to promote real integration, the stability of exchange rate is essential, together with regional policy to reduce income gap (cf. Parsley and Wei 2001; Rose and Engel 2002).

The organization of this paper is as follows. Section 2 examines the methods and data to measure market integration and price convergence in East Asia. Section 3 shows the trend of price convergence in East Asia using the mean and standard deviation of price differences as the (inverse) measures of price convergence. Section 4 investigates the determinants of price differences in East Asia. Section 5 concludes with some implications for regional monetary integration.

2. Measures of Market Integration and Price Data

The increasing economic linkages among East Asian countries suggest that the markets among East Asian countries are integrating over time. This is essentially due to the following two reasons.

First, tariff rates in East Asia have continued to decline over the last 20 years. Table 1 shows the trend of tariff rates for non-agricultural and non-fuel products in East Asia since 1990. As easily understood, the tariff rates in most of East Asian countries turned out rapidly falling down. In the case of Korea, for instance, the tariff rate declined from 12.38% in 1990 to 7.65% in 2004. In the case of China, the tariff rate attaining 43.31% in 1992 dropped to 9.71% in 2004 with the joining of the WTO. The same trend is observed even for a country like Japan where the tariff rate was relatively low. The tariff rate in Japan declined to 3.55% in 2004 from 5.16% in 1990. While the tariff rate tended to decline over time, the tariff rate in most of East Asian countries still remains high except for Hong Kong, Singapore and Japan. This is especially true for China, Malaysia and Thailand.

Second, intra-regional economic interaction has been continuing to increase over time. Currently the intra-regional trade share in East Asia

Table 1. Tariff Rates in East Asia

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
KOR	12.38	12.38	10.54	10.54	10.54	7.59	8.32	8.32	8.32	7.64	7.64	7.64	7.65	7.65	7.65
JAP	5.16	5.1	5.12	5.12	5.12	4.9	4.48	4.51	4.36	4.16	4.04	3.88	3.81	3.69	3.55
CHN	-	-	43.31	40.39	36.29	36.29	22.24	16.85	16.75	16.34	15.98	14.86	14.86	10.54	9.71
TAI	10.52	10.52	6.71	6.71	6.71	6.71	6.48	6.48	6.48	6.53	6.23	6.19	6.07	5.34	5.34
IND	20.83	20.83	20.83	19.68	19.68	17.19	12.85	12.85	12.85	11.52	9.31	7.37	7.37	7.38	7.38
MAL	17.06	17.23	17.23	14.82	14.82	14.82	11.34	11.6	11.6	11.6	11.6	13.68	13.67	13.7	13.7
PHI	19.07	19.07	19.05	21.5	20.88	19.13	19.13	19.13	9.92	9.01	7.07	6.73	5.13	4.25	4.25
SIN	0.56	0.56	0.56	0.56	0.56	0	0	0	0	0	0	0	0	0	0
Tha	39.88	39.93	39.93	45.35	45.35	20.97	20.97	20.97	20.97	20.97	15.78	16.34	16.34	14.9	14.9
HK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: for non-agricultural and non-fuel products only

Source: UNCTAD (<http://stats.und.org/Handbook/TableViewer/tableView.aspx>)

Table 2. Intra-regional Trade in East Asia

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
KOR	34.0	38.9	39.8	40.2	41.4	42.3	41.2	41.2	39.4	42.6	44.1	43.8	46.0	48.3	48.5
JPN	28.8	31.2	32.4	35.0	37.0	39.4	39.8	38.8	34.6	37.4	40.6	40.3	42.4	44.6	45.9
CHN	57.1	60.3	58.7	47.4	49.7	50.8	50.2	50.8	47.3	46.9	46.7	45.5	46.4	46.4	45.7
TAI	39.3	42.0	43.5	45.4	47.5	49.9	48.9	47.8	46.3	50.0	52.3	51.7	55.0	57.2	58.5
IND	58.1	57.7	55.2	54.7	55.8	56.4	53.1	53.8	51.7	54.3	57.5	55.3	56.3	58.5	59.0
PHI	42.1	43.9	42.8	44.4	47.1	47.3	46.4	48.5	49.4	50.7	53.1	53.7	56.7	59.8	61.9
SIN	47.4	49.8	49.1	52.9	55.4	56.1	54.2	53.6	50.5	52.9	55.6	54.4	56.0	64.3	63.7
MAL	55.8	58.1	57.6	57.1	55.7	55.8	57.9	56.9	53.1	54.3	58.1	56.7	58.4	58.8	58.4
THA	48.5	48.2	49.1	49.9	51.7	49.7	50.9	50.2	47.2	50.1	52.3	51.0	53.0	54.7	55.5
HK	58.7	61.1	62.3	63.7	64.4	65.0	65.6	65.9	65.0	66.3	67.5	67.8	70.3	70.8	71.2
EA15	41.1	44.4	45.7	46.5	48.3	49.5	49.5	49.3	46.6	48.4	50.4	49.9	51.7	53.2	53.3

Note: EA 15 means ASEAN10+3, HK and Taiwan

Source: ADB (www.adb.org)

is attaining the level of the European Union. As indicated in Table 2, the intra-regional trade share, which was 41.1% in 1990, increased to 53.3% in 2004 despite a temporary setback during the currency crisis period. Similar pattern is observed for individual East Asian country. In the case of Korea, for example, the intra-regional trade share increased from 34.0% in 1990 to 42.3% in 1995 and to 48.5% in 2004. In the case of Japan, this trend is more remarkable because its share, which was the lowest in East Asia with 28.8% in 1990, rose to 39.4% in 1995 and to 45.9% in 2004, catching up with the level of Korea. In the case of China, the share declined slightly. But this fact should be interpreted cautiously because it is related to the fact that China's trade with the rest of world including the US and the EU increased relatively more than its trade with East Asian countries. Finally, in the case of ASEAN countries, the intra-regional trade share turned out higher than NEA countries such as Korea, China and Japan. It might be due to the fact that they have tried most actively to facilitate free trade among themselves.

Under these situations, it seems that goods prices among East Asian countries are likely to converge over time. We think that markets in East Asia are not yet completely integrated and thus the conventional method to test the validity of purchasing power parity by looking at the real exchange rate could not be used. In fact, as Engel (2004) rightly pointed out, PPP fails due to three types of shocks; deviations from the law of one price for traded goods, terms of trade shocks, and shocks to the relative price of non-tradable goods. Deviations from the law of one price can occur due to transport costs, tariffs, other barriers to trade and so on. Terms of trade shocks occur because the weights in the price indexes are different across countries. Shocks to the relative price of non-tradable goods can be brought out by the difference of productivity change (the so-called Balassa-Samuelson effect), impediment of factor movement, non-homothetic preferences. Thus, following Engel and Rogers (1995), Parsley and Wei (2001), and Haffner (2002), we try to measure the extent of price convergence by examining the price differences among East Asian countries and see whether they tend to decline over time.

Now let $P(i,k,t)$ be the US dollar price of a commodity k in an East Asian capital city i at a given time t . For a given city pair (i,j) and a given good k at a time t , we define the absolute log price difference as:

$$Q(i, j, k, t) = |\ln P(i, k, t) - \ln P(j, k, t)| \tag{1}$$

where $\ln P(i, k, t)$ is the log price of commodity k at time t in city i and $\ln P(j, k, t)$ is the log price of commodity k at time t in city j .

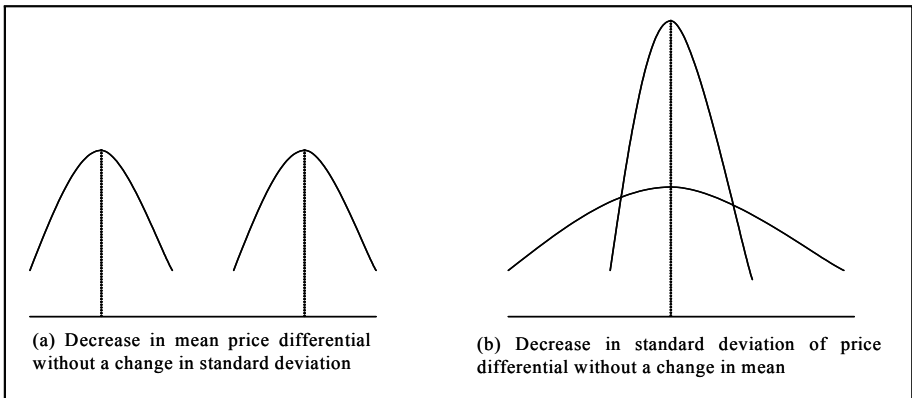
Different indicators could be used to measure the price convergence. For example, Haffner (2002) defined the price difference on the basis of intra-industry index.¹⁾ To measure the price convergence, we focus on the following mean ($E[Q]$) and standard deviation ($V[Q]$) of the absolute log price differences across all N commodities.

$$E[Q(i, j, t)] = \sum_k |Q(i, j, t)| / N \tag{2}$$

$$V[Q(i, j, t)] = \sqrt{\sum_k \{|Q(i, j, t)| - E[Q(i, j, t)]\}^2 / N} \tag{3}$$

Parsley and Wei considered only the volatilities (standard deviation) of price differences to examine the price convergence. This paper tries to use both the mean and standard deviation of price differences over all the items of commodities considered (63 goods and services). The reason is

Figure 1. Two Cases to Measure the Price Convergence



1) Haffner defined price similarity index as $100 - 100 \times \sum_k w_k \frac{|P(i, k, t) - P(j, k, t)|}{|P(i, k, t) + P(j, k, t)|}$.

simple. If only the standard deviation is considered as in Parsley and Wei, then the indicator does not take into account the case that the mean of price differences is reduced without any change in the volatilities (See the case (a) in Figure 1). Also, if only the mean of price differences is considered, it does not explain the case that the standard deviation is reduced without any change in the mean value (See the case (b) in Figure 1).

This paper uses the raw price data compiled by the Economist Intelligence Unit (EIU). The EIU publishes disaggregated price data for about 160 commodities and services in 123 cities of the world under the name of EIU City Data. This data was first used by Hufbauer et al. (2000) to calculate the welfare benefit that could arise if national prices converge to the world price. Since then, it was used by many economists including Rogers (2000) and Parsley and Wei (2001).

Naturally, price data is not available for all commodities and cities. Dropping commodities with missing data, this paper focuses on 63 goods and services. The entire sample of goods and services used in our data is listed in the Appendix. Thus, the data use a 3-dimensional panel of 63 disaggregated prices from 10 Asian capitals (Korea, Japan, China, HK, Taiwan and 5 most developed ASEAN countries such as Singapore, Philippines, Thailand, Malaysia and Indonesia) during the 15 year period from 1990 to 2004. The total number of data is thus $10 \times 15 \times 63 = 9450$. Finally, in order to compare prices denominated in different national currencies with each other, all the national price data are converted to the US dollar price on the basis of the market exchange rate.

3. Price Convergence Trend

On the basis of the mean and standard deviation of price differences over 63 items, this chapter firstly looks at whether the prices in each East Asian nation shows a convergence with each other.

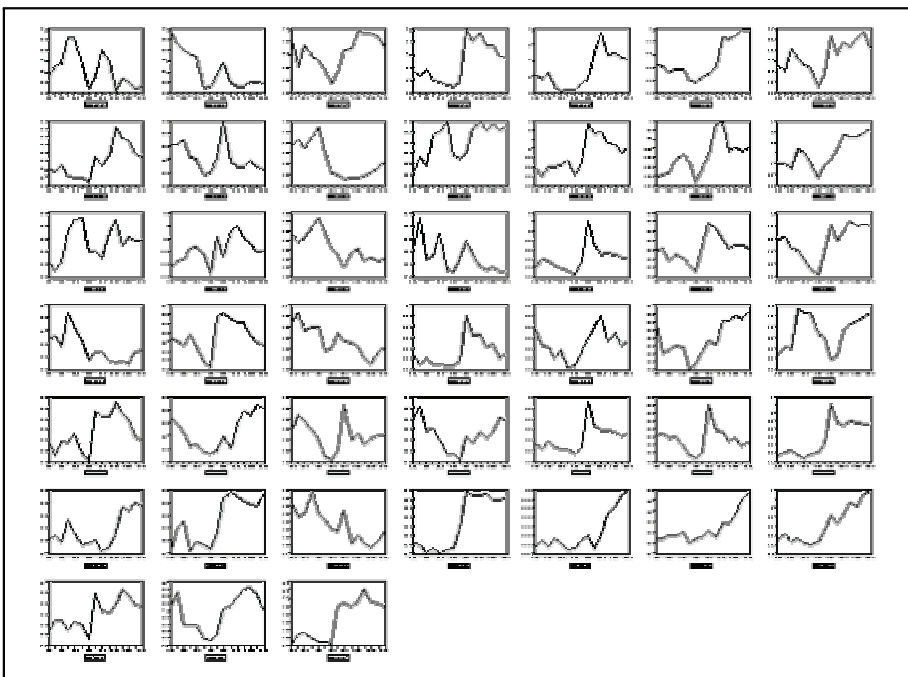
3.1. *Bilateral Trend*

The bilateral price differences for country i and j could be used to examine price convergence among East Asian countries. Figure 2A shows the time trend of these price differentials for 45 city pairs²⁾ in East Asia.

2) For 10 cities, there are 45 bilateral combinations of price differences.

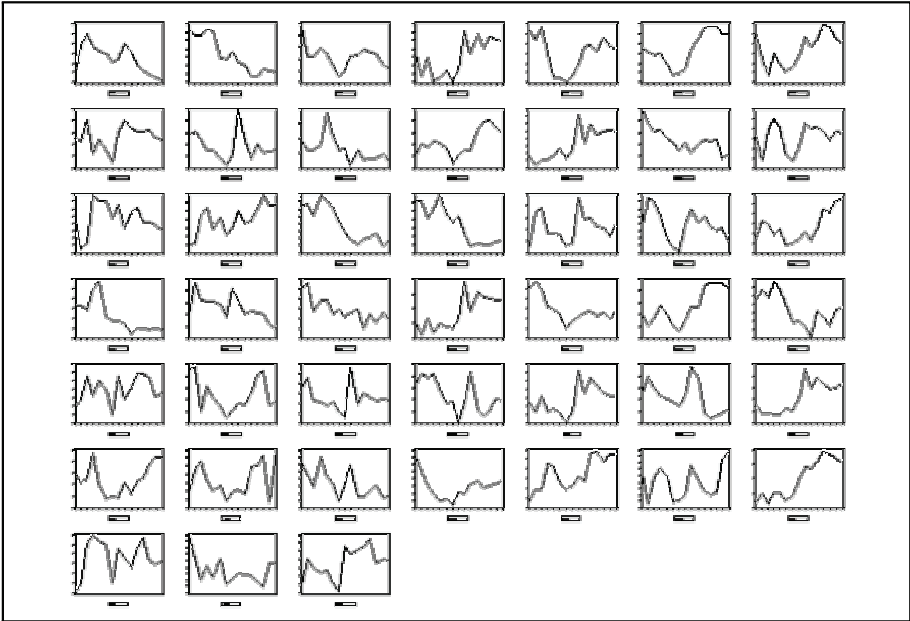
First, the bilateral price differences measured by the mean of 63 individual price differences tended to diverge for most of city pairs. Price convergence occurs largely among some city pairs belonging to NEA such as Seoul-Tokyo, Seoul-Beijing, Tokyo-Beijing, Tokyo-Hong Kong, Beijing-Taipei, Beijing-Hong Kong, etc. Similar trend is observed for bilateral price differential measured in terms of standard deviation (See Figure 2B). The standard deviations of price differences are not decreasing largely except for some groups of NEA city pairs.

Figure 2A. Trend of Bilateral Price Convergence ($E[Q]$)



Note: The order of the city pair is as follows: seto, sebe, seta, seja, seku, sema, sesi, seba, seho, tobe, tota, toja, toku, toma, tosi, toba, toho, beta, beja, beku, bema, besi, beba, beho, taja, taku, tama, tasi, taba, taho, jaku, jama, jasi, jaba, jaho, kuma, kusi, kuba, kuho, masi, maba, maho, siba, siho, baho, where SE: Seoul, To: Tokyo, Be: Beijing, Ta: Taipei, Ja: Jakarta, Ku: Kuala Lumpur, Ma: Manila, Si: Singapore, Ba: Bangkok and Ho: Hong Kong.

Figure 2B. Trend of Bilateral Price Convergence ($V[Q]$)



Note: the same as Figure 2A

3.2. Group Trend

To see the price convergence trend for the whole East Asian countries and for some sub-groups, we take the average across 45 city pairs of the previous bilateral price differential measures. For example, the averages for the whole East Asian countries are

$$E[Q(t)] = \sum_{i=1} \sum_{j \neq i} E[Q(i, j, t)] / 45 \tag{4}$$

$$V[Q(t)] = \sum_{i=1} \sum_{j \neq i} V[Q(i, j, t)] / 45 \tag{5}$$

We can use similar equations to the above to calculate averages for other sub-groups.

As Figure 3A and 3B show, there are two noticeable features to

note. First, East Asia as a whole does not show any trend toward price convergence. Rather price differences tend to increase over time and especially since the 1997 currency crisis. However, price convergence trend could be ascertained for the group of NEA countries. Second, the price deviation indicators of East Asian countries reveal that the economic crisis in 1997-1998 had an important impact on price convergence. In particular, the exchange rate volatility brought about by the currency crisis in many East Asian countries seems to have a strong negative impact on the price convergence.

Figure 3A. Trend of Price Convergence by Group ($E[Q]$)

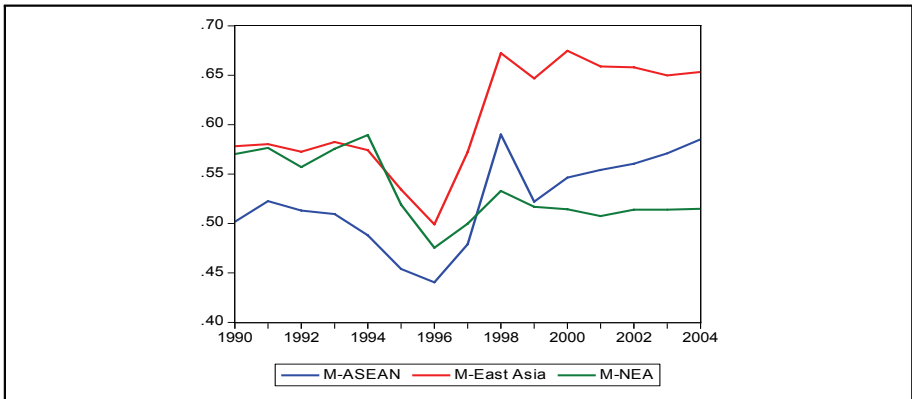
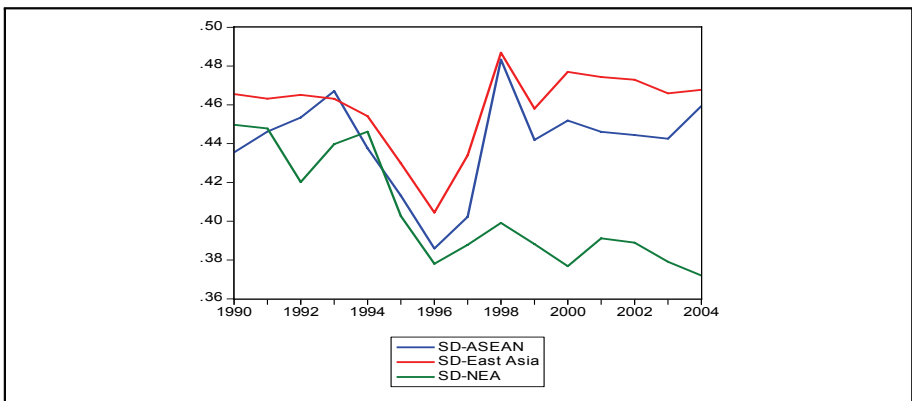


Figure 3B. Trend of Price Convergence by Group ($V[Q]$)



3.3. Comparison with the Europe

Finally we compare the price convergence in East Asia with that in the European Union. For the comparison, ten European capital cities are selected to include Paris (France), Berlin (Germany), Brussels (Belgium), Hague (Netherlands), Luxembourg (Luxembourg), Copenhagen (Denmark), Helsinki (Finland), Lisbon (Portugal), Madrid (Spain) and Dublin (Ireland). Then we take the average across 45 city pairs of the bilateral price differential measures using (4) and (5). Table 3 shows the average across time of the price differences measured respectively by the mean and standard deviation for 45 city pairs in East Asia and Europe.

Table 3. Price Difference: East Asia vs. Europe

	$E[Q]$	$V[Q]$
East Asia	0.64	0.46
Europe	0.34	0.30

From the table, we can see that price differences turn out higher in East Asia than in Europe and markets in East Asia are far less integrated than European markets. Three important factors could explain these differences. First, after the signing of the Treaty of Rome in 1957, European countries continued to remove all the trade barriers between them and harmonize different regulations related to the free movement of goods and services. These efforts culminated with the achievement of the Single Market Program in 1986.

Second, East Asian countries were characterized by wider exchange rate fluctuations among themselves. Especially since the 1997 currency crisis, countries in East Asia have divergent exchange regimes, making intra-regional exchange rate coordination difficult. It seemed to have an important impact on price convergence in East Asia. In contrast, the exchange rates among European currencies remained relatively stable except for the turbulent period of the 1992-3 ERM crisis. With the introduction of single currency EURO in 1999, the exchange rate fluctuations among European currencies were even completely removed. Indeed, this explains why, in Rogers (2000), the effect on price convergence of exchange rate stabilization turned out smaller than the effect of the removal of trade barriers since 1990 in Europe.

Thirdly, income disparities among East Asian cities are relatively larger than those in Europe. Wider income disparities in East Asia imply wider productivity differentials, which, according to the Balassa-Samuelson effect, will cause wider price differentials. Indeed, countries with high income such as Japan, Singapore, Hong Kong, and Korea have a high relative price of non-tradables and a higher general price level.

4. Determinants of Price Differences

4.1. Model

We begin our formal investigation of factors affecting price differences (or inversely price convergence) in East Asia by estimating the following equation:

$$D(Q(i, j, t)) = \beta_0 + \beta_1 Dis(i, j) + \beta_2 Tariff(i, j, t) + \beta_3 Exvol(i, j, t) + \beta_4 Incom(i, j, t) + \beta_5 ASEAN + \beta_6 NEA + TIME \quad (6)$$

where $D(Q(i, j, t))$ is the price difference measured either by the mean $E[Q(i, j, t)]$ or by the standard deviation $V[Q(i, j, t)]$ of $Q(i, j, t)$ over 63 goods, $Dis(i, j)$ is the log of the distance between cities i and j , $Tariff(i, j, t)$ is the sum of the tariff rates between two cities i and j , $Exvol(i, j, t)$ is the standard deviation of log changes in the monthly bilateral exchange rates between two cities, $Incom(i, j, t)$ is the absolute value of the log difference in the income level (per capita income) between two cities, $ASEAN$ and NEA are the dummy variables taking the value 1 if the observation involves cities that are in ASEAN or in NEA respectively, and $TIME$ is the time dummy for the fixed effect model where applied.

The equation was based on Parsley and Wei (2001). They considered as the factors that affect the price difference the distance between two cities, tariff rates, exchange volatilities and exchange arrangement dummy variables. Because we focus on the price differences in East Asia, we do not take into account exchange rate arrangement dummies and retain only distance, tariff and exchange variability as explanatory variables.

The distance was one of the most fundamental variables representing the transportation cost and trade barriers in the gravity model. The data for distance was obtained from the website of John Havem.³⁾ The tariff

rate was used to measure the extent of trade barriers between two cities. As indicated, simple average and weighted average tariff rates could be considered. In this paper, the simple average tariff rate was used.⁴⁾ The data for tariff rate was obtained from the UNCTAD data base. Exchange rate variability may make the comparison of different prices in different cities difficult and prevent price convergence. The data for monthly exchange rate is obtained from the IFS of the IMF.

In addition to these three variables, we consider income gap between a pair of cities as an independent variable to explain price differences. In fact, there is a close link between income gap and price difference according to the Balassa-Samuelson effect. But in the study of Parsley and Wei (2001) this effect is not taken into account. The data for national income was obtained from the World Bank data base.

Finally, we consider two additional dummy variables for ASEAN and NEA countries. The first one is needed to take into account the effect of ASEAN as a free trade group on price convergence. The second one is justified on the ground that Korea, Japan, China with its two neighboring countries, Taiwan and Hong Kong are culturally and historically much closer to each other than any other countries in East Asia.

Before estimation, we present the basic statistics of major variables.

4.2. Basic Regression

Table 5A shows first the results using $E[Q(i, j, t)]$ as the dependent variable. The estimation is conducted both by the OLS and by the fixed effect model with time dummy. In the case of the OLS, the equation does not correctly capture the effect of the tariff rate on price difference (See columns 1, 3, 5 and 7). In contrast, the fixed effect model correctly predicts the effect of tariff rate and other variables (See columns 2, 4, 6, and 8). Moreover, the model with time dummies turns out more significant with the increased R^2 values. Thus, the fitting by the fixed effect model looks more appropriate, and the following interpretation is based on column 8.

As expected, the price differences between city pairs increase with

3) <http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html>

4) Indeed, there is little change in the estimation result even if the weighted average tariff rate is used.

distance, consistent with the interpretation that distance is a proxy for transportation cost. The same result is confirmed by similar studies carried out by Parsley and Wei (2001). ASEAN and NEA dummies have all expected correct signs and turn out greatly significant. Tariff rate has the expected sign but does not look very significant and its impact is also negligible. Increased exchange rate variability turns out to be closely associated with increased price differences. For instance, reducing monthly exchange rate variability from the sample average 0.023 to zero reduces price difference by 0.036 ($=1.646 \times 0.023$), while the increase of the exchange rate variability to its maximum value 0.177 will bring about the increase in price difference by 0.253 ($=1.646 \times (0.177-0.023)$). Finally, the price difference is increasing when the related country pairs show a larger income gap. Countries or cities with relatively large income differences therefore tend to show higher price differences. For instance, reducing the income gap from the sample average 1.783 to its lowest value 0.004 will lower the price difference by 0.156 ($=0.088 \times (1.783- 0.004)$), whereas the rise in income gap to its maximum 4.558 will cause the increase in price difference by 0.244 ($=0.088 \times (4.558-1.783)$).

When we compare the effect of exchange rate variability with that of income gap, we could confirm the importance of exchange rate stability in promoting price convergence in East Asia. For example, the changes in price difference due to exchange rate fluctuation could vary between 0.571 and 0.860 while those due to the fluctuation of income gap could be between 0.451 and 0.851. On average, the change due to the first is larger than that due to the latter.

Table 4. Statistics of Major Variables Averaged across City Pairs and Time

	Mean	Maximum	Minimum
$E[Q(i, j, t)]$	0.607	1.333	0.271
$V[Q(i, j, t)]$	0.457	0.807	0.219
$Dis(i, j)$	7.770	8.665	5.764
$Tariff(i, j, t)$	0.217	0.857	0
$Exvol(i, j, t)$	0.023	0.177	0
$Incom(i, j, t)$	1.783	4.558	0.004

Table 5B shows the results using $V[Q(i, j, t)]$ as the dependent variable. This was in fact the methodology adopted by Parsley and Wei and our results are quite similar to theirs. What is noteworthy is the fact that, compared to Parsley and Wei, the effect of the exchange rate variability on price differences turns out far greater in East Asia.

As in the previous case, the effect of tariff rate seemed minimal although it turned out a little more significant. Suppose that intra-regional tariff rates are reduced to zero possibly due to regional trade arrangement in East Asia. Then, the standard deviation of price difference will be reduced by 0.009 ($=0.045 \times 0.217$). Given that the average standard deviation of log price difference for East Asia is 0.46, the effect of tariff removal seems very tiny. Also, the factors of ASEAN and NEA have significant effect in reducing price differences and leading to price convergence. But the influence of distance becomes somewhat weaker than the case in Table 5A.

Consider now the impact of exchange rate volatility and income gap. If the exchange rate volatility is reduced to zero, say, due to a currency union, the standard deviation of log price difference will decrease by

Table 5A. Estimation Results ($E[Q]$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Distance	0.020 (1.41)	0.014 (1.03)	0.004 (0.36)	0.000 (0.48)	0.042 (3.72)	0.042 (4.01)	0.039 (3.41)	0.030 (2.86)
Tariff	-0.069 (-1.41)	0.093 (1.72)	—	—	—	—	-0.107 (-2.76)	0.030 (0.73)
Exvol	—	—	1.774 (7.06)	2.401 (7.45)	—	—	1.250 (6.00)	1.646 (6.36)
Income	—	—	—	—	0.091 (18.92)	0.091 (20.45)	0.090 (18.57)	0.088 (19.32)
ASEAN	-0.128 (-6.13)	-0.140 (-6.98)	-0.147 (-7.46)	-0.152 (-8.01)	-0.035 (-4.94)	-0.082 (-5.27)	-0.081 (-4.85)	-0.096 (-6.08)
NEA	-0.139 (-6.91)	-0.136 (-7.10)	-0.129 (-6.82)	-0.130 (-7.17)	-0.095 (-5.96)	-0.095 (-6.38)	-0.100 (-6.32)	-0.099 (-6.68)
Time	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.15	0.26	0.20	0.26	0.44	0.52	0.49	0.56
No of Observations	657	657	657	657	657	657	657	657

Note: Figures in parenthesis are t-values.

Table 5B. Estimation Results ($V[Q]$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Distance	-0.001 (-0.16)	-0.002 (-0.38)	-0.005 (-0.66)	-0.008 (-1.11)	0.016 (2.87)	0.016 (2.95)	0.011 (2.01)	0.008 (1.50)
Tariff	0.041 (1.51)	0.086 (2.78)	—	—	—	—	0.012 (0.62)	0.045 (2.02)
Exvol	—	—	0.844 (5.92)	1.334 (7.16)	—	—	0.583 (5.39)	0.871 (6.29)
Income	—	—	—	—	0.058 (23.51)	0.058 (24.18)	0.056 (22.23)	0.055 (22.68)
ASEAN	-0.049 (-4.27)	-0.052 (-4.62)	-0.052 (-4.70)	-0.056 (-5.13)	-0.013 (-1.54)	-0.013 (-1.59)	-0.018 (-2.14)	-0.023 (-2.83)
NEA	-0.090 (-8.09)	-0.089 (8.17)	-0.084 (-7.81)	-0.084 (-8.07)	-0.062 (-7.61)	-0.062 (-7.84)	-0.066 (-79.9)	-0.065 (-8.30)
Time	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.13	0.17	0.15	0.21	0.51	0.55	0.53	0.58
No of Observations	657	657	657	657	657	657	657	657

Note: Figures in parenthesis are t-values

0.017($=0.746 \times 0.023$), whereas, if the exchange rate volatility increases to the maximum value of 0.177 from 0.023 in Table 4, then the standard deviation of log price difference increases by 0.114 ($=0.746 \times (0.177-0.023)$). Similarly, if the income gap is lowered to 0.004 from its average value of 1.783, then the standard deviation of log price difference will decline by 0.098($=0.055 \times (1.783-0.004)$), while if it increases to 4.558 from 1.783, the standard deviation of log price difference will rise by 0.152($=0.055 \times (4.558-1.783)$).

Thus, the standard deviation of log price difference will move within the boundary between 0.040 and 0.571, with exchange rate fluctuating from its minimum to its maximum. On the other hand, it will move between 0.359 and 0.609, with the income gap moving from the minimum to the maximum value. The price difference becomes much larger due to exchange rate volatility than due to income gap. This suggests that exchange rate volatility was a key variable preventing price convergence in East Asia.

4.3. Extensions and Robustness of the Model

We consider a host of extensions. First, we consider two sub-periods, periods before 1997 (until the end of 1996) and after 1997 (from the beginning of 1997). Since the Asian crisis, East Asian countries have taken much effort to cooperate with each other, and their interactions have deepened a lot. This might be expected to have an important impact on price convergence.

Table 6 presents the estimation results for the pre and post crisis periods. One thing to note is that the influence of distance, tariff, and exchange rate volatility is reduced while the other three factors become more influential. Distance has an expected sign but becomes insignificant, and tariff even has a wrong sign in the case of using $V[Q]$. Compared to the pre-crisis period, the effect of exchange rate volatility turned out smaller in the post-crisis period. The decrease of the coefficient seems mainly due to the increase of exchange rate volatility after the crisis when many East Asian countries adopted floating exchange rates. But its

Table 6. Estimation Results Before and After the Crisis

	$E[Q]$				$V[Q]$			
	Before the crisis		After the crisis		Before the crisis		After the crisis	
Distance	0.027 (2.59)	0.024 (2.37)	0.026 (1.64)	0.017 (1.10)	0.002 (0.26)	0.002 (0.34)	0.013 (1.71)	0.009 (1.16)
Tariff	0.045 (4.59)	0.137 (4.37)	-0.072 (-0.73)	0.018 (0.18)	0.131 (5.64)	0.114 (4.79)	-0.107 (-2.22)	-0.059 (-1.23)
Exvol	7.064 (13.46)	8.034 (14.63)	0.274 (1.125)	0.934 (3.12)	2.574 (6.71)	2.670 (6.41)	0.343 (2.86)	0.671 (4.57)
Income	0.068 (14.61)	0.066 (14.88)	0.099 (14.79)	0.097 (14.81)	0.040 (11.95)	0.041 (12.08)	0.064 (19.53)	0.063 (19.71)
ASEAN	-0.040 (-2.61)	-0.041 (-2.80)	-0.141 (-5.99)	-0.155 (-6.67)	-0.012 (-1.11)	-0.011 (-0.97)	-0.031 (-2.76)	-0.038 (-3.42)
NEA	-0.028 (-1.92)	-0.035 (-2.43)	-0.181 (-8.18)	-0.179 (-8.30)	-0.039 (-3.54)	-0.039 (-3.63)	-0.096 (-8.86)	-0.095 (-8.99)
Time	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.67	0.72	0.54	0.57	0.52	0.54	0.63	0.65
No of Observations	297	297	360	360	297	297	360	360

effect is still much larger than that of income gap which grew more significant after the crisis period.

It is very interesting that the price convergence effect of sub-regional factors such as ASEAN and NEA is much larger in the post-crisis period than in the pre-crisis period. This may suggest that price differences within a subgroup of relatively similar countries decrease due to regional cooperation efforts after the crisis but still there are gaps among subgroups in East Asia.

We also consider possible non-linear effects of distance, exchange rate volatility and income gap. To this end, we include the squares of

Table 7. Non-linear Estimation Result

	Distance2		Exvol2		Income2	
	$E[Q]$	$V[Q]$	$E[Q]$	$V[Q]$	$E[Q]$	$V[Q]$
Distance	-0.154 (-1.07)	0.067 (0.86)	0.025 (2.41)	0.007 (1.26)	0.019 (1.75)	-0.001 (-0.17)
Distance2	0.012 (1.28)	-0.003 (-0.75)	— —	— —	— —	— —
Tariff	0.039 (0.92)	0.042 (1.88)	0.049 (1.17)	0.050 (2.23)	0.062 (1.48)	0.070 (3.24)
Exvol	1.616 (6.22)	0.880 (6.34)	3.686 (6.27)	1.421 (4.48)	1.519 (5.93)	0.767 (5.73)
Exvol2	— —	— —	-14.539 (-3.85)	-3.920 (-1.92)	— —	— —
Income	0.088 (19.33)	0.055 (22.67)	0.087 (19.26)	0.055 (22.56)	0.007 (0.40)	-0.010 (-1.15)
Income2	— —	— —	— —	— —	0.020 (4.63)	0.017 (7.25)
ASEAN	-0.093 (-5.86)	-0.024 (-2.90)	-0.101 (-6.45)	-0.025 (-2.99)	-0.104 (-6.69)	-0.031 (-3.79)
NEA	-0.092 (-5.88)	-0.068 (-8.08)	-0.102 (-6.96)	-0.066 (-8.42)	-0.118 (-7.79)	-0.081 (-10.29)
Time	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.56	0.58	0.57	0.58	0.57	0.61
No of Observations	657	657	657	657	657	657

Note: Figures in parenthesis are t-values.

these variables as additional regressors. When two or all three square variables are included together, only one variable of them turned out important. Also, when square variables are included, either an original variable or its square variable tends to become insignificant. Thus it is more appropriate to include only one square variable each time. Table 7 presents the estimation results. The evidence suggests that the addition of these variables does not improve the fitness of the model substantially. The square of distance is not significant at all. That of income gap is significant but the significance of original income gap variable disappears. This result for non-linearity is somewhat different from Parsley and Wei (2001), where especially non-linear effects of distance as well as exchange rate volatility turned out very significant. When 83 cities all over the world are included as in Parsley and Wei, distances are so variant and such an additional effect as non-linearity can be found. However, we only consider East Asian countries and it may not be needed to pay additional special attention to such a non-linear effect other than its original effect.

Only the square of the exchange rate volatility is meaningful. Its negative sign can be interpreted this way. The effect of exchange rate volatility on price difference is positively concave, suggesting that higher exchange rate volatility is associated with a greater price difference but the incremental effect gets smaller as volatility increases (Parsley and Wei 2001).

5. Conclusion and Implications

This paper measured the price differences among East Asian countries and examined whether prices have converged in East Asia since 1990. It also tried to identify the factors of those price differences in the region using a gravity model.

The results of this paper show that compared with the EU, there does not arise any noticeable trend of price-convergence among East Asian countries. There are rather increasing price differences and price difference volatilities; after the crisis, prices seem to diverge further in East Asia. But within subgroups, in particular within NEA, there is some noticeable price convergence.

From the regression analysis, this paper found that such price convergence failure can be explained largely by the large exchange rate

fluctuations among East Asian currencies and the wide income disparities among East Asian countries. Distance and tariff, which are considered important in a gravity model, are found not to be very important. In contrast, sub-regional dummies of ASEAN and NEA appeared very significant in reducing price differences. The influence of these dummies was further increased after the Asian crisis in 1997.

The results of this study suggest that exchange rate variability and income gap between East Asian countries are the two major hurdles preventing market integration and price convergence in East Asia. Therefore, to move regional cooperation effort forward and to further deepen regional integration, East Asian countries need an effort to make intra-regional exchange rates stable as European countries did in the EMS. Also they may need to establish a development institution similar to the European Investment Bank to fill the development gap between countries. It would take a long time, however, to reduce income gaps among East Asian countries. This may suggest that focusing on stabilizing exchange rates will be the first and most imperative agenda for monetary cooperation in East Asia.

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(Appendix) Prices Included

White bread, 1 kg (supermarket)	Cigarettes, Marlboro (pack of 20) (supermarket)
Butter, 500 g (supermarket)	Cigarettes, local brand (pack of 20) (supermarket)
Sugar, white (1 kg) (supermarket)	Business suit, two piece, medium weight (chain store)
Cornflakes (375 g) (supermarket)	Business shirt, white (chain store)
Olive oil (1 l) (supermarket)	Socks, wool mixture (chain store)
Peanut or corn oil (1 l) (supermarket)	Dress, ready to wear, daytime (chain store)
Potatoes (2 kg) (supermarket)	Kodak colour film (36 exposures) (average)
Onions (1 kg) (supermarket)	International foreign daily newspaper (average)
Tomatoes (1 kg) (supermarket)	Daily local newspaper (average)
Carrots (1 kg) (supermarket)	International weekly news magazine (Time) (average)
Lettuce (one) (supermarket)	Paperback novel (at bookstore) (average)
Eggs (12) (supermarket)	Compact car (1300-1799 cc) (low)
Pork: chops (1 kg) (supermarket)	Family car (1800-2499 cc) (low)
Bacon (1 kg) (supermarket)	Regular unleaded petrol (1 l) (average)
Instant coffee (125g) (supermarket)	Laundry (one shirt) (standard high-street outlet)
Ground coffee (500g) (supermarket)	Dry cleaning, man's suit (standard high-street outlet)
Tea bags (25 bags) (supermarket)	Dry cleaning, woman's dress (standard high-street outlet)
Coca-Cola (1 l) (supermarket)	Dry cleaning, trousers (standard high-street outlet)
Tonic water (200 ml) (supermarket)	Man's haircut (tips included) (average)
Beer, local brand (1 l) (supermarket)	Woman's cut & blow dry (tips included) (average)
Beer, top quality (330 ml) (supermarket)	Electricity, monthly bill (average)
Cognac, French VSOP (700 ml) (supermarket)	Babysitter's rate per hour (average)
Soap (100 g) (supermarket)	Three-course dinner for four people (average)
Laundry detergent (3 l) (supermarket)	Yearly road tax or registration fee (low)
Toilet tissue (two rolls) (supermarket)	Annual premium for car insurance (low)
Dishwashing liquid (750 ml) (supermarket)	Taxi: airport to city centre (average)
Light bulbs (two, 60watts) (supermarket)	Hilton-type hotel, single room, one night including breakfast (average)
Batteries (two, size D/LR20) (supermarket)	Moderate hotel, single room, one night including breakfast (average)
Frying pan (Teflon or good equivalent) (supermarket)	One drink at bar of first class hotel (average)
Toothpaste with fluoride (120g) (supermarket)	Two-course meal for two people (average)
Facial tissues (box of 100) (supermarket)	Simple meal for one person (average)
Lipstick (deluxe type) (supermarket)	

Chapter 4

Regional Cooperation in Asia

Selected Issues on Asian Monetary Cooperation

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1. Introduction

Since the Asian currency and financial crises of 1997 there has been substantial increase of interest in the possibilities of greater Asian monetary and financial cooperation and several important initial steps such as the Chiang Mai Initiative (CMI) have already been undertaken. In this paper we hope to contribute to the ongoing discussion of these issues by offering perspective on both sets of literature that are highly relevant to these issues. One is the literature on optimum currency area analysis and its applications to Asia (Section 2). The second is on the lessons for Asia from the European experience (Section 3). Sections 4 and 5 focus on two particular aspects of the lessons. The first concerns the role of dynamic spillovers in contributions to increases in regional cooperation over time. The second concerns composite currency units and the model of the European exchange rate mechanism. We conclude in section 6 by raising a number of issues for possible discussion by our panel.

2. The OCA approach

The literature on the theory of optimum currency areas (OCA) provides the proper economic framework for analyzing the costs and benefits of joining a currency union. Less broadly recognized is that it also provides the proper framework for analyzing issues of monetary

and macroeconomic policy coordination. This is because we can interpret this literature more generally in terms of how much weight should be given to external considerations in setting national monetary policies with fixed and freely floating rates representing the two corners of one hundred percent and zero weights respectively. (See Willett 2003) This formulation does not address the issue of unsterilized interventions in the foreign exchange markets, but this can be explicitly added drawing on the optimal policy literature which analyzes optimal policy responses in the face of different types of disturbances and is thus appropriate for analyzing when discretionary interventions in the foreign exchange market are appropriate—say in the case of currency substitution or destabilizing speculation and whether the monetary effects of such interventions should be sterilized or not (no in the first case and yes in the second). These optimum currency area (OCA) and optimal policy approaches can also be quite valuable for analyzing open economy aspects of flexible inflation targeting. (See Willett 2003)

After a period of neglect, OCA analysis is currently quite in vogue but it is unfortunately often misapplied. One of the most common misapplications is in technical papers that focus on a small number of OCA criteria and then draw strong conclusions about the economic suitability of countries to adopt a common currency.

As the recent Argentina crisis reminds us, just meeting well one or two OCA criteria is not enough. A list of these criteria is given in Table 1.

Table 1. OCA criteria

Traditional Ones Summarized by Tavlas

1. Factor mobility
2. Wage and price flexibility
3. Size and openness
4. Goods market integration
5. Commodity diversification
6. Fiscal integration
7. Similar inflation trends
8. Real exchange rate variability
(Generalized PPP)
9. Political factors

Additional Traditional Ones

10. Financial integration
(it is ambiguous)
11. Patterns of shocks
 - a. Optimal stabilization
 - b. Asymmetric shocks

New Criteria Added More Recently

12. Optimal public finance
13. Currency substitution
14. New classical policy ineffectiveness
15. Informativeness of price and quantity signals
16. Time inconsistency and credibility
17. Discipline
18. Controllability of money supply
19. Liability dollarization
20. Endogenous OCA
21. Financial instability

While Argentina met the substantial currency substitution criteria with its high level of dollarization, its economy was rather closed with respect to trade and lacked a high degree of domestic economic flexibility. Coupled with the failure of its currency board to promote strong fiscal as well as monetary discipline, the results were tragic.

As a consequence of this tendency to focus on only a small number of factors, the recent literature applying OCA analysis to Asia can easily give the impression that Asia meets OCA criteria much better than is in fact the case. In part because of the easy availability of relevant data and of applicable statistical techniques it has become popular to emphasize patterns of shocks and the degree of synchronization of business cycles as the primary criteria. In contrast there is very little evidence on the degree of labor mobility and the authors of recent papers have offered quite different judgments. For example while Eichengreen and Bayoumi (1999) draw on the 1994 study by Goto and Hamada to suggest that "Labor mobility is relatively high in Asia", Rhee (2004) and Ruffini (2006) both suggest that labor mobility is low. Zhang and Yin (2005)

conclude that "although the level of labor mobility is rather low in East Asia ... it has been rapidly increasing since 1990" (p.9) while Salvatore (2007) suggests that labor mobility is relatively high in Malaysia, Singapore, and Thailand but low in Japan and Korea. Results also differ on the speeds of adjustment in output markets. For example, while Bayoumi and Eichengreen (2000) find them generally to be high in East Asia, Baek and Song (2002) find estimates that are much lower.

While few of the studies on growth correlations and patterns of shocks conclude that all of East Asia currently meets the OCA criteria, many of these studies suggest that sub groupings do. For example, the recent survey by economists at the Bank of Japan concludes, "subsets of Asian currencies meet the optimal currency area criteria to the same degree as European countries did in their pre-euro phase." (Watanabe and Ogura 2006, p. 11)

There is considerable variability across studies, however, in the composition of the subgroups. This is perhaps not surprising, given the range of methodologies applied across studies, but we would argue that it also reflects the fact that such correlations are frequently not stable over time. They reflect not just the degree of economic and financial interdependence among countries but also the particular shocks that occur and there is no reason to believe that these will be stable over time.¹⁾ Nothing the difference between the groupings found in his study and those found by Bayoumi, Eichengreen, and Masahiro Kawai argue in a similar vein that "this difference reveals the limited reliance that one can put on historical shocks as a guide to the choice of an exchange rate regime."

A number of studies have emphasized the increase in correlations among Asian economies over the past decade. Correlations, however, can be influenced by the pattern of shocks as well as the degree of interdependence. Much of the increase in correlations over the 1990s was due to the effects of the Asian crisis in 1997-1998. This is illustrated in Table 2.

1) We can of course make some generalizations from structural characteristics such as that a country heavily concentrated in exporting raw materials is likely to face considerably greater export stability than a country with a well diversified export base.

Table 2. Unweighted average correlations of real output growth rates for Korea with other Asian countries over different time horizons and different periods

correlation coefficients of real output growth rates	within south east countries*	within east Asian countries**	all countries	avg corr. of Korea and other countries
between 1965 - 2005				
annual growth	0.4718	0.0112	0.2153	0.2689
2-year growth	0.4759	0.1963	0.2228	0.2874
3-year growth	0.5073	0.0645	0.2098	0.3045
between 1968 - 1991				
annual growth	0.4360	0.1259	0.1658	0.0416
2-year growth	0.4202	0.1338	0.1389	-0.0432
3-year growth	0.4722	0.0816	0.0411	0.0046
between 1992 - 2005 (<i>excl. 97 & 98</i>)				
annual growth	0.5560	0.1694	0.3646	0.3163
2-year growth	0.6409	0.2819	0.4726	0.3459
3-year growth	0.4760	0.0853	0.3049	0.2992
between 1992 - 2005 (<i>incl. 97 & 98</i>)				
annual growth	0.7407	0.4621	0.5621	0.6071
2-year growth	0.6944	0.4020	0.5715	0.6089
3-year growth	0.5925	0.4583	0.5596	0.6153

* south east = Indonesia, Malaysia, Philippines, Singapore, Thailand, excl. Cambodia, Laos, Vietnam

** east = Japan, China and Hong Kong, excl. Korea

The average annual correlation of growth rates between Korea and

its East Asian neighbors, China, Hong Kong, and Japan rose from 0.126 from 1968 to 1991 to 0.462 from 1992 to 2005. However, if we exclude the crisis years of 1997-1998 from the post 1992 sample, the correlation drops back down to 0.169. Similarly, Korea's average correlation with a group of countries from Southeast Asia also rises dramatically from 0.436 pre 1992 to 0.741 in the second period, but the increase is much more modest to 0.556 if the crisis years are excluded.

Another point which has received insufficient attention is the time periods over which the degree of business cycle synchronization is measured. The primary argument for treating high correlations as favorable for common currencies is that they imply smaller differences in optimal national monetary policies and hence a lower cost of abandoning national monetary policies for a common one. It is most common to measure such correlations over one year periods, but it isn't clear that this is an appropriate time period for this criteria. It implies a very high degree of technical ability to use monetary policy to fine tune the economy. Lags in recognition of shocks and in the effects of monetary policy once implemented suggest that looking at correlations over longer time periods would be more appropriate when evaluating the constraints imposed by a common currency on discretionary monetary policy. Indeed an argument can be made that one year correlations are more relevant for automatic stabilization criteria and from this perspective low short run correlations are more desirable. While Table 2 reveals substantial differences in Korea's average correlation within Northern versus Southern neighbors, there are generally not huge differences across the correlations for one, two, and three year periods. The largest difference is the drop in the two to three year correlations with East Asia is for the post 1992 period when the crisis years are excluded. This fall is from 0.282 to 0.085. It does not appear when the crisis years are included.

The substantial differences that are made by including or excluding the crisis years are further illustrated on a country by country basis for one and two year correlations in charts 1 and 2. The differences are especially strong for the two year correlations.

Figure 1. Comparison of annual correlations of real output growth of Korea with other Asian countries when crisis period (1997-98) is included and excluded

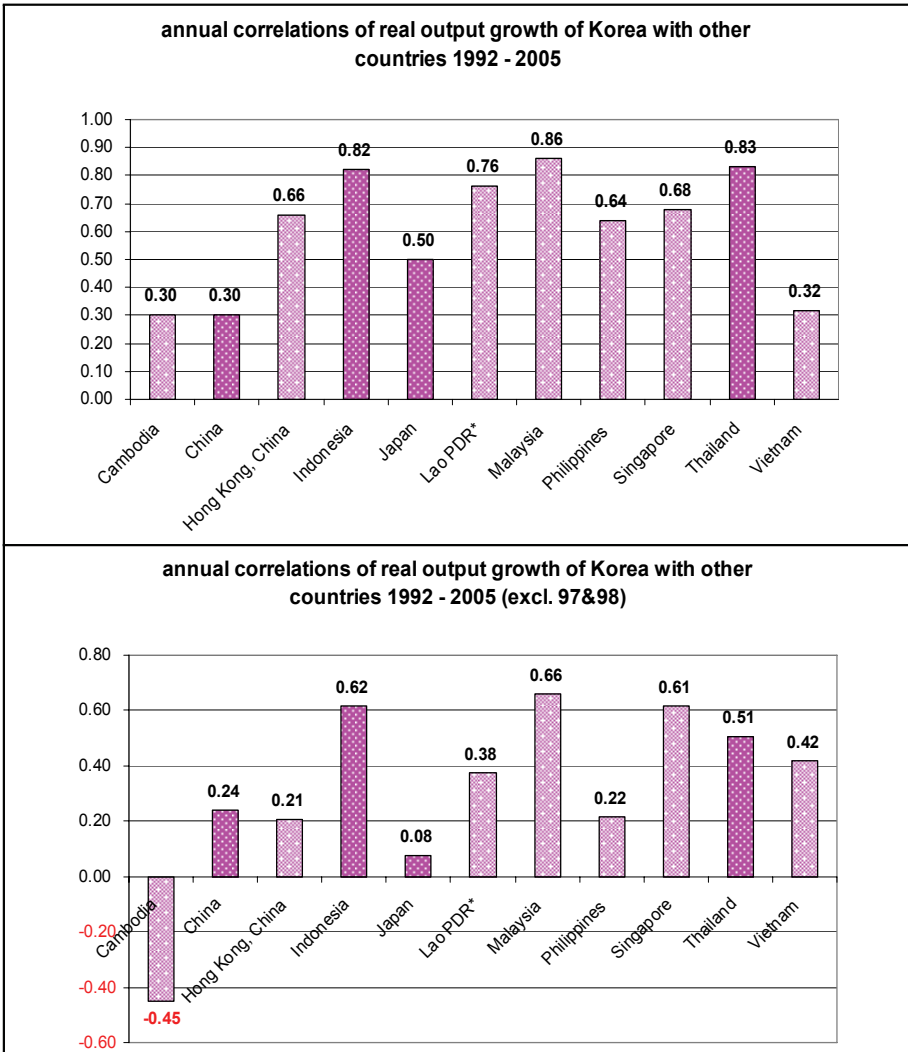
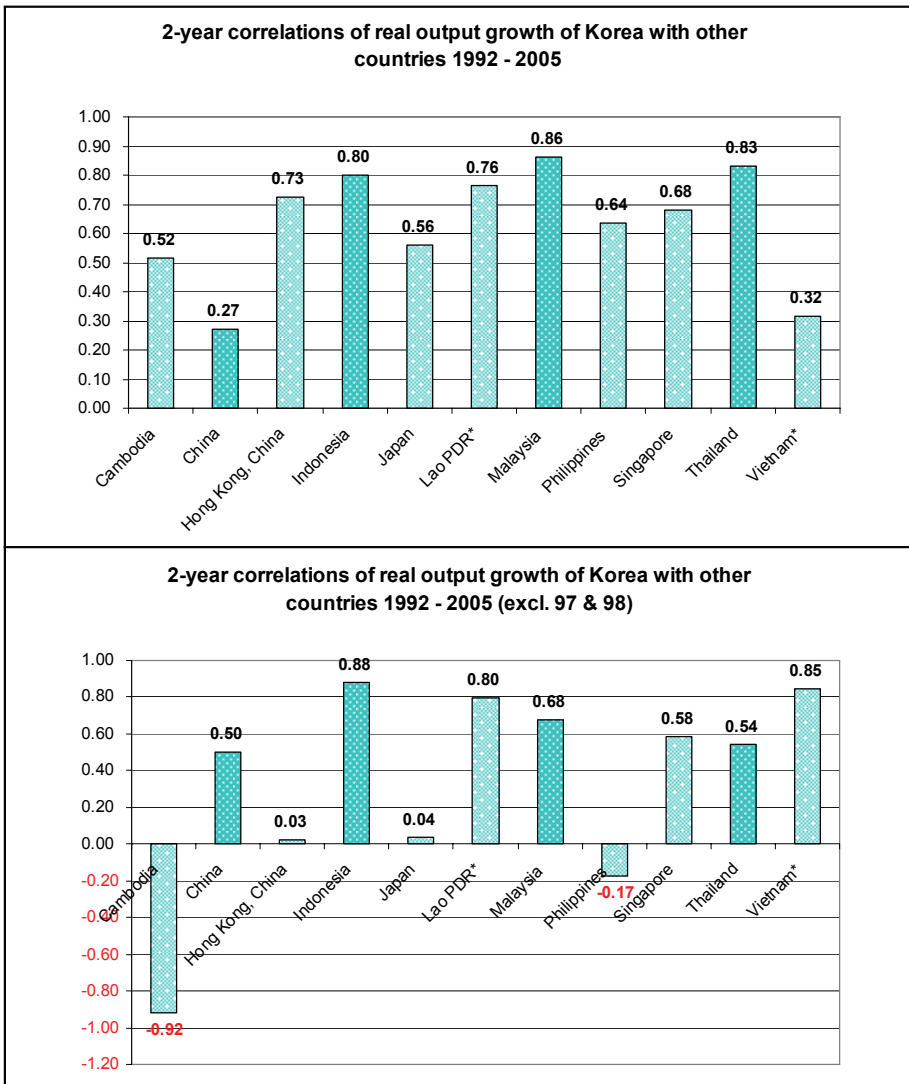


Figure 2. Comparison of annual correlations of real output growth of Korea with other Asian countries when crisis period (1997-98) is included and excluded



Another important problem is that there has been relatively little careful analysis of what represents high or low correlations. The most common tendency has been to compare Asian correlations with those in Europe before the euro was launched.²⁾ While quite understandable, it is not clear how relevant such comparisons are for policy analysis.

There is rather widespread agreement that the launching of the euro was primarily the result of political rather than economic considerations, and that while particular sub groupings of the euro countries may have met OCA criteria this was not true for the whole group.³⁾ While the OCA criteria had relatively little relevance to the political economy of the creation of the euro, they may still have a substantial influence on how well it works. To date, the euro hasn't led to disasters such as the Argentine crisis, but neither has it operated as well as many of its supporters hoped. The growing real appreciations of countries such as Italy are a major source of concern to some economists.

In recent years a major challenge to the relevance of OCA criteria has been launched. Some have argued that the traditional sequencing of regional economic integration as followed by Europe should be reversed and that monetary integration should lead rather than follow trade integration.⁴⁾ There is a substantial history to this sequencing debate. In the early days of European integration this was labeled the monetarists versus economists debate. Recently, however, it has enjoyed a major revival due to the development of endogenous OCA analysis. As originally presented by Frankel and Rose (1998), endogenous OCA analysis quite correctly argues that what is relevant for how well a currency area will work is the degree to which the OCA criteria are met *ex post* not *ex ante*. Furthermore, we have strong reasons to believe that forming a currency area could have substantial effects on how well these criteria are met. For example, trade within the area would increase and this would increase the area's OCA score both directly and quite likely also indirectly through increasing the degree of business cycle synchronization.⁵⁾

More generally we would expect most OCA criteria to be met better *ex post* than *ex ante*. It is much too strong, however, to argue, as some

2) See, for example, Bayoumi and Eichengreen (1994).

3) See, for example, De Grauwe (2004).

4) See, for example, Boyer (2005).

5) On the later issue, see the analysis and references in Shin and Wang (2003).

leading scholars have, that *ex ante* conditions are therefore largely irrelevant. For example, Masahiro Kawai (2007) goes too far when he argues, "once a group of countries permanently fixes its exchange rate, the degree of intra-area economic integration will rise and shocks will become more symmetric. One need not worry too much, then about the OCA criteria since these will obtain endogenously... Only political commitment is required." (p. 111) What is important is not just direction of change, but also the magnitude. Again Argentina provides a valuable example. Although theoretical models show that the effects could go either way, it is most common to argue that fixing the exchange rate should induce an increase in labor market flexibility since the cost of rigidities would rise. It appears that this was generally true in Argentina. The amounts of increased flexibility were fairly small, however, and weren't nearly enough to avoid high unemployment.

In general political economy analysis suggests greater skepticism about the amounts of increased flexibility and policy coordination that will be endured by fixing exchange rates than does in economic efficiency analysis. (See Willett, Permpoon, and Wihlborg 2007) In any event, we have underway a major experiment in Europe of the power of endogenous responses. It is too soon to draw definitive conclusions, but a preliminary analysis is possible. The creation of the euro has been associated with substantial increases in trade and business cycle correlations for the euro members. Trade and growth correlations have also increased substantially between the euro countries and their Western European neighbors, however. Thus we do not have a clear before and after experiment. Other factors have not been held constant.

With respect to increased economic flexibility, the results are mixed while the failure of the fiscal agreements suggests limits to the increase in the spirit of policy cooperation that has been generated. One has the impression that the most effective influence in policy reforms was in the run up to entry and that once entry was achieved reform fatigue has dominated further endogenous responses. In our judgment, it would be wise to await further evidence before giving substantial weight to hopes that joining a currency area would induce a process of strong endogenous policy reforms and increased flexibility in domestic economies.

3. Lessons from Europe

There has been considerable interest in the lessons that can be drawn for Asia from the experience of integration in Europe. There is a tendency for those who have not studied the European experience in depth to assume that once the process was started, monetary union was the inevitable result. This was far from the case, however. While the outcome is consistent with this neo functionalist interpretation, this result was far from certain.

Progress was made in fits and starts and at times the process stagnated to the point that functionalism fell largely out of fashion among international relations scholars only to be rejuvenated again under the label of neo functionalism as a result of the Single Market Act. This neo functionalist approach makes the important point that cooperation can stimulate important dynamics and that agreements in one area can have spillover effects in others—both from increased challenges that are posed by (often unanticipated) consequences and through the build up of trust. These are possibilities, however, not certainties, and the functionalist approach has in general suffered from both weak micro analytic foundations and a lack of careful objective testing. Progress is now starting to be made by a new generation of political scientists working this area.⁶⁾

One conclusion from this new literature is the importance of institutionalization of the integration process in increasing the likelihood that spillovers would lead to further policy responses.⁷⁾ This suggests that we should not expect the largely market led process of regional integration in Asia to duplicate the responses to spillovers that occurred in Europe unless much greater emphasis is put on institutionalizing cooperation as Asian integration goes forward.

A second major difference between the European and Asian integration processes so far is the huge role that geopolitical objectives has played in the European process. The key driver of European integration was widespread acceptance of the idea that entangling Germany in a web of economic interdependence and institutions was

6) See, for example, Sandholtz and Sweet (1998) and Stone and Sweet (2001).

7) As Wyplosz has argued, “pragmatism is the first ingredient of Europe’s successful integration process ••• The second ingredient is institution building.” (p. 10)

essential for the future peace of Europe. Those who are not European specialists often fail to recognize how important the acceptance of this view has been and how easily it might not have come to dominate. After all this view of the potential geopolitical importance of regional economic integration had little effect on Europe after World War I or in Asia with respect to Japan after World War II.⁸⁾ In part because it has been a constant backdrop in the post World War II period, it also has failed to be sufficiently appreciated in some of the recent political science literature on European integration that has gotten caught in disputes about the relevance of a number of theoretical innovations.

But few scholars of European history would dispute that without the prevalence of this shared mental model of economic and geopolitical relationships, the euro area would never have been created. Of course other factors such as changing perceptions of inflation - unemployment relationships were also important,⁹⁾ but they were secondary. Indeed because of the new generation of leadership in Germany that now takes place in Western Europe for granted, it is highly unlikely that today Germany would be willing to enter into an agreement to give up its monetary autonomy. Thus, rather than having been inevitable, we view Europe's march to the euro as having been a highly contingent process that illustrates more the difficulties than the ease of getting a substantial group of countries to give up their monetary sovereignty.

In Asia not only is there no common geopolitical paradigm such as united European leaders, the legacy of distrust from WWII and before lingers much more strongly in a number of countries. This makes economic cooperation more difficult, but also potentially more important. For example, while the increasing integration of China into the world economy is certainly no guarantee against serious geopolitical conflict, the odds of such conflict are likely to be substantially lowered. It may not be too late for Asia to adopt its own modified version of Europe's economic integration makes for more peaceful relations paradigm.

Our view that European Monetary Union was far from inevitable does not imply that there is nothing for other regions to learn from the European experience, but it does suggest that these lessons will have

8) On the role of mental models more generally see the analyses and references in Roy, Denzau, and Willett (2007).

9) See Andrews and Willett (1997) and Kathleen McNamara (1998).

more to do with the pragmatic seizing of opportunities than with devising grand schemes. As Wyplosz (2002) has argued, "in the end, Europe's integration has always been characterized by a process of muddling through... Integration can be seen as a dynamic process, but one that is not predetermined. Time is not of the essence, opportunities are."

This suggests that more than in Europe, primacy in Asia should be put on cooperative actions that are expected to bring benefits in their own right as opposed to costly actions that it is hoped will bring future spillover benefits. Here Europe's Common Agricultural Policy comes to mind. Its economic costs have been tremendous, but many students of European integration argue that it was an essential compensation mechanism without which further progress on economic integration would not have been feasible politically. If true, these high costs were worth the even higher benefits. However, given the quite different set of political relationships within Asia, we recommend avoidance of such high cost strategies.

4. NeoFunctionalism and Spillover Effects

In considering strategies based on expectations of future spillover effects it is important to differentiate clearly between different types of spillover processes and to recognize that there is considerable uncertainty about how strong these effects will be. As Eichengreen (2007a) has recently noted, "the five phases in the European project ... overlapped and a number of them proceeded in fits and starts. Thus the nature, extent, and even existence of spillovers can be reasonably questioned" (p. 5) We have little doubt that there have been important spillovers in the process of European integration, but these and the channels through which they operated have not been generally documented with the level of rigor we would like to see. Such uncertainty need not be a serious obstacle to all planning strategies, however. For example, for the spillover mechanism based on the assumption that increasing interactions will build up trust and a spirit of co operation over time one can start the process and see how it develops, adding more items to the integration agenda as trust and willingness to co-operate are increased. There will still be uncertainty about the pace and amount of increased co operation, but the danger of serious welfare losses should be minimal.

A good example is the Economic Review and Policy Dialogue of the ASEAN + 3 finance minister's group. This group has already begun to move beyond pure information exchange. How far and how fast this process will evolve toward genuine policy coordination is uncertain, but it is hard to conceive of this process not being beneficial and indeed well worth the modest costs of funding the development of a high quality secretariat for it. (See Kawai and Houser 2007).

Two other types of spillover strategies are high risk, however. One type is where costly policies are adopted in hopes that these will build support for integration that may pay substantial dividends in the future. As noted, the creation of the Common Agricultural Policy is an example. In Europe, this worked, but in a region with weaker interest in political integration, it would have much lower odds of success. This is not to argue that it never makes sense to include policies that are bad on economic grounds in a package of mostly good policies in order to secure necessary political support. Rather the point is that in playing such games of distributional politics one should make sure that the beneficial policies are part of the agreed package, not just something that may become more likely as a result.

A second type of high risk linkage or spillover strategy is where the adoption of policy A will increase the costs of policy B in hopes that this will force changes in B. A classic example is the adoption of pegged exchange rates in the hope that this will promote greater discipline over national macroeconomic policies and/or a greater willingness to coordinate these policies within a regional grouping. Such strategies do sometimes, but they also frequently fail and often in quite costly manner. France's commitment to a hard franc policy under the Mitterand government did have considerable success in taming French inflation, but the European exchange rate mechanism had much less success in promoting broader monetary and fiscal policy co-ordination among member countries. This resulted in the major currency crises of 1992 and 1993. Where just a little nudge is needed to promote substantial policy changes than such spillover strategies can be quite effective, but where the political obstacles to policy changes are strong, this will be a high risk approach.

In our judgment the European experience suggests the view that those who are interested in strengthening monetary cooperation in Asia should de-emphasize talk about common currencies and focus more on the less dramatic but likely more productive steps such as developing a

regional institution with a highly capable staff to help enhance regional policy dialogues. We believe that this is crucial for the initiatives begun at Chiang Mai to reach their full potential. Given the past history of the proposal for an Asian Monetary Fund, we suggest that a name such as Asian Monetary Institute would be more appropriate.

Another important issue to keep in mind is the limits to social planning. It is certainly important for us to evaluate alternative types of strategies but as Wyplosz (2006) has indicated, we cannot expect adherence to a full scale blue print for developments over a long time period. The potential dynamics are much too complex. But since windows of political opportunity come and go, to fully capture the potential benefits of these windows it is essential to have done a good deal of previous analysis. Thus we should certainly not limit our attention to only those actions that appear to have a reasonable possibility of being politically feasible in the short term.

5. ACUs and Exchange Rate Mechanisms

The desirability of creating an Asian Currency Unit (ACU) in the near future is less clear. There is no question that calculations of such indices are valuable and that governments and central banks need to give more attention to their effective exchange rates relative to their dollar exchange rates than was typical before the Asian crisis. Unless it is to be used as part of a mechanism to limit exchange rate fluctuations, however, there are advantages to letting each country make the calculations it prefers, thus avoiding the need to secure common agreement on membership and weights. Of course an agreed unit might help standardization in the private markets although the role played by the ECU on this score appears to have been rather limited. An agreed ACU would also be desirable if one wished to pursue the parallel currency approach to monetary integration suggested by Eichengreen.

The most controversial aspect of ACU proposals (of both the internal and external varieties) is that they be used as a basis for limiting exchange rate fluctuations. Few like exchange rate fluctuations so the interest in limiting them is natural, especially in a region with a strong tradition of export led growth. But it is highly dangerous to think that agreeing on a scheme for exchange rate pegging will provide greater

stability over the longer run. To those who see the European experience as a model for Asia to emulate, the creation of an Asian exchange rate mechanism to mirror Europe's Exchange Rate Mechanism is seen as a natural transition step toward monetary union.

Such an approach runs right into the problem of the unstable middle, however. As has been frequently noted, one important difference between Asia today and Europe at the beginning of its monetary integration process is the degree of capital mobility. When Europe started they still had substantial control on capital flows. While there is considerable debate within Asia today about measures to limit the volatility of capital flows, this is within the context of substantial financial liberalization.

It is important to remember that as capital flows were liberalized within Europe parity changes within the ERM becomes less frequent until major currency crises were provoked in 1992 and 1993. This is exactly what is first predicted by the unstable middle hypothesis. A strong case can be made that flexible rates with increasing monetary policy coordination provides a safer transition path to monetary union than the ERM approach. (See Wihlborg and Willett 1991) Of course if the ERM is given sufficiently wide bands such as the +/- 15 percent adopted during the 1993 crisis then the differences become muted. Recent empirical research suggests that while the narrow band adjustably pegged center of the spectrum of exchange rate regimes is indeed the most crisis prone, one does not have to go all the way to the free floating end of the spectrum to substantially reduce crisis probabilities as implied by the two corners hypothesis.¹⁰ Thus, if implemented with sufficient flexibility, Williamson's (2001) BBC proposal can be a viable strategy for monetary cooperation even in a world of substantial capital mobility. Its superiority to Goldstein's managed floating plus inflation targeting approach is not obvious, however. The relative costs and benefits of these approaches should be a major focus of attention.

In such analysis it is crucial to emphasize the requirements on national monetary policies necessary for strategies of limited exchange rate flexibility to operate in a stable manner. Especially at the political level there is sometimes a tendency to believe that the coordination of exchange rate policy can make a major contribution to reducing exchange

10) See Angkinand, Chiu, and Willett (forthcoming) and Chiu and Willett (2007).

rate fluctuations without putting substantial constraints on the autonomy of national monetary policies.

While capital mobility in Asia is substantial, it is less than perfect, so there is some scope for sterilized intervention to be effective. However, except for countries such as China that maintain a strong set of capital controls, the amount of what can be done with sterilized intervention appears likely to be fairly limited. Thus substantial reductions in exchange rate variability would almost certainly require coordination of monetary policies. It might provide useful discipline if all policy discussions of limiting intra regional exchange rate fluctuations could be required to replace the use of the term exchange rate coordination with monetary policy coordination.

The experience with the European monetary system demonstrates that it is overly optimistic to assume that agreements on limiting exchange rate movements will automatically bring about the coordination of macroeconomic policies. This can of course sometimes be the case. For example, France's decisions to not to devalue again in 1983 was accompanied by major changes in its macro economic policy strategy. But such shifts did not extend to all members of the EMS. If they had then we would not have had the crises of 1992 and 1993. Salvatore (2007) notes, "the fundamental weakness of the EMS in attempting to keep exchange rates among member nations within narrowly defined limits without at the same time integrating their monetary, fiscal, tax, and other policies."¹¹ (p. 6)

In analyzing alternative approaches to regional monetary cooperation and alternative regimes of limited exchange rate flexibility recent literature has shown that it is important to focus on political economy as well as purely technical economic considerations. There can be strong political pressures that make it difficult to operate regimes of limited exchange rate flexibility in a stable manner. (See Willett 2007) The adoption of institutional mechanisms to help insulate monetary and exchange rate policy making from such political pressures may well prove more important than what form of exchange rate regime is adopted once one has moved away from the dead center of fairly narrow band adjustable pegs.

11) For further analysis of problems with the ERM approach see Genberg (2006) and Genberg and He (2007).

6. Some Questions for Discussion

Let us conclude by raising questions on non exclusive set of for discussion (not in a particular order):

1. It appears that many East Asian countries are more financially integrated with outside markets than with their regional neighbors. What are the implications of this for the importance of strategies for intra regional monetary policy coordination?
2. In a series of papers. Eiji Ogawa has pointed out that the adoption of different exchange rate regimes within East Asia can generate coordination failure externalities. On the other hand, OCA theory suggests that in a heterogeneous region different exchange rate regimes will be optimal for different countries. What can we say about the relative costs of these possible non optimalities?
3. How can the process of policy dialogue among the ASEAN+3 be most efficiently enhanced? What lessons can we draw from Europe and other experiences about the best ways to promote the evolution of regional economic and monetary cooperation over time? How do the Asian traditions of non interference and less institutionalized approaches affect strategies for cooperation?
4. What is the scope for effective regional coordination of exchange rate policies in the absence of monetary policy coordination?
5. What are the prospects for meaningful monetary policy coordination within Asia over the medium term future? Under what types of condition could you foresee acts of monetary and exchange rate policy coordination in the near term future?
6. How great is the need for policy coordination within Asia to help deal with the current problem of global economic imbalances and what appear to be the most promising types of strategies for attempting to bring such coordination about?
7. What are the conditions necessary for the band-basket-and-crawl approach to be a non crisis prone strategy for Asian monetary cooperation?
8. What are the major comparative advantages and disadvantages of the BBC approach compared with the harmonized inflation targeting approach recommended by Genberg and He (2007) and others.

9. How far has regional cooperation developed on the monitoring of international capital flows, and the development of early warning system and risk management strategies? To what extent are purely national efforts in these areas sufficient?
10. What should be the priorities for regional cooperation on the development of stronger financial markets?
11. How important and desirable is it to develop a common Asian currency unit as a focal point for various types of monetary and financial cooperation? What would be its most important purpose if many countries continue to practice managed floats for the medium term future? Would Eichengreen's (2006) suggestion of a parallel currency approach work better with some types of exchange rate regimes than others?

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Program

Capital Flows, Macroeconomic Management and Regional Cooperation in Asia

Date: November 30, 2007
Venue: KEI, Washington DC

Nov. 30 (Fri)

08:45~09:00 [Registration]

09:00~09:15 [Welcoming Address]

• *Kyung Tae Lee*, President, KIEP

09:15~10:45 [Chapter 1]

Capital Account Liberalization and Capital Flows in Asia

Chaired by *Sven W. Arndt*, *Claremont McKenna College*

Paper 1. Monetary Policy Independence, the Currency Regime, and the Capital Account in China, *Eswar Prasad*, Cornell University

Paper 2. What Tools are Available to Policymakers in Emerging Market Economies to Deal with Capital Inflows?, *Carmen M. Reinhart*, University of Maryland and *Vincent Reinhart*, AEI

• Discussants:

Prakash Loungani, IMF and SAIS

Mine Zeynep Senses, SAIS

10:45~11:00 [Coffee Break]

11:00~12:30 [Chapter 2]

Monetary Sterilization in Asia: Magnitude and Effectiveness

Chaired by *Louellen Stedman*, KEI

Paper 1. Sterilized Intervention in Emerging Asia: Is It Effective?, *Charles F. Kramer, et al*, IMF

190 Capital Flows, Macroeconomic Management and Regional Cooperation in Asia

11:00~12:30	<p>Paper 2. Monetary Sterilization in China and India, <i>Alice Ouyang</i>, SUFE and <i>Ramkishan S. Rajan</i>, George Mason University</p> <ul style="list-style-type: none">• Discussants: <i>Edwin M. Truman</i>, Peterson Institute <i>Shaghil Ahmed</i>, Federal Reserve Board <hr/>
12:30~14:00	<p>[Luncheon] Venue: KEI Lunch Speaker: <i>Masahiro Kawai</i>, Dean and Chief Executive Officer, Asian Development Bank Institute (ADBI)</p> <hr/>
14:00~15:30	<p>[Chapter 3] <i>Policy Coordination Issues in East Asia</i> <i>Chaired by Kalpana Kochhar, IMF</i></p> <p>Paper 1. Exchange Rate Regimes and Macroeconomic Stability in East Asia, <i>Deok Ryong Yoon</i>, KIEP and SAIS and <i>Jung Sik Kim</i>, Yonsei University</p> <p>Paper 2. Price Convergence in East Asia and Its Implication for Regional Monetary Integration, <i>Woosik Moon</i>, SNU and <i>Yeongseop Rhee</i>, Sookmyung University</p> <ul style="list-style-type: none">• Discussants: <i>Andrew Hughes Hallett</i>, George Mason University <i>Rabin Hattari</i>, World Bank and George Mason University <hr/>
15:30~15:45	<p>[Coffee Break]</p> <hr/>
15:45~17:45	<p>[Chapter 4] <i>Panel on Regional Cooperation in Asia</i> <i>Chaired by Prakash Loungani, IMF and SAIS</i></p> <p>Background Paper on Asian Monetary Cooperation, <i>Tomas D. Willett</i>, Claremont Graduate University</p> <ul style="list-style-type: none">• Panelists: <i>Richard N. Cooper</i>, Harvard University <i>C. Randall Henning</i>, American University and Peterson Institute <i>Masahiro Kawai</i>, ADBI <hr/>
17:45~18:00	<p>[Concluding]</p> <hr/>

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