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## The Recent Trend of Real Effective Exchange Rate in Selected East Asian Countries

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Exchange rate management has become a hot topic in academic circles examining the merits of fixed versus floating regimes. The 1997-98 Asian crises have refocused attention on the exchange rate management of East Asian countries. Most views expressed criticize the pre-crisis US dollar peg regime as one cause of the crisis. It is said that this regime caused the appreciation of real effective exchange rate and the subsequent loss of competitiveness. Most of the views also have favored greater exchange rate flexibility. In spite of the suggestion of greater flexibility, after the Asian crisis, not all East Asian countries seem to prefer the same exchange rate arrangement and assessment does not always seem to reach clear-cut consensus.

This article evaluates the pre-crisis and post-crisis exchange rate management in the selected East Asian countries by focusing on examining the trend of real effective exchange rate (REER), an indicator of a country's international price competitiveness. The main findings of the study are as follows : First, we found that the REER shows a clear trend of appreciation during the pre-crisis period while it reveals a rather stable movement during the post-crisis period. Second, we verified that the pre-crisis REER appreciation, which came from the pre-crisis dollar peg regime, gave the significantly negative impact on trade balance in some East Asian countries. Third, Our empirical evidence indicated that in the post-crisis exchange rate management, some East Asian countries have come to care more about the factor of the inflation adjustment in addition to the US dollar linkage. We speculate that they may have learned the lessons that the Asian crisis was partly caused by the simple US dollar peg regime accompanied by the REER appreciation and the worsened trade balance.

### 1 . Introduction

Exchange rate management is a crucial component of macroeconomic policy. Since the postwar period, there has been a long-term debate over the merits of fixed versus floating exchange rates. The 1997-98 Asian crises have refocused attention on exchange rate management of East Asian countries. Most views expressed criticize the pre-crisis US dollar peg regime as a cause of the crisis. It is said that this regime caused the appreciation of real effective exchange rate and the subsequent loss of competitiveness. Most of the views also have favored greater exchange rate flexibility. In spite of the suggestion of greater flexibility, after the Asian crisis, not all East Asian countries seem to prefer the same exchange rate arrangement and assessment does not always seem to reach clear-cut consensus.

This article evaluates the pre-crisis and post-crisis exchange rate management in the selected

East Asian countries by focusing on examining the trend of real effective exchange rate (REER), an indicator of a country's international price competitiveness. Specifically, the two main questions are these : in the pre-crisis period, whether the REER of East Asian countries did in fact appreciate under dollar peg system and give a negative impact on trade balance in those countries ; in the post-crisis period, whether the behavior of the REER has been changing and finding another path to follow by learning a lesson from the crisis. In this article, we focus, as sample countries, on the hardest-hit countries among the East Asian countries : Indonesia, Korea, the Philippines, Malaysia, and Thailand.

The rest of the paper is organized as follows. Section 2 simply observes trend of real effective exchange rate (REER) in the sample countries during both pre-crisis and post-crisis period. Section 3 focuses on the analysis of the pre-crisis trend of the REER appreciation and its relationship with worsening trade balance. Section 4 focuses on the analysis of the post-crisis trend of the REER, verifying the hypothesis that the sample countries have come to value inflation adjustment in their exchange rate management during the post-crisis period. Section 5 presents some concluding remarks.

## 2 . The Recent Trend of Real Effective Exchange Rate

In this section, we simply look at the trend of real effective exchange rate (REER) in the sample countries during both pre-crisis and post-crisis period.

The REER is an indicator of a country's international price competitiveness, specifically of a country's prices relative to those of other countries. Dornbusch and Fischer (1990) explains that we look at the real rate to take into account what happened to prices here and abroad, and that the effective rate represents the prices of a representative basket of foreign currencies. Therefore, a country's REER levels off when an exchange rate is fully adjusted according to a country's prices relative to those of other countries (the country follows purchasing power parity).

There are, in general, two kinds of REER : One is the prices of one country relative to those of competitors in the world export market, which are obtained by dividing the US dollar value of the price level of a country in question by the US dollar value of the world export unit value index. This indices represent the effective rate in the sense that the US dollar value of the world export unit value index covers the prices of a basket of foreign currencies of not only the trading partners but also the competitors in the world export markets. The other is the weighted average of the bilateral real exchange rates with a trading partner wherein the weight is the share of the trade with the trading partner in the country's total trade, the typical example of which is the Morgan Guaranty indexes (JP Morgan (2002)). The former values the role of competitors in third markets, while the latter reflects the relative importance of a country's trading partners. We here use the former indices of REER by taking the role of competitors in third markets into account and calculate it in the following way (taking Indonesia as an example).

$$\text{REER}_{\text{Indonesia}} = \{ \text{WPI}_{\text{Indonesia}} / \text{ER} (\text{Rupiah} / \text{U.S. dollar}) \} / \text{WEUVI}$$

where WPI is wholesale price index on local currency base, ER (Rupiah /U.S. dollar) is actual exchange rate on the U.S. dollar base, and WEUVI is world export unit value index on the U.S. dollar

base.

The main findings from Figure 1 and Table 1 are as follows. During the pre-crisis period of 1987-96, the REERs show a clear trend of appreciation by 10-40 percent. There is, however, a difference in the timing of appreciation between Korea and the other four countries; the REER of Korea appreciated mainly for 1987-1990, while those of the other countries appreciated mainly for 1990-1996. During the post-crisis period from 1999 to 2001 (the second quarter), the REERs reveal no significant trend of appreciation, but a rather stable movement compared with the pre-crisis period. The following sections analyze both the pre-crisis and post-crisis trends of the REER.

### 3. The Pre-crisis Appreciation and Trade Balance

In this section, we focus on the analysis of the pre-crisis trend of the REER appreciation and its relationship with worsening trade balance. First, we review the analyses of the pre-crisis de facto exchange rate regimes: the dollar peg regime in the East Asian countries. Second, we show the general assessments of the pre-crisis dollar peg regime from the viewpoint of its negative effect on trade balance through the REER appreciation. Third, we conduct empirical studies including regression and simulation analyses to examine the negative impact of the REER appreciation on trade balance.

#### 3. 1. De Facto Exchange Rate Regime

The IMF classification of exchange rate arrangements did not necessarily reflect actual exchange rate management, since it was based on member countries' formally announced regimes. For example, the pre-crisis exchange rate arrangements of Indonesia, Korea, and Malaysia were classified as "Managed Float," for the Philippines it was "Independent Float," and for Thailand the classification was "Pegged to Currency Composite," although all of them appeared to have adopted dollar peg regimes.

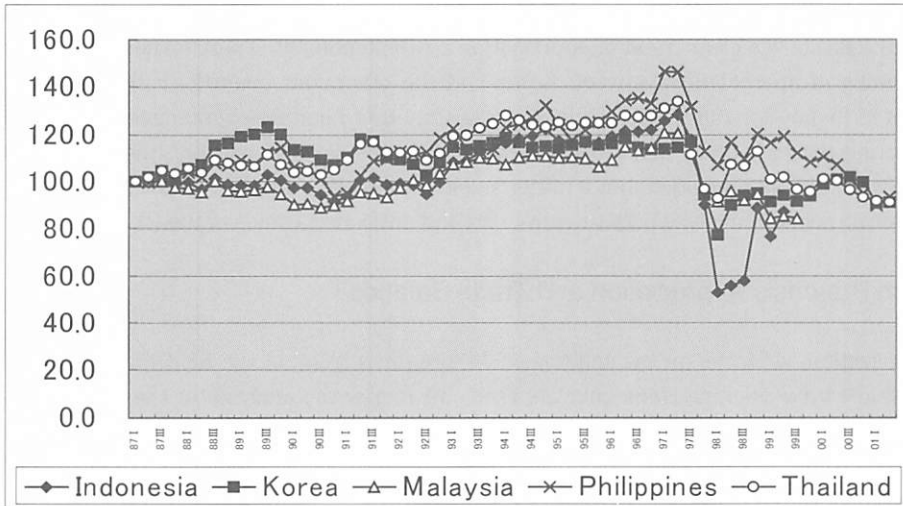
Frankel and Wei (1994) and Kawai (1997) presented their own analysis of the de facto exchange rate regimes. Frankel and Wei (1994) estimated the weights placed on major foreign currencies in their exchange rate policy during the period between 1979 and 1992, while Kawai (1997) estimated them during the period between 1990 and 1996, using the same method as Frankel and Wei. According to their estimations, for example, the weight on the US dollar is 0.91 (Frankel and Wei (1994)) and 0.789 (Kawai (1997)) for Thailand. The weight on the US dollar is nearly equal to one for Indonesia, Korea, and Philippines. Thus, the estimation indicates that these countries have adopted the de facto US dollar-pegged-rate system. Researchers and policymakers seem to be in agreement over this analysis.

#### 3. 2. Assessment of US Dollar peg Regime

We next review the assessments of the pre-crisis dollar peg. Most views criticize the system because of its tendency to cause appreciation of real exchange rates with the subsequent loss of competitiveness and to deteriorate trade balance, which was one cause of the Asian crisis.

Ito (2001) picks up three types of problem which the de facto dollar peg gives rise to, two of

Fig. 1 The Trends of Real Effective Exchange Rates



Notes: All the indexes on exchange rates are expressed as the foreign currency price of a unit of domestic currency. Thus, an increase in the index means appreciation of the currency.  
 Source: IFS (IMF 2002)

Table 1 The Trends of Real Effective Exchange Rates

	Price relative to World Export Unit Price (87I=100)					Price relative to World Export Unit Price (87I=100)					
	Indonesia	Korea	Malaysia	Philippines	Thailand	Indonesia	Korea	Malaysia	Philippines	Thailand	
87 I	100.0	100.0	100.0	100.0	100.0	95 II	115.8	115.4	110.2	117.7	123.8
87 II	99.5	101.9	100.0	99.4	101.6	95 III	116.7	116.8	109.8	121.7	125.0
87 III	100.2	104.5	100.0	103.2	104.7	95 IV	116.5	115.4	106.1	125.3	124.9
87 IV	98.5	100.3	97.3	101.9	103.3	96 I	119.2	116.2	109.1	129.5	124.9
88 I	99.6	105.6	97.0	103.7	105.5	96 II	121.5	118.3	114.6	134.3	127.9
88 II	96.4	107.1	95.3	101.8	103.7	96 III	121.3	114.5	113.0	135.2	127.4
88 III	101.3	115.5	100.0	107.7	109.0	96 IV	122.0	113.6	114.3	133.0	127.9
88 IV	98.6	116.3	95.8	106.7	107.9	97 I	125.9	113.9	120.7	146.3	130.9
89 I	98.3	119.2	95.5	109.2	106.7	97 II	128.3	114.5	120.5	146.1	133.7
89 II	98.2	120.2	96.2	107.2	106.4	97 III	117.9	116.8	n.a.	131.6	111.5
89 III	102.8	123.1	97.6	112.5	111.4	97 IV	89.9	94.2	n.a.	112.9	96.6
89 IV	100.3	120.0	94.4	114.5	107.1	98 I	53.1	77.2	91.3	106.9	92.7
90 I	97.3	113.4	89.9	105.9	103.8	98 II	56.0	89.6	95.5	116.7	107.1
90 II	97.3	112.7	90.3	105.5	104.3	98 III	58.0	93.7	91.8	109.6	106.4
90 III	94.2	109.1	88.7	101.1	102.7	98 IV	88.6	94.7	94.5	120.3	112.7
90 IV	91.4	106.9	89.7	93.5	105.0	99 I	76.4	91.2	84.2	116.5	100.8
91 I	93.4	110.3	91.4	94.8	109.0	99 II	86.9	93.8	85.0	119.3	101.7
91 II	100.5	118.1	95.3	102.3	116.0	99 III	n.a.	91.4	84.1	111.9	96.4
91 III	101.4	117.3	94.8	108.8	116.9	99 IV	n.a.	93.6	n.a.	108.2	95.4
91 IV	98.3	110.3	93.0	109.5	112.4	00 I	n.a.	98.6	n.a.	110.5	100.8
92 I	98.9	109.2	97.0	112.9	112.3	00 II	n.a.	100.6	n.a.	107.0	100.2
92 II	98.3	107.2	100.5	111.5	112.9	00 III	n.a.	101.7	n.a.	101.2	96.2
92 III	94.4	102.5	98.2	112.6	109.0	00 IV	n.a.	99.5	n.a.	94.7	93.1
92 IV	99.5	107.9	103.4	118.7	111.9	01 I	n.a.	90.6	n.a.	89.4	91.4
93 I	108.2	114.6	107.2	122.6	119.3	01 II	n.a.	90.9	n.a.	93.3	90.9
93 II	108.7	113.5	108.2	113.9	119.8						
93 III	112.6	115.2	110.0	112.9	122.8						
93 IV	115.0	116.5	109.7	113.9	124.6						
94 I	116.4	118.6	107.0	122.9	128.1	87I-90I	-2.7	13.4	-10.1	5.9	3.8
94 II	118.3	116.6	110.3	124.3	126.0	90I-91I	29.4	0.4	34.3	38.1	26.1
94 III	119.3	114.5	110.9	127.3	124.1	91I-92I					
94 IV	122.3	115.0	110.6	132.1	123.3	99I-01I	n.a.	-0.4	n.a.	-19.9	-9.8
95 I	117.3	114.1	110.0	124.1	125.0						

Note: The "n.a." means the missing data.  
 Source: IFS (IMF 2002)

which are related to competitiveness. First, when inflation at home is higher than in the United States, the export sectors lose competitiveness in the long run. Where productivity growth compensates for the inflation differential, the real appreciation of the exchange rate can be absorbed. But, unfortunately, this was not the case for most Asian countries. Second, Asian countries have extensive trade relationships with Japan. For many Asian countries, one-quarter to one-third of their exports and imports are to and from Japan. Even though the exchange rate was fixed to the US dollar, the exchange rate relative to the yen fluctuated greatly. Therefore, the fixed exchange rate relative to the US dollar led to instability of the real, effective exchange rate-the trade-weighted, inflation-adjusted exchange rate.

The international organizations also comment on the pre-crisis dollar peg system as follows. The World Bank (1998) stated that in most of the ASEAN countries, the dollar pegged currencies lost competitiveness against the important yen market because the yen depreciated against the US dollar throughout much of 1996. The ADB (1998) explained that the pegged exchange rate contributed to current account deficits and rising real exchange rates, the combination of which provided a vital ingredient of the financial crisis. They attributed the rising real rate to a combination of factors that included higher domestic inflation in relation to the world average ; appreciation of the US dollar, to which these currencies were pegged ; depreciation of the Japanese yen ; and devaluation of the PRC currency in 1994.

### 3. 3. Empirical Studies on Relationship between REER and Trade Balance

We next turn to empirical analyses to examine whether the REER appreciation really deteriorated trade balance in the selected East Asian countries. We here take two steps in our analyses. First, we conduct a regression analysis to verify the relationship between REER and trade balance during the pre-crisis period. Second, we conduct a simulation analysis of trade balances with the assumption that the sample countries had adopted a policy to stabilize REER instead of the de facto US dollar peg system during the pre-crisis period. We can then examine the negative effect of REER appreciation on trade balances. All data throughout the empirical studies come from the IFS of the IMF (IMF 2002). We use IFS annual data for the regression and simulation analyses considering data availability, the sample period for which is from 1960 to 1996 (For Indonesia, the sample period is from 1971 to 1996 due to a constraint on data). We exclude the period after 1997 because of macroeconomic turbulence during the financial crisis.

#### 3. 3. 1. Regression Analysis on Trade Balance

We here conduct a regression analysis to prove the negative impact of the REER appreciation on trade balance during the pre-crisis period. We here follow the analytical framework of trade balance equation presented by Rose and Yellen (1989), and Baharumshah (2001) ; The trade balance is expressed as a function of the REER and the levels of domestic and foreign incomes, which is derived from the functions of foreign and domestic demands for imported goods depending upon the relative prices and the levels of domestic and foreign incomes. We choose to work with this framework for the following reasons : First, the trade balance equation, in which the REER is predetermined, seems to be appropriate at least under the pre-crisis dollar peg regime where the exchange rate is controlled by the central bank. Second, the trade balance equation can simply

capture the net effects of the REER on the trade balance, which will be used for the simulation analysis in the next section of 3.3.2. The concrete equation form in the estimating model is shown as follows.

$$\Delta \ln(\text{TB}) = \alpha_1 \Delta \ln(\text{REER}) + \alpha_2 \Delta \ln(\text{REER}_{-1}) + \beta \Delta \ln(\text{YR}) + \gamma \Delta \ln(\text{WYR}) + \mu$$

$$\alpha_1 < 0, \quad \alpha_2 < 0, \quad \beta > 0 \quad \text{or} \quad < 0, \quad \gamma > 0$$

where  $\ln$  shows natural logarithm, and  $u$  is assumed to be a white-noise process. TB, the trade balance, is expressed by the ratio of export value to import value (In Indonesia, oil export value is excluded). Using the ratio enables us to do without price index to express trade balance in real terms and to avoid the scale problem of time-series increase of value. REER, the real effective exchange rate, is the one defined in the previous section of 2. The reason for using both variables of REER and REER<sub>-1</sub> is that it is possible to take a certain time to improve trade balance because of the J-curve effect. Of particular importance are the signs and magnitude of the coefficient of REER,  $\alpha_1$ , and  $\alpha_2$ . They are expected to be negative if the Marshall-Lerner condition holds, that is, if the REER has meaningful impacts on trade balance. For YR, the domestic real income, we use GDP in real terms. The sign of  $\beta$  is ambiguous, depending on whether YR represents the level of domestic demands or the supply volume of exportables. For WYR, foreign real income, we use industrial production of industrial countries. The sign of  $\gamma$  is expected to be positive because WYR is seen as the foreign demand for the country's export. The regression model is multivariate ordinary least squares for each country.

We first test the stationarity of all the data series for the regression by using the unit root tests of the Augmented Dickey-Fuller (ADF) test and the Philips-Perron (PP) test (for the test methodology, see Matsuura and McKenzie 2001). Due to a failure to reject the null of a unit root for each level data, we specify the function above in the first-differenced data. The Appendix of Table 2 reports that, at the 5 percent significance level, all the first-differenced data series are confirmed as stationary in both tests, thereby suggesting that a regression analysis using all the first-differenced data series is valid.

Table 2 reports the results of the regressions. We observed as follows: The coefficients of REER are significantly negative in Korea and Philippines, and that of REER<sub>-1</sub> is significantly negative in Thailand. The coefficients of YR are negative except for Korea, but only significant in Philippines. The coefficients of WYR are positive in all the sample countries, but significant in Indonesia, Korea and Philippines. From these observations, we could at least verify the meaningful impacts of the REER on trade balance during the pre-crisis period in Korea, Philippines and Thailand. As reasons why Indonesia and Malaysia do not show a significant effect of the REER on trade balance, we speculate that Indonesian exports, recording a large share of raw materials (even if crude oil is excluded) may have been highly influenced by the movements of world commodity prices, and that Malaysian exports, consisting largely of machinery components for the Asian industrial production network, may not have been so sensitive to price mechanisms.

### 3. 3. 2. Simulation Analysis on Trade Balance

We next turn to a simulation analysis to examine how and to what extent the sample countries would have changed their trade balance trend if they had adopted a policy to stabilize their REER instead of the de facto US dollar peg system during the pre-crisis period. We here exclude Indonesia



Table 2. The Results of Regression on Trade Balance Functions

	Indonesia	Korea	Malaysia	Philippines	Thailand
$\Delta \ln(\text{REER})$	-0.41	-0.90 ***	0.20	-0.33 **	-0.47
$\Delta \ln(\text{REER}_{-1})$	-0.07	0.11	0.27	-0.23	-0.64 *
$\Delta \ln(\text{YR})$	-0.98	0.02	-0.28	-1.51 ***	-0.38
$\Delta \ln(\text{WYR})$	4.11 ***	1.35 *	0.79	1.74 ***	0.48
Adj R <sup>2</sup>	0.40	0.27	0.04	0.32	0.14
D.W.	1.98	1.37	2.04	2.65	2.48
Sample	1973-1996	1962-1996	1962-1996	1962-1996	1962-1996

Notes:

1) The specified Trade Balance Function is:

$$\Delta \ln(\text{TB}) = \alpha_1 \Delta \ln(\text{REER}) + \alpha_2 \Delta \ln(\text{REER}_{-1}) + \beta \Delta \ln(\text{YR}) + \gamma \Delta \ln(\text{WYR})$$

TB: Trade Balance (Export/Import)

REER: Real Effective Exchange Rate

YR: Real GDP

WYR: Industrial Production (Industrial Countries)

2) \*, \*\*, \*\*\* indicate that the coefficient is significant at the 90, 95, and 99 percent level.

Source: IFS (IMF 2002)

Appendix The Unit Root Tests on Data for Regression in Table 2

Variables	ADF Statistic		PP Statistic	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Indonesia (1973-1996)				
$\Delta \ln(\text{TB})$	-4.39 ***	-4.27 **	-4.96 ***	-4.82 ***
$\Delta \ln(\text{REER})$	-3.89 ***	-3.80 **	-3.75 ***	-3.65 **
$\Delta \ln(\text{YR})$	-3.28 **	-3.17	-3.41 **	-3.26 *
$\Delta \ln(\text{WYR})$	-5.00 ***	-4.91 ***	-4.45 ***	-4.27 **
Korea (1962-1996)				
$\Delta \ln(\text{TB})$	-4.24 ***	-5.84 ***	-4.23 ***	-4.81 ***
$\Delta \ln(\text{REER})$	-6.50 ***	-6.79 ***	-10.00 ***	-9.79 ***
$\Delta \ln(\text{YR})$	-4.56 ***	-4.59 ***	-5.34 ***	-5.26 ***
$\Delta \ln(\text{WYR})$	-4.35 ***	-5.55 ***	-4.29 ***	-5.02 ***
Malaysia (1962-1996)				
$\Delta \ln(\text{TB})$	-5.18 ***	-5.15 ***	-5.95 ***	-5.87 ***
$\Delta \ln(\text{REER})$	-4.10 ***	-4.14 **	-3.91 ***	-3.80 **
$\Delta \ln(\text{YR})$	-3.92 ***	-4.07 **	-5.45 ***	-5.53 ***
$\Delta \ln(\text{WYR})$	-4.35 ***	-5.55 ***	-4.29 ***	-5.02 ***
Philippines (1962-1996)				
$\Delta \ln(\text{TB})$	-6.52 ***	-6.45 ***	-7.56 ***	-7.50 ***
$\Delta \ln(\text{REER})$	-6.05 ***	-6.15 ***	-7.19 ***	-7.92 ***
$\Delta \ln(\text{YR})$	-3.32 **	-3.53 *	-3.02 **	-3.07
$\Delta \ln(\text{WYR})$	-4.35 ***	-5.55 ***	-4.29 ***	-5.02 ***
Thailand (1962-1996)				
$\Delta \ln(\text{TB})$	-4.26 ***	-4.21 **	-6.75 ***	-6.79 ***
$\Delta \ln(\text{REER})$	-4.90 ***	-4.97 ***	-4.79 ***	-4.74 ***
$\Delta \ln(\text{YR})$	-3.38 **	-3.33 *	-3.85 ***	-3.74 **
$\Delta \ln(\text{WYR})$	-4.35 ***	-5.55 ***	-4.29 ***	-5.02 ***

Notes:

1) The lag truncation is one quarter in the ADF test, and three quarters in the PP test.

2) \*\*\*, \*\*, and \* indicate rejection of the null of nonstationarity at the 1 percent, 5 percent, and 10 percent significance levels with critical values taken from Davidson and MacKinnon (1993).

Source: IFS(IMF 2002)

and Malaysia from the simulation analysis because we could not verify the meaningful effects of the REER on trade balance in the regression analysis of the previous section of 3.3.1.

We proceed to the simulation analysis in the following way. First, we materialize the policy to stabilize the REER in such a way that the REER levels off from 1987 to 1996. Second, we simulated the trade balance by replacing only the actual REER with the leveled-off REER in the regression equation estimated in the previous section of 3.3.1. We here assume that the coefficients on the explaining variable in the regression equation are unchanged even if the monetary authorities change their exchange rate management. Third, we compare the simulated trade balance with the one estimated under the actual REER appreciation, and then calculate the gap for both values. The gap really shows the extent to which the sample countries would have improved their trade balance trend if they had adopted a policy to stabilize their REER instead of the de facto US dollar peg system during the pre-crisis period. This can also be understood as the negative effect of the pre-crisis REER appreciation under the dollar peg regime on trade balance.

Figure 2 and Table 3 report the results of the calculation above. The main observations are as follows. The cumulative negative impact of the REER appreciation on trade balance from 1987 until 1996 in three sample countries amounts to 0.1-0.2 points of the export-import ratio. During the same period, three countries' trade balances had deteriorated by 0.1-0.3 points of the export-import ratio. We can therefore conclude that the negative effect of the REER appreciation on external balance was large enough to be considered as one of the causes of the currency crisis since 1997 in three sample countries. The simulation analysis above implies the importance of stabilizing the REER in exchange rate management as a policy implication.

## 4 . The Post-crisis Exchange Rate Management

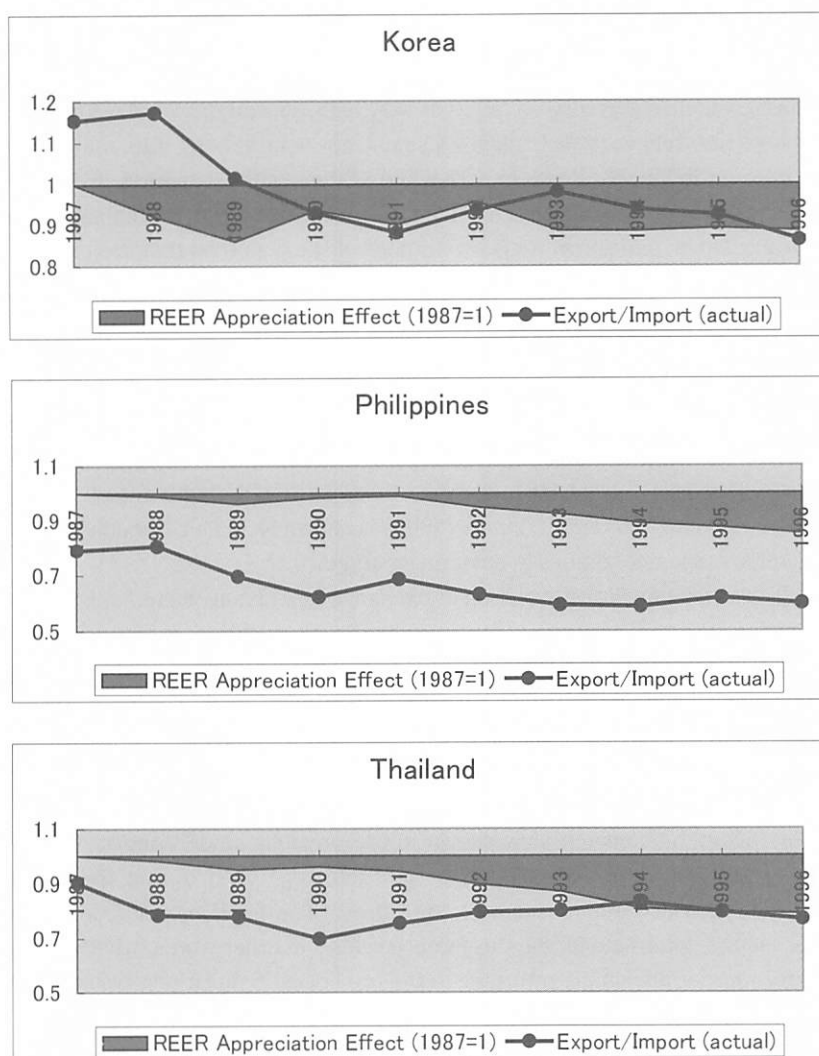
In this section, we focus on the analysis of the post-crisis trend of the REER. As shown in Section 2, the REER reveals no significant trend of appreciation, but a rather stable movement during the post-crisis period of 1998-2001. We here present the hypothesis that the sample countries, not simply relying on the US dollar standard, have come to pay more attention to inflation rates in their exchange rate management during the post-crisis period. We speculate that they may have learned the lessons that the Asian crisis was partly caused by the simple US dollar peg regime accompanied by rising the REER and worsening trade balance.

We first review the analyses of the post-crisis exchange rate management in East Asian countries. We then verify the hypothesis above by a regression analysis for examining the factors determining the targeted reference rates in managing exchange rates.

### 4 . 1 . Previous Studies on Post-crisis Exchange Rate Management

We here review the analyses of the post-crisis exchange rate management in East Asian countries. As shown in Section 3.2, the pre-crisis US dollar-pegged-rate regime has been criticized because of its tendency to cause the appreciation of real exchange rates with the loss of competitiveness. Most of the views also have favored greater exchange rate flexibility. In spite of the suggestion of greater flexibility, after the Asian crisis, not all East Asian countries seem to prefer the same exchange rate arrangement and assessment does not always seem to reach clear-cut consensus. We pick up some

Figure 2. The Effect of REER Appreciation on External Balance



Source: IFS (IMF 2002)

Table 3. The Effect of REER Appreciation on Trade Balance

	Actual Trade Balance (Export/Import)			The Effect of REER appreciation (1987-1996)
	1987	1996	1987-1996	
Korea	1.15	0.86	-0.29	-0.11
Philippines	0.79	0.60	-0.19	-0.15
Thailand	0.90	0.77	-0.13	-0.21

Source: IFS (IMF 2002)

previous studies as follows.

Calvo and Reinhart (2000) found that countries that say they allow their exchange rate to float mostly do not - there seems to be an epidemic case of "fear of floating." They showed, as one of the key evidences of the "fear of floating", that in the countries that say they allow their exchange rate to float, the foreign exchange reserve volatility is very high, contrary to what would be expected in a floating exchange rate regime, which suggests significant central bank intervention. Their analysis included the cases of Indonesia, Korea and Thailand in the post-crisis period, and the Philippines in the recent decade, where their foreign exchange reserve volatilities are higher than those of the United States and Japan, and surprisingly, even those of the countries that are classified in "limited Flexibility" according to the IMF system. Their analysis, therefore, showed that some East Asian countries that are categorized as having floating currencies since the Asian crisis are, in effect, holding loose pegs.

Mckinnon (2001) analyzed how the post-crisis exchange rate regime has evolved since 1998. According to his analyses, dollar exchange rates, particularly when observed on a high-frequency (daily) basis, have become as stable as they were before the crisis. Therefore, he stated that the East Asian dollar standard, except for Indonesia, seems to be resurrecting itself, and that the "fear of floating" identified by Calvo and Reinhart (2000) is shown at higher frequencies to be a rational response to capital market conditions in emerging markets.

Kawai (2002) also examined the evolution of exchange rate arrangements in East Asia's emerging market economies over the last ten years. According to his analyses, in the post crisis period the dollar has regained prominence in some countries (notably in Malaysia), while its dominance has been reduced and exchange rate flexibility has risen in others (notably in Indonesia). Interesting is the observation that Korea and Thailand appear to have shifted to a de facto currency basket arrangement with significant weights on the US dollar and the yen, similar to Singapore's managed floating arrangement.

We basically follow the common view shown in the previous studies above that the East Asian countries except for Malaysia are holding to the "soft peg" even during the post-crisis period regardless of their official announcement of "free float". The focus of our following analysis is to examine what factors determine targeted reference rates ; in other words, whether, after the crisis, the East Asian countries are simply returning to the pre-crisis US dollar peg system, or whether they have learned a lesson from the crisis and are finding another path to follow.

#### 4 . 2 . Regression Analysis for Examining Exchange Rate Targeting

We next turn to a regression analysis to identify the factors determining the targeted reference rates including inflation rate in managing exchange rates. We follow the work of Frankel and Wei (1994)<sup>1</sup> and specify the regression model in the following way.

$$\Delta \log (\text{Local Currency} / \text{SWF}) = \alpha_1 \Delta \log (\text{USD} / \text{SWF}) + \alpha_2 \Delta \log (\text{JPY} / \text{SWF}) \\ + \alpha_3 \Delta \log (\text{DEM} / \text{SWF}) + \alpha_4 \Delta \log ((\text{CPI} + \text{CPI}_1) / 2) + \epsilon$$

Where SWF is the Swiss franc, USD is the US dollar, JPY is the Japanese yen, DEM is the German mark and  $\epsilon$  is assumed to be a well-behaved error term, following  $N(0, \sigma^2)$ . CPI is the Consumer

Price Index of the local country with a time lag to take the causality relationship between CPI and the value of local currency into account. The Swiss franc is chosen as an arbitrary numéraire for measuring variations in the exchange rate because it is an independently floating currency of an advanced country which nonetheless carries little weight in Asia's trade. Based on the first difference of logarithms (percentage changes), the simple regression model is multivariate ordinary least squares for each country and time period. All the sample data are monthly ones taken from the International Financial Statistics of the International Monetary Fund. The data are broken up into two periods - pre-crisis from January 1994 to December 1996, and post-crisis from January 1999 to December 2000.

According to Frankel and Wei (1994), if the local currency is tightly fixed to some particular value of the US dollar, then the regression coefficient  $\alpha_1$  should be discernable and approximately unity, while the others,  $\alpha_2$  and  $\alpha_3$ , are close to 0. Another crucial variable is the local CPI. If the coefficient of the local CPI,  $\alpha_4$ , is significantly positive, we assume that the domestic inflation rate can be one of the factors determining the targeted reference rates in managing exchange rates.

Before the regression, we test the stationarity of all the data series by using the unit root tests of the Augmented Dickey-Fuller (ADF) test and the Philips-Perron (PP). The Appendix of Table 4 reports that at the 5 percent significance level, all the first-differenced data series are confirmed as stationary in both tests, thereby suggesting that a regression analysis using all the first-differenced data series is valid.

## Results and Interpretations

Table 4 reports the results of the regressions. The main observations and their interpretations are as follows. First, the coefficients of the US dollar in all local currencies are significantly positive throughout the pre- and post- periods. In particular, the Philippine Peso of both periods and the pre-crisis Indonesian Rupiah have an approximate unity as a coefficient of the US dollar and the post-crisis Malaysian Ringgit has a rigid unity. The sample countries, except for Malaysia, therefore, seem to be holding the "soft peg" to the US dollar, during not only the pre-crisis period but also the post-crisis period, regardless of its assigned weights. Malaysia, who has announced "Pegged to US dollar" since 1998 is econometrically verified to fix its currency to the US dollar in the post-crisis period. Second, the coefficients of the local CPI are significantly positive in the post-crisis of the Thai Baht, the Philippine Peso and the Korean Won. Korea, the Philippines and Thailand, therefore, may have come to take the domestic inflation rates into account as one of the factors determining the targeted reference rates during the post- crisis period. The importance of the local CPI variable in the three sample countries is also justified by the result that the post-crisis estimation with the local CPI variable shows better performance in both adjusted R-squared and Durbin-Watson statistic than the post-crisis estimation without the local CPI variable does in each sample country. Third, most of the coefficients of the Japanese yen and the German mark are insignificant and do not have a noteworthy difference between the pre-crisis period to the post crisis one. Thus, there seem to be no significant changes in the weights assigned to the Japanese yen and German mark. Lastly, the post-crisis Indonesia Rupiah shows a relatively worse performance in the adjusted R-squared. Post-crisis Indonesia may have had its currency influenced by other factors such as political instability. We can therefore conclude that post-crisis exchange rate targeting appears to be somewhat different from the simple US dollar standard in the pre-crisis period, and that Korea, the Philippines

Period	USD	JPY	DEM	(CPI+CPI(-1))/2	R**2	D.W.
Baht pre-crisis	0.85***	0.10***	0.04	0.01	0.998	1.275
Baht post-crisis	0.66***	0.23	-0.02	4.17**	0.481	1.488
Baht pre-crisis	1.05***	0.05	0.37	-0.22	0.843	0.805
Baht post-crisis	1.15***	-0.18	0.08	2.78***	0.825	1.820
Peso pre-crisis	1.05***	-0.14	0.04		0.617	0.645
Peso post-crisis	0.82***	0.20	-0.14	0.18	0.908	1.472
Won pre-crisis	1.06***	0.44***	0.01	2.15**	0.750	1.731
Won post-crisis	1.08***	0.40***	0.01		0.716	1.475
Rupiah pre-crisis	0.97***	0.01	0.06	0.20***	0.986	1.459
Rupiah post-crisis	2.13**	-0.85	-0.04	1.31	0.273	2.034
Rupiah pre-crisis	1.51**	-0.27	-0.16		0.234	1.730
Rupiah post-crisis	0.78***	0.10	0.64**	0.23	0.780	1.367
Ringgit pre-crisis	1.00***	0.00	-0.00	0.00	1.000	2.829
Ringgit post-crisis	1.00***	0.00	-0.00	0.00	1.000	2.770

Notes:

- (1) All currencies are in terms of units of Swiss francs.  
 (2) The pre-crisis period is from January 1994 to December 1996, and the post-crisis period is from January 1999 to December 2000, except for the Baht (from June 1998 to December 2000) and the Won (from June 1998 to April 2001).  
 (3) \*, \*\*, \*\*\* indicate that the coefficient is significant at the 90, 95, and 99 percent levels, respectively.

Source: IFS (IMF 2002)

Appendix The Unit Root Tests on Data for Regression in Table 4

Variables	ADF Statistic			Trend and Intercept
	Intercept	Intercept	Intercept	
Pre-crisis (Jan 1994-Dec 1996)	-3.75***	-4.41***	-4.09**	-4.23***
log(Baht)	-4.01***	-4.09**	-4.09**	-3.89***
log(Peso)	-4.15***	-4.40***	-4.64***	-4.51***
log(Won)	-3.87***	-4.64***	-4.24***	-4.81***
log(Rupiah)	-4.57***	-5.35***	-4.31***	-4.83***
log(Ringgit)	-3.75***	-4.45***	-4.13***	-4.63***
log(USD)	-3.32**	-3.27*	-4.55***	-4.48***
log(JPY)	-3.77***	-4.18**	-4.73***	-5.01***
log(DEM)	-5.76***	-5.41***	-3.72***	-3.74**
log((CPI+CPI(-1))/2) Thailand	-4.61***	-4.70***	-3.03**	-3.14
log((CPI+CPI(-1))/2) Philippines	-6.15***	-6.58***	-3.07**	-3.34*
log((CPI+CPI(-1))/2) Korea	-4.61***	-4.70***	-3.03**	-3.40*
log((CPI+CPI(-1))/2) Indonesia	-4.61***	-5.12***	-3.17**	-3.68**
log((CPI+CPI(-1))/2) Malaysia	-4.64***	-4.81***	-3.65***	
Post-crisis (Jun 1998-Apr 2001)	-5.57***	-5.83***	-4.99***	-5.00***
log(Baht)	-4.01***	-3.99***	-4.69***	-4.63***
log(Peso)	-4.67***	-5.04***	-4.36***	-4.51***
log(Won)	-5.79***	-6.04***	-4.03***	-4.13**
log(Rupiah)	-3.50**	-3.47*	-5.82***	-5.76***
log(Ringgit)	-3.70***	-3.94**	-4.80***	-5.02***
log(USD)	-4.15***	-4.28***	-6.02***	-6.13***
log(DEM)	-3.78***	-3.81**	-2.88**	-2.91
log((CPI+CPI(-1))/2) Philippines	-5.29***	-7.23***	-3.03**	-3.51*
log((CPI+CPI(-1))/2) Korea	-3.25**	-3.08	-1.79**	-1.51
log((CPI+CPI(-1))/2) Indonesia	-3.92***	-3.99**	-3.09**	-3.02

Notes:

- (1) The lag truncation is one quarter in the ADF test, and three quarters in the PP test.  
 (2) \*\*\*, \*\*, and \* indicate rejection of the null of nonstationarity at the 1 percent, 5 percent, and 10 percent significance levels with critical values taken from Davidson and MacKinnon (1993).  
 Source: IFS (IMF 2002)

and Thailand have come to value inflation adjustment in exchange rate targeting in addition to the US dollar linkage during the post-crisis period.

We here compare the result of the above estimation with that of Kawai (2002). The main difference lies in the post-crisis weight assigned to the US dollar and the Japanese yen ; Kawai (2002) shows that Korea and Thailand have significantly shifted the weight from the US dollar to the Japanese yen in their post-crisis managed floating arrangement, while our estimation identifies no significant weight-shift. We speculate that the difference in the result might mainly come from the difference in the frequency in exchange rate management to be analyzed ; Kawai (2002) conducts a Frankel-Wei type of regression on a daily base for examining the highly- frequent exchange rate management (the original analysis by Frankel and Wei (1994) is on a weekly base). On the other hand, our analysis concentrates on the lower- frequent (monthly) exchange rate management. In fact, the data for the key variable in our analysis, CPI, is usually available on monthly base<sup>(2)</sup>.

We lastly make a brief comment on the way of keeping the targeted reference rate. To defend the rate, central bank intervenes foreign exchange markets. To make the interventions effective, it is said that the following policy actions should be taken. First, the targeted reference rate should be announced publicly so that it could provide market guidance for where exchange rates are likely to be in the longer term, as Williamson (2000) argues. Second, the authorities need to display a strong commitment. IMF (1999) states that the authorities need to be willing to bear the costs of a defense, particularly in terms of higher interest rates, but also in terms of fiscal retrenchment and other structural policy changes, as required.

## 5 . Concluding Remarks

In this study we set out to examine the trend of the REER of the selected East Asian countries during both pre-crisis and post-crisis period, for the purpose of evaluating the exchange rate management.

First, we found that the REER shows a clear trend of appreciation during the pre-crisis period while it reveals a rather stable movement during the post-crisis period. Second, we verified that the pre-crisis REER appreciation, which came from the pre-crisis dollar peg regime, gave the significantly negative impact on trade balance in some East Asian countries. Third, Our empirical evidence indicated that in the post-crisis exchange rate management, some East Asian countries have come to care more about the factor of the inflation adjustment in addition to the US dollar linkage. We speculate that they may have learned the lessons that the Asian crisis was partly caused by the simple US dollar peg regime accompanied by the REER appreciation and the worsened trade balance.

Other analytical issues remain. First, the post-crisis period is, up to now, a little too short to provide sufficient data for sophisticated analyses of the exchange rate management. We will, therefore, need to keep track of the upcoming trends on the relevant economic indices and policies. Second, it may be useful for our analysis to examine the exchange rate management of non-crisis countries and to compare them with the management of hardest-hit crisis countries. Third, we have to analyze more deeply the merits and demerits of inflation-adjusted management on exchange rates.

## Notes

- (1) Some of the local currencies are de facto linked to a basket of major currencies and the weights assigned to various currencies are not announced. Frankel and Wei (1994) argue that it is important to infer policies by observing actual behavior, rather than relying on official pronouncements, and estimate the implicit weights econometrically.
- (2) Even on the analysis of the highly- frequent (daily) exchange rate management, McKinnon (2001) shows the different results from Kawai (2002) ; McKinnon (2001) claims that the East Asian dollar exchange rates, particularly when observed on a high-frequency (daily) basis, have become as stable as they were before the crisis (implies no significant weight-shift towards the Japanese yen).

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