Characterizing Foreign Exchange Rate Policies: The Two Parameter Exchange Market Pressure Framework

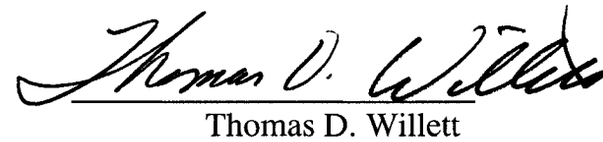
By

Yongbok (Jeff) Kim

A Dissertation submitted to the Faculty of Claremont Graduate University in Partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Graduate Faculty of Economics

Claremont, California
2007

Approved by:

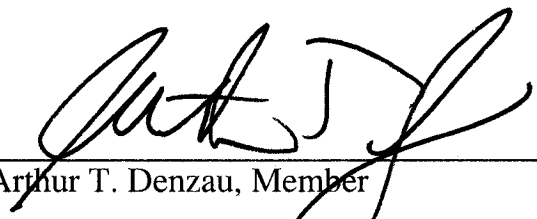


Thomas D. Willett

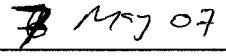
We, the undersigned, certify that we have read this dissertation of Yongbok (Jeff) Kim and approve it as adequate in scope and quality for the degree of Doctor of Philosophy.

Dissertation Committee:

Thomas D. Willett, Chair



Arthur T. Denzau, Member



Ramkishen S. Rajan, Member

Abstract of the Dissertation

Characterizing Foreign Exchange Rate Policies:

The Two Parameter Exchange Market Pressure Framework

by

Yongbok (Jeff) Kim

Claremont Graduate University: 2007

Many recent analyses of exchange rate regimes are based on the concept of how much exchange market pressure is taken on the exchange rate versus changes in reserves as a proxy for official intervention. However, the popular method of taking ratios of variations of exchange rate and reserve change is inadequate to deal with trends problems and with cases of leaning with the wind intervention. Nor does it identify that at least two parameters are required to classify exchange rate regimes: One related to trends and one related to management around trends.

The Two Parameter Exchange Market Pressure (TPEMP) framework is developed from the concept of exchange market pressure to characterize exchange rate regimes taking into account such problems. It uses two parameters, a trend coefficient and propensity to intervene around trend.

My dissertation applies the TPEMP framework to a number of countries that have been the center of attention.

While Japan has been classified by several studies as an example of a highly flexible or free floating exchange rate regime, the TPEMP framework finds that prior to

the cessation of intervention in 2004, Japan had substantially increased intervention during the post Asian crisis period relative to the precrisis period.

The TPEMP framework supports the idea that Asian countries have moved toward flexible exchange rate regimes after the crisis with the exception of announced pegs such as Malaysia and Singapore. Indeed, interventions in Korea, Indonesia, and Thailand have been weaker during the postcrisis relative to the precrisis. It also finds that there exists evidence on fear of floating in Indonesia and Thailand. Both nations have increased interventions again. However, it does not support McKinnon and Schnabl's argument of Asia generally having returned to soft dollar pegs. Korea has reduced intervention and interventions in Indonesia and Thailand during the postcrisis period, although having increased, are weaker than the precrisis pegs.

Dedication

For Sunjung and Jun.

TALBE OF CONTENTS

Chapter I

Review of Recent Papers on Classifying Exchange Rate Regimes

1. Introduction

There has been a great deal of interest in the classification of exchange rate regimes to investigate the nexus of alternative regimes with currency crisis[1]. Through repeated currency crises, it is accepted in general that adjustable pegs with narrow band such as the regime under the Bretton Woods are highly crisis prone under high capital mobility. There is, however, much disagreement about a stronger form of this hypothesis. While the bi-polar hypothesis argues that there are two extreme options, including permanently fixed or floating regime to reduce the crisis problem under substantial capital mobility, the fear of floating hypothesis insists that many countries announcing their exchange rate regimes as free floating tend to still intervene in foreign exchange markets.

Early empirical studies on this issue used the old IMF classifications based on countries' official reports. It has however been recognized that such official reports can often be unreliable. Consequently, an important and active research agenda in international economics has been to produce behavioral measures characterizing exchange rate policies based on what governments actually do rather than what they say they do.

Much advance has been made in the behavioral classification of exchange rate

[1] There have been many studies on associations of exchange rate regimes with other major macro variables such as inflation and growth. For those issues, see Ghosh, Gulde, and Wolf (2003), Shambaugh (2004), Levy Yeyati and Sturzenegger (2003) etc.

regimes. However, none of these new classification schemes are fully satisfactory. The most fundamental problem is that their classifications for same cases are quite often different from each other. For example, both the new IMF classification and Reinhart and Rogoff (RR, 2004) place Korea in the most flexible category. Willett and Kim (2006) however classify it as managed float. Levy Yeyati and Sturzenegger (LYS, 2005) classify Korea even as having a fixed rate. Recent empirical works on exchange rate regimes have therefore led to very different conclusions depending on what set of classifications is used, particularly with regard to flexible end of spectrum such as free floating and managed floating.

My dissertation reviews recent studies on classifying exchange rate regimes before introducing its analytical framework. Section 2 reviews methodologies in recent studies such as Ghosh, Gulde, and Wolf (GGW, 2003), RR, LYS, IMF, Bubula and Ötker-Robe (BÖR, 2002), Weymark (1995, 1997, and 1998), Calvo and Reinhart (CR, 2002), and Pontines and Siregar (PS, 2005). Section 3 proposes several methodological issues on classifying exchange rate regimes.

2. Reviews of Methodologies in Recent Studies

2-1. Ghosh, Gulde, and Wolf (GGW, 2003)

GGW classify de jure and de facto exchange rate regimes across 167 countries for 1970-1999. GGW's classification has 15 detailed categories for de jure regimes and 3 categories for de facto regimes as well as de jure regimes.

For their de jure classification GGW use the classification of the IMF. The

IMF de jure classification also contributes much to classifying their de facto classification. They find a relative frequency distribution of the IMF de jure classification every year. The distribution has three broad categories: pegged, intermediate, and float. For de facto classification, they create a composite statistic which represents annual behaviors of nominal exchange rates. The statistic, z-score, is calculated for all the observations. The z-score is

$$z = \sqrt{\mu_{\Delta e}^2 + \sigma_{\Delta e}^2},$$

where $\mu_{\Delta e}$ is the average monthly rate of change of the nominal exchange rate during the year and $\sigma_{\Delta e}$ is the variance of those monthly changes.

They find the relative frequency distribution of z-scores and compare it with the relative distribution of the IMF de jure classification. They classify de facto exchange rate regimes by imposing the relative frequency distribution of the IMF de jure regimes on the distribution of z-score.

Crucial assumption to find GGW's classification of de facto exchange rate regimes is that the relative frequency distributions of the IMF de jure regimes and de facto regimes are same. However, GGW don't explain why they are same. It seems difficult to find any intuitive or theoretical rationalization. They create another classification, consensus classification, to reduce such weakness. The consensus classification is composed of episodes which are in the same categories of de jure as well as de facto exchange rate regimes.

For the de facto classification, GGW depend on the z-score, which is composed of the average rate and the variance of monthly changes in nominal

exchange rates. Since the score is constructed only based on the behaviors of exchange rates, GGW do not control shocks in the foreign exchange rate market. For example, exchange rates with small volatility could result from a lack of shocks or strong interventions against shocks. Without considering intervention behaviors, it is impossible distinguish one from the other.

2-2. Reinhart and Rogoff (2004)

RR investigate 153 countries for 1946-2001 with a systemic approach from historical and statistical perspectives. RR's classification has 14 fine categories and 5 coarse categories (see table 1).

RR develop a new category they call freely falling regimes. Freely falling regime is similar with freely floating under their classification in the sense that both have large volatility in exchange rates. However, the freely falling is distinctive due to having high inflation. RR use two rules to classify the freely falling: the twelve-month rate of inflation equal or exceed 40 percent, and the six months immediately following a currency crisis.

In order to classify other exchange rate regimes, they use descriptive statistics of exchange rates, specifically the probability that percentage changes of exchange rates over rolling 5-year (sometimes 2 years) period remain with certain levels of bands such as 1%, 2%, and 5%. Since multiple rates and parallel market have existed quite often, they use market rates rather than official rates. This is perhaps the most important contribution of their study.

RR also use a special probability measure to distinguish the freely floating

from the managed float. They construct an exchange rate flexibility index,

$$\frac{\varepsilon}{P(\varepsilon < 1\%)},$$

where the numerator is the mean absolute monthly percentage change in the exchange rate over a rolling five-year period and the denominator is the probability that percentage changes of exchange rates over rolling 5-year period remain within 1%. RR compare the frequency distribution of the index of each country with what they deem to be free floaters such as US dollar/Euro, US dollar/Yen, US dollar/Australian Dollar, and US dollar/New Zealand Dollar over post 1973 period. As well be discussed it is questionable that Japan should be classified as a free floater.

RR also have a similar problem as GGW. They do not control shocks in the foreign exchange rate market since taking into account only behaviors of exchange rates.

When RR distinguish the managed floating from the freely floating, the null hypothesis is that the episode in consideration is the free floating. Therefore, RR are very conservative about classifying countries as the managed floating and their decision rule is biased toward the freely floating. They separate observations with large volatility of exchange rates and high inflation from the freely floating using the category, freely falling. Therefore, the freely floating is free from serious inflation problems. One of important issues regarding role of exchange rate regime is its discipline effect. If any researchers use RR's classification, they would conclude that the freely floating has good performance against inflation.

2-3. Levy Yeyati and Sturzenegger (LYS, 2005)

LYS classify exchange rate regimes across 183 countries for 1974-2004. They classify episodes into 5 categories - flexible, dirty float, crawling peg, fixed, and inconclusive - using three classifying variables, exchange rate volatility, volatility of exchange rate changes, and volatility of reserves (see table 2).

The exchange rate volatility is measured by the average of the absolute monthly percentage changes in the nominal bilateral exchange rate during a calendar year. The volatility of exchange rate changes is the standard deviation of the monthly percentage changes in the exchange rate. To compute the volatility of reserves, they use several steps. First, they subtract central government deposit from net foreign asset and divide it by the exchange rate, which is denominated by R_t in the equation below. Second, they compute first order differenced value of R_t and divide it by lagged money base, which is their intervention proxy and denominated by r_t. The volatility of reserves is the average absolute monthly changes in r_t.

$$r_t = \frac{\Delta R_t}{S_t} = \frac{\dfrac{FA_t - FL_t - CGD_t}{e_t} - \dfrac{FA_{t-1} - FL_{t-1} - CGD_{t-1}}{e_{t-1}}}{\dfrac{MB_{t-1}}{e_{t-1}}},$$

where R is net foreign asset, S is monetary scaling variable, FA is foreign asset, FL is foreign liability, CGD is central government deposit, and MB is money base.

They use K-means cluster (KMC) analysis with three classifying variables. The K-means cluster algorithm produces groups from episodes such that they have the smallest total distance between episodes and the center of the group. They say, "k-means cluster analysis has advantage of avoiding any discretion from the

researcher except selection of the classifying variables and assignment of clusters to different exchange rate regimes and our method evaluates the deviations in the classifying variables relative to the world norm, rather than to some ad hoc reference cases".

However, it is necessary to verify such two discretions since there is no economic rationale behind them.

First, whether do 5 groups reflect all possible cases? They divide each classifying variable into two categories such as having high level or low level. Then, we have eight cases including their 5 cases in table 2 and additional 3 cases such as (i) low volatile exchange rate, highly volatile exchange rate changes, and low volatile reserves (ii) low volatile exchange rate, highly volatile exchange rate changes, and high volatile reserves (iii) highly volatile exchange rate, low volatile exchange rate changes, and low volatile reserves. The first and the second cases are not possible for practical purposes in the sense that exchange rates are very volatile with highly volatile exchange rate changes. However, the third case is possible implying LYS should have taken 6 groups into account. The third group could be regarded as flexible regime or inconclusive depending on whether episodes with the volatile exchange rate can be considered as having enough flexibility for the flexible regime.

Second, do classifying variables in four regimes have reasonable numbers from economic perspective? LYS report minimum, centroid, and maximum values of each classifying variables (See table 3). Table 3 shows that values of each classifying

variables are overlapped across exchange rate regimes. There are also several peculiar levels of classifying variables. Fore example, centroids of volatility of exchange rate, volatility in the change of the exchange rate, and volatility of reserves for the flexible regime are 2.3, 2.0, and 4.6. LYS describe them as high, high, and low. The volatility measures in the dirty float regime are 17.3, 8.5, and 6.98 and authors describe them as high, high, and high. But the first two numbers are very different and the third numbers are similar. Maximum average monthly volatility in the exchange rate of the float regime and the fixed regime is same, 7.22 percent. In conclusion, LYS do not have clear-cut reference variables for each exchange rate regimes.

2-4. IMF and BÖR

The IMF announced exchange rate regimes of countries based on their official reports. Previous studies found that the role of exchange rate regime was different from what they expected since actual regimes were quite often different from the official report.

Therefore, the IMF developed a new methodology based on staff judgment of actual behaviors of authorities since 1999. The new methodology of classification is based on a statistical analysis of exchange rate behavior and other information such as IMF desk economists, press reports, news article, and other relevant papers. BÖR improve the methodology by extending time span of the IMF classification. They apply its methodology to exchange change rate regimes from 1990.

The IMF changed the principal question to classify exchange rate regime

from 'How strong does a country intervene' to 'Does a country target any path in the exchange rate?'. Such different approaches are reflected into names of exchange rate regimes, i.e., cooperative arrangement vs. managed floating with no pre-announced path. There are eight categories in the old IMF classification and thirteen categories in BÖR (see table 1). BÖR also hire another three categories as a broader classification.

2-5. Weymark (1995, 1997, and 1998)

Weymark estimates exchange market pressure and constructs the following intervention index based on a small open economy model with the assumption that monetary authority does not use domestic credit to influence the exchange rate:

$$EMP_t = \Delta e_t + \eta \Delta r_t \Rightarrow \omega_t = \frac{\eta \Delta r_t}{EMP_t},$$

where e_t is the period t exchange rate expressed in terms of the domestic currency cost of one unit of foreign currency and Δr_t is the change in foreign exchange reserves expressed as a proportion of the inherited monetary base.

The intervention index ranges from $-\infty$ to $+\infty$. It is 0 for a free floating and 1 for a perfectly fixed exchange rate. Intermediate exchange rate regimes have an index between 0 and 1. The intervention index is less than 0 when policy authority actively depreciates (appreciates) the domestic currency with respect to its free float value when the exogenously generated excess demand for domestic currency is negative (positive). It is greater than 1 when policy authority actively deprecates (appreciates) the domestic currency with respect to its free float value when the exogenously generated excess demand for domestic currency is positive (negative).

It is not clear how strong indices less than 0 or higher than 1 are in Weymark's framework. Conceptually, 1 is maximum level since it stands for a perfectly fixed exchange rate. Then, the Weymark index larger than 1 would be close but less than 1 since the situation with indices larger than 1 is a very strong intervention defined in the exchange market theorem. The intervention is so strong that exchange rate changes further than equilibrium rate. The index less than 0 could be between 0 and 1 since monetary authority intervenes to attain its objective level of exchange rate while market rate moves the same direction. In other words, the authorities pursuit faster adjustment to new equilibrium although the exchange rate market lead exchange rate to the new equilibrium level. Or, it could be considered as super flexibility since the authorities help market mechanism.

Weymark uses the convergence condition for the solution of difference equation to conclude whether any country has managed float. She applies the methodology to analyze exchange rate regime in Canada. Canadian intervention index is 0.94 and Weymark concludes that Canada has managed floating regime since absolute value of intervention index is less than 1 implying the Canadian dollar move towards its underlying value.

The conclusion does not take into account that 0.94 is not scalar but an estimator of average intervention. Therefore, a hypothesis test is necessary to confirm statistical significance. Moreover, although lower intervention indices such as 0.2 satisfy the condition, it is questionable that we should classify such cases as the managed float since movement of exchange rate toward a new equilibrium is

very fast. The more appropriate category for the case is 'flexible'.

2-6. Calvo and Reinhart (CV, 2002)

Calvo and Reinhart employ a probability approach and exchange rate flexibility in order to investigate foreign exchange rate policy.

Three probabilities on exchange rate, foreign reserves, and interest rate give them information on authorities' intervention behaviors. Basically, each probability measures likelihood that one of previous variables stay inside of a threshold: probability that absolute percentage changes in exchange rates are smaller than 2.5%, probability that absolute percentage changes in foreign reserves-gold are smaller than 2.5%, and probability that absolute change of money market rate are greater than 4%. CV find that high probabilities on foreign reserves and interest rate are common in many countries announcing that they have free floating exchange rate regimes. They call the phenomenon as 'fear of float'.

They think this approach can reduce an outlier problem and apply it mechanically. However, outliers have useful information on changes in foreign exchange rate policy. For example, authorities would change goals on fixed exchange rates or crawling rates. Then, there are big changes in exchange rates. It is therefore necessary to analyze those periods in order to make sure whether there is any change of policy rather than to delete it.

They also construct an exchange rate flexibility index based on small open economy model. The index is

$$\lambda = \frac{\sigma_e^2}{\sigma_i^2 + \sigma_F^2},$$

where e is change rate in exchange rate, F is foreign asset in central bank balance sheet, and i is interest rate.

2-7. Pontines and Siregar (PS, 2005)

PS construct an intervention index based on probabilities of key indicators (interest rate, reserve, and exchange rate) to be in the high-volatility state by adopting the Markov-regime switching ARCH.

PS use three steps to construct intervention index. First, they estimate the probability of high-volatility state through SWATCH model assuming there are two states such as high-volatility state and low-volatility state. Second, they define exchange market pressure with three probabilities:

$$P_{exr}^{H} + P_{reserves}^{H} + P_{\text{int}\,r}^{H}$$

where P_{exr}^{H}, $P_{reserves}^{H}$, *and* $P_{\text{int}\,r}^{H}$ are the conditional probabilities that the changes in exchange rate, reserves, and interest rates (first difference), respectively are in a high-volatility state at date (t). Finally they define intervention index,

$$\frac{P_{reserves}^{H} + P_{\text{int}\,r}^{H}}{P_{exr}^{H} + P_{reserves}^{H} + P_{\text{int}\,r}^{H}}$$

They argue that using the smoothed probabilities of the conditional variances for the intervention index helps them to avoid the problem with using a parametric measure of volatility such as variance or standard deviation where these measures are prone to outliers and structural breaks. Again, PS do not consider usefulness of trend breaks like CV. Their index ranges from 0 to 1. 1 is for fixed regime, and 0 is for floating.

Pontines and Siregar assume that there are two states, high and low, in each

classification variables. Since they include the Asian crisis period, their conclusion could well be affected by a single anomalous event. Therefore, it is necessary to capture the effect of the crisis and calculate probabilities that classification variables are in states with normal volatilities. One method is to use three states one of which reflects such huge volatility.

3. Methodological Issues on Classifying Exchange Rate Regimes

The basic idea of the EMP underlies most of the recent efforts at classification of exchange rate regimes. However, these studies often do not fully conform to the concept of the proportion of exchange market pressure taken on the exchange rate versus intervention. Calvo and Reinhart (2002)[2], and Hernández and Montiel (2003) look at the volatilities of exchange rate, international reserves and interest rates to characterize exchange rate policies. However, they compare the volatilities of each variable across countries separately rather than comparing their rates. While Levy Yeyati and Sturzenegger (LYS, 2005) don't refer to the EMP concept explicitly, their methodology also uses the EMP as a theoretical basis.

While the basic idea of comparing relative volatilities fits broadly with the concept of the proportion of EMP taken in reserves versus exchange rate changes, there are several technical problems with the particular formulations of these studies.

It is clearly appropriate to use changes in interest rates or other monetary variables such as money supplies or degrees of sterilization in classifying countries'

[2] Calvo and Reinhart (2002) present empirical result on the composite index of exchange rate flexibility. However, it is not based on the EMP concept.

over all monetary cum exchange rate regimes, but it is not clear how the behaviors of these monetary policy variables should be related to the classification of the degree of flexibility of the exchange rate regime. Calvo and Reinhart are able to make a strong link only by making the assumption that interest rate changes are only used to limit exchange rate movements. They argue correctly that "such interest rate volatility is not the result of adhering to strict monetary targets in the face of large and frequent money demand shock..." (p 392). However, they then jump directly from this statement to the conclusion that "Interest rate volatility would appear to be the byproduct of a combination of trying to stabilize the exchange rate through domestic open market operation and lack of credibility" (p 392). This leaves out the possibility of the effects of other types of shocks and of domestically motivated monetary policy actions dictated by discretion rather than monetary rule. Interest rate changes can also be used to protect reserve levels. Thus, we see no clear basis for a presumption that higher interest rate variability should be considered as an indicator of less flexibility in the exchange rate regime. This is certainly an issue worthy of further investigation, however.

Where government policies lean with rather than against the wind, i.e. where reserve declines occur during a period of currency appreciation or reserve increases during a period of depreciation, the concept of intervention index is not well defined in the EMP framework.

It is not easy to know how these wrong sign observations should be treated. Wrong signs can be caused by imperfections in the reserve change proxy as well as

by episodes of leaning with the wind i.e. pushing the rate even further than the market has been taking it or of extreme forms of leaning against the wind where the rate is forced in the opposite direction from market forces. Actual leaning with the wind in a downward direction is classic beggar thy neighbor policy and is discouraged by the IMF's guidelines except for cases where a currency is judged to be seriously overvalued. Leaning with the wind in the upward direction may be justified during periods in which country's currencies are considered to have overdepreciated. The aftermath of the Asian crisis is a prominent example of such overdepreciation.

Where imperfect proxies are the cause of the wrong sign, the best solution would likely be to drop these observations. With true leaning with the wind, one could argue either that this is a case of government management or that it should be considered as super flexibility. Which interpretation is better may depend on the use to be made of the classification.

Wrong signs could also result from an extreme form of leaning against the wind, i.e., instead of allowing domestic currency to depreciate in the face of excess supply in the foreign exchange market, the government could actively appreciate the exchange rate. Likewise, despite an excess demand in foreign exchange market, a mercantilist government could force down the exchange rate. It would seem that these should be treated as cases of government management or of super fixity. Thus depending on the cause of the wrong sign, it can be argued that a value of zero or one should be assigned or that the observation should be deleted.

In general, we will not be able to distinguish between wrong sign observations due to imperfect proxies and those due to leaning with the wind or extreme forms of leaning against the wind. Thus, this dissertation deletes the observations.

Except RR, previous studies use annual basis for their analysis. However, foreign exchange rate policies often show structural changes during the year. To investigate structural changes during the year, my dissertation inspects trend movements in exchange rates and percentage changes in intervention proxy. Structural breaks of trends in exchange rate are regarded as having possibility of structural changes in foreign exchange policy.

There has been considerable debate about the degree of post crisis exchange rate flexibility in Asia.[3] While it is widely assumed that there has been a substantial increase in exchange rate flexibility, there has also been considerable accumulation of reserves. This has led some economists to argue that there has recently been little change in exchange rate policies.[4] My dissertation can help clarify this debate by distinguishing (conceptually at least) between intervention designed to accumulate reserves such as may be highly desirable after a period of reserve losses, intervention to hold down the average level of the exchange rate for competitive advantage, and intervention to smooth out short-run fluctuations in the exchange rate.[5]

---

[3] See Calvo and Reinhart (2002), Hernández and Montiel (2003), Kim, Kim, and Wang (2004), McKinnon and Schnabl (2004), Ogawa and Yang (2004), Park and Wyploz (2004), Cavoli and Rajan (2005), Pontines and Siregar (2005) etc.

[4] See McKinnon and Schnabl (2004).

[5] Of course, there could also be the intervention to prop up the rate to avoid inflation. This is especially likely before elections.

The first two motives will be observationally equivalent in terms of the statistical data during the early stages of recouping reserve losses. In the later stages of reserve accumulation distinctions would have to be based on judgments about whether reserve accumulations were becoming "excessive". The appropriate level of reserves for a country can of course be a matter of considerable dispute.[6]

The third type of intervention – to limit short-term fluctuations in the exchange rate - is more easily identified. Indeed, that is what the framework in my dissertation is designed to capture, once detrending changes in reserves as well as changes in the exchange rate.

Still another difficult issue lies in front of empirical studies although ignoring previous problems. Every study uses its own categories (see table 1). For example, GGW have updated IMF de jure classification. Their classification has 6 categories such as float with rule-based intervention, float with discretionary intervention, and floating regimes. As names implies, they use intervention rule based categories. However, the IMF de facto classification is based on path dependency rather than levels of intervention, i.e. Managed floating with no predetermined path for the exchange rate. If RR's categories are included, the problem becomes worse. RR's classification is based on whether authorities preannounce and how broad bands are. Therefore, empirical studies on the role of exchange rate regimes such as Bleaney and Francisco (2003), Angkinand, Chiu, and Willett (2006) spend time to explain how they reorganize exchange rate regimes in

[6] For recent discussions of the high levels of reserve holdings in post crisis Asia, see Aizenmann and Marian (2002), Bird and Rajan (2002), Kim et al (2004), and Li, Sula, and Willett (2006).

previous studies.

Without considering such difference among classification schemes, there are many cases in disagreement even among clear categories such as free float and managed float. A huge gray area is found across classifications, which gives rise to different conclusions of empirical studies depending on what classifications are used. Therefore, it is desirable to give such cases more consideration. My dissertation investigates Japan, and several Asian countries.

Table 1 Categories of exchange rate regimes

GGW de jure classification	New IMF
1. Hard pegs	1. Exchange rate with no separate legal tender
2. Single currency pegs	2. Currency board arrangement
3. Basket pegs	3. Conventional pegged arrangement
4. Floats with rule-based intervention	4. Pegged exchange rate within horizontal bands
5. Floats with discretionary intervention	5. Crawling peg
6. Floating regimes	6. Crawling band
	7. Managed floating with no predetermined path for the exchange rate
	8. Independently floating

BÖR	
Finer Categorization	Three Categorization
1. Exchange regimes with another currency as legal tender	1. Hard peg regime (1-3)
2. Exchange regimes with no legal tender	
3. Currency board arrangement	2. Intermediate regime (4-11)
4. Conventional peg to a single currency	
5. Conventional peg to a basket	
6. Horizontal bands	
7. Forward looking crawling peg	
8. Backward looking crawling peg	
9. Forward looking crawling bands	
10. Backward looking crawling bands	
11. Tightly managed float	3. Other floating (12-13)
12. Other managed float	
13. Independently floating	

Reinhart of Rogoff		LYS
Fine Grid	Coarse Grid	
1. No separate legal tender	1. Peg (1-4)	1. Fixed
2. Pre announced peg or currency board arrangement		2. Dirty/Crawling Peg
3. Pre announced horizontal band that is narrower than or equal to +/-2%		3. Dirty
4. De facto peg		4. Float
5. Pre announced crawling peg	2. Limited Flexibility (5-9)	5. Inconclusive
6. Pre announced crawling band that is narrower than or equal to +/-2%		
7. De factor crawling peg		
8. De facto crawling band that is narrower than or equal to +/-2%		
9. Pre announced crawling band that is wider than or equal to +/-2%		
10. De facto crawling band that is narrower than or equal to +/-5%	3. Managed floating (10-12)	
11. Moving band that is narrower than or equal to +/-2%		
12. Managed floating		
13. Freely floating	4. Freely floating (13)	
14. Freely falling	5. Freely falling (14)	

Table 2 Exchange Rate Regimes in LYS (2005)

	σ_e	$\sigma_{\Delta e}$	σ_r
Inconclusive	Low	Low	Low
Flexible	High	High	Low
Dirty float	High	High	High
Crawling peg	High	Low	High
Fixed	Low	Low	High

Table 3 Cluster boundaries

	σ_e			$\sigma_{\Delta e}$			σ_r		
	Min (%)	Centroid (%)	Max (%)	Min (%)	Centroid (%)	Max (%)	Min (%)	Centroid (%)	Max (%)
First round boundaries									
Float	0.09	2.31	7.22	0.81	2.03	6.70	0.60	4.59	13.44
Dirty	12.80	17.27	26.94	4.76	8.51	13.68	0.88	6.98	23.07
Dirty/CP	0.53	6.96	14.22	2.49	5.21	13.74	1.38	8.67	27.52
Fixed	0.00	0.20	7.22	0.00	0.23	4.61	10.57	14.68	29.87
Second round boundaries									
Float	0.72	1.18	2.37	0.36	0.96	1.37	0.25	3.19	6.46
Dirty	0.16	0.95	1.77	0.33	0.86	1.58	5.38	7.86	10.63
Dirty/CP	0.02	0.53	1.05	0.24	0.50	1.44	0.35	4.29	7.53
Fixed	0.00	0.00	0.63	0.00	0.00	0.66	5.65	7.51	11.02

Source: LYS(2005)

Chapter II

Two Parameter Exchange Market Pressure (TPEMP) Framework

1. Two Parameter Approach

The use of two parameters to capture the rate of crawl and the width of the band around parity are easily interpreted in terms of the institutional characteristics of exchange rate regimes. The coefficient of the country-specific time trend on the log of the bilateral exchange rate is a proxy for the rate of crawl. The minimum and the maximum of deviations from the trend is a proxy for a bandwidth.[7]

Note, however, that band widths defined either as announced limits or the maximum actual fluctuations around parity or trend are not fully adequate to describe a countries' propensity to intervene. What is needed is the propensity to intervene in the face of exchange market pressure that deviates from trend. Thus we need to use a two parameter characterization, the trend rate of change of the exchange rate and the propensity to smooth fluctuations around trend. This characterization is straight forward, however, only when there is no trend in the level of reserves. In many cases there have been substantial increases in reserves, however, with the huge post crisis buildup of reserves in many Asian countries. Therefore, Two Parameter Exchange Market Pressure framework presents trend and deviation from trend propensities to intervene as measures of exchange rate flexibility.

[7] Since there frequently exist outliers in soft bands, the maximum and the minimum of the deviations could be substituted with other boundaries such as 95% frequency distribution.

2. Trend Coefficients

The first step in calculating two parameter indices is to break down the two main variables, the exchange rate and policy instrument, into trend and deviation from trend components:

(1) $e_t = T_{e_t} + u_{e_t}$
(2) $r_t = T_{r_t} + u_{r_t}$

where e and r are exchange rate and policy instrument in logarithm, T and u are trend component and deviation from the trend component, and t denotes periods.

There are various ways to filter trends. My dissertation uses linear time trend as a main method. Since subperiods are less than 2 years in most cases, there is no significant benefit of other more complicated methods such as the Hodrick-Prescott filter in terms of parsimony. The trend coefficient of the exchange rate reflects the average rate of the appreciation or depreciation over time. Under a crawling peg or band or a managed float operated as a de facto crawl it would reflect the rate of crawling. Under a free floating rate it would just reflect the average rate of appreciation or depreciation. The trend coefficient of reserves gives the average rate of accumulation or loss in reserves.

3. Propensities to Intervene

Propensities to intervene measure the degree of intervention in the framework. They are based on the exchange market pressure equation,

(3) $EMP_t = \Delta e_t + \varepsilon_t \cdot \Delta r_t$,

where EMP implies the exchange market pressure and ε is an intervention elasticity of exchange market pressure. Through the first order difference of equations (1) and (2), we have equations (4) and (5), which are decompositions of the terms at the right side of equation (3). Substitution of equation (4) and (5) into equation (3) leads to equations (6), (7), and (8). They indicate that exchange market pressure (EMP_t^C) is composed of two sub-pressures: trend pressure (EMP_t^T) and detrended pressure (EMP_t^{DT}).

(4) $\Delta e_t = \Delta T_{e_t} + \Delta u_{e_t}$

(5) $\Delta r_t = \Delta T_{r_t} + \Delta u_{r_t}$

(6) $EMP_t^C = \Delta e_t + \varepsilon_t \cdot \Delta r_t = (\Delta T_{e_t} + \varepsilon_t \cdot \Delta T_{r_t}) + (\Delta u_{e_t} + \varepsilon_t \cdot \Delta u_{r_t})$

(7) $EMP_t^T = \Delta T_{e_t} + \varepsilon_t \cdot \Delta T_{r_t}$

(8) $EMP_t^{DT} = \Delta u_{e_t} + \varepsilon_t \cdot \Delta u_{r_t}$

It is not uncommon for governments who say that they are only intervening to smooth out temporary fluctuations in the exchange rate to have sustained increases or decreases in reserves. If continued over long periods this is a clear indication that the authorities are doing more than just smoothing. A run in reserve changes for sometimes may be quite consistent with purely smoothing interventions since in the short term it can be hard to distinguish changes in trends from movements around the trends. However, if authorities don't want there to be an appreciating trend for their currency, say for competitive reasons, they are likely to be slow to recognize a market driven trend and continue for sometimes to smooth it away. Likewise, we

could see asymmetric smoothing where governments are more concerned with movements in one direction than the other.[8] Looking at monthly ratios and breaking them into trend and cyclical components allows us to investigate such issues in a way that cannot be captured in ratios of variance. Of course, even ex post there can be disagreement about what to consider as shifts in trends versus movements around them so application won't always be free from ambiguity.

TPEMP framework estimates trend propensities to intervene, TPI, smoothing propensities to intervene, SPI and combined propensities to intervene, CPI according to the following equations.

$$(9)\ EMP_t^C = \Delta e_t + \varepsilon_t \cdot \Delta r_t \Rightarrow CPI_t = \left| \frac{\varepsilon_t \cdot \Delta r_t}{\Delta e_t + \varepsilon_t \cdot \Delta r_t} \right|$$

$$(10)\ EMP_t^T = \Delta T_{e_t} + \varepsilon_t \cdot \Delta T_{r_t} \Rightarrow TPI_t = \left| \frac{\varepsilon_t \cdot \Delta T_{r_t}}{\Delta T_{e_t} + \varepsilon_t \cdot \Delta T_{r_t}} \right|$$

$$(11)\ EMP_t^{DT} = \Delta u_{e_t} + \varepsilon_t \cdot \Delta u_{r_t} \Rightarrow SPI_t = \left| \frac{\varepsilon_t \cdot \Delta u_{r_t}}{\Delta u_{e_t} + \varepsilon_t \cdot \Delta u_{r_t}} \right|$$

In order to calculate propensities to intervene, it is necessary to make an assumption on ε_t, the intervention elasticity of the exchange market pressure. Following most of the literatures[9], a unitary elasticity is assumed. The indices become,

$$(12)\ CPI_t = \left| \frac{-\Delta r_t}{\Delta e_t - \Delta r_t} \right|$$

[8] Building up depleted reserve may of course be a 'legitimate' reason for prolonged reserve accumulations.

[9] An exception is Weymark (1995, 1997, and 1998) who estimates the elasticity.

$$(13)\ TPI_t = \left| \frac{-\Delta T_{r_t}}{\Delta T_{e_t} - \Delta T_{r_t}} \right|$$

$$(14)\ SPI_t = \left| \frac{-\Delta u_{r_t}}{\Delta u_{e_t} - \Delta u_{r_t}} \right|.$$

For most applications, these are averages over the time periods of interest.

4. Intervention Proxies

One of the most difficult problems in applying the EMP approach is that few countries make data on their exchange market intervention publicly available. Most empirical studies use changes in reserves as a proxy but acknowledge that this is far from perfect. Reserves can change due to interest earnings, valuation changes, and official borrowings as well as intervention. And interventions can include actions in forward, not just spot markets. These problems have led some researchers to give up using reserve measures all together. (See Ghosh et al). This seems too strong a reaction, however, since where reserve accumulations are huge, such as those at times by Japan and Korea, there can be little doubt that intervention was a primary cause.

One adjustment that can be made fairly easily is to subtract an estimate of interest earnings from the reserve figures. Since dollar values of reserves are used in most cross national empirical studies, valuation changes due to exchange rate movements can also be important. Since exchange rate changes among reserve currencies are often much larger over short periods than interest rate differences,

estimates of the currency composition of reserves are particularly important for such calculations. For many countries published figures or good estimates on the currency composition of reserves are not available, but efforts to take valuation changes into account have been made in some country studies. See Ouyang, Rajan, and Willett (2006).

In chapter III my dissertation adjusts reserve changes only for estimates of interest earnings, but find that the resulting series fairly closely track the actual data on Japan's interventions over the period 1991 to 2005. Of course, this proxy may not work as well for other countries, but results for Japan suggest that this approach is worth using in the absence of better information, while remembering that it is only a proxy.

A final problem is that a constant amount of intervention per period in the same direction would give rise to varying percentage changes as reserve levels rose or fell.[10] Likewise, initial reserve levels can make a substantial difference. Studies such as Calvo and Reinhart (2001), and Hernández and Montiel (2003) characterize Japan as having a low volatility in foreign reserves. Although Japan intervened heavily in absolute terms in the foreign exchange market in the early 2000s, the percentage changes in reserves were fairly small due to the high initial levels of reserves.

There are several methods to deal with this problem. The most popular method is to use scaling variables for intervention proxies. Holden et al (1979),

[10] This problem can of course also apply to continued appreciation or depreciation.

Weymark (1997), Eichengreen and Bayoumi (1998), and LYS (2005) use the lagged money base, lagged narrow money, and the sum of export and import for 12 months as scaling variables. This variation problem is not so serious in the TPEMP framework since detrending intervention proxies moderates it. Trends incorporate huge or small accumulation of intervention instruments and the SPI deals with deviations from the trends. Therefore, the variation problem is relatively minor in the framework.

5. Empirical Methodologies

A benchmark method is to use four indices of the TPEMP framework based on observations with the right sign and TFRIRLN[11]. For comparative purposes, alternative indices and results of other methodologies are also reported.

There are two types of alternative indices. First, I calculate propensities with all the observations, that is, including observations with the wrong sign are calculated. As discussed in chapter II observations undefined within the EMP framework yield ambiguous information on the extent to which governments intervene to influence exchange rates. Some may be due to the imperfect proxy of official interventions, strong interventions, or super flexibility of exchange rates.

[11] There are six feasible intervention proxies considering interest earnings, valuation effect, and official loan:
(i) TFR: Foreign reserves
(ii) NFA: Net foreign asset
(iii) TFRIR: (Foreign reserves)-(US TB rate)×(one lagged foreign reserves)
(iv) NFAIR: (Net foreign asset)-(US TB rate)×(one lagged net foreign asset)
(v) TFRLN: (Foreign reserves)-(IMF loan)
(vi) TFRIRLN: (Foreign reserves)-(US TB rate)×(one lagged foreign reserves)-(IMF loan)

Since equations (12)~(14) can produce abnormal levels of indices for observations with the wrong sign[12], my dissertation uses the absolute percentage changes for observations with the wrong sign. For the second indices, I use alternative intervention proxies instead of TFRIRLN.

In addition, my dissertation employs the probability approach in Calvo and Reinhart (2002), and variance ratio. Although their specific methodologies are different, these studies compare the volatilities of policy tools such as foreign reserves and interest rate with exchange rate volatility to measure intervention behavior. However, my dissertation does not use interest rate as an intervention instrument since interest rate is often used for other objectives such as defending international reserve positions and domestic monetary policy. Without information on their relative weights, such practice is inappropriate for characterizing foreign exchange rate policies. Calvo and Reinhart (2002) calculate the probabilities that absolute percentage changes of exchange rates and foreign reserves are smaller than 2.5%. I also consider alternative levels of thresholds to investigate the robustness of their conclusions. My dissertation reports results of 2%, 2.5%, and 3% thresholds.

[12] For example, assume Δe_t is 0.1 and Δr_t is 0.0999. Then, PTI_t^{ALL} is 999 (=|-0.0999/0.0001|).

Chapter III

Robustness of the Two Parameter Exchange Market Pressure Framework: Foreign Exchange Rate Policy in Japan

1. Official Intervention and Proxy in Japan

Japan is one of the rare countries that release data on its intervention in the foreign exchange market. This data enables my dissertation to investigate how well proxies reflect official intervention using official intervention data.

Figure 1 shows the behavior of intervention proxy and the actual data on official interventions from January 1991 to September 2005. The intervention proxy is the change in adjusted foreign reserves, i.e., foreign reserves minus interest earings. Interest earnings are computed by multiplying the US treasury bill rate with the level of foreign reserves lagged one period. There are periods when the intervention proxy shows intervention behaviors without any official intervention, such as between the middle of 1996 and the end of 1997, in general the proxy follows the actual intervention figures fairly closely.

Figure 2 presents a scatter diagram between the official intervention and the intervention proxy. It shows that there is a very strong positive linear relation between them. The correlation coefficient of 0.9 confirms the graphical inference. The estimated coefficient of the intervention proxy in the regression of official intervention on the intervention proxy is 1.05, and is not significantly different from

one. Thus, at least for Japan, changes in reserves do seem to be a reasonable proxy for official interventions.

2. Foreign Exchange Rate Policy in Japan

Japan has been classified by several studies as an example of a highly flexible or their free floating exchange rate regime. The IMF, LYS, and RR have all classified Japan into their most flexible categories since 1982, 1974, and 1978, respectively. The IMF uses the term "independently floating" and LYS use "flexible", both of which are reasonable as would RR's use of floating, if they hadn't preceded it by "free". Calvo and Reinhart (2002) also conclude that Japan has a more flexible regime than Canada, Australia, or New Zealand. Their probability measures of staying within a zone for the exchange rate and nominal interest rate for Japan are relatively low, while the probability measure for reserves is relatively high (See table 8).

However, the TPEMP framework finds that prior to the cessation of intervention in 2004, Japan had substantially increased intervention during the post Asian crisis period relative to the precrisis period.

Figure 3 contains graphical analysis of changes of regimes in Japan. Figure 3 suggests that while the broad category of flexible rates is an appropriate label for Japan's exchange rate regime over this whole period, there have been substantial changes in intervention behavior over the period. For some issues such as effects of exchange rate regimes on economic growth, these changes in behavior are likely not

of great importance. For the characterization of intervention reaction functions they seem quite important, however.

During the Asian crisis the yen depreciated against the dollar. While the yen has an overall appreciation trend over the post Asian crisis, it is far from steady. We observe a number of rather sharp breaks in each rate behavior. Based on inspection of figure 5 I divided the postcrisis period into four subperiods: (i) September 1999-November 2000, (ii) March 2001-August 2003, (iii) October 2003-April 2004, (iv) June 2004-September 2005 and estimated the two parameter EMP framework with the proxy (table 1).

The first column in table 1 lists periods, the second, their time spans, and the remaining columns the indices: trend coefficients of exchange rates and intervention proxy, trend propensity to intervene, smoothing propensities to intervene, and combined propensities to intervene. Benchmark propensities to intervene are TPI and SPI calculated with correctly-signed observations. The estimated exchange trends are depicted in figure 5.

During the precrisis period, the Yen had a strong depreciation trend and small volatility around the trend, but this low volatility did not result from intervention policy. TPI was wrong sign and SPI was quite low, 0.273.

Exchange rate policy changed after 1999. Japan intervened strongly in the foreign exchange market. Foreign reserves accumulated by 23% per year on average and the SPI rose to 0.53 from 1999 through 2005. Analysis of subperiods helps clarify characteristics of Japanese foreign exchange policy. TPIs are correctly signed

during subperiods with appreciation trends in the exchange rates. SPIs for all subperiods are higher than for the precrisis period. They are 0.5 and 0.61 for the first and third subperiods. After June 2004, the SPI fell to 0.38, but was still higher than for the precrisis period.[13]

In order to test the robustness of the methodology I calculate the SPIs using the ratio of official intervention to adjusted foreign reserves in the previous period.[14] The first column in table 2 lists regime periods, and the second gives their time spans. The remaining columns report the smoothing propensities to intervene, and the combined propensities to intervene.

SPIs using actual data are lower than SPIs using the proxy since there are many observations with zero intervention in actual data which are considered as having right signs. The estimators are 0.06 for the actual data and 0.27 for the proxy during the precrisis period. They are 0.2 and 0.66 for the first and third subperiods using the official intervention and 0.5 and 0.61 using on the proxy. After June 2004, the SPI using the official intervention was 0.0 while using the proxy yielded 0.38.

However, graph 4 indicates that SPIs using the proxy and the actual data show very similar patterns of intervention behaviors. SPIs for all subperiods are higher than the precrisis period except the fourth subperiod during which there was no official intervention. They are highest during the subperiod 3.

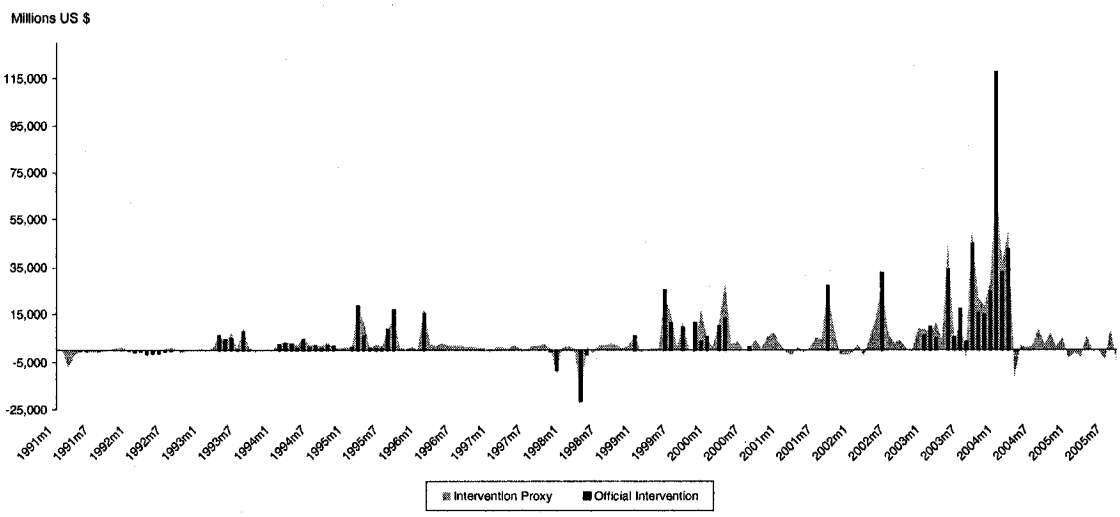
---

[13] Variance index shows the same pattern although individual level is different. (see table 7).
[14] Foreign reserves without adjusting interest earings can be the base value for the ratio of the official intervention. However, there is no significant difference between two cases since interest earings are very small relative to foreign reserves.

Finally, reserve money and M1 are used as scaling variables for the intervention proxy and the official intervention to take into account the problem of initial levels (table 3-6). These results also support the conclusion that intervention behavior in Japan during the postcrisis period became stronger than during the precrisis period. It was highest for the third subperiod.

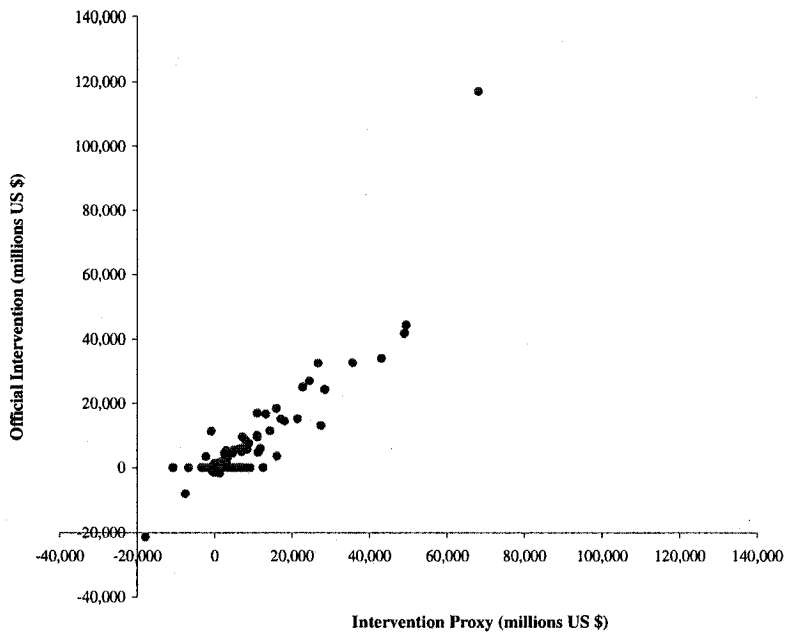
At least for Japan, the TPEMP framework can effectively characterize foreign exchange rate policy in the sense that there is very similar pattern in propensities to intervene using the proxy and actual official intervention. However, the gap between both propensities to intervene implies that the adjustment of interest earings does not sufficiently reduce the discrepancy between foreign reserves and the actual intervention.

Figure 1 Official Intervention and Intervention Proxy



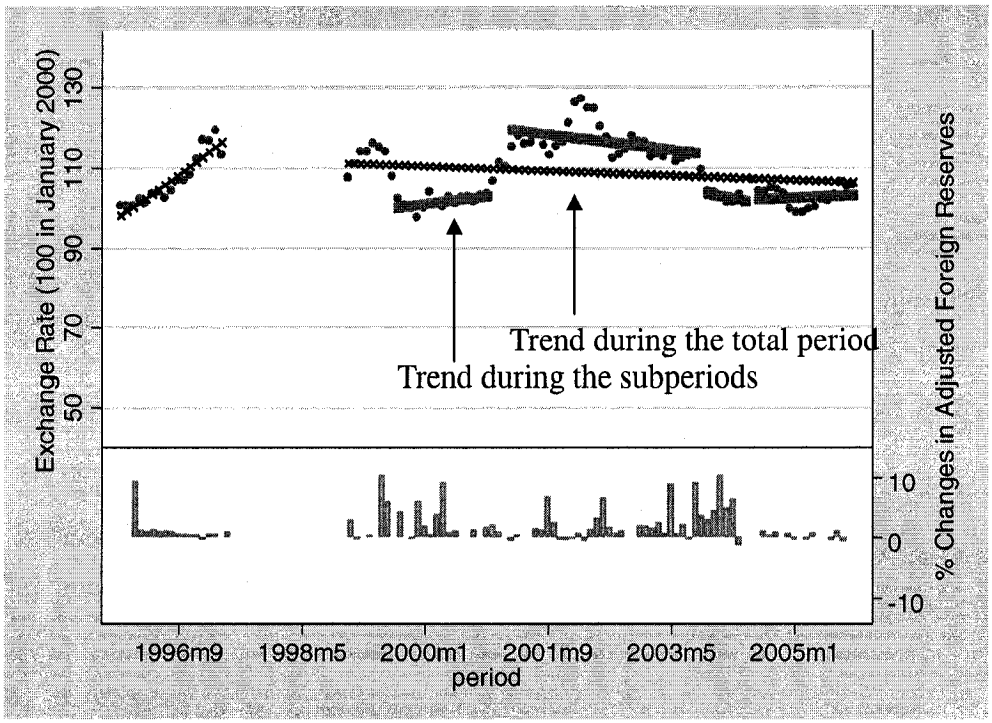
Data source: IFS and the Ministry of Finance Japan

Figure 2 Scatter Diagram between Official Intervention and Intervention Proxy



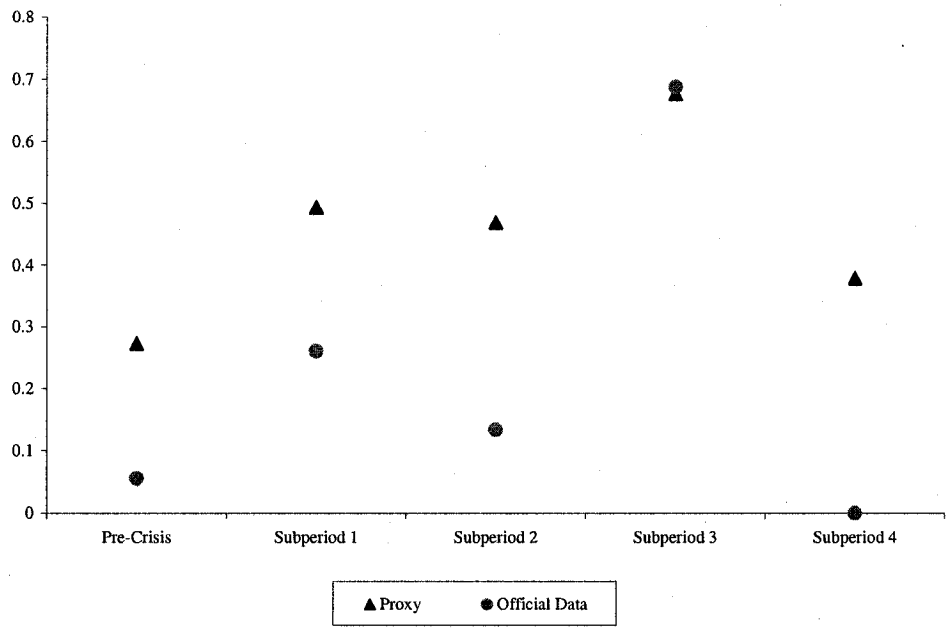
Data source: IFS and the Ministry of Finance Japan

Figure 3 Exchange rate and adjusted foreign reserves in Japan



Data source: IFS and authors' estimation

Figure 4 SPIs using intervention proxy and official data



Data source: Authors' estimation

Table 1 TPEMP framework using the intervention proxy

	Time Span	TC_er	TC_int	TPI	SPI_A	CPI_A	SPI_B	CPI_B
Precrisis	1996:1-1997:5	0.135	0.097	WS	0.273 (12/16)	0.514 (7/16)	0.249	0.418
Postcrisis	1999:1-2005:9	-0.007	0.234	0.972	0.525 (54/80)	0.493 (44/80)	0.525	0.431
Sub 1	1999:9~2000:11	0.023	0.278	WS	0.494 (9/14)	0.470 (7/14)	0.526	0.369
Sub 2	2001:3~2003:8	-0.020	0.200	0.908	0.469 (23/29)	0.541 (14/29)	0.464	0.463
Sub 3	2003:10~2004:4	-0.037	0.832	0.957	0.678 (2/6)	0.854 (3/6)	0.668	0.805
Sub 4	2004:6-2005:9	0.008	0.020	WS	0.380 (11/15)	0.419 (11/15)	0.353	0.372

Note:
1. TC_er and TC_int: trend coefficients of exchange rates (local currency/US$) and adjusted foreign reserves
2. TPI and SPI: trend propensity to intervene and smoothing propensity to intervene
3. CPI: combined propensity to intervene
4. A and B: right-signed data and all data

Table 2 SPI and CPI using proportion of the official intervention to adjusted foreign reserves

	Time Span	SPI_A	CPI_A	SPI_B	CPI_B
Precrisis	1996:1-1997:5	0.055 (16/16)	0.062 (16/16)	0.055	0.062
Postcrisis	1999:1-2005:9	0.163 (72/80)	0.161 (72/80)	0.219	0.22
Sub 1	1999:9~2000:11	0.261 (13/14)	0.214 (12/14)	0.275	0.266
Sub 2	2001:3~2003:8	0.134 (25/29)	0.129 (25/29)	0.212	0.217
Sub 3	2003:10~2004:4	0.688 (4/6)	0.642 (4/6)	0.731	0.717
Sub 4	2004:6-2005:9	0.0 (15/15)	0.0 (15/15)	0.0	0.0

Note:
1. SPI: only exchange rate is detrended
2. A and B: right-signed data and all data

Table 3 SPI and CPI using proportion of the intervention proxy to lagged reserve money

	Time Span	SPI_A	CPI_A	SPI_B	CPI_B
Precrisis	1996:1-1997:5	0.256 (9/16)	0.404 (7/16)	0.248	0.312
Postcrisis	1999:1-2005:9	0.423 (44/80)	0.418 (44/80)	0.354	0.357
Sub 1	1999:9~2000:11	0.371 (6/14)	0.348 (7/14)	0.276	0.261
Sub 2	2001:3~2003:8	0.428 (13/29)	0.458 (14/29)	0.363	0.378
Sub 3	2003:10~2004:4	0.875 (3/6)	0.797 (3/6)	0.788	0.757
Sub 4	2004:6-2005:9	0.382 (11/15)	0.378 (11/15)	0.338	0.334

Note:
1. SPI: only exchange rate is detrended
2. A and B: right-signed data and all data

Table 4 SPI and CPI using proportion of the intervention proxy to lagged M1

	Time Span	SPI_A	CPI_A	SPI_B	CPI_B
Precrisis	1996:1-1997:5	0.118 (9/16)	0.254 (7/16)	0.105	0.182
Postcrisis	1999:1-2005:9	0.236 (44/80)	0.228 (44/80)	0.189	0.19
Sub 1	1999:9~2000:11	0.181 (6/14)	0.171 (7/14)	0.133	0.124
Sub 2	2001:3~2003:8	0.237 (13/29)	0.252 (14/29)	0.189	0.19
Sub 3	2003:10~2004:4	0.706 (3/6)	0.55 (3/6)	0.585	0.541
Sub 4	2004:6-2005:9	0.201 (11/15)	0.181 (11/15)	0.171	0.156

Note:
1. SPI: only exchange rate is detrended
2. A and B: right-signed data and all data

Table 5 SPI and CPI using proportion of official intervention to lagged reserve money

	Time Span	SPI_A	CPI_A	SPI_B	CPI_B
Precrisis	1996:1-1997:5	0.047 (16/16)	0.061 (16/16)	0.047	0.061
Postcrisis	1999:1-2005:9	0.135 (72/80)	0.133 (72/80)	0.184	0.185
Sub 1	1999:9~2000:11	0.201 (13/14)	0.155 (12/14)	0.202	0.189
Sub 2	2001:3~2003:8	0.113 (25/29)	0.107 (25/29)	0.179	0.187
Sub 3	2003:10~2004:4	0.66 (4/6)	0.597 (4/6)	0.698	0.677
Sub 4	2004:6-2005:9	0.0 (15/15)	0.0 (15/15)	0.0	0.0

Note:
1. SPI: only exchange rate is detrended
2. A and B: right-signed data and all data

Table 6 SPI and CPI using proportion of official intervention to lagged M1

	Time Span	SPI_A	CPI_A	SPI_B	CPI_B
Precrisis	1996:1-1997:5	0.029 (16/16)	0.057 (16/16)	0.029	0.057
Postcrisis	1999:1-2005:9	0.077 (72/80)	0.075 (72/80)	0.109	0.111
Sub 1	1999:9~2000:11	0.113 (13/14)	0.077 (12/14)	0.112	0.093
Sub 2	2001:3~2003:8	0.058 (25/29)	0.053 (25/29)	0.094	0.104
Sub 3	2003:10~2004:4	0.542 (4/6)	0.419 (4/6)	0.544	0.506
Sub 4	2004:6-2005:9	0.0 (15/15)	0.0 (15/15)	0.0	0.0

Note:
1. SPI: only exchange rate is detrended
2. A and B: right-signed data and all data

Table 7 Variance Intervention Index for Japan

	Time Span	Var_index
Precrisis	1996:1-1997:5	0.464
Postcrisis	1999:1-2005:9	0.564
Sub 1	1999:9~2000:11	0.630
Sub 2	2001:3~2003:8	0.506
Sub 3	2003:10~2004:4	0.897
Sub 4	2004:6-2005:9	0.105

Table 8 Volatility of Exchange Rate, Reserves, and Nominal Interest Rate in Selected Countries

Country	Period	Exchange Rate[1]	Reserves[2]	Nominal Interest Rate[3]
Japan	Feb. 1973-Nov. 1999	61.2	74.3	0.0
Canada	Jun. 1970-Nov. 1999	93.6	36.6	2.8
Australia	Jan 1984-Nov. 1999	70.3	50.0	0.0
New Zealand	Mar. 1985-Nov. 1999	72.2	31.4	1.8
United State $/DM	Feb. 1973-Nov. 1999	58.7	62.2	0.3

Note:
1. Probability that the monthly change of exchange rate is within ±2.5 percent band
2. Probability that the monthly change of reserves is within ±2.5 percent band
3. Probability that the monthly change of nominal interest rate is greater than ±4 percent band

Source: Calvo and Reinhart (2002)

Chapter IV

How Have Asia's Floating Regimes Changed During the Postcrisis Period?

There has still been considerable disagreement in Asia's postcrisis exchange rate regimes. While the view that most of the crisis countries shifted from precrisis fixed rates to postcrisis floating rates has become popular, many scholars point out its oversimplification. Pontines and Siregar (2005) find that Indonesia, Korea, and Thailand have maintained a *de-facto* flexible exchange rate regime during the post-1997 period but Singapore has increased intervention. McKinnon and Schnabl (2005), however, argue that postcrisis Asian foreign exchange policies show strong intervention and they indeed have returned to soft dollar peg. Hernández and Montiel (2003) find that postcrisis foreign exchange policies in East Asia become more flexible than before but less than real free floating. Cavoli and Rajan (2005) cannot on the other hand find any general patterns.[15] In light of these differences, chapter IV revisits the issue by characterizing foreign exchange rate policies in Korea, Indonesia, Thailand, and Singapore.

1. Preliminary Analysis

Preliminary graphical analysis is useful in inspecting changes in exchange rate policies. Figures 1 through 5 present exchange rates, percentage changes in the adjusted foreign reserves, TFRIRLN, and estimated time trends in exchange rates

[15] See table 1 for exchange rate regimes of Korea, Indonesia, Thailand, and Singapore in IMF, LYS, and Reinhart and Rogoff.

during the subperiods as well as the total period from January 1996 to September 2005. Exchange rates are normalized such that the exchange rate in January 2000 is 100, which enables us to compare behaviors of exchange rates across four countries.

Exchange rates in Korea have demonstrated an appreciation trend on average during the postcrisis period and have several stable subperiods after transition periods with jumps. Positive signs are dominant in percentage changes of the adjusted foreign reserves, implying that the stock of foreign reserves has increased consistently. Percentage changes of the adjusted foreign reserves are relatively high from 1999 through 2000. Therefore, it is likely that Korea performed strong interventions in 1999 and 2000. I divide the postcrisis period into five subperiods based on such characteristics: (i) January 1999-October 1999, (ii) December 1999-October 2000, (iii) March 2001-April 2002, (iv) July 2002-October 2004, and (v) December 2004-September 2005.

Exchange rates in Indonesia have demonstrated a depreciation trend on average during the postcrisis period. While exchange rates were quite volatile until the middle of 2002, they have been stable since then. With the exception of 2001, there are many observations with absolute value of percentage changes of the adjusted foreign reserves larger than 5%. Therefore, there is the possibility of strong intervention since the middle of 2002. The postcrisis period of Indonesia is also divided into five subperiods: (i) April 1999-January 2000, (ii) March 2000-January 2001, (iii) April 2001-April 2002, (iv) July 2002-April 2003, and (v) June 2003-September 2005.

Exchange rates in Thailand have also shown depreciation trend on average during the postcrisis period and they are relatively stable from 2001 to early 2003. Percentage changes of the adjusted foreign reserves have more positive signs and are relatively small from 2000 and through 2001. Therefore, Thailand seems to have managed strong intervention in 2002 and early 2003. I divide the postcrisis period of Thailand into four subperiods: (i) January 1999-Februry 2000, (ii) March 2000-November 2000, (iii) April 2001-August 2003, and (iv) October 2003-September 2005.

Exchange rates in Singapore have shown an appreciation trend on average during the postcrisis period and they are quite stable. Although absolute values of percentage changes of the adjusted foreign reserves are smaller than 5%, the adjusted foreign reserves show consistent changes. These characteristics imply that Singapore may have intervened systemically. The postcrisis period of Singapore is divided to five subperiods: (i) April 1999-January 2000, (ii) March 2000-January 2001, (iii) April 2001-April 2002, (iv) August 2002-May 2003, and (v) July 2003-March 2005.

2. Benchmark Results

Tables 1.1-1.4 contain the results based on the benchmark intervention proxy for Korea, Indonesia, Thailand, and Singapore. The first columns list periods, the second their time spans, and the remaining columns the indices such as trend coefficients of exchange rates and the adjusted foreign reserves, trend propensity to intervene (TPI), and smoothing propensity to intervene (SPI)

Korea pursued foreign reserve accumulation as the primary objective rather than managing the trend in exchange rates during the postcrisis period. It is a significant characteristic with regard to Korea's foreign exchange policy that there was a consistently positive trend coefficient in the adjusted foreign reserves regardless to movement in exchange rates[16]. Estimates for TPI have therefore correct signs in three subperiods when exchange rates appreciate. However, there is a possibility that importance of foreign reserve accumulation as the primary objective seems to be reduced recently. Trend coefficient of the adjusted foreign reserves has gone down significantly during the subperiod 5.

Relative to the precrisis period Korea has reduced intervention for smoothing operation during the postcrisis period. The SPI during the postcrisis period is 0.55 while it is 0.73 for the precrisis period. SPIs for the subperiods confirm this conclusion. They are well below than the precrisis period with the exception of period two and it is particularly low during the subperiod 5, running 0.27.

A final interesting result is that there is a tendency toward asymmetrical intervention in Korea. There was much stronger smoothing intervention in the second period (with a strong won), when SPI is 0.79, while SPI for period three (with a weak won) is quite low, with 0.45.

Indonesia has also reduced intervention during the postcrisis for smoothing intervention. SPI for the postcrisis period is 0.43 while it is quite high, running 0.93, for the precrisis period. Although SPIs for the subperiods of the postcrisis are also

[16] This result is same across all the other intervention proxies regardless to the interest earnings and the valuation changes.

relatively lower than SPI for the precrisis, there is an interesting characteristic different from Korea. There is a tendency that smoothing intervention comes back although they are not as strong as the precrisis. SPIs for period 4 and period 5 are 0.51 and 0.52, while they are around 0.2 for period 1 and period 3.

Other noticeable indices are TPIs during the subperiods. Although they are small except the subperiod 4, they have right signs, which is unusual in the TPEMP framework. Trend intervention, however, seems low. Annual increasing rates in the adjusted foreign reserves are less than 2.2% except period 4 and they are quite small relative to annual increasing rate in exchange rates.

Thailand has characteristics similar to Korea and Indonesia. Like Korea, Thailand has pursued foreign reserve accumulation as a policy objective during the postcrisis period. A significant characteristic is that there has also been a consistently positive trend coefficient in the adjusted foreign reserves regardless of movement in exchange rates[17]. Therefore, estimates for TPI have correct signs only during the subperiod 3 when exchange rates appreciate.

Like Indonesia, Thailand has reduced intervention during the postcrisis period relative to the precrisis period for smoothing intervention, but there is a suggestion that smoothing intervention has recently returned.[18] During the postcrisis period, SPI is 0.55 while it is quite high, running 0.75, during the precrisis period. SPIs for period 4 and period 5 are 0.56 while they are less than 0.45 for period 1 and period 2.

---

[17] This is true for all the other intervention proxies despite considering the interest earnings and the valuation changes.

[18] This perceived change for Thailand is widely believed to have resulted from the change in Governor of the Thai central bank which occurred in May 2001

Singapore has intervened strongly during the postcrisis period relative to the precrisis period. Table 2.4 reports that SPIs for all the subperiods as well as total postcrisis period are lager than the precrisis period. Since Singapore is known to maintain a currency basket regime[19], this result implies that the US dollar has a high weight in the basket.

3. Comparative Results of the TPEMP framework

I report selected alternative results. Two categories summarize them: (i) results of the TPEMP framework based on TFR and NFAIR (ii) Combined propensity to intervene (CPI) with right signs.[20]

Tables 2.1-2.8 present the results based on foreign asset, TFR, and the adjusted net foreign asset, NFAIR, for intervention proxies. The first columns list periods, the second their time spans, and the remaining columns the indices such as trend coefficients of exchange rates and foreign asset or adjusted net foreign asset, TPI, and SPI.

The benchmark results for Korea seem robust except that the results based on NFAIR do not confirm the existence of asymmetric intervention. All trend coefficients of TFR and NFAIR for the postcrisis are positive, but it is quite small for the subperiod 5. SPIs calculated with both proxies have reduced during the postcrisis period. While SPI calculated with TFR shows asymmetric intervention, 0.78 for the subperiod 2 and 0.38 for the subperiods 3, SPIs calculated with

[19] See Rajan (2002)
[20] See appendix I for results of all observations

NFAIR present that there is only decreasing tendency of smoothing intervention.

While the indices calculated with both intervention proxies confirm that Indonesia has reduced smoothing intervention during the postcrisis period relative to during the precrisis period, only SPIs with TFR present that smoothing intervention returns recently. SPIs for the postcrisis period are smaller than SPI for the precrisis period by at least 0.3. SPIs calculated with TFR for subperiod 4 and subperiod 5 are 0.64 and 0.56 respectively. On the other hand, SPIs calculated with NFAIR show only the possibility of strong smoothing intervention during the postcrisis period. SPIs for period 3 and period 5 are 0.78 and 0.5, respectively.

For Thailand, the indices based on both proxies show the same results with Indonesia. That is, they confirm the benchmark result that Thailand has reduced smoothing intervention during the postcrisis period relative to precrisis period but only SPI calculated with TFR shows that there is a tendency that smoothing intervention returns. SPI for the postcrisis period are smaller than SPI for the precrisis period by around 0.2. SPIs calculated with TFR for subperiod 4 and subperiod 5 are 0.64 and 0.56 respectively.

The indices based on both proxies for confirm the robustness of the benchmark result. Except SPI calculated with NFAIR for subperiod 4, SPIs for all subperiods of the postcrisis are higher than the precrisis.

Tables 3.1-3.4 list CPIs. The first columns list periods, the second their time spans, and the remaining columns CPIs calculated with TFR, TFRIRLN, and NFAIR.

CPI confirms that the benchmark results are robust in Korea. All CPIs for the

postcrisis are smaller than precrisis. CPI for period 2 is quite high while low for period 3. Although CPIs for Indonesia report similar results with the benchmark method, there is a significant difference. CPIs calculated with TFR and TFRIRLN for the postcrisis are higher than the precrisis. The trend problem made an important role for such uncanny result. It is well known that the Indonesian government intervened strongly in foreign exchange market before the Asian crisis. There was a consistent trend in exchange rates and most of high monthly SPI were deleted since they have wrong signs. Therefore, Indonesia is a good example illustrating the importance of the trend problem.

CPIs also have similar results with the benchmark method except that CPIs with NFAIR do not confirm the return of smoothing intervention. CPIs for Singapore do not support the benchmark results precisely but there are many subperiods during which CPIs are higher than the precrisis.

4. CPI using the Intervention Proxies Scaled by Reserve Money and M1

Tables 4.1-4.4 show results of the CPIs using the main intervention proxies scaled by reserve money and M1. The first column lists periods, the second time spans, and the remaining columns CPIs.[21]

Results for Korea indicate that the Korean government has reduced intervention since December 2004, performing the asymmetric intervention. CPIs are relatively low for subperiod 5, 0.61 with reserve money and 0.51 with M1. CPIs are 0.94 with reserve money and 0.91 with M1 for subperiod 2 while 0.76 with reserve money and

[21] See appendix I results of all observations

0.71 with M1 for subperiod 3.

CPIs for Indonesia show that the authority intervened more strongly during the postcrisis than during the precrisis. This result also points out the problem of trend. High CPIs are deleted due to having wrong sign, which is same with the CPIs in section 3. CPIs for Indonesia and Thailand show that both countries increased interventions recently.

Singapore has high CPIs during the postcrisis as well as the precrisis. It is worthy of note that CPIs during the postcrisis except for subperiod 4 are higher than during the precrisis.

5. Probabilities in Calvo and Reinhart and Variance Intervention Index

Tables 5.1-5.4 present results of the methodology in Calvo and Reinhart. The first column lists periods, the second three thresholds, and the remaining columns proportions that monthly percentage changes of exchange rates, TFR, TFRIRLN, and NFAIR are within the thresholds.

Results for Korea confirm that the Korean government has reduced intervention. Proportions of exchange rates for the postcrisis decease relative to the precrisis at each threshold but proportions of intervention proxies for the postcrisis increase.

However, benchmark results of Indonesia and Thailand receive partial support from the CR method. While proportions of exchange rates, TFR, and TFRIRLN for Indonesia and Thailand show reductions of their intervention polici during the postcrisis period, proportions of NFAIR decease at 2.5% and 3% for Indonesia and at

3% for Thailand.

For Singapore, proportions of exchange rates for the postcrisis are similar with precrisis but proportions of intervention proxies increase slightly. Therefore, the CR method does not support the benchmark result that Singapore increases intervention during the postcrisis period.

Tables 6.1-6.4 report variance intervention index. The variance index indicates that Korea, Indonesia, and Thailand have decreased intervention during the postcrisis period. Singapore has higher intervention index during the postcrisis period although not being significantly high relative to the precrisis period.

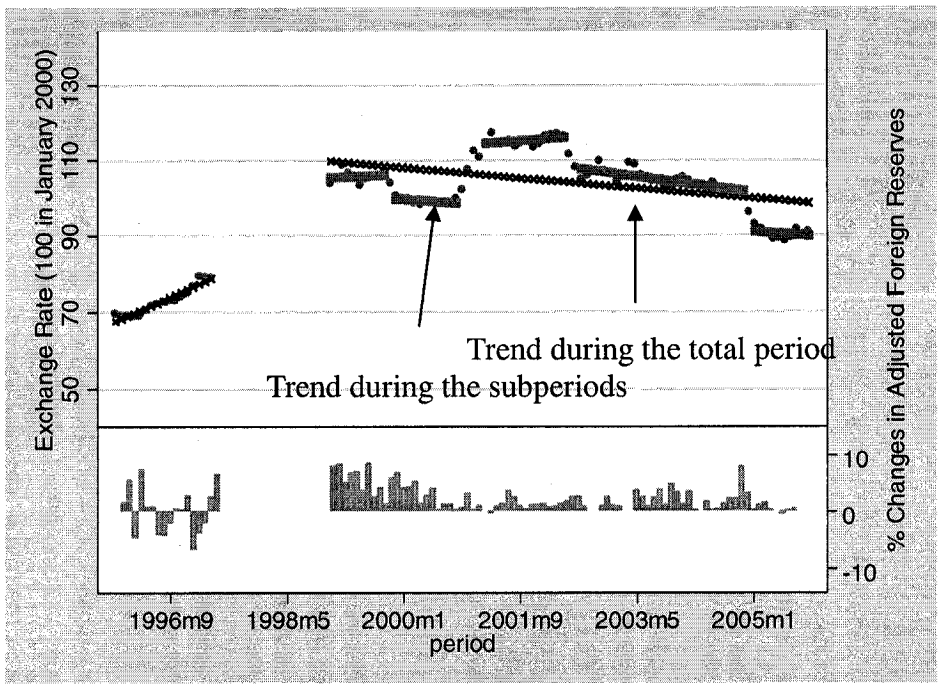
6. Conclusion

Through the TPEMP framework, my dissertation documents that relative to the precrisis period, Korea, Indonesia, and Thailand have reduced foreign exchange market intervention during the postcrisis periods. More specifically, Korea has reduced foreign exchange market intervention and its intervention has become quite low recently. On the other hand, Indonesia and Thailand have increased intervention recently although their levels are lower than the precrisis. My dissertation also documents that Singapore has intervened in foreign exchange market more strongly during the postcrisis period.

The results support the prevalent view that most Asian countries have moved toward flexible exchange rate regimes after the crisis with the exception of announced pegs such as Malaysia and China and the managed float of Singapore. I

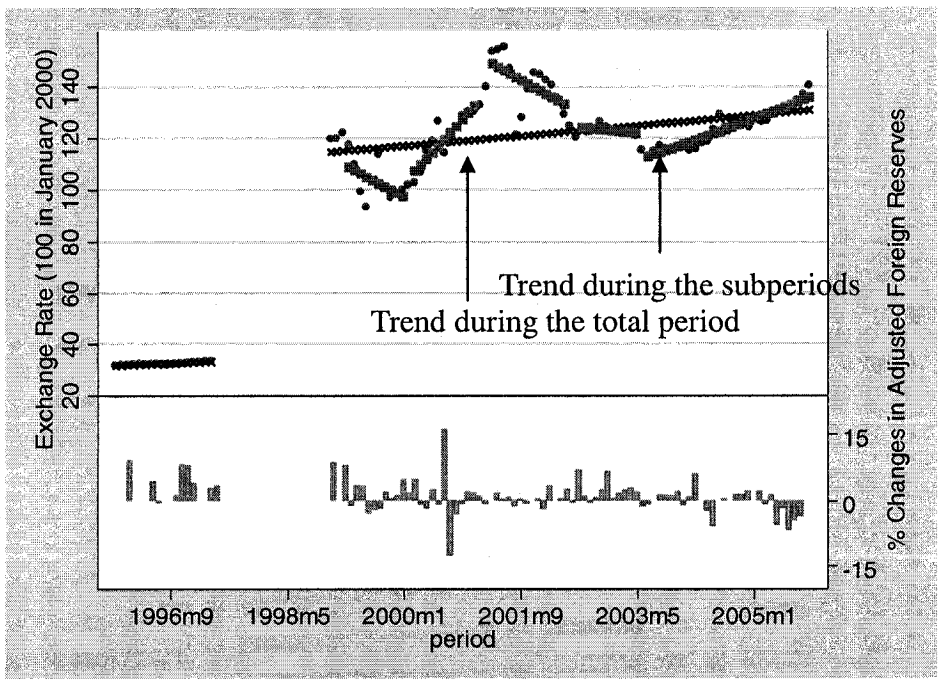
also find that there exists evidence on fear of floating in Indonesia and Thailand. Both nations have recently increased interventions. However, it is against McKinnon and Schnabl (2003)'s argument that Asian countries have returned to soft dollar peg. Korea has reduced intervention and the returning of Indonesia and Thailand keeps away from the precrisis pegs.

Figure 1 Exchange Rates and Adjusted Foreign Reserves in Korea



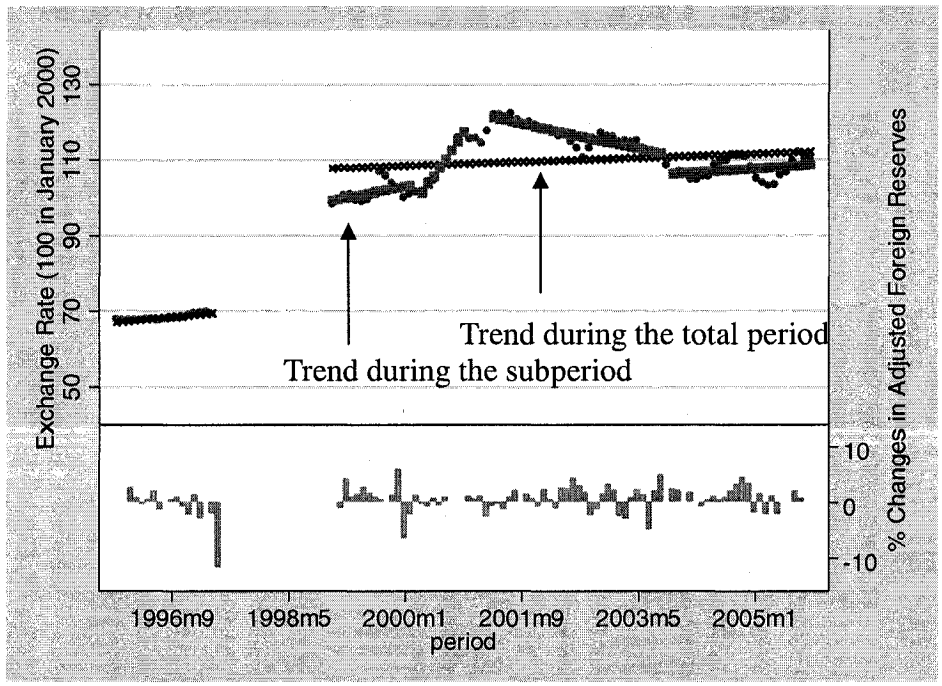
Source: IFS and author's calculation

Figure 2 Exchange Rates and Adjusted Foreign Reserves in Indonesia



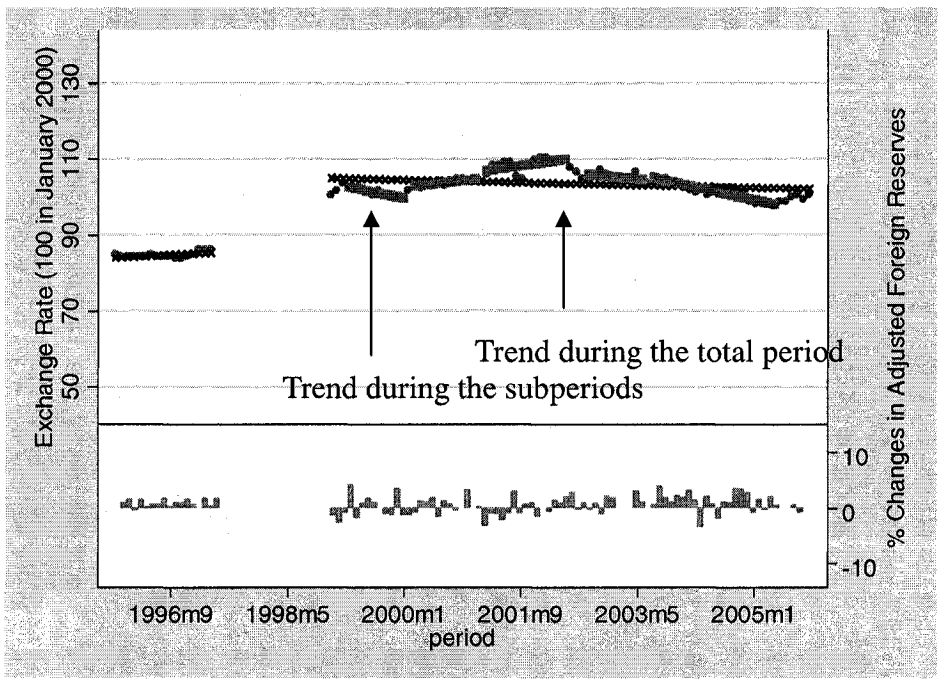
Source: IFS and author's calculation

Figure 3 Exchange Rates and Adjusted Foreign Reserves in Thailand



Source: IFS and author's calculation

Figure 4 Exchange Rates and Adjusted Foreign Reserves in Singapore



Source: IFS and author's calculation

Table 1.1 The TPEMP framework with TFRIRLN for Korea

	Time Span	TC_er	TC_tfrirln	TPI	SPI
Precrisis	1996:1-1997:5	0.119	-0.096	0.176	0.732
Postcrisis	1999:1-2005:9	-0.016	0.240	0.938	0.545
Sub 1	1999:1-1999:10	0.007	0.851	WS	0.631
Sub 2	1999:12-2000:10	-0.013	0.342	0.964	0.788
Sub 3	2001:3-2002:4	0.013	0.179	WS	0.451
Sub 4	2002:7-2004:10	-0.025	0.238	0.906	0.549
Sub 5	2004:12-2005:9	-0.015	0.048	0.759	0.286

Table 1.2 The TPEMP framework with TFRIRLN for Indonesia

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.037	0.306	WS	0.927
Postcrisis	1999:1-2005:9	0.020	0.082	WS	0.428
Sub 1	1999:4-2000:1	-0.136	0.021	0.136	0.195
Sub 2	2000:3-2001:1	0.285	-0.019	0.061	0.453
Sub 3	2001:4-2002:4	-0.107	0.009	0.076	0.197
Sub 4	2002:7-2003:4	-0.024	0.267	0.917	0.510
Sub 5	2003:6-2005:9	0.085	-0.018	0.177	0.520

Table 1.3 The TPEMP framework with TFRIRLN for Thailand

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.024	-0.044	0.647	0.749
Postcrisis	1999:1-2005:9	0.006	0.106	WS	0.553
Sub 1	1999:1-2000:2	0.037	0.148	WS	0.448
Sub 2	2000:3-2000:11	0.278	0.033	WS	0.390
Sub 3	2001:4-2003:8	-0.034	0.151	0.815	0.555
Sub 4	2003:10-2005:9	0.011	0.119	WS	0.558

Table 1.4 The TPEMP framework with TFRIRLN for Singapore

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.011	0.112	WS	0.550
Postcrisis	1999:1-2005:9	-0.004	0.073	0.947	0.639
Sub 1	1999:4-2000:1	-0.037	0.039	0.514	0.615
Sub 2	2000:3~2001:1	0.020	0.078	WS	0.671
Sub 3	2001:4~2002:4	0.025	-0.006	0.183	0.688
Sub 4	2002:8~2003:5	-0.016	0.080	0.837	0.563
Sub 5	2003:7~2005:3	-0.039	0.158	0.801	0.639

Table 2.1 The TPEMP framework with TFR for Korea

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.095	-0.020	0.176	0.731
Postcrisis	1999:1-2005:9	-0.016	0.205	0.928	0.529
Sub 1	1999:1-1999:10	0.007	0.329	WS	0.668
Sub 2	1999:12-2000:10	-0.013	0.309	0.960	0.777
Sub 3	2001:3-2002:4	0.013	0.147	WS	0.376
Sub 4	2002:7-2004:10	-0.025	0.237	0.906	0.549
Sub 5	2004:12-2005:9	-0.015	0.049	0.764	0.286

Table 2.2 The TPEMP framework with NFAIR for Korea

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.095	-0.039	0.248	0.757
Postcrisis	1999:1-2005:9	-0.016	0.220	0.933	0.518
Sub 1	1999:1-1999:10	0.007	0.538	WS	0.644
Sub 2	1999:12-2000:10	-0.013	0.287	0.957	0.646
Sub 3	2001:3-2002:4	0.013	0.213	WS	0.562
Sub 4	2002:7-2004:10	-0.025	0.222	0.900	0.520
Sub 5	2004:12-2005:9	-0.015	0.005	0.250	0.505

Table 2.3 The TPEMP framework with TFR for Indonesia

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.037	0.306	WS	0.926
Postcrisis	1999:1-2005:9	0.020	0.049	WS	0.419
Sub 1	1999:4-2000:1	-0.136	0.078	0.363	0.113
Sub 2	2000:3-2001:1	0.285	0.012	WS	0.418
Sub 3	2001:4-2002:4	-0.107	-0.042	WS	0.230
Sub 4	2002:7-2003:4	-0.024	0.164	0.871	0.641
Sub 5	2003:6-2000:5	0.085	-0.025	0.229	0.561

Table 2.4 The TPEMP framework with NFAIR for Indonesia

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.037	0.413	WS	0.883
Postcrisis	1999:1-2005:9	0.020	0.134	WS	0.556
Sub 1	1999:4-2000:1	-0.136	-0.111	WS	0.484
Sub 2	2000:3-2001:1	0.285	0.499	WS	0.223
Sub 3	2001:4-2002:4	-0.107	-0.116	WS	0.784
Sub 4	2002:7-2003:4	-0.024	0.182	0.883	0.394
Sub 5	2003:6-2005:9	0.085	0.085	WS	0.497

Table 2.5 The TPEMP framework with TFR for Thailand

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.024	-0.044	0.646	0.750
Postcrisis	1999:1-2005:9	0.006	0.080	WS	0.535
Sub 1	1999:1-2000:2	0.037	0.142	WS	0.427
Sub 2	2000:3-2000:11	0.278	0.017	WS	0.331
Sub 3	2001:4-2003:8	-0.034	0.105	0.754	0.639
Sub 4	2003:10-2005:9	0.011	0.120	WS	0.558

Table 2.6 The TPEMP framework with NFAIR for Thailand

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.024	-0.020	0.458	0.772
Postcrisis	1999:1-2005:9	0.006	0.203	WS	0.530
Sub 1	1999:1-2000:2	0.037	0.182	WS	0.570
Sub 2	2000:3-2000:11	0.278	0.345	WS	0.702
Sub 3	2001:4-2003:8	-0.034	0.298	0.897	0.532
Sub 4	2003:10-2005:9	0.011	0.129	WS	0.520

Table 2.7 The TPEMP framework with TFR for Singapore

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.011	0.112	WS	0.548
Postcrisis	1999:1-2005:9	-0.004	0.073	0.947	0.638
Sub 1	1999:4-2000:1	-0.037	0.040	0.520	0.613
Sub 2	2000:3~2001:1	0.020	0.079	WS	0.671
Sub 3	2001:4~2002:4	0.025	-0.008	0.246	0.690
Sub 4	2002:8~2003:5	-0.016	0.079	0.835	0.562
Sub 5	2003:7~2005:3	-0.039	0.159	0.802	0.640

Table 2.8 The TPEMP framework with NFAIR for Singapore

	Time Span	TC_er	TC_int	TPI	SPI
Precrisis	1996:1-1997:5	0.011	0.125	WS	0.478
Postcrisis	1999:1-2005:9	-0.004	0.069	0.944	0.586
Sub 1	1999:4-2000:1	-0.037	0.017	0.311	0.601
Sub 2	2000:3~2001:1	0.020	0.105	WS	0.663
Sub 3	2001:4~2002:4	0.025	0.013	WS	0.541
Sub 4	2002:8~2003:5	-0.016	0.069	0.815	0.358
Sub 5	2003:7~2005:3	-0.039	0.113	0.743	0.626

Table 3.1 Combined propensity to intervene with right signs for Korea

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.835	0.835	0.803
Postcrisis	1999:1-2005:9	0.557	0.575	0.620
Sub 1	1999:1-1999:10	0.487	0.759	0.762
Sub 2	1999:12-2000:10	0.784	0.812	0.891
Sub 3	2001:3-2002:4	0.457	0.463	0.499
Sub 4	2002:7-2004:10	0.602	0.601	0.645
Sub 5	2004:12-2005:9	0.382	0.327	0.497

Table 3.2 Combined propensity to intervene with right signs for Indonesia

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.312	0.283	0.772
Postcrisis	1999:1-2005:9	0.384	0.390	0.638
Sub 1	1999:4-2000:1	0.151	0.191	0.744
Sub 2	2000:3-2001:1	0.308	0.353	0.991
Sub 3	2001:4-2002:4	0.200	0.245	0.626
Sub 4	2002:7-2003:4	0.496	0.628	0.729
Sub 5	2003:6-2005:9	0.546	0.476	0.504

Table 3.3 Combined propensity to intervene with right signs for Thailand

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.729	0.729	0.742
Postcrisis	1999:1-2005:9	0.581	0.592	0.610
Sub 1	1999:1-2000:2	0.562	0.583	0.728
Sub 2	2000:3-2000:11	0.208	0.200	0.134
Sub 3	2001:4-2003:8	0.634	0.669	0.700
Sub 4	2003:10-2005:9	0.686	0.685	0.547

Table 3.4 Combined propensity to intervene with right signs for Singapore

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.527	0.533	0.555
Postcrisis	1999:1-2005:9	0.562	0.562	0.490
Sub 1	1999:4-2000:1	0.602	0.601	0.501
Sub 2	2000:3~2001:1	0.642	0.641	0.563
Sub 3	2001:4~2002:4	0.579	0.576	0.403
Sub 4	2002:8~2003:5	0.415	0.415	0.386
Sub 5	2003:7~2005:3	0.694	0.693	0.581

Table 4.1 CPI using proportion of the main intervention proxy to lagged reserve money and M1 in Korea

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.842	0.792
Postcrisis	1999:1-2005:9	0.779	0.721
Sub 1	1999:1-1999:10	0.887	0.839
Sub 2	1999:12-2000:10	0.938	0.912
Sub 3	2001:3-2002:4	0.763	0.706
Sub 4	2002:7-2004:10	0.791	0.791
Sub 5	2004:12-2005:9	0.612	0.513

Table 4.2 CPI using proportion of the main intervention proxy to lagged reserve money and M1 in Indonesia

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.291	0.251
Postcrisis	1999:1-2005:9	0.428	0.401
Sub 1	1999:4-2000:1	0.240	0.229
Sub 2	2000:3-2001:1	0.403	0.375
Sub 3	2001:4-2002:4	0.286	0.262
Sub 4	2002:7-2003:4	0.675	0.642
Sub 5	2003:6-2005:9	0.496	0.465

Table 4.3 CPI using proportion of the main intervention proxy to lagged reserve money and M1 in Thailand

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.814	0.818
Postcrisis	1999:1-2005:9	0.704	0.715
Sub 1	1999:1-2000:2	0.713	0.717
Sub 2	2000:3-2000:11	0.295	0.291
Sub 3	2001:4-2003:8	0.794	0.808
Sub 4	2003:10-2005:9	0.764	0.782

Table 4.4 CPI using proportion of the main intervention proxy to lagged reserve money and M1 in Singapore

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.813	0.760
Postcrisis	1999:1-2005:9	0.876	0.807
Sub 1	1999:4-2000:1	0.910	0.853
Sub 2	2000:3-2001:1	0.921	0.868
Sub 3	2001:4-2002:4	0.889	0.820
Sub 4	2002:7-2003:4	0.765	0.670
Sub 5	2003:6-2000:5	0.945	0.900

Table 5.1 Method in Calvo and Reinhart (2002) for Korea

	Thresholds	BLER	TFR	TFRIRLN	NFAIR
Precrisis	2% (1.5%)	98.8	47.6	47.6	34.5
1990:1-1996:12	2.5% (2%)	98.8	57.1	57.1	46.4
	3% (2.5%)	100.0	64.3	64.3	58.3
Post crisis	2% (1.5%)	64.1	61.5	57.7	53.8
1999:1-2005:6	2.5% (2%)	78.2	66.7	62.8	61.5
	3% (2.5%)	84.6	75.6	70.5	64.1

Table 5.2 Method in Calvo and Reinhart for Indonesia

	Thresholds	BLER	TFR	TFRIRLN	NFAIR
Precrisis	2% (1.5%)	100.0	50.0	51.2	32.1
1990:1-1996:12	2.5% (2%)	100.0	52.4	53.6	39.3
	3% (2.5%)	100.0	61.9	61.9	47.6
Post crisis	2% (1.5%)	46.2	75.6	69.2	33.3
1999:1-2005:6	2.5% (2%)	53.8	80.8	78.2	37.2
	3% (2.5%)	60.3	82.1	80.8	42.3

Table 5.3 Method in Calvo and Reinhart for Thailand

	Thresholds	BLER	TFR	TFRIRLN	NFAIR
Precrisis	2% (1.5%)	100.0	48.8	48.8	53.6
1990:1-1996:12	2.5% (2%)	100.0	60.7	60.7	64.3
	3% (2.5%)	100.0	67.9	67.9	76.2
Post crisis	2% (1.5%)	79.5	64.1	64.1	59.0
1999:1-2005:6	2.5% (2%)	82.1	80.8	79.5	69.2
	3% (2.5%)	87.2	87.2	85.9	70.5

Table 5.4 Method in Calvo and Reinhart for Singapore

	Thresholds	BLER	TFR	TFRIRLN	NFAIR
Precrisis	2% (1.5%)	92.9	64.3	63.1	83.3
1990:1-1996:12	2.5% (2%)	97.6	73.8	73.8	90.5
	3% (2.5%)	97.6	83.3	83.3	94.0
Post crisis	2% (1.5%)	93.6	73.1	73.1	83.3
1999:1-2005:6	2.5% (2%)	96.2	82.1	82.1	94.9
	3% (2.5%)	97.4	85.9	85.9	96.2

Table 6.1 Variance intervention index for Korea

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1990:1-1996:12	0.934	0.934	0.936
Postcrisis	1999:1-2005:6	0.448	0.549	0.759

Table 6.2 Variance intervention index for Indonesia

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1990:1-1996:12	0.984	0.984	0.992
Postcrisis	1999:1-2005:6	0.229	0.356	0.628

Table 6.3 Variance intervention index for Thailand

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1990:1-1996:12	0.984	0.984	0.992
Postcrisis	1999:1-2005:6	0.229	0.356	0.628

Table 6.4 Variance intervention index for Singapore

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1990:1-1996:12	0.609	0.612	0.671
Postcrisis	1999:1-2005:6	0.684	0.684	0.586

Chapter V

Foreign Exchange Rate Policies Targeting Nominal Effective Exchange Rate in Selected Asian Countries

1. Characteristics of Foreign Exchange Rate Policy

There has been increasing interest in foreign exchange rate policy targeting currency baskets among Asian countries since the Asian crisis. Economists such as Williamson (1999) and Rajan (2002) suggest the currency basket arrangement as an option of foreign exchange rate regime for Asian countries under the high capital mobility. Indeed, the Monetary Authority of Singapore (MAS) officially announces that it manages the Singapore dollar against a basket of currencies of Singapore's main trading partners and competitors.

This section investigates how four countries, including Singapore, intervene in the foreign exchange market targeting nominal effective exchange rates (NEER). The TPEMP framework in section IV is applied again except that nominal effective exchange rate (NEER) is substituted for the bilateral exchange rate of local currencies to the US dollar (BLER)[22]. My dissertation uses the NEER published by the Bank for International Settlement (BIS).

Figure 1 reports NEER and percentage changes in the adjusted foreign reserves, TFRIRLN for Korea. The higher number implies the more appreciated NEER, which is opposite to how the BLER was reported. NEER in Korea has been depreciated slightly during the postcrisis periods except for appreciations during the

[22] See appendix II for results with all observations.

second and fifth subperiods. Since NEER has similar structural breaks with BLER the postcrisis period is divided into the same subperiods in chapter IV.

Table 1 reports the benchmark result of the TPEMP framework, which uses the benchmark intervention proxy and observations with right sign. The first columns list periods, the second their time spans, and the remaining columns indices such as trend coefficients of exchange rates and TFRIRLN, trend propensity to intervene (TPI), smoothing propensity to intervene (SPI), and combined propensity to intervene (CPI). Although NEER has been depreciated on average during the postcrisis period, Korea experienced appreciations often, i.e., subperiods 2, 3, and 5. Korea has TPIs with right signs during appreciation periods but they do not indicate strong intervention targeting trend in NEER since rights signs resulted from the consistent increase of foreign reserves as discussed in section IV. High SPI, 0.707 for subperiod 2, indicates that Korea intervened strongly in the foreign exchange market while NEER was appreciated. SPI does not decrease much during subperiod 5, running 0.434, implying that there is no strong evidence of decreases of intervention.

Figure 4 and 5 compare patterns among SPIs and CPIs using alternative intervention proxies. They have similar patterns except that SPI using net foreign asset adjusted by interest earnings increases during subperiod 5.

Tables 2 reports CPIs using proportion of the benchmark intervention proxy to reserve money and M1 lagged by one month. It also indicates that there has been a reduction of intervention during the postcrisis period.

Figure 2 displays NEER and percentage changes in the adjusted foreign

reserves for Indonesia. Since NEER has very similar pattern with BLER, the postcrisis period is divided into the same subperiods with BLER.

Table 3 reports the benchmark result of TPEMP framework. While being appreciated during the precrisis period on average by 2.5% annually, NEER is depreciated during the postcrisis period on average by 3%. There is evidence that intervention was reduced during the postcrisis period. SPIs fell into 0.436 during the postcrisis period from 0.768 during the precrisis period. However, SPIs increased recently although being lower than the precrisis. They became 0.523 and 0.567 for subperiods 3 and 4. CPIs also have similar results.

Figures 7 and 8 compare patterns among SPIs and CPIs using alternative intervention proxies. Except for CPI using net foreign asset adjusted by interest earnings all SPIs and CPIs show that intervention during the postcrisis period is lower than the precrisis but it increased during subperiods 4 and 5, which is also supported by CPI using proportion of the benchmark intervention proxy to reserve money and M1 lagged by one month in the table 4.

Figure 3 shows NEER and percentage changes in the adjusted foreign reserves for Thailand. Since NEER has very similar pattern with BLER, the postcrisis period is divided into the same subperiods with BLER.

Table 5 reports the benchmark result of TPEMP framework. While being appreciated during the precrisis period on average by 4% annually, NEER is depreciated during the postcrisis period on average by 1.4%. Intervention was reduced during the postcrisis period. SPI is 0.565 during the postcrisis period while

being 0.768 during the precrisis period. However, SPIs increased recently. They became 0.589 and 0.616 for subperiods 3 and 4. CPIs also have similar results.

Figures 9 and 10, and table 4 present SPIs and CPIs using alternative intervention proxies. Except for CPI using net foreign asset adjusted by interest earnings, all SPIs and CPIs show the same result that intervention during the postcrisis period is lower than the precrisis but it increased during subperiods 3 and 4.

Figure 4 illustrates NEER and percentage changes in the adjusted foreign reserves for Singapore. While NEER in Singapore has depreciation trend on average during the postcrisis periods, it was appreciated and then returned to deprecation in 2000. Based on such breaks in NEER, I divide the postcrisis period into four subperiods: (i) January 1999-May 2000, (ii) August 2000-September 2001, (iii) January 2002-September 2003, (iv) November 2003-September 2005.

Table 7 contains the benchmark result of the TPEMP framework. While NEER was appreciated on average by 5.2% annually during the precrisis period, it has been depreciated by 1.4% during the postcrisis period. TPIs with wrong signs for three subperiods indicate that trend in NEER was not target of foreign exchange rate policy. Singapore has performed significant intervention during the postcrisis period as well as the precrisis period. SPIs are higher than 0.6 except for subperiod 1. CPIs are also higher than 0.6 except for precrisis period and subperiod 3. These results support the idea that Singapore maintains the currency basket regime.

Figure 11 and 12 compare patterns among SPIs and CPIs using alternative intervention proxies. Both figures present that patterns in SPIs and CPIs are very

similar across intervention proxies.

Table 8 reports CPIs using proportion of the intervention proxy to reserve money and M1 lagged by one month. Except for subperiod 3, CPIs are higher than 0.8.

Since IMF publishes NEER for Singapore, the TPEMP framework is applied to NEER of IMF for comparative purpose. Figure 13 shows that NEER of IMF is more stable than NEER of BIS implying that intervention measure using IMF data might be higher than using BIS data. Table 9 confirms the conjecture that SPIs using NEER of IMF are higher that using NEER of BIS.

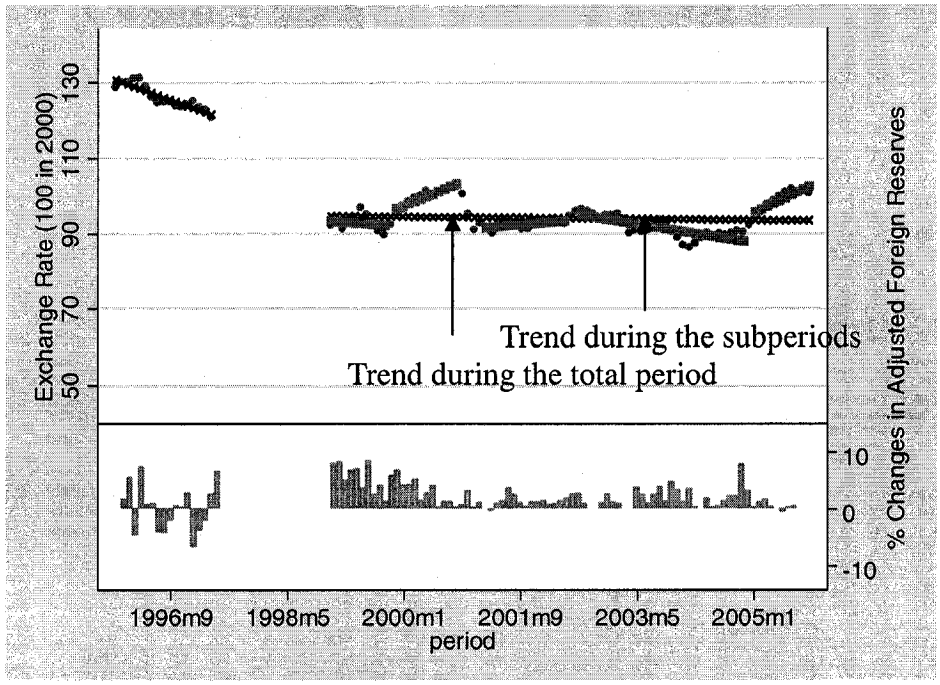
2. BLER or NEER?

Finally my dissertation compares foreign exchange rate policies targeting BLER and NEER to investigate whether there exists any change in the target exchange rate of post Asian foreign exchange rate policies. Section 2 compares SPIs of BLER and NEER for Korea, Indonesia, Thailand, and Singpore since there is no evidence on their managing trends in exchange rates.

Figures 14-17 report benchmark SPIs, using observations with right signs, of BLER and NEER for precrisis and subperiods of postcrisis. Except Singapore, three Asian countries have very similar patterns in SPIs of BLER and NEER. Although differences of SPIs in Korea, i.e. subperiods 2 and 5, are 0.15-0.2, SPIs of BLER and NEER have similar levels in other cases. Therefore, my dissertation does not find any firm evidence on which exchange rates Asian countries target, BLER or NEER.

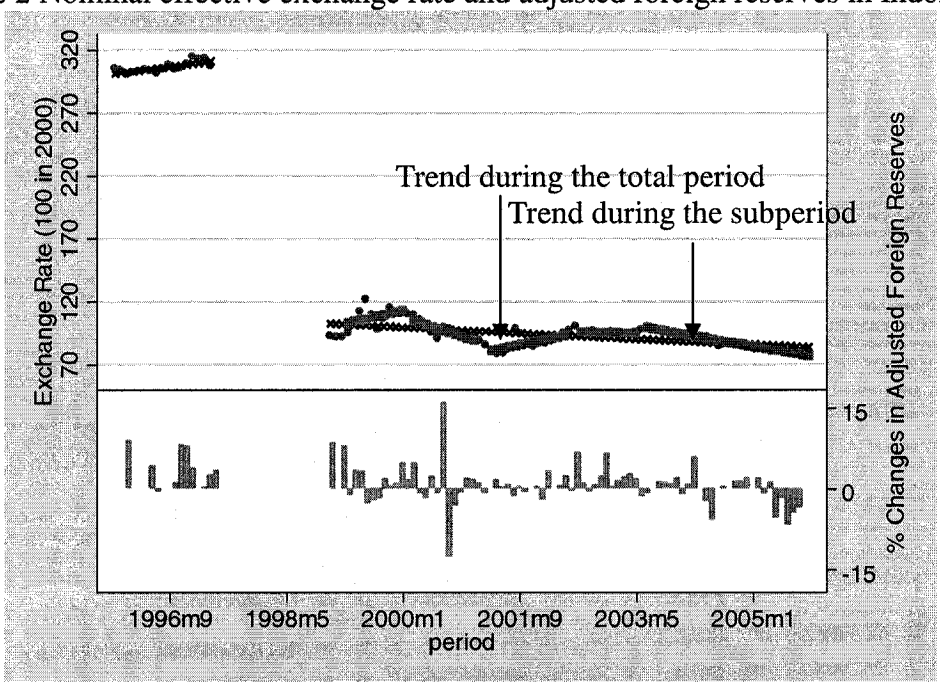
However, there is a very interesting tendency, which will be a research issue. All countries have stronger SPIs of NEER than BLER since some period of the postcrisis. SPIs of BLER in Korea were higher for subperiods 1, 2, and 3 but SPIs of NEER become higher for subperiod 5. SPIs of NEER in Indonesia have been higher since subperiod 2. SPIs of NEER in Thailand have been higher since subperiod 3 while SPIs of BLER were higher for precrisis, subperiods 1 and 2. SPIs of NEER in Singapore have been higher since subperiod 4.

Figure 1 Nominal effective exchange rate and adjusted foreign reserves in Korea



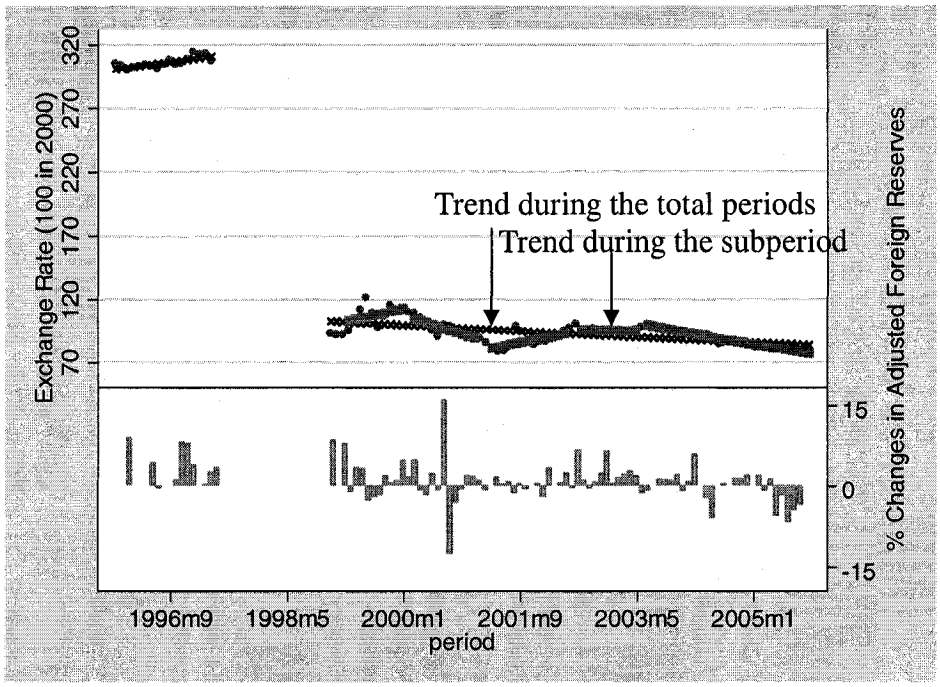
Source: IFS, BIS and author's estimation

Figure 2 Nominal effective exchange rate and adjusted foreign reserves in Indonesia



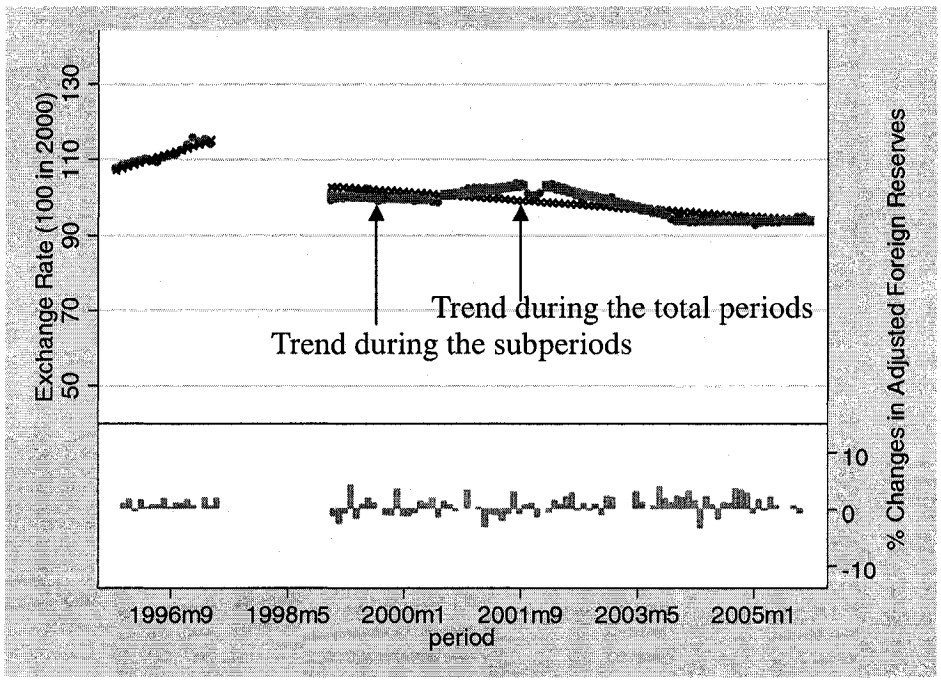
Source: IFS, BIS and author's estimation

Figure 3 Nominal effective exchange rate and adjusted foreign reserves in Thailand



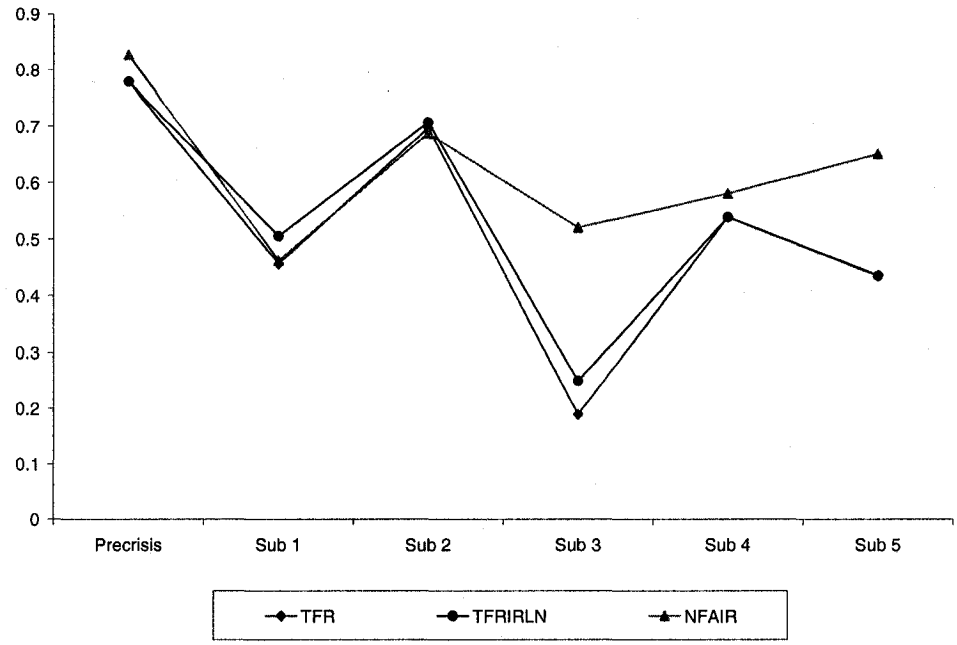
Source: IFS, BIS and author's estimation

Figure 4. Nominal effective exchange rate and adjusted foreign reserves in Singapore



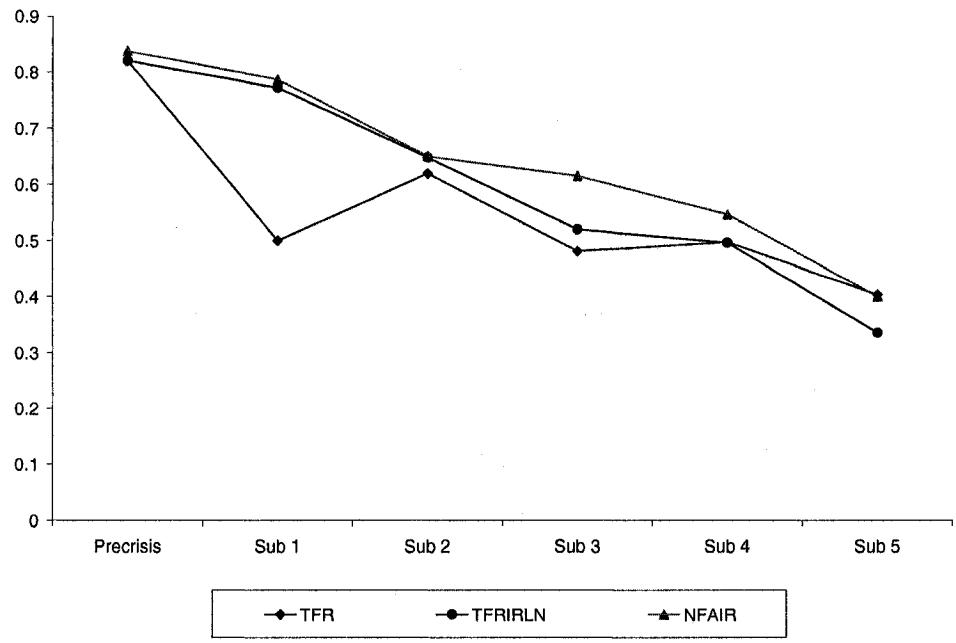
Source: IFS, BIS and author's estimation

Figure 5 SPI with right sign for Korea



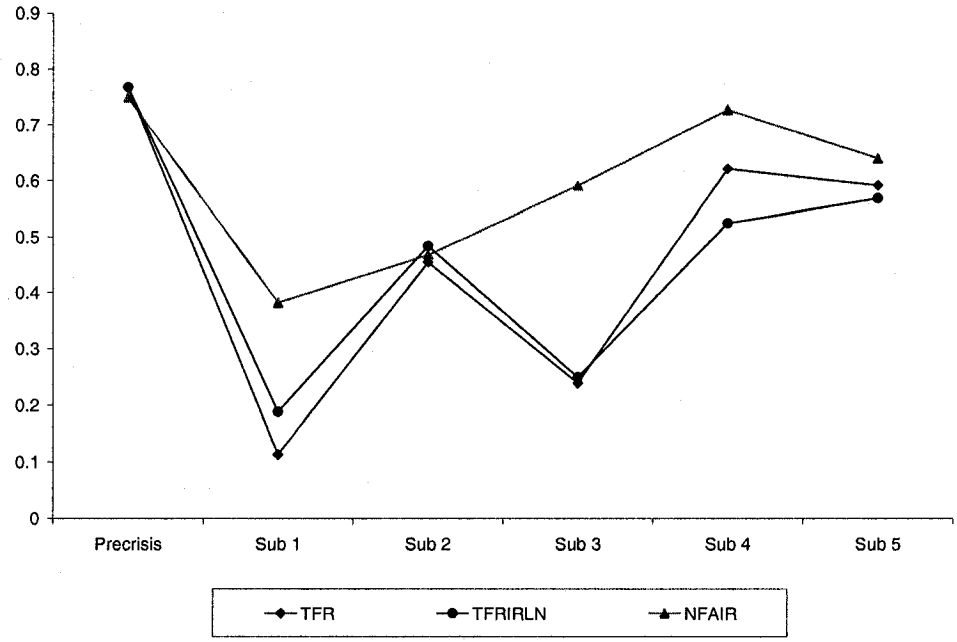
Source: author's estimation

Figure 6 CPI with right sign for Korea



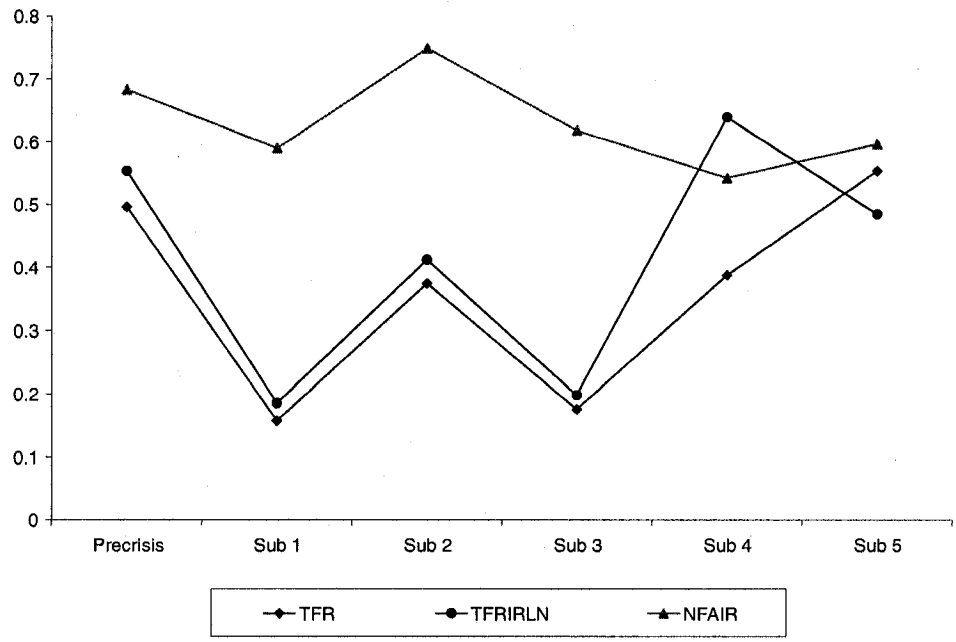
Source: author's estimation

Figure 7 SPI with right sign for Indonesia



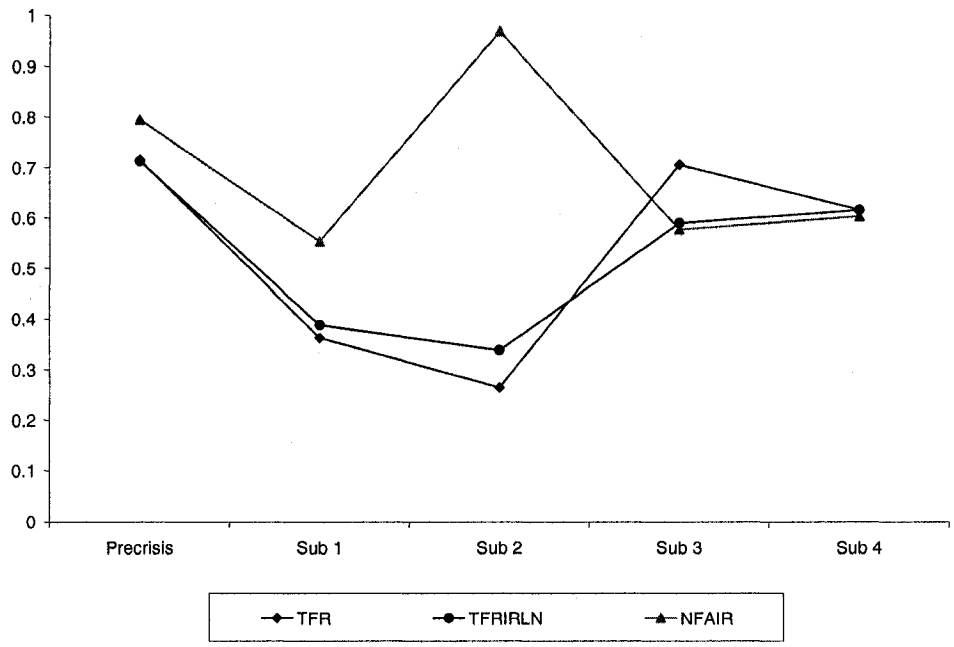
Source: author's estimation

Figure 8 CPI with right sign for Indonesia



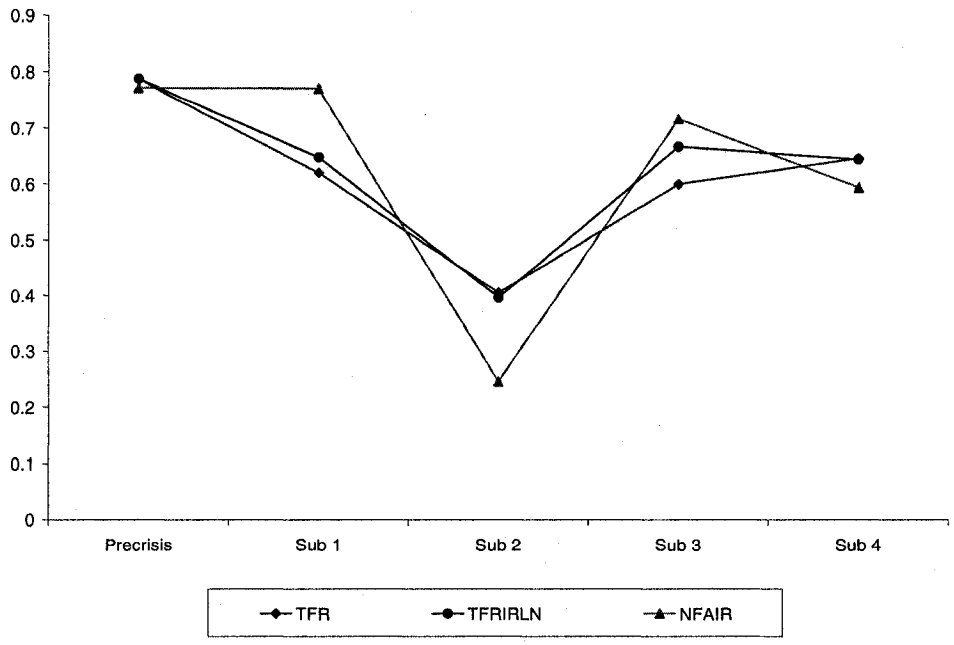
Source: author's estimation

Figure 9 SPI with right sign for Thailand



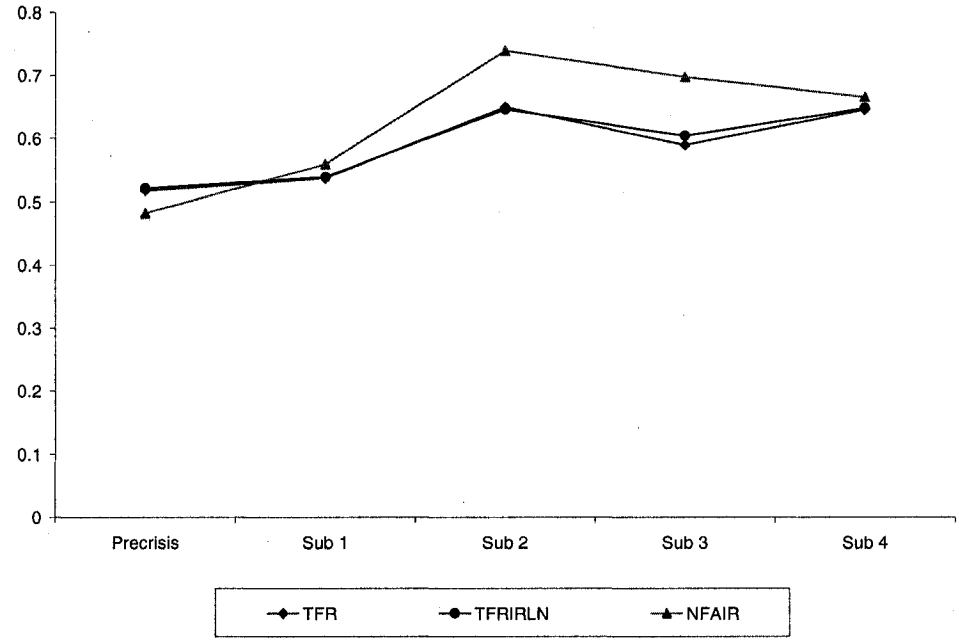
Source: author's estimation

Figure 10 CPI with right sign for Thailand



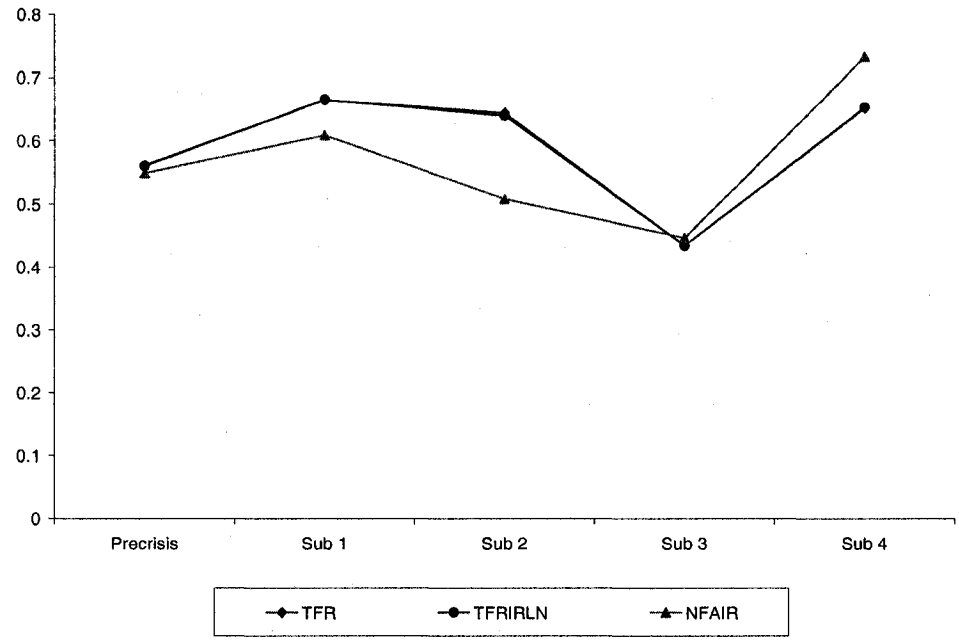
Source: author's estimation

Figure 11 SPI with right sign for Singapore



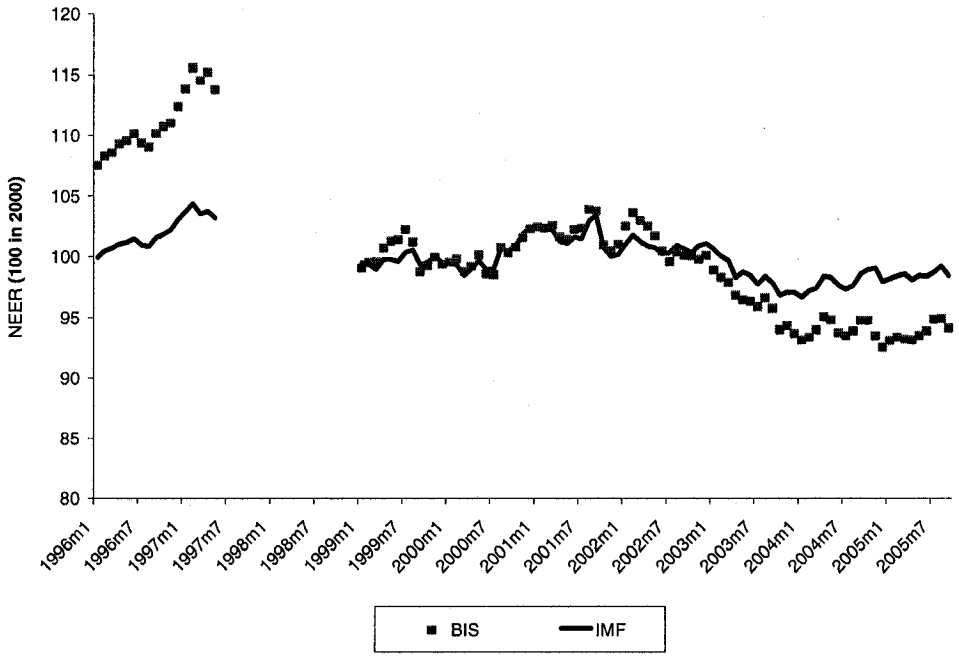
Source: author's estimation

Figure 12 CPI with right sign for Singapore



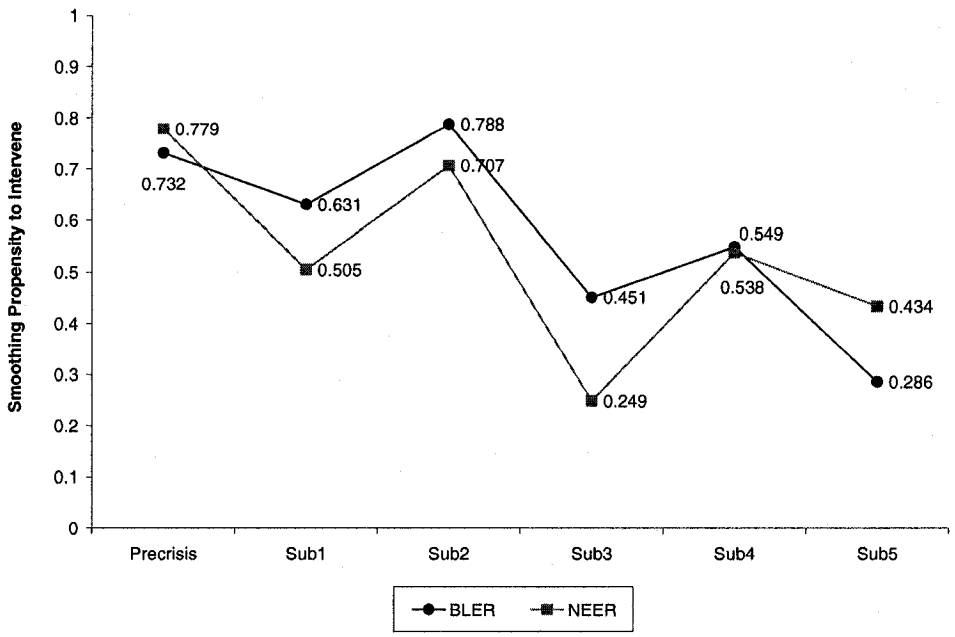
Source: author's estimation

Figure 13 NEER in BIS and IMF for Singapore



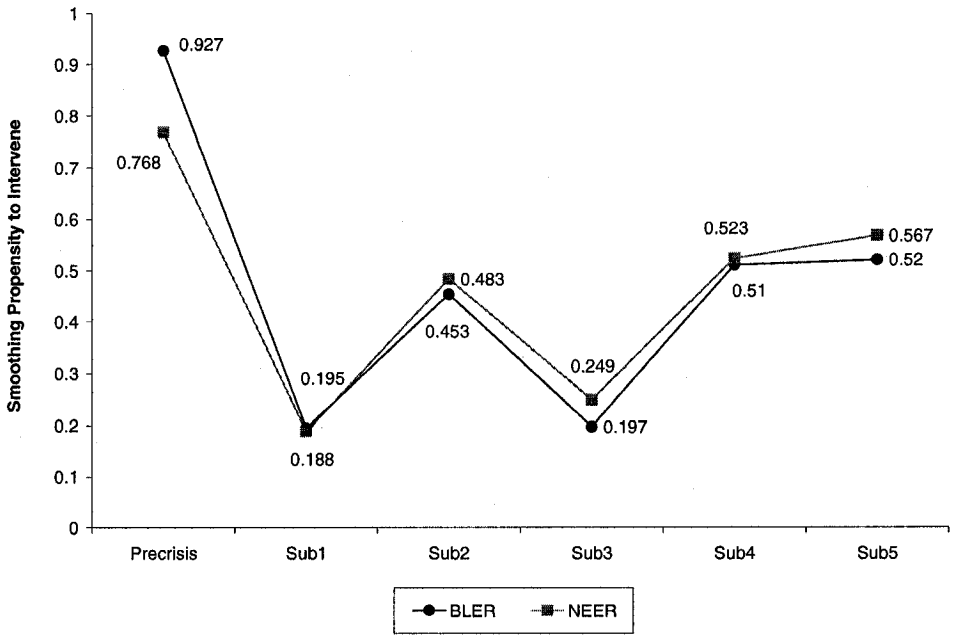
Source: BIS and IMF

Figure 14 SPIs of BLER and NEER for Korea



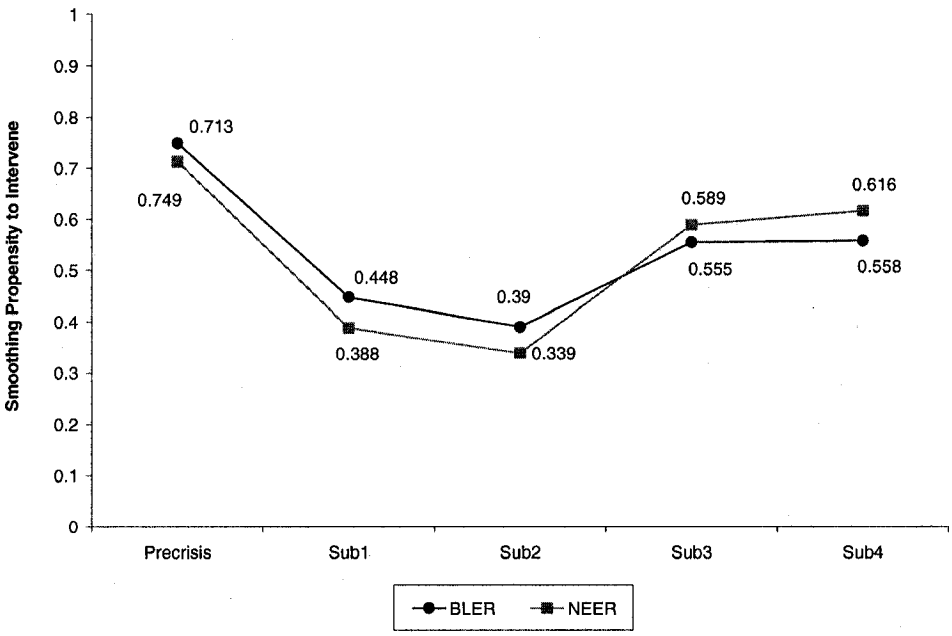
Source: author's estimation

Figure 15 SPIs of BLER and NEER for Indonesia



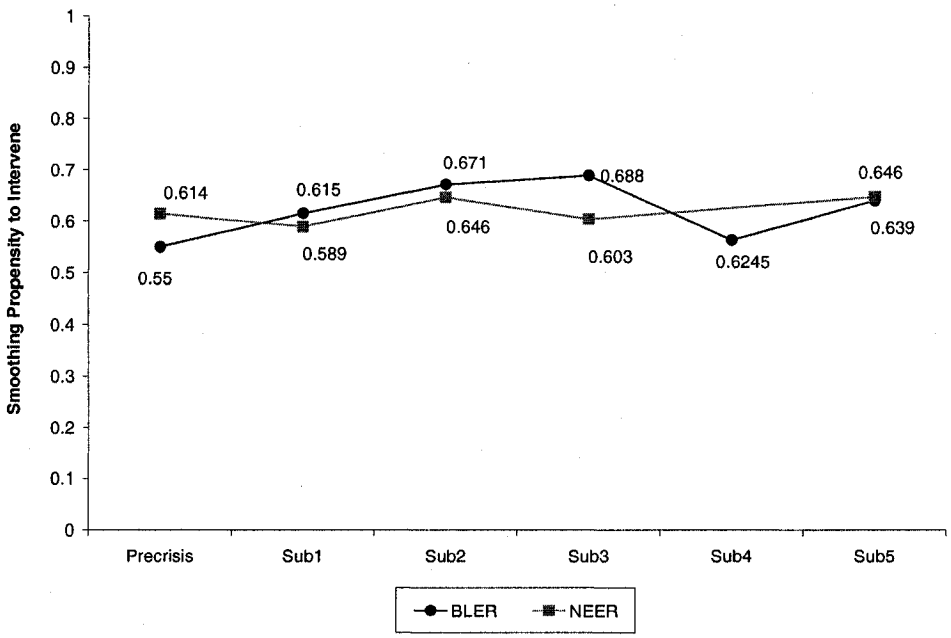
Source: author's estimation

Figure 16 SPIs of BLER and NEER for Thailand



Source: author's estimation

Figure 17 SPIs of BLER and NEER for Singapore



Source: author's estimation

Table 1 TPEMP Framework with TFRIRLN for Korea

	Time Span	TC_neer	TC_int	TPI	SPI	CPI
Pre-crisis	1996:1-1997:5	0.052	-0.096	0.649	0.779	0.821
Post-crisis	1999:1-2005:9	0.002	0.240	WS	0.526	0.542
Sub 1	1999:1-1999:10	0.017	0.851	WS	0.505	0.772
Sub 2	1999:12-2000:10	-0.082	0.342	0.807	0.707	0.648
Sub 3	2001:3-2002:4	-0.018	0.179	0.911	0.249	0.520
Sub 4	2002:7-2004:10	0.033	0.238	WS	0.538	0.496
Sub 5	2004:12-2005:9	-0.096	0.048	0.33	0.434	0.336

Table 2 CPI using proportion of the intervention proxy to lagged reserve money and M1 for Korea

	Time Span	CPI_RB	CPI_M1
Pre-crisis	1996:1-1997:5	0.825	0.768
Post-crisis	1999:1-2005:9	0.764	0.701
Sub 1	1999:1-1999:10	0.892	0.846
Sub 2	1999:12-2000:10	0.830	0.777
Sub 3	2001:3-2002:4	0.774	0.708
Sub 4	2002:7-2004:10	0.754	0.698
Sub 5	2004:12-2005:9	0.615	0.523

Table 3 TPEMP Framework with TFRIRLN for Indonesia

	Time Span	TC_neer	TC_int	TPI	SPI	CPI
Pre-crisis	1996:1-1997:5	-0.025	0.306	0.925	0.768	0.553
Post-crisis	1999:1-2005:9	0.030	0.082	WS	0.436	0.368
Sub 1	1999:4-2000:1	-0.125	0.021	0.147	0.188	0.186
Sub 2	2000:3-2001:1	0.172	0.019	WS	0.483	0.412
Sub 3	2001:4-2002:4	-0.144	0.009	0.057	0.249	0.198
Sub 4	2002:7-2003:4	0.014	0.164	WS	0.523	0.639
Sub 5	2003:6-2005:9	0.106	-0.018	0.148	0.567	0.485

Table 4 CPI using proportion of the intervention proxy to lagged reserve money and M1 for Indonesia

	Time Span	CPI_RB	CPI_M1
Pre-crisis	1996:1-1997:5	0.566	0.512
Post-crisis	1999:1-2005:9	0.409	0.382
Sub 1	1999:4-2000:1	0.234	0.224
Sub 2	2000:3-2001:1	0.458	0.433
Sub 3	2001:4-2002:4	0.245	0.219
Sub 4	2002:7-2003:4	0.693	0.656
Sub 5	2003:6-2005:9	0.509	0.476

Table 5 TPEMP Framework with TFRIRLN for Thailand

	Time Span	TC_neer	TC_int	TPI	SPI	CPI
Pre-crisis	1996:1-1997:5	-0.040	-0.044	WS	0.713	0.788
Post-crisis	1999:1-2005:9	0.014	0.106	WS	0.565	0.626
Sub 1	1999:1-2000:2	0.055	0.148	WS	0.388	0.648
Sub 2	2000:3-2000:11	0.167	0.033	WS	0.339	0.397
Sub 3	2001:4-2003:8	-0.002	0.151	0.987	0.589	0.667
Sub 4	2003:10-2005:9	0.025	0.119	WS	0.616	0.644

Table 6 CPI using proportion of the intervention proxy to lagged reserve money and M1 for Thailand

	Time Span	CPI_RB	CPI_M1
Pre-crisis	1996:1-1997:5	0.889	0.891
Post-crisis	1999:1-2005:9	0.737	0.748
Sub 1	1999:1-2000:5	0.766	0.768
Sub 2	2000:8-2001:9	0.497	0.493
Sub 3	2002:1-2003:9	0.791	0.806
Sub 4	2003:11-2005:9	0.731	0.752

Table 7 TPEMP Framework with TFRIRLN for Singapore

	Time Span	TC_neer	TC_int	TPI	SPI	CPI
Pre-crisis	1996:1-1997:5	-0.052	0.112	0.683	0.614	0.561
Post-crisis	1999:1-2005:9	0.014	0.073	WS	0.616	0.600
Sub 1	1999:1-2000:5	-0.011	0.116	0.915	0.589	0.674
Sub 2	2000:8-2001:9	-0.024	-0.043	WS	0.646	0.640
Sub 3	2002:1-2003:9	0.045	0.105	WS	0.603	0.434
Sub 4	2003:11-2005:9	7.05E-6	0.128	WS	0.646	0.646

Table 8 CPI using proportion of the intervention proxy to lagged reserve money and M1 for Singapore

	Time Span	CPI_RB	CPI_M1
Pre-crisis	1996:1-1997:5	0.862	0.813
Post-crisis	1999:1-2005:9	0.870	0.808
Sub 1	1999:1-2000:5	0.927	0.882
Sub 2	2000:8-2001:9	0.885	0.828
Sub 3	2002:1-2003:9	0.779	0.686
Sub 4	2003:11-2005:9	0.892	0.840

Table 9 TPEMP Framework with TFRIRLN and NEER of IMF for Singapore

	Time Span	TC_neer	TC_int	TPI	SPI	CPI
Pre-crisis	1996:1-1997:5	-0.029	0.112	0.683	0.648	0.561
Post-crisis	1999:1-2005:9	0.004	0.073	WS	0.663	0.600
Sub 1	1999:1-2000:5	0.003	0.116	WS	0.655	0.665
Sub 2	2000:8-2001:9	-0.014	-0.043	WS	0.678	0.640
Sub 3	2002:1-2003:9	0.021	0.105	WS	0.583	0.434
Sub 4	2003:11-2005:9	-0.009	0.128	0.931	0.723	0.653

Chapter VI

Conclusion

My dissertation offers a critical review of recent studies on classifying exchange rate regimes and introduces the Two Parameter Exchange Market Pressure (TPEMP) framework which is developed from the concept of exchange market pressure to characterize exchange rate regimes. Finally, the TPEMP framework is applied to several countries which have been at the center of attention: Japan, Korea, Thailand, Indonesia, and Singapore.

Many recent analyses of exchange rate regimes are based on the concept of how much exchange market pressure is taken on the exchange rate versus changes in reserves as a proxy for official intervention. However, the popular method of taking ratios of variations of exchange rate and reserve change is inadequate to deal with trends problems and with cases of leaning with the wind intervention.

The Two Parameter Exchange Market Pressure (TPEMP) framework is developed from the concept of exchange market pressure to characterize exchange rate regimes taking into account such problems. It uses two parameters, a trend coefficient and propensity to intervene around trend.

While Japan has been classified by a few of studies as an example of a highly flexible or free floating exchange rate regime, my dissertation finds that prior to the cessation of intervention in 2004, Japan had substantially increased intervention during the post Asian crisis period relative to the precrisis period.

My dissertation supports the idea that Asian countries have moved toward flexible exchange rate regimes after the crisis with the exception of announced pegs such as Malaysia and Singapore. Indeed, interventions in Korea, Indonesia, and Thailand have been weaker during the postcrisis relative to the precrisis. It also finds that there recently exists evidence on fear of floating in Indonesia and Thailand. Both nations have increased interventions again. However, it does not support McKinnon and Schnabl's argument of Asia generally having returned to soft dollar pegs. Korea has reduced intervention and interventions in Indonesia and Thailand during the postcrisis period, although having increased, are weaker than the precrisis pegs.

Although my dissertation produces an updated analysis on characteristics of exchange rate policies in selected countries using a recently developed analytical framework, it does not provide any sound clues on three basic questions which will be research agendas after this dissertation: comparing exchange rate policies among countries, assessing whether a country has arrived at free floating, and investigating which exchange rates countries target, BLER or NEER.

There is another important dimension of classification. This is the extent to which monetary policy is adjusted to external considerations. The degree to which intervention is sterilized or not should have important implications for the stability of exchange rate regimes (see Willett (2003)). Thus we ultimately need to be concerned not just with exchange rate regimes, but with monetary cum exchange rate regimes. The inclusion of sterilization measures and/or interest rate behavior in such broader

classifications is another important area for further research.[23]

[23] See, for example, CR, Hernandez and Montiel (2001), and McCauley (2001).

References

Aizenman, J. and Marion, N., 2002. The High Demand for International Reserves in the Far East: What's Going On? NBER Working Paper No. 9266.

Al-Marhubi, F., 1994. Determinants of Exchange Rate Regime Choice. Ph.D. Dissertation, Claremont Graduate University.

Baig, T., 2001. Characterizing Exchange Rate Regimes in Postcrisis East Asia. IMF Working Paper No. 152.

Bayoumi, T., and Eichengreen, B., 1998. Exchange Rate Volatility and Intervention: Implications of the Theory of Optimum Currency Area. Journal of International Economics 45, 191-209.

Bird, G. and Rajan, R., 2002. Too Much of a Good Thing? The Adequacy of International Reserves in the Aftermath of Crises. World Economy 26, 873-891.

Bofinger, P., and Wollmershauser, T., 2001. Managed Floating: Understanding the New International Monetary Order. Wurzburg Economic Papers No. 30, Universitat Wurzburg.

Bubula, A. and Ötker-Robe, I., 2002. The Evolution of Exchange Rate Regimes Since 1990: Evidence From De Facto Policies. IMF Working Papers, 02/155.

_____, 2003. Are Pegged and Intermediate Exchange Rate Regimes More Crisis Prone? IMF Working Papers, 03/223.

Calvo, G. and Reinhart, C., 2002. Fear of Floating. Quarterly Journal of Economics

CXVII, 379-409.

Caramazza, F., Ricci, L., and Salgado, R., 2000. Trade and Financial Contagion in Currency Crises. IMF Working Paper No. 00/55.

Cavoli, T. and Rajan, R., 2005. Have Exchange Rate Regimes in Asia Become More Flexible Post Crisis? Re-visiting the Evidence. National University of Singapore, Working Paper 0519.

Cukierman, A., Kiguel, M., and Liviatan, N., 1995. How Much to Commit to an Exchange Rate Rule: Balancing Credibility and Flexibility. in Pierre Siklos, ed., Varieties of Monetary Reforems : Lessons and Experiences on the Road to Monetary Union, 73-94. Boston:Kluwer.

De Gregorio, J., and Valdes, R. O., 1999. Crisis Transmission: Evidence from the Debt, Tequila, and Asian Flu Crises. Paper presented at the Conference on International Financial Contagion: How It Spreads and How It Can Be Stopped. Washington, DC.

Fischer, Stanley, 2001. Is the Bipolar View Correct? Paper prepared for the 2001 American Economic Asosociation meetings. IMF

Frieden, Jeffry, Piero Ghezzi, and Ernesto Stein. 2001. "Politics and Exchange Rates: A Cross-Country Approach," in Jeffry Frieden and Ernesto Stein, eds., The Currency Game: Exchange Rate Politics in Latin America, 21-64. Washington, D.C.: Inter-American Development Bank.

Girton, L. and Roper, D., 1977. A Monetary Model of Exchange Market Pressure Applied to the Postwar Canadian Experience. American Economic Review,

537-48.

Glick, R., Kretzmer, P., and Wihlborg, C., 1995. Real Exchange Rate Effects of Monetary Disturbances Under Different Degrees of Exchange Rate Flexibility: An Empirical Analysis. Journal of International Economics 38, 249-73.

Glick, R., and Hutchison, M., 2000. Stopping "Hot Money" or Signaling Bad Policy? Capital Controls and the Onset of Currency Crisis. Paper presented at the Claremont Conference on the Political Economy of International Financial Crises.

Ghosh, A. R., Gulde, A., Ostry, J. D., and Wolf, H., 1997. Does the Nominal Exchange Rate Regimes Matter? NBER Working Paper No. 5874.

Ghosh, A. R., Gulde, A., and Wolf, H., 2003. Exchange Rate Regimes: Choices and Consequences. MIT Press.

_____, 2002. Exchange Rate Regimes: Classifications and Consequences. Presented at the LSE conference on Dollarization and Euroization: Viable Policy Options?

Grier, K., and Grier, R., 2001. Macroeconomic Indicators, Exchange Rate Regimes, Currency Depreciation and Stock Market Performance in the 1997 Crisis. Economic Inquiry 39, 139-48.

Hausmann, R., Panizza, U., and Stein, E., 2001. Why Do Countries Float the Way They Float? Mimeo. Inter-American Development Bank.

Hernández, L. and Montiel, P. J., 2003. Postcrisis exchange rate policy in five Asian

countries: Filling in the "hollow middle"? Journal of the Japanese and International Economics 17, 336-369.

Holden, P., Holden, M., and Suss, E., 1979. The Determinants of Exchange Rate Flexibility: An Empirical Investigation. Review of Economics and Statistics 61, 327-33.

Kim, J. S., Li, J., Rajan, R., Sula, O., and Willett, T., 2004. Reserve Adequacy in Asia Revisited: New Benchmark Based on the Size and Composition of Capital Flows. Paper prepared for Claremont-KIEP Conference.

Kim, S, Kim, S. H., and Wang, Y., 2004. Fear of Floating in East Asia. paper for Claremont·KIEP conference on Monetary and Exchange Rate Arrangements in East Asia.

Levy Yeyati, E. and Sturzenegger, F., 2003. To Float or to Fix: Evidence on the Impact of Exchange Rate Regimes on Growth. American Economic Review 93, 1173-1193.

_____, 2005. Classifying Exchange Rate Regimes: Deeds vs. Words. European Economic Review 49, 1603-1635.

Li, J., Sula, O. and Willett, T., 2006. A New Framework for Analyzing Adequate and Excessive Reserve Levels Under High Capital Mobility. mimeo.

Li, J., Rajan, R., and Willett, T., 2006. Measuring Currency Crises using Exchange Market Pressure Indices: The Imprecision of Precision Weights. mimeo.

McCauley, R. N., 2001. Setting Monetary Policy in East Asia: Goals, Developments and Institutions. Paper for the Reserve Bank of Australia Conference on

Future Directions for Monetary Policies in East Asia.

McKinnon, R. and Schnabl, G., 2004. The East Asian Dollar Standard, Fear of Floating, and Original Sin. Review of Development Economics 8, 331-360.

Ogawa, E. and Yang, D. Y., 2004. Exchange Rate Arrangement in East Asia. paper for Claremont·KIEP conference on Monetary and Exchange Rate Arrangements in East Asia.

Ouyang, A., Rajan, R., and Willett, T., 2006. Monetary Sterilization in China Since the 1990s: How Much and How Effective. mimeo.

Park, Y. C. and Wyploz, C., 2004. Exchange Rate Arrangements in East Asia: Do They Matter? paper for Claremont·KIEP conference on Monetary and Exchange Rate Arrangements in East Asia.

Pontines, V. and Reza S., 2005. Exchange Market Intervention and Evidence of Postcrisis Flexible Exchange Rate Regimes in Selected East Asian Economies. mimeo.

Popper, H. and Lowell, J., 1994. Officially Floating, Implicitly Targeted Exchange Rates: Examples from Pacific Basin. in Exchange Rate Policy and Independence, edited by Reuven Glick and Michael Hutchison, Campbridge University Press.

Porison, Ilelene, 2000. How Do Countries Choose Their Exchange Rate Regime. IMF Working Paper No. 01/46.

Rajan, R., 2002. Exchange Rate Policy Options for Southeast Asia: Is there a Case for Currency Baskets? World Economy 25, 137-63.

Reinhart, C. and Rogoff, K., 2004. The Modern History of Exchange Rate Arrangements: A Reinterpretation. Quarterly Journal of Economics 119, 1-48.

Shambaugh, J. C., 2004. The effect of fixed exchange rates on monetary policy. Quarterly Journal of Economics 119, 300-351.

Weymark, D., 1995. Estimating exchange market pressure and the degree of exchange market pressure for Canada. Journal of International Economics 39, 273-295.

_____, 1997. Measuring the Degree of Exchange Rate Market Intervention in a Small Open Economy. Journal of International Money and Finance 16, 55-79.

_____, 1998. A General Approach to Measuring Exchange Market Pressure. Oxford Economic Papers 50, 106-121.

Williamson, J., 1996. The Crawling Band as an Exchange Rate Regime. Washington D.C. Institute for International Economics.

Williamson, J., 2001. The case for a Basket, Band and Crawl (BBC) Regime for East Asia. Reserve Bank of Australia 2001 Conference.

Willett, T., 2003. Fear of Floating Needn't Imply Fixed Rates: Feasible Options for Intermediate Exchange Rate Regimes. Open Economies Review 14, 71-91.

Willett, T., Nitithanprapas, E., Nitithanprapas, I., and Rongala, S., 2004. The Asian Crises Reexamed. Asian Economic Papers 3, 32-87.

Willett, T. and Kim, Y., 2006. Korea's Post Crisis Exchange Rate Policy. Korea's Economy 2006, 5-15.

Willett, T., Kim, Y., and Nitithanprapas, I., 2005. Some Methodological Issues in the Classification of Exchange Rate Regimes. mimeo.

Appendix I More Results Targeting BLER

1. CPI using proportion of alternative intervention proxies to lagged reserve money and M1 with right sign

Table 1-1 Intervention proxy based on TFR for Korea

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.843	0.793
Postcrisis	1999:1-2005:9	0.780	0.716
Sub 1	1999:1-1999:10	0.718	0.638
Sub 2	1999:12-2000:10	0.926	0.897
Sub 3	2001:3-2002:4	0.726	0.669
Sub 4	2002:7-2004:10	0.792	0.739
Sub 5	2004:12-2005:9	0.723	0.610

Table 1-2 Intervention proxy based on NFAIR for Korea

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.816	0.763
Postcrisis	1999:1-2005:9	0.820	0.764
Sub 1	1999:1-1999:10	0.882	0.839
Sub 2	1999:12-2000:10	0.963	0.947
Sub 3	2001:3-2002:4	0.749	0.682
Sub 4	2002:7-2004:10	0.821	0.773
Sub 5	2004:12-2005:9	0.792	0.709

Table 1-3 Intervention proxy based on TFR for Indonesia

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.321	0.278
Postcrisis	1999:1-2005:9	0.496	0.468
Sub 1	1999:4-2000:1	0.277	0.266
Sub 2	2000:3-2001:1	0.447	0.417
Sub 3	2001:4-2002:4	0.322	0.290
Sub 4	2002:7-2003:4	0.584	0.562
Sub 5	2003:6-2005:9	0.633	0.601

Table 1-4 Intervention proxy based on NFAIR for Indonesia

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.836	0.769
Postcrisis	1999:1-2005:9	0.651	0.631
Sub 1	1999:4-2000:1	0.746	0.724
Sub 2	2000:3-2001:1	0.992	0.992
Sub 3	2001:4-2002:4	0.666	0.645
Sub 4	2002:7-2003:4	0.757	0.726
Sub 5	2003:6-2005:9	0.507	0.485

Table 1-5 Intervention proxy based on TFR for Thailand

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.814	0.818
Postcrisis	1999:1-2005:9	0.700	0.716
Sub 1	1999:1-2000:2	0.712	0.716
Sub 2	2000:3-2000:11	0.335	0.329
Sub 3	2001:4-2003:8	0.760	0.773
Sub 4	2003:10-2005:9	0.765	0.783

Table 1-6 Intervention proxy based on NFAIR for Thailand

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.846	0.849
Postcrisis	1999:1-2005:9	0.687	0.699
Sub 1	1999:1-2000:2	0.780	0.781
Sub 2	2000:3-2000:11	0.165	0.163
Sub 3	2001:4-2003:8	0.786	0.798
Sub 4	2003:10-2005:9	0.629	0.647

Table 1-7 Intervention proxy based on TFR for Singapore

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.803	0.752
Postcrisis	1999:1-2005:9	0.876	0.807
Sub 1	1999:4-2000:1	0.910	0.854
Sub 2	2000:3-2001:1	0.922	0.869
Sub 3	2001:4-2002:4	0.892	0.823
Sub 4	2002:7-2003:4	0.766	0.671
Sub 5	2003:6-2000:5	0.945	0.900

Table 1-8 Intervention proxy based on NFAIR for Singapore

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.870	0.820
Postcrisis	1999:1-2005:9	0.826	0.747
Sub 1	1999:4-2000:1	0.875	0.800
Sub 2	2000:3-2001:1	0.888	0.818
Sub 3	2001:4-2002:4	0.705	0.627
Sub 4	2002:7-2003:4	0.757	0.652
Sub 5	2003:6-2000:5	0.868	0.804

2. Results using all observations

Table 2-1 Smoothing propensity to intervene for Korea

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.757	0.757	0.770
Postcrisis	1999:1-2005:9	0.515	0.548	0.555
Sub 1	1999:1-1999:10	0.558	0.615	0.589
Sub 2	1999:12-2000:10	0.754	0.760	0.701
Sub 3	2001:3-2002:4	0.403	0.395	0.558
Sub 4	2002:7-2004:10	0.556	0.556	0.573
Sub 5	2004:12-2005:9	0.268	0.266	0.437

Table 2-2 Smoothing propensity to intervene for Indonesia

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.872	0.872	0.873
Postcrisis	1999:1-2005:9	0.422	0.441	0.578
Sub 1	1999:4-2000:1	0.159	0.271	0.515
Sub 2	2000:3-2001:1	0.454	0.481	0.487
Sub 3	2001:4-2002:4	0.247	0.258	0.580
Sub 4	2002:7-2003:4	0.623	0.545	0.557
Sub 5	2003:6-2005:9	0.540	0.523	0.560

Table 2-3 Smoothing propensity to intervene for Thailand

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.784	0.784	0.812
Postcrisis	1999:1-2005:9	0.520	0.525	0.539
Sub 1	1999:1-1999:10	0.527	0.548	0.659
Sub 2	1999:12-2000:10	0.331	0.390	0.674
Sub 3	2001:3-2002:4	0.601	0.590	0.582
Sub 4	2002:7-2004:10	0.538	0.539	0.415

Table 2-4 Smoothing propensity to intervene for Singapore

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.626	0.628	0.575
Postcrisis	1999:1-2005:9	0.640	0.640	0.583
Sub 1	1999:4-2000:1	0.669	0.669	0.651
Sub 2	2000:3~2001:1	0.593	0.592	0.560
Sub 3	2001:4~2002:4	0.601	0.602	0.612
Sub 4	2002:8~2003:5	0.520	0.520	0.412
Sub 5	2003:7~2005:3	0.629	0.629	0.617

Table 2-5 Combined propensity to intervene for Korea

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.759	0.760	0.800
Postcrisis	1999:1-2005:9	0.536	0.563	0.605
Sub 1	1999:1-1999:10	0.616	0.779	0.771
Sub 2	1999:12-2000:10	0.730	0.760	0.716
Sub 3	2001:3-2002:4	0.589	0.592	0.617
Sub 4	2002:7-2004:10	0.563	0.562	0.618
Sub 5	2004:12-2005:9	0.312	0.310	0.460

Table 2-6 Combined propensity to intervene for Indonesia

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.559	0.561	0.826
Postcrisis	1999:1-2005:9	0.401	0.436	0.574
Sub 1	1999:4-2000:1	0.197	0.297	0.540
Sub 2	2000:3-2001:1	0.427	0.452	0.536
Sub 3	2001:4-2002:4	0.201	0.272	0.611
Sub 4	2002:7-2003:4	0.512	0.641	0.543
Sub 5	2003:6-2005:9	0.512	0.505	0.581

Table 2-7 Combined propensity to intervene for Thailand

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.778	0.778	0.797
Postcrisis	1999:1-2005:9	0.560	0.569	0.567
Sub 1	1999:1-2000:2	0.568	0.573	0.695
Sub 2	2000:3-2000:11	0.232	0.280	0.505
Sub 3	2001:4-2003:8	0.648	0.665	0.684
Sub 4	2003:10-2005:9	0.575	0.573	0.508

Table 2-8 Combined propensity to intervene for Singapore

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.788	0.790	0.821
Postcrisis	1999:1-2005:9	0.661	0.661	0.626
Sub 1	1999:4-2000:1	0.719	0.718	0.732
Sub 2	2000:3~2001:1	0.705	0.704	0.703
Sub 3	2001:4~2002:4	0.700	0.701	0.640
Sub 4	2002:8~2003:5	0.489	0.489	0.431
Sub 5	2003:7~2005:3	0.778	0.779	0.719

Table 2-9 CPI using proportion of the main intervention proxy to lagged reserve money and M1 for Korea

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.777	0.721
Postcrisis	1999:1-2005:9	0.772	0.710
Sub 1	1999:1-1999:10	0.899	0.854
Sub 2	1999:12-2000:10	0.891	0.857
Sub 3	2001:3-2002:4	0.820	0.761
Sub 4	2002:7-2004:10	0.785	0.705
Sub 5	2004:12-2005:9	0.614	0.514

Table 2-10 CPI using proportion of the main intervention proxy to lagged reserve money and M1 for Indonesia

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.574	0.530
Postcrisis	1999:1-2005:9	0.470	0.447
Sub 1	1999:4-2000:1	0.339	0.328
Sub 2	2000:3-2001:1	0.499	0.474
Sub 3	2001:4-2002:4	0.309	0.290
Sub 4	2002:7-2003:4	0.682	0.653
Sub 5	2003:6-2005:9	0.521	0.495

Table 2-11 CPI using proportion of the main intervention proxy to lagged reserve money and M1 for Thailand

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.862	0.864
Postcrisis	1999:1-2005:9	0.671	0.682
Sub 1	1999:1-2000:2	0.692	0.698
Sub 2	2000:3-2000:11	0.382	0.377
Sub 3	2001:4-2003:8	0.781	0.795
Sub 4	2003:10-2005:9	0.649	0.667

Table 2-12 CPI using proportion of the main intervention proxy to lagged reserve money and M1 for Singapore

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.926	0.902
Postcrisis	1999:1-2005:9	0.893	0.839
Sub 1	1999:4-2000:1	0.805	0.865
Sub 2	2000:3-2001:1	0.929	0.883
Sub 3	2001:4-2002:4	0.913	0.861
Sub 4	2002:7-2003:4	0.812	0.731
Sub 5	2003:6-2000:5	0.956	0.922

Appendix II More Results Targeting NEER

1. CPI using proportion of alternative intervention proxies to lagged reserve money and M1 with right sign

Table 1-1 Intervention proxy based on TFR for Korea

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.826	0.768
Postcrisis	1999:1-2005:9	0.756	0.690
Sub 1	1999:1-1999:10	0.690	0.625
Sub 2	1999:12-2000:10	0.811	0.758
Sub 3	2001:3-2002:4	0.727	0.662
Sub 4	2002:7-2004:10	0.755	0.699
Sub 5	2004:12-2005:9	0.719	0.618

Table 1-2 Intervention proxy based on NFAIR for Korea

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.847	0.795
Postcrisis	1999:1-2005:9	0.803	0.744
Sub 1	1999:1-1999:10	0.897	0.857
Sub 2	1999:12-2000:10	0.774	0.740
Sub 3	2001:3-2002:4	0.835	0.782
Sub 4	2002:7-2004:10	0.810	0.755
Sub 5	2004:12-2005:9	0.791	0.706

Table 1-3 Intervention proxy based on TFR for Indonesia

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.508	0.459
Postcrisis	1999:1-2005:9	0.486	0.458
Sub 1	1999:4-2000:1	0.287	0.275
Sub 2	2000:3-2001:1	0.505	0.479
Sub 3	2001:4-2002:4	0.306	0.271
Sub 4	2002:7-2003:4	0.441	0.425
Sub 5	2003:6-2005:9	0.639	0.605

Table 1-4 Intervention proxy based on NFAIR for Indonesia

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.752	0.681
Postcrisis	1999:1-2005:9	0.633	0.610
Sub 1	1999:4-2000:1	0.592	0.565
Sub 2	2000:3-2001:1	0.761	0.756
Sub 3	2001:4-2002:4	0.675	0.647
Sub 4	2002:7-2003:4	0.568	0.546
Sub 5	2003:6-2005:9	0.612	0.587

Table 1-5 Intervention proxy based on TFR for Thailand

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.888	0.890
Postcrisis	1999:1-2005:9	0.715	0.726
Sub 1	1999:1-2000:2	0.755	0.756
Sub 2	2000:3-2000:11	0.540	0.535
Sub 3	2001:4-2003:8	0.720	0.734
Sub 4	2003:10-2005:9	0.733	0.754

Table 1-6 Intervention proxy based on NFAIR for Thailand

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0865	0.869
Postcrisis	1999:1-2005:9	0.723	0.734
Sub 1	1999:1-2000:2	0.820	0.825
Sub 2	2000:3-2000:11	0.293	0.290
Sub 3	2001:4-2003:8	0.788	0.799
Sub 4	2003:10-2005:9	0.680	0.699

Table 1-7 Intervention proxy based on TFR for Singapore

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.863	0.814
Postcrisis	1999:1-2005:9	0.872	0.810
Sub 1	1999:1-2000:5	0.926	0.882
Sub 2	2000:8-2001:9	0.888	0.832
Sub 3	2002:1-2003:9	0780	0.687
Sub 4	2003:11-2005:9	0.895	0.841

Table 1-8 Intervention proxy based on NFAIR for Singapore

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.864	0.813
Postcrisis	1999:1-2005:9	0.853	0.789
Sub 1	1999:1-2000:5	0.905	0.850
Sub 2	2000:8-2001:9	0.800	0.724
Sub 3	2002:1-2003:9	0.754	0.674
Sub 4	2003:11-2005:9	0.946	0.903

2. Results Using All Observations

Table 2-1 Smoothing propensity to intervene for Korea

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.784	0.784	0.791
Postcrisis	1999:1-2005:9	0.496	0.528	0545
Sub 1	1999:1-1999:10	0.450	0.503	0.489
Sub 2	1999:12-2000:10	0.712	0.719	0.682
Sub 3	2001:3-2002:4	0.416	0.429	0.570
Sub 4	2002:7-2004:10	0.528	0.528	0.589
Sub 5	2004:12-2005:9	0.380	0.379	0.516

Table 2-2 Smoothing propensity to intervene for Indonesia

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.750	0.751	0.732
Postcrisis	1999:1-2005:9	0.460	0.466	0.612
Sub 1	1999:4-2000:1	0.146	0.256	0.491
Sub 2	2000:3-2001:1	0.505	0.524	0.653
Sub 3	2001:4-2002:4	0.245	0.235	0.568
Sub 4	2002:7-2003:4	0.641	0.583	0.602
Sub 5	2003:6-2005:9	0.583	0.578	0.600

Table 2-3 Smoothing propensity to intervene for Thailand

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.768	0.767	0.799
Postcrisis	1999:1-2005:9	0.580	0.571	0.585
Sub 1	1999:1-1999:10	0.471	0.499	0.614
Sub 2	1999:12-2000:10	0.388	0.438	0.717
Sub 3	2001:3-2002:4	0.641	0.641	0.617
Sub 4	2002:7-2004:10	0.590	0.590	0.479

Table 2-4 Smoothing propensity to intervene for Singapore

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.518	0.522	0.482
Postcrisis	1999:1-2005:9	0.624	0.624	0.573
Sub 1	1999:1-2000:5	0.662	0.663	0.602
Sub 2	2000:8-2001:9	0.650	0.651	0.629
Sub 3	2002:1-2003:9	0.625	0.632	0.633
Sub 4	2003:11-2005:9	0.656	0.657	0.625

Table 2-5 Combined propensity to intervene for Korea

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.773	0.773	0.821
Postcrisis	1999:1-2005:9	0.526	0.552	0.598
Sub 1	1999:1-1999:10	0.528	0.703	0.695
Sub 2	1999:12-2000:10	0.632	0.666	0.637
Sub 3	2001:3-2002:4	0.595	0.620	0.641
Sub 4	2002:7-2004:10	0.541	0.541	0.606
Sub 5	2004:12-2005:9	0.315	0.313	0.453

Table 2-6 Combined propensity to intervene for Indonesia

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.494	0.497	0.736
Postcrisis	1999:1-2005:9	0.427	0.455	0.604
Sub 1	1999:4-2000:1	0.187	0.274	0.512
Sub 2	2000:3-2001:1	0.430	0.460	0.546
Sub 3	2001:4-2002:4	0.225	0.249	0.587
Sub 4	2002:7-2003:4	0.498	0.655	0.578
Sub 5	2003:6-2005:9	0.568	0.547	0.645

Table 2-7 Combined propensity to intervene for Thailand

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.695	0.695	0.719
Postcrisis	1999:1-2005:9	0.598	0.613	0.642
Sub 1	1999:1-1999:10	0.592	0.598	0.710
Sub 2	1999:12-2000:10	0.282	0.346	0.576
Sub 3	2001:3-2002:4	0.696	0.717	0.739
Sub 4	2002:7-2004:10	0.598	0.596	0.552

Table 2-8 Combined propensity to intervene for Singapore

	Time Span	TFR	TFRIRLN	NFAIR
Precrisis	1996:1-1997:5	0.554	0.554	0.580
Postcrisis	1999:1-2005:9	0.639	0.639	0.606
Sub 1	1999:1-2000:5	0.683	0.683	0.612
Sub 2	2000:8-2001:9	0.676	0.673	0.586
Sub 3	2002:1-2003:9	0.575	0.576	0.566
Sub 4	2003:11-2005:9	0.685	0.686	0.671

Table 2-9 CPI using proportion of the main intervention proxy to lagged reserve money and M1 for Korea

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.792	0.736
Postcrisis	1999:1-2005:9	0.772	0.708
Sub 1	1999:1-1999:10	0.860	0.802
Sub 2	1999:12-2000:10	0.854	0.806
Sub 3	2001:3-2002:4	0.834	0.779
Sub 4	2002:7-2004:10	0.758	0.695
Sub 5	2004:12-2005:9	0.624	0.525

Table 2-10 CPI using proportion of the main intervention proxy to lagged reserve money and M1 for Indonesia

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.511	0.460
Postcrisis	1999:1-2005:9	0.488	0.465
Sub 1	1999:4-2000:1	0.315	0.305
Sub 2	2000:3-2001:1	0.506	0.482
Sub 3	2001:4-2002:4	0.289	0.268
Sub 4	2002:7-2003:4	0.691	0.666
Sub 5	2003:6-2005:9	0.566	0.539

Table 2-11 CPI using proportion of the main intervention proxy to lagged reserve money and M1 for Thailand

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.807	0.811
Postcrisis	1999:1-2005:9	0.712	0.723
Sub 1	1999:1-2000:2	0.707	0.711
Sub 2	2000:3-2000:11	0.449	0.444
Sub 3	2001:4-2003:8	0.816	0.827
Sub 4	2003:10-2005:9	0.683	0.703

Table 2-12 CPI using proportion of the main intervention proxy to lagged reserve money and M1 for Singapore

	Time Span	Reserve Money	M1
Precrisis	1996:1-1997:5	0.841	0.891
Postcrisis	1999:1-2005:9	0.793	0.836
Sub 1	1999:1-2000:5	0.906	0.866
Sub 2	2000:8-2001:9	0.913	0.864
Sub 3	2002:1-2003:9	0.860	0.792
Sub 4	2003:11-2005:9	0.917	0.867

Appendix III

Summary of Papers on Classifying Exchange Rate Regimes

(Updated summary in Willett, Kim, and Nitithanprapas (2005))

Study	Methodology	Classification or Comments
Old IMF Classification (June 82-Before revised)	• Based on the publicly stated commitment of the central bank	• Peg: single currency, composite currency • Flexibility limited: vis-à-vis single currency, cooperative arrangements • More Flexible: adjusted to indicator, managed float, independent float
Revised IMF Classification (1999)	• Based on IMF staff judgement of the regimes • Also classify exchange rate regimes against alternative monetary policy frameworks	• Exchange rate arrangement with no legal tender • Currency Board • Other conventional Fixed (ER fluctuates within a narrow margin at most +-1% around a central rate) • Horizontal bands (margins are wider than +-1%) • Crawling pegs • Crawling bands • Managed Float (the monetary authority influences the movement of ER through active intervention without specifying pre-announced path of exchange

Study	Methodology	Classification or Comments
		rate. • Independent Float(the ER is market determined, with any intervention aimed at moderating the rate of change rather than establishing level) • Exchange rate as nominal anchor • Monetary aggregate anchor • Inflation-target framework • IMF supported or other monetary program • Other –the country has no explicitly stated nominal anchor but rather monitors various indicators in implementing monetary policy
Calvo and Reinhart (2002)	(Probability approach) • Probability that absolute percentage changes in exchange rates are smaller than 2.5% • Probability that absolute percentage changes in foreign reserves-gold are smaller than 2.5% • Probability that absolute change of money market rate are greater than 4%	• Float : ones having a high probability that the monthly percent change in reserves falls within a +-1 or 2.25 percent band • Fix : ones having a low probability that the monthly percent change in exchange rate falls within a +-1 or 2.25 percent band

Study	Methodology	Classification or Comments
	(Exchange rate flexibility index) • $\lambda = \frac{\sigma_e^2}{\sigma_i^2 + \sigma_F^2}$	
Bofinger and Wollmershauser (2001)	• Index of floating is calculated as the ratio of the sum of effective changes in foreign reserves to the sum of absolute changes in foreign reserves using 2 methods of normalization • normalized changes in reserves as a ratio of external sizes (measured by a 12 month moving average of the arithmetic mean of import and export) • normalized changes in reserves as a percentage of the level of reserves at the beginning of underlying period	• A value closer to zero indicates as independent float regimes (intervention were carried out in order to smooth short-run fluctuation around determined trend) • A value closer to one or minus one indicates as managed float regimes (a central bank tried to influence the trend of exchange rate. • Independent float : prob (-0.33< Index float< 0.33)>=0.5: • Managed float: prob(-0.33<Index float<0.33)< 0.5
Hausmann, Panizza, and Steinl (2001)	• Characterize the difference in exchange rate management on 3 variables using factor analysis • Stock of reserves relative to M2 • Std(dER)/std[Resereves/ave(M2 in dollars)] • Std(dER)/std(interest rate)	Provide a continuous index of exchange rate flexibility between 0 and 1.

Study	Methodology	Classification or Comments
Hernandez and Montiel (2001)	The degree of fixity can be inferred from the following statistics • Exchange rate volatility measured by standard deviation/range of monthly percentage exchange rate changes • Foreign reserve volatility measured by mean absolute/ standard deviation monthly percentage change in reserves • Interest Rate volatility measured by mean absolute/standard deviation monthly changes in nominal interest rates • Severity of shock measured by volatility ratios of exchange rate changes relative to interest rate changes and volatility ratios of exchange rate changes relative to reserve changes	• Countries that have relatively more volatile exchange rates, and volatile reserves and interest rates can be judged as more flexible than others. • Given countries such as US as a benchmark of 'pure floaters', the degree to which other countries deviate from such regimes can be evaluated by comparing the volatility of these variables relative to those of the benchmark.
Holden, Holden, Suss (1979)	• Intervention proxy: absolute changes in reserves divided by the sum of imports and exports for 12 months • Measure the index of flexibility: ratio of the sum of (absolute value of monthly percentage	• The index has a range of 0 and infinity • The higher the value of the index, the higher is the degree of exchange rate flexibility

Study	Methodology	Classification or Comments
	changes in the trade-weighted exchange rate) to the sum of (absolute changes in reserves divided by the sum of imports and exports) for 24 months	$F^i = \frac{\sum_{k=0}^{23} \frac{\lvert E_{t-k} - E_{t-k-1} \rvert}{E_{t-k-1}}}{\sum_{k=0}^{23} \frac{\lvert R_{t-k} - R_{t-k-1} \rvert}{\sum_{j=0}^{11} (X_{t-k-j} + I_{t-k-j})}}$
Porison (2001)	The degree of exchange rate flexibility is the ratio of the average absolute value of the monthly nominal exchange rate depreciation to the average absolute value of the monthly change in reserves normalized by the monetary base in the previous month.	Same as Holden et al
Al-Marhubi (1994)	• Uses the ratio of exchange rate volatility to speculative pressures as measures of exchange rate flexibility • They used the variance of exchange rate as exchange rate volatility and used the sum of the variance of exchange rate and the variance of reserves as measures of speculative pressure	• Provide a continuous index, ranging from 0 to 1 • The higher the value, the higher is the degree of exchange rate flexibility.
Glick et al (1995)	The degree of exchange rate flexibility is the variance of unanticipated changes in the nominal exchange rate over the sum of the variance of	• The exchange rate is perfectly flexible as the degree equals one • The exchange rate is perfectly as the degree equals

Study	Methodology	Classification or Comments
	unperceived changes in reserves, measured as a fraction of monetary base, and the variance of unanticipated changes in exchange rates	zero • The value between 0 and 1 denotes the intermediate degree of exchange rate flexibility
Eichengreen and Bayoumi (1998)	• Intervention proxy=dReserves/(one lagged Narrow money) • The speculative pressure between countries i and j is: • dER_{ij}+$intervention_i$-$intervention_j$ • A measure of intervention is: • 1-std(dER)/std(speculative pressure)	• Heavy intervention defined as intervention index over 0.85. • Medium levels intervention defined as an intervention indexes between 0.7 and 0.85
Popper and Lowell (1994)	• The degree of intervention equals the ratio of normalized intervention to currency appreciation • The normalized intervention is defined as the net foreign assets as a fraction of lag of monetary base • Appreciation is measured as the annualized rate of change in the exchange rate over its level at the end of period	• Positive values of the ratio represent leaning against the wind • Negative values imply the intervention and exchange rate were push in the same direction • Values close to zero indicate small reserve movements and /or large exchange rate changes
Weymark (1997)	• Intervention proxy: the change in foreign exchange reserves expressed as a proportion of	• Weymark's index has a range from $-\infty$ to $+\infty$

Study	Methodology	Classification or Comments
	the inherited monetary base • Exchange market pressure: $EMP_t = \Delta e_t + \eta \Delta r_t$ • It equals the ratio of changes in reserves to the sum of change in exchange rate, divided by the elasticity of excess demand in foreign exchange market and change in reserves. • The elasticity can be derived using the structural model of small open economy model with rational expectation • Weymark estimates the bilateral intervention statistics for Canada over the period 1975-1990 using 2SLS for estimates of the elasticity.	• When the sign of changes in exchange rate and reserves is correct (Exchange rates depreciate and reserves decline), Weymark's index has a range from 0 to 1, with values closer to 1 indicating higher degree of fixity • When the exchange rate changes are the same sign but have a greater absolute magnitude than the changes that would have occurred in the case of no intervention, Weymark's index is negative • When the exchange rate appreciates (depreciates) with excess supply (demand) of domestic currency, Weymark's index is greater than one
LYS (2005) They investigate relationship between exchange rate regime and growth based on this classification in LYS (2003).	• Based on the behavioral of exchange rate volatility (σ_e), the volatility of its rate of change ($\sigma_{\Delta e}$), and the volatility of reserves(σ_r) • σ_e = average of the absolute monthly percentage changes in nominal exchange rate • $\sigma_{\Delta e}$=standard deviation of the monthly	• Inconclusive – countries with low σ_e, low $\sigma_{\Delta e}$, low σ_r • Flexible – countries with high σ_e, high $\sigma_{\Delta e}$, low σ_r • Dirty Float – countries with high σ_e, high $\sigma_{\Delta e}$, high σ_r • Crawling Peg –countries with high σ_e, low $\sigma_{\Delta e}$,

Study	Methodology	Classification or Comments
	percentage changes in nominal exchange rate • σ_r =average of absolute monthly change in reserves relative to monthly base in the previous month	high σ_r • Fixed- countries with low σ_e, low $\sigma_{\Delta e}$, high σ_r
Grier and Grier (2001)	Classify countries in samples as either peggers or floaters according to the exchange rate movements in the first two months of 1997	• Pegged – countries with a predetermined pattern in exchange rate movement • Float – countries with a non predetermined pattern in exchange rate movement
Fischer (2001)	Revised IMF classification	• Hard peg : currency boards or those with no separate currency • Intermediate : conventional fixed pegs, crawling pegs, horizontal bands, and crawling bands • Float: either managed float with no specified central rate or independent float
Collins (1996) and Edwards (1996)	Old IMF classification	• Pegged : a single currency peg or basket of currencies • More flexible : Other than pegged
Frieden et al (2000)	Based on old IMF classification. They classify 26 countries during 1960-1994. In a given year where regimes were changed, a country's regime is the one	• Fixed : to single currency, basket, or frequent adjustment • Forward-looking crawling pegs and bands

Study	Methodology	Classification or Comments
	that occurred in the largest portion of that year.	• Backward-looking crawling pegs and bands • Flexible: managed or independent float
Williamson (1996)	Based on his judgement. He classify 47 countries during 1992-1995 periods	• ERM band • Crawling peg • Adj. Peg • fixed • float • managed float • unclassified (nature of regime is not known or regime changed during the period of obs. or does not fit other categories
Glick and Hutchison (2000)	Assigns a discrete value on a scale of 0 to 1 according to a country's exchange rate classification in a given year. The classification data is from the IMF's Annual Report on Exchange Rate Arrangement and Exchange Rate Restriction	• Indep Float = 0 • Managed float = 0.1 • Wide-band CP = 0.2 • Narrow-band CP or adjusted by indicator= 0.3 • Peg with frequent changes = 0.4 • Cooperative Float = 0.5 • Basket Peg = 0.6 • De facto peg = 0.7

Study	Methodology	Classification or Comments
		• SDR peg = 0.8 • Single currency peg =0.9
Domac (2000)	Use both official and behavioral classification as alternatives	(Official classification) • 2 category dummy fixed and others • 3 category dummy: fixed, intermediate, float (Behavioral Classification) • Define a dummy that takes the value of one when a country's exchange rate changes by less than 5 % • Use a data set on frequent and infrequent adjusted peg • put together by Ghosh et al (1997)
Ghosh et al (1997)	• Based primarily on the official classification as in IMF's annual report • Secondary classification is based on behavioral classification. • The frequent adjusted peg is defined as all regimes with more than one change per year in either parity or for basket pegs in the weights.	(Primary Classification) • Pegs : Single currency pegs, SDR pegs, other official basket pegs, and secret basket pegs • Intermediate: cooperative systems, unclassified floats, and floats within a pre-determined range • Float : floats without a pre-determined range and pure float (Secondary Classification)

Study	Methodology	Classification or Comments
		• Frequent adjusted peg • Infrequent adjusted peg
De Gregorio and Valdes (1999)	Based on the official classification as in IMF report Exchange Arrangements and Exchange Rate Restriction.	• Use 0,1,2 as index of exchange rate flexibility • Fixed regimes (peg to single currency, peg to SDR, and cooperative arrangement)= 0 • Flexible Regimes (peg to basket and Managed float and other flexible arrangements) =1 • Float regimes (Free floating) = 2
Caramazza et al (2000)	Use 3 indices of exchange rate flexibility based on the official classification, the variability of nominal exchange rate and the number of times there are substantial changes in the exchange rate (Dummies equal one under a flexible regime, and 0 otherwise)	• Official classification : The index equals one if a flexible exchange rate regime in IMF's Annual Report and 0 if otherwise. • The variability of nominal exchange rate: The index equals one if the standard deviation of monthly change of the exchange rate with respect to dollar was greater than 0.5 and 0 if otherwise. • The Number of times there are substantial changes in Exchange Rate: The index equals one if at least one monthly change of the exchange rate greater than 1 percent, and 0 if otherwise.
Reinhart and Rogoff	• Classify exchange rate arrangements into 14	• no separate legal tender

Study	Methodology	Classification or Comments
(2004)	categories based on historical chronologies and descriptive statistics of exchange rates.	• preannouced peg or currency board arrangement • preannounced horizontal band that is narrower than or equal to +-2%, de facto peg • pre announced crawling peg, preannounced crawling band that is narrower than or equal to +-2% • de facto crawling peg • de facto crawling band that is narrower than or equal to +-2%, preannounced crawling band that is wider than or equal to +-2% • de facto crawling band that is narrower than or equal to +-5% • moving band that is narrower than or equal to +-2% (i.e., allows for both appreciation and depreciation over time) • managed floating • freely floating • freely falling. • Since they consider only exchange rates, they cannot control shocks

Study	Methodology	Classification or Comments
Baig (2001)	To discern regime-specific behavior • Volatilities of exchange rate, interest rate and reserves • The exchange rate flexibility index: $index = \frac{SDEX}{SDEX + SDREV}$ where, SDEX: standard deviation of exchange rate changes (log difference), SDREV: standard deviation of the ratio of changes in reserves, divided by lagged stock of base money • The weight of the Japanese yen, and the German mark from the multivariate OLS regression To distinguish smoothing and pegging characteristics • The ARCH (1, 1) corrected residuals of the random walk regression	• Countries that have relatively more volatile exchange rate, and less volatile reserve and interest rate can be judged as more flexible than others • If the regression residuals for East Asian currencies seem to be similar between the pre and post-crisis periods, combined with the continued large weight to the dollar, then return to the dollar peg can gain support
Gosh, Gulde, and Wolf (2002)	For de jure regime • The classification of IMF is used For de facto regime • z-score: $z = \sqrt{\mu_{\Delta e}^2 + \sigma_{\Delta e}^2}$	• The continuous z-score is mapped into a discrete three-way de facto classification (pegged, intermediate, and float) by imposing the relative frequency distribution of the de jure classification for that year

Study	Methodology	Classification or Comments
	where $\mu_{\Delta e}$ is the average monthly rate of change of the nominal exchange rate during the year and $\sigma_{\Delta e}$ is the variance of those monthly changes	• Consensus classification is the same classification in terms of de jure and de facto regime • Only nominal exchange rate is used • Nothing supports that the distributions of de jure and de facto regime are same
McKinnon and Schnab (2003)	For High-Frequency Pegging • The weight of the Japanese yen, and the German mark from the multivariate OLS regression • Test difference of weight between pre and post crisis using Wald test • Change of the weight of the US dollar and the Yen using rolling regression • Standard deviations of the percentage daily change of the national currency against the US dollar and the Yen during the pre-crisis, the crisis, the post-crisis, and 2003 for volatility of exchange rates For Low-Frequency Pegging • Standard deviations of monthly exchange rate fluctuations against dollar and yen	From high-frequency analysis, • Countries whose the weights of the US dollar and the Yen in pre-crisis and post-crisis are not different significantly can be judged as they return to pegging system • The degree to which Asian countries deviated from benchmark can be evaluated by comparing the standard deviations of the percentage daily change of the national currency against the US dollar and the Yen between them From low-frequency analysis, • The degree to which Asian countries deviated from benchmark can be evaluated by comparing the standard deviations of the percentage daily change of the national currency against the US dollar and

Study	Methodology	Classification or Comments
		the Yen between them • This methodology cannot distinguish adjustable peg regimes • Since only movement of exchange rate considered for high frequency pegging, it cannot be explained whether it is resulted from intervention of government or market
Pontines and Siregar (2005)	• Intervention index based on probabilities of key indicators (interest rate, reserve, and exchange rate) to be in the high-volatility state • Adopt the Markov-regime switching ARCH to estimate probabilities • $\frac{P^H_{reserves} + P^H_{\text{int}\,r}}{P^H_{exr} + P^H_{reserves} + P^H_{\text{int}\,r}}$	• Two states are not enough to control Asian crisis period • They do not investigate regime changes • In order to find episodes of free floating for each country, they investigate only historical episodes of the country. Therefore, each country has periods of free floating. They need to consider episodes of other countries to classify exchange rate regimes
Kim, Kim, and Wang (2004)	• Probability measures and the exchange rate flexibility index suggested by Calvo and Reinhart (2002) • Probability that the absolute value of the	• It is questionable to use Japan as a benchmark of a free floater, even better benchmark than Australia • Moreover, their measurements of several countries show less flexibility of exchange rate than that of

Study	Methodology	Classification or Comments
	percentage changes of exchange rate, foreign reserves and interest rate is higher (or lower) than some threshold values (2.5%, 1%) • Flexibility index: the ratio of variance of the percentage changes in exchange rate to the sum of the variances of the percentage change in foreign exchange reserves and the change in interest rate • Measures of responses to shocks in two variable VAR model suggested by Kim (2004) $\begin{bmatrix} \Delta E_t \\ \Delta FR_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ A_{21}(L) & A_{22}(L) \end{bmatrix} \begin{bmatrix} \Delta E_{t-1} \\ \Delta FR_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{E,t} \\ \varepsilon_{FR,t} \end{bmatrix}$ • Where E is exchange rate, FR is foreign reserves. • They analyze the response of interest rate to shock by substituting interest rate for foreign reserves	Japan • Since they use change rate of foreign reserves, their VAR model cannot reflect huge accumulation of foreign reserves through positive trend • It is too strong to argue movement to bi-polar regimes on the basis of increased flexibility of exchange rate during the post-crisis periods. Many literatures have found that exchange rate flexibility in several countries came back to the level of pre-crisis period and the level of their interventions cannot be ignored
Ogawa and Yang (2004)	• Standard deviation of nominal and real exchange rates	

Study	Methodology	Classification or Comments
	• Weight measures of foreign currencies in currency basket suggested by Frankel and Wei (1994) • Exchange rate flexibility index: • $\frac{sdex}{sdex+sdrev}$, where sdex is the standard deviation of the log difference of exchange rate and sdrev is the standard deviation of changes in foreign reserves divided by lagged stock of high-powered money	
Park and Wyplosz (2004)	• Exchange rate reaction function: $de^i = c_{i1} + c_{i2}de^Y + c_{i3}de^{\epsilon} + u^i + \varepsilon^i$,where ε^i is a random shock and u^i is a control error, e^i, e^Y and e^{ϵ} are the log of the dollar exchange rates of local currency, the yen and the euro • $u^i = c_{4i}[de^i(-1) - c_{i1} - c_{i2}de^Y(-1) - c_{i3}de^{\varepsilon}(-1)]$ Probability measures suggested by Calvo and Reinhart (2002): 0.25% threshold for exchange rate, 2.5% threshold for reserves	• Since they use change of each currency in exchange rate reaction function, they cannot analyze the case that currencies have trend relationship such as cointegration or time trend • There is no supporting analysis for the important argument on the sterilized intervention against the current and capital account surpluses