Japanese yen and East-Asian currencies: before and after the Asian financial crisis

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Abstract

The purpose of this paper is to investigate whether the impact of the Japanese yen on the values of East Asian currencies has increased since the 1997 East Asian financial crisis. In particular, this paper focuses on four crisis-affected countries: Indonesia, the Republic of Korea, the Philippines and Thailand. To this end, this paper estimates the weights of the Japanese yen in the determination of the values of the East Asian currencies using daily exchange rate data sets covering the pre-crisis period from January 1990 to June 1997 and the post-crisis period from January 1999 to December 2000. Empirical test results indicate that the impact of the Japanese yen on East Asian currencies has increased since the 1997 financial crisis. The null hypothesis that the weight of the Japanese yen remains the same is rejected for all the four countries examined supporting the alternative that it has increased since the financial crisis.

Introduction

The purpose of this paper is to investigate whether the role of the Japanese yen in determining the values of East Asian currencies has changed since the 1997 East Asian financial crisis. In particular, this paper focuses on the impact of the Japanese yen on the values of the Indonesian rupiah, the South Korean won, the Philippines peso and the Thai baht. The Malaysian ringgit which also sharply depreciated during the course of the financial crisis is excluded in this research, because its nominal exchange rate have been pegged to the US dollar since September, 1998.

The role of the Japanese yen in determining the values of East Asian currencies attracted the interests of researchers in the early 1990s, as economists noticed the intensified economic interdependence between Japan and other East Asian countries. As Nakamura and Matsuzaki (1997) and Takagi (1996) point out, East Asia and Japan were already major trading partners with each other in the mid 1990s. For example, Takagi (1996) shows Japan's share in the imports of East Asian countries exceeded the share of the US in 1994. According to Nakamura and Matsuzaki (1997), the share of Asian markets of Japan's exports reached 45% in mid 1990s, a significant increase from the 20% of 1985.

Observing this trend in East Asia, Frankel and Wei (1994) estimated the implicit weights of the Japanese yen in the determination of the nominal values of East Asian currencies and found, despite the increasing intra-regional trade, the impact of the Japanese yen on East Asian currencies was quite negligible. This somewhat surprising finding, which has been also confirmed by other researchers such as Kwan (1995) and Ohno (1999), can be explained by the fact that the local monetary authorities had pegged their currencies to the U.S. dollar, alone. Even though East Asian countries had taken some steps to deregulate their foreign currency markets before the financial crisis, it is well known that the local monetary authorities had effectively pegged their currencies to the U.S. dollar. Kawai and Takagi (2001) explain the "fear of floating" sensed from many developing countries by their concerns and limited ability regarding domestic price fluctuations and exchange rate risk management.

After the 1997 financial crisis, as Ohno (1999) mentions, exchange rate rigidity was blamed as one of the causal factors of the crisis. Since the U.S. dollar continued to appreciate against Western European currencies and the Japanese yen for a few years before the crisis, the dollar-peg policy of East Asian countries inevitably led to their loss of competitiveness in international markets.

Against this background, the crisis affected East Asian countries, except Malaysia, shifted to a free-floating exchange rate system after the 1997 crisis. Therefore, the exchange rates of their currencies are determined more freely in the market by supply and demand conditions.

If the negligible role of the yen in the determination of the value of the East Asian currencies is the result of their explicit or implicit dollar-peg policy, the impact of the yen on their currencies after the crisis is expected to be greater than before the crisis, reflecting the status of Japan as their major trading partner.

Ito et al. (1998) computed the optimal weights of the yen in the determination of the values of East Asian currencies and found they should be much higher than the actual weights of the yen adopted before the crisis. Their finding also suggests that the impact of the yen on East Asian currencies should be greater in a more market-oriented economic environment. Baak (2001) examined the impacts of the Japanese yen on the Korean won using weekly exchange rates and concluded the impact of the Japanese yen has increased since the financial crisis, while the impact of the U.S. dollar has decreased, even though the impact of the U.S. dollar is still greater than that of the Japanese yen.

Against this background, the present paper aims to determine whether the role of the Japanese yen in determining the values of crisis-affected East Asian currencies has increased since the 1997 financial crisis. To this end, this paper performs some econometric tests with daily exchange rate data covering the period from January 1990 to December 2000 (the whole period, hereafter). The data set splits into two sub-sample periods, one for the pre-crisis period from January 1990 to June 1997 (period 1, hereafter) and the other for the post-crisis period from January 1999 to December 2000 (period 2, hereafter). The impacts of the Japanese yen on the currencies of the crisis-affected East Asian countries for periods 1 and 2 along with for the whole period will be estimated and compared.

It is not controversial that the 1997 financial crisis started with the Thai baht depreciation of July 2nd of the year. In contrast, it is still inconclusive when the financial crisis was over, or even whether it really is over. However, regarding exchange rate volatility, as Kawai and Takagi (2001) show, the values of East Asian currencies began to show relative stability from November 1998.

This may justify the period split of this paper. This issue will be revisited in section 3, where the test results for structural breaks are presented.

In section 2, as a preparation for the major research, unit root tests for each currency (the four East Asian currencies and the Japanese yen and the U.S. dollar) and tests for cointegration of each East Asian currency with the Japanese yen and the U.S. dollar are performed. All the currencies involved turn out to be integrated of order one. However, none of them turn out to be cointegrated with the Japanese yen and the U.S. dollar.

In section 3, following Frankel and Wei (1994), the exchange rate changes of each East Asian currency are regressed on those of the Japanese yen and the US dollar. The estimation results indicate the null hypothesis that the relative impact of the Japanese yen remains the same should be rejected supporting the alternative that it has increased since the financial crisis for all the four East Asian currencies examined in this paper.

Unit root tests and cointegration tests

Following Frankel and Wei (1994), in this paper, the weights of the Japanese yen in determining the value of East Asian currencies are estimated by regressing the exchange rate changes of each East Asian currency on those of the Japanese yen and the US dollar. Since Frankel and Wei (1994) and Ohno (1999) report that the impacts of other currencies such as the Deutsche mark and Australian dollar are negligible, those currencies are not included in the regression equations.

To measure the values of the currencies involved, the Swiss franc was used as the numeraire.[1] Therefore, for example, the exchange rate of the dollar is the value of the dollar for one Swiss franc. The exchange rate data for the Korean won and the Thailand baht were obtained from the Board of Governors of the Federal Reserve System of the U.S. The exchange rate data for the Indonesian rupiah and the Philippines peso were obtained from Data Stream.

In particular, the following regression equation is estimated for each East Asian country:

[1] For the merit of using the Swiss franc as the numeraire, see Ohno (1999, footnote 2). Frankel and Wei (1994) and Ohno (1999) used the Swiss franc as the numeraire and Aggarwal and Mougoue (1996) used the European Currency Unit (ECR). When I used as the numeraire the ECR for the period from 1990 to 1998 and the Euro for the

(1) $$\Delta E_t^i = \beta_0 + \beta_1 \Delta E_t^J + \beta_2 \Delta E_t^U + \varepsilon_i$$

where $\Delta E_t^i = \ln(EX_t^i) - \ln(EX_{t-1}^i)$, EX_t^i is the daily exchange rate of country *i* against the Swiss franc and *I, K, P, T, J,* and *U* represent Indonesia, Korea, the Philippines, Thailand, Japan and the U.S., respectively.

Table 1 shows some statistics of the data and Figure 1 illustrates the movements of the values of the six currencies (EX_t^I, EX_t^K, EX_t^P, EX_t^T, EX_t^J, EX_t^U).

The estimation of equation (1) requires tests for the presence of unit roots in the variables included in the equation. Table 2 shows the augmented Dickey-Fuller test statistics for the levels of all the six currencies ($\ln(EX_t^I)$, $\ln(EX_t^K)$, $\ln(EX_t^P)$, $\ln(EX_t^T)$, $\ln(EX_t^J)$, and $\ln(EX_t^U)$) do not exceed the critical values for the rejection of the presence of a unit root at the 5 % significance level, with one exception being the Indonesian rupiah in period 2 whose statistic exceeds the 5 % critical value but does not exceed the 1 % critical value. Therefore, the null hypothesis of a unit root is accepted for the Indonesian rupiah of period 2 at the 1 % significance level and for all the other currencies at the 5 % significance level. The length of lags included when implementing the unit root tests were selected by the Akaike information criterion and are presented in parentheses.

In the meantime, the null hypothesis of a unit root is rejected for the first differences of all the six currencies (ΔEX_t^I, ΔEX_t^K, ΔEX_t^P, ΔEX_t^T, ΔEX_t^J and ΔEX_t^U, where $\Delta E_t^i = \ln(EX_t^i) - \ln(EX_{t-1}^i)$ for country *i*) at the 5 % significance level.

Since the levels integrated are of order one, while the first differences are stationary, the cointegration of each East Asian currency with the Japanese yen and the U.S. dollar should be tested before the estimation of equation (1). If they are cointegrated, then equation (1) should be reformulated as an error-correction model.

As Table 3 shows, the null hypothesis of no cointegration is accepted for all the East Asian countries, implying no long-run equilibrium relationship among East Asian local currencies and the two international currencies (the Japanese yen and the U.S. dollar) regardless of the sample periods.

period from 1999 to 2000, the estimation results were not significantly different from those reported in the present paper.

Therefore, the weights of the Japanese yen and the U.S. dollar in the determination of the value of each East Asian currency can be estimated using equation (1).

The weights of the Japanese yen before and after the financial crisis

The results of the estimations of equation (1) are reported in Table 4. For the whole sample period, the weights of the yen in the determination of East Asian currencies are estimated to be much smaller than the weights of the dollar, re-confirming the reports of the extant literature in this area. However, the estimated values of the weights of the yen are higher than in other articles[2] that explored only pre-crisis samples, implying the weights of the yen have increased after the financial crisis. This also implies that the financial crisis may have made a structural break in the relationship between East Asian currencies and the Japanese yen.

To determine the presence of a structural break, the CUSUM statistics of equation (1) are computed. As Figure 2 illustrates, the CUSUM statistic sharply rises in the beginning of the crisis for all the four countries examined, implying instability in the parameters of the equation.[3]

Therefore, equation (1) is re-estimated for two sub-sample periods, one for the pre-crisis period (period 1: January 1990 to June 1997) and the other for the post-crisis period (period 2: January 1999 to December 2000). Considering the unstable economic environment and the troubled foreign exchange markets in East Asia during the financial crisis, the period of the crisis (July 1997 to December 1998) is excluded from both sub-data sets.

It is not controversial that the 1997 financial crisis started with the Thai baht depreciation of July 2nd of the year. In contrast, it is still inconclusive as to when the financial crisis finished or whether it is really over. However, regarding exchange rate volatility, as Kawai and Takagi (2001) show, the values of East Asian currencies began to show relative stability from November 1998. This is why this paper sets the crisis-period to be from July 1997 to December 1998.

In fact, the CUSUM statistics of the estimations for the two sub-sample periods, as illustrated in Figures 3 and 4, indicate relative stability in the estimated parameter values. However,

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[2] See, for example, Frankel and Wei (1994), Kwan (1995), and Ohno (1999).

[3] Even though the CUSUM statistics sharply rise in the beginning of the crisis, they are still within the 95 % confidence bands. However, if we examine a shorter period around September 1997, the CUSUM statistic exceeds

the crisis period CUSUM statistics, which are not reported in this paper, were far from stable for all the four countries. In addition, the Chow tests also detected the ending point of period 1 and the starting point of period 2 as structural breaks in the estimation of equation (1) for all the four countries.[4]

The estimation results for the two sub-sample periods are reported in Table 4. The CUSUM statistics are illustrated in Figures 3 and 4. Considering the high Durbin-Watson statistic in the second period for the data from Thailand, the standard errors were also computed by the Heteroscedasticity Consistent Covariance of Newey and West (1987). But, the estimation results were only marginally changed.

The estimation results for the two sub-sample periods show that the weight of the yen has increased in period 2 compared with period 1 in all the four countries, while the weight of the dollar has declined in period 2 in three countries or remained almost the same in Korea. In addition, the estimated values of the weights of the Japanese yen in period 1 are not significantly different from zero at the 5 % significance level in all the countries except Thailand. In contrast, the weights are significant in all countries in period 2.

As greater scientific evidence, the null hypothesis that the weight of the Japanese yen remains the same across the two sample periods is tested against the alternative that it has increased after the financial crisis. Specifically, the null and the alternative hypothesis will be the following:

$$H_0 : \boldsymbol{b}_1^1 = \boldsymbol{b}_1^2$$
$$H_A : \boldsymbol{b}_1^1 < \boldsymbol{b}_1^2$$

where $\boldsymbol{b}_1^1$ and $\boldsymbol{b}_1^2$ are the weights of the Japanese yen in period 1 and 2, respectively. The null hypothesis can be tested by computing the following statistic:

the 95 % confidence bands with a great margin. The Chow test also detected the financial crisis as a structural break in the estimation of equation (1).

[4] It should be reported, however, that moving the ending points of period 1 and the starting points of period 2 backward or forward by several weeks do not significantly change the estimation results.

$$\frac{b_1^2 - b_1^1}{\sqrt{\left(s_1^1\right)^2 + \left(s_1^2\right)^2}}$$

where b_1^1 and b_1^2 are the estimated values for $\boldsymbol{b}_1^1$ and $\boldsymbol{b}_1^2$, and s_1^1 and s_1^2 are the standard errors of b_1^1 and b_1^2. If the statistic is higher than 1.645 or 1.96, then the null hypothesis is rejected at the 5 % or 1 % significance level.

As Table 5 shows, the null hypothesis is rejected at the 1 % significance level in three out of the four countries, and at the 5 % significance level in Thailand, supporting the alternative that the weight of the Japanese yen has increased in the post crisis period.

Summary and Conclusion

The main task of this paper is to determine whether the role of the Japanese yen in determining the value of four crisis-affected East Asian currencies (Indonesian rupiah, Korean won, Philippines peso and Thai baht) has increased since the financial crisis. The extant literature, investigating the role of the Japanese yen in the determination of the values of East Asian currencies, reported that it was quite negligible despite the status of Japan as a major trading partner of most East Asian countries. This somewhat surprising finding can be explained by the implicit dollar peg policy of the East Asian local monetary authorities who had feared exchange rate volatility.

However, since East Asian countries have been constructing more-market oriented foreign exchange markets and floating exchange rate systems after the financial crisis, this paper raised and tested for the possibility that the role of the Japanese yen has increased since the crisis.

The empirical tests using the regression equations of Frankel and Wei (1994) strongly indicate that the impact of the yen on East Asian currencies has increased since the financial crisis. The estimated values of the weights of the Japanese yen in the pre-crisis period were estimated to be insignificant at the 5 % significance level in all the countries examined except Thailand. In contrast, they were all significant in the post-crisis period. The null hypothesis that the weight of the Japanese yen remains the same was strongly rejected in all the four countries studied, supporting the alternative that it has increased in the post crisis period.

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[Table 1] Sample mean and standard deviation

Variable	EX_t^I	EX_t^K	EX_t^P	EX_t^T	EX_t^J	EX_t^U
Mean	2.741	0.648	2.132	2.103	0.836	0.713
Std. Dev.	1.992	0.139	0.400	0.384	0.116	0.074

EX_t^I = (daily exchange rate of the Indonesian rupiah against the Swiss franc)/1000

EX_t^K = (daily exchange rate of the Korean won against the Swiss franc)/1000

EX_t^P = (daily exchange rate of the Philippines peso against the Swiss franc)/10

EX_t^T = (daily exchange rate of the Thai baht against the Swiss franc)/10

EX_t^J = (daily exchange rate of the Japanese yen against the Swiss franc)/100

EX_t^U = daily exchange rate of the U.S. dollar against the Swiss franc

[Table2] Tests for unit roots (Augmented Dickey Fuller test)

		Whole Period	1st Period	2nd Period
Indonesia	(Level)	-1.416 (5)	-0.989 (7)	-2.956 (15)
	(1st Diff)	-18.123 (6)	-13.771 (6)	-5.007 (12)
Korea	(Level)	-2.295 (14)	-2.126 (14)	-1.34 (14)
	(1st Diff)	-9.754 (13)	-14.541 (5)	-4.396 (13)
Philippines	(Level)	-1.346 (7)	-2.340 (20)	-1.325 (13)
	(1st Diff)	-7.007 (19)	-5.891 (18)	-3.101 (20)
Thailand	(Level)	-1.814 (18)	-0.487 (20)	-2.457 (7)
	(1st Diff)	-23.248 (3)	-5.763 (18)	-6.090 (14)
Japan	(Level)	-0.688 (7)	0.274 (6)	-1.721 (10)
	(1st Diff)	-16.572 (6)	-17.395 (4)	-7.984 (6)
US	(Level)	-1.381 (11)	-1.463 (11)	-0.808 (14)
	(1st Diff)	-13.464 (9)	-15.560 (5)	-5.345 (13)

1) The critical values for rejection of the null hypothesis of a unit root at the 1 percent significance level are between -3.48 and -3.43 and at the 5 % level are between -2.88 and -2.83.
2) The numbers in parentheses are the lengths of lags included in the test equations. The lengths of lags were chosen by the Akaike information criterion.

[Table 3] Results of cointegration tests

			Likelihood Ratio		
		H0:	r = 0	r < 1	r < 2
Country	Period	H1:	r = 1	r = 2	r = 3
Indonesia	Whole		22.601 (29.68)	5.158 (15.41)	0.284 (3.76)
	1st period		10.730 (29.68)	2.300 (15.41)	0.164 (3.76)
	2nd period		19.614 (29.68)	5.960 (15.41)	0.246 (3.76)
Korea	Whole		19.079 (29.68)	3.764 (15.41)	0.166 (3.76)
	1st period		22.331 (29.68)	4.698 (15.41)	1.148 (3.76)
	2nd period		17.954 (29.68)	5.530 (15.41)	1.0756 (3.76)
Philippines	Whole		8.543 (29.68)	3.326 (15.41)	0.479 (3.76)
	1st period		16.335 (29.68)	5.761 (15.41)	1.556 (3.76)
	2nd period		20.396 (29.68)	5.692 (15.41)	0.669 (3.76)
Thailand	Whole		9.700 (29.68)	2.262 (15.41)	0.106 (3.76)
	1st period		8.032 (29.68)	3.593 (15.41)	0.068 (3.76)
	2nd period		14.769 (29.68)	7.196 (15.41)	3.314 (3.76)

Note: Numbers in parentheses are the critical values for rejection of the null hypothesis at 5 % significance level.

[Table 4] Estimation results of regression equation (1)

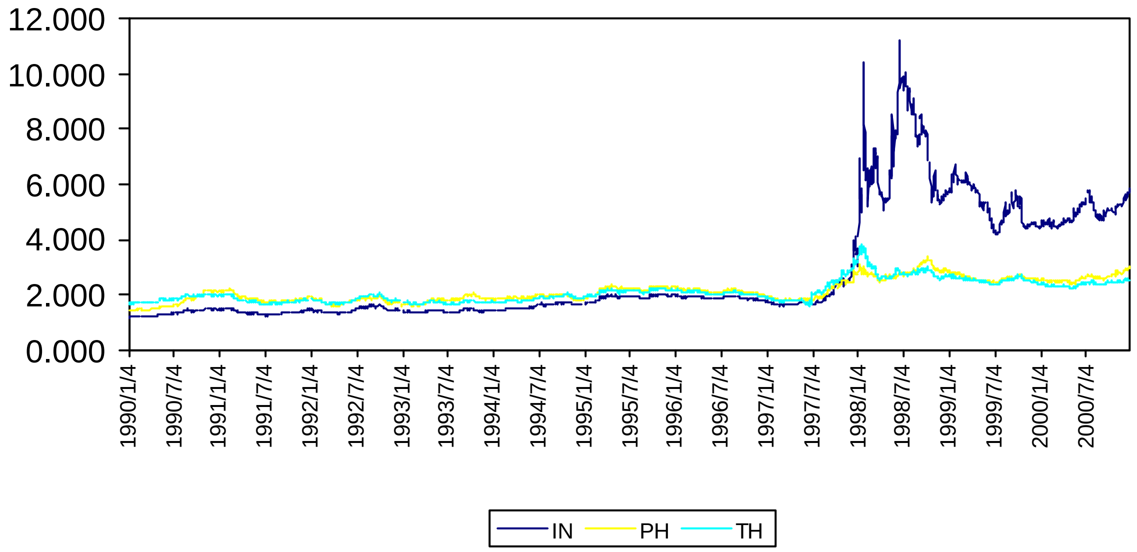
		C	b1(JA)	b2(US)	R2	DW
Indonesia	Whole	0.000	0.332***	0.814***	0.127	1.951
		(0.000)	(0.059)	(0.063)		
	1st Period	0.000***	0.009	0.985***	0.965	2.135
		(0.000)	(0.006)	(0.006)		
	2nd Period	0.000	0.286***	0.921***	0.223	1.886
		(0.000)	(0.093)	(0.130)		
Korea	Whole	0.000*	0.043*	1.001***	0.464	1.681
		(0.000)	(0.024)	(0.026)		
	1st Period	0.000***	0.007	0.996***	0.943	2.123
		(0.000)	(0.008)	(0.007)		
	2nd Period	0.000	0.064**	1.004***	0.732	1.806
		(0.000)	(0.027)	(0.037)		
Philippines	Whole	0.000**	0105***	0.926***	0.516	1.870
		(0.000)	(0.021)	(0.022)		
	1st Period	0.000	-0.004	0.986***	0.731	2.069
		(0.000)	(0.019)	(0.018)		
	2nd Period	0.000**	0.092***	0.926***	0.596	2.186
		(0.000)	(0.034)	(0.048)		
Thailand	Whole	0.000	0.184***	0.837***	0.430	2.188
		(0.000)	(0.024)	(0.026)		
	1st Period	0.000	0.088***	0.912***	0.790	2.608
		(0.000)	(0.016)	(0.015)		
	2nd Period	0.000	0.153***	0.809***	0.577	2.10
		(0.000)	(0.034)	(0.047)		

1) Numbers in parentheses are standard errors.
2) ***, **, and * represent statistical significance at one, five, and ten % significance level, respectively.

[Table 5] The hypothesis test statistics

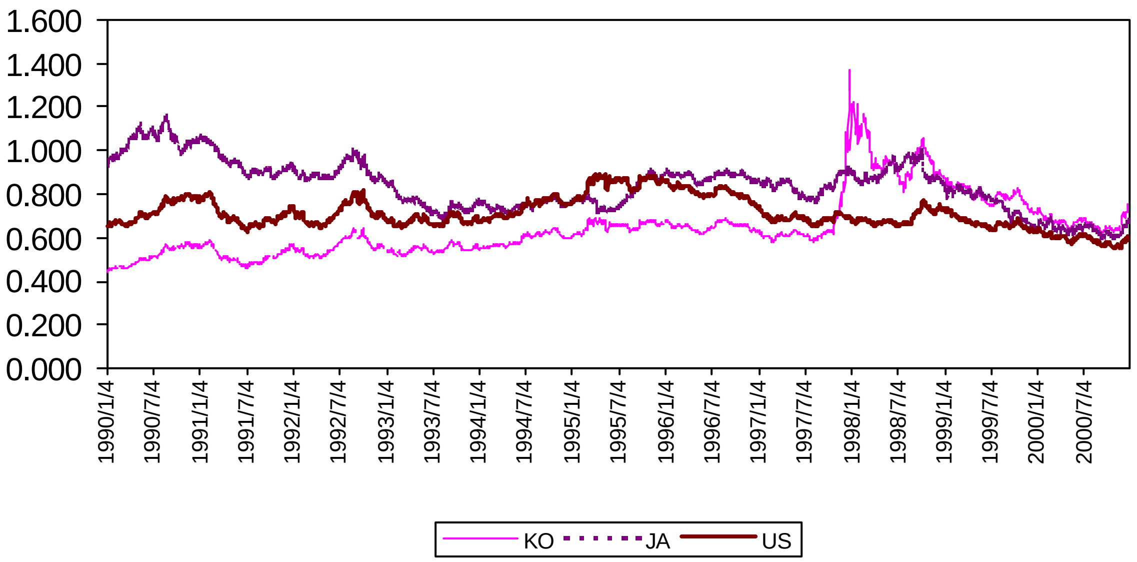
Country	Indonesia	Korea	Philippines	Thailand
Statistic	2.972	2.024	2.465	1.730

[Figure 1-1] Exchange rates against the Swiss franc



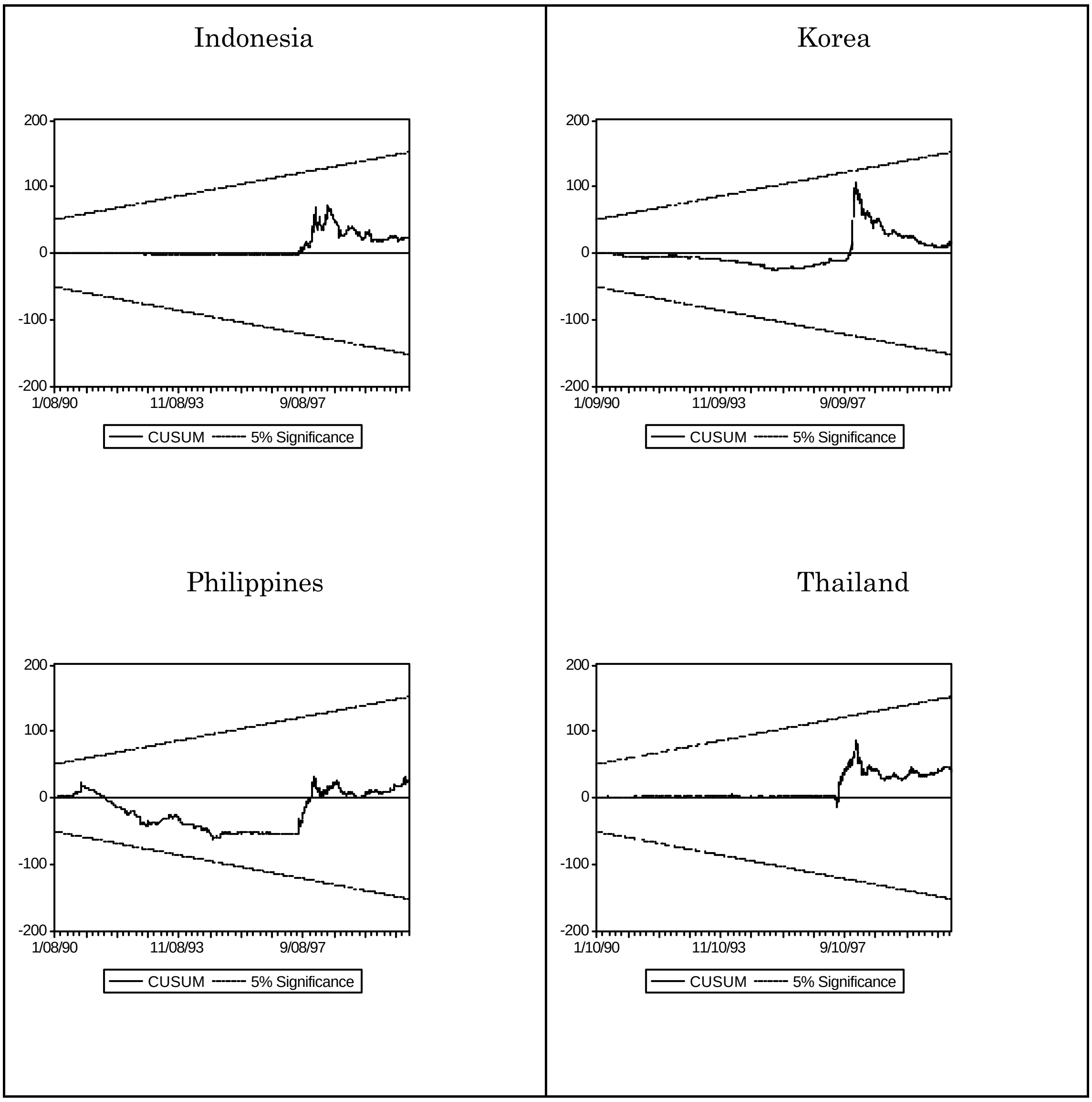
IN= EX_t^I ; PH= EX_t^P ; TH= EX_t^T

[Figure 1-2] Exchange rates against the Swiss franc

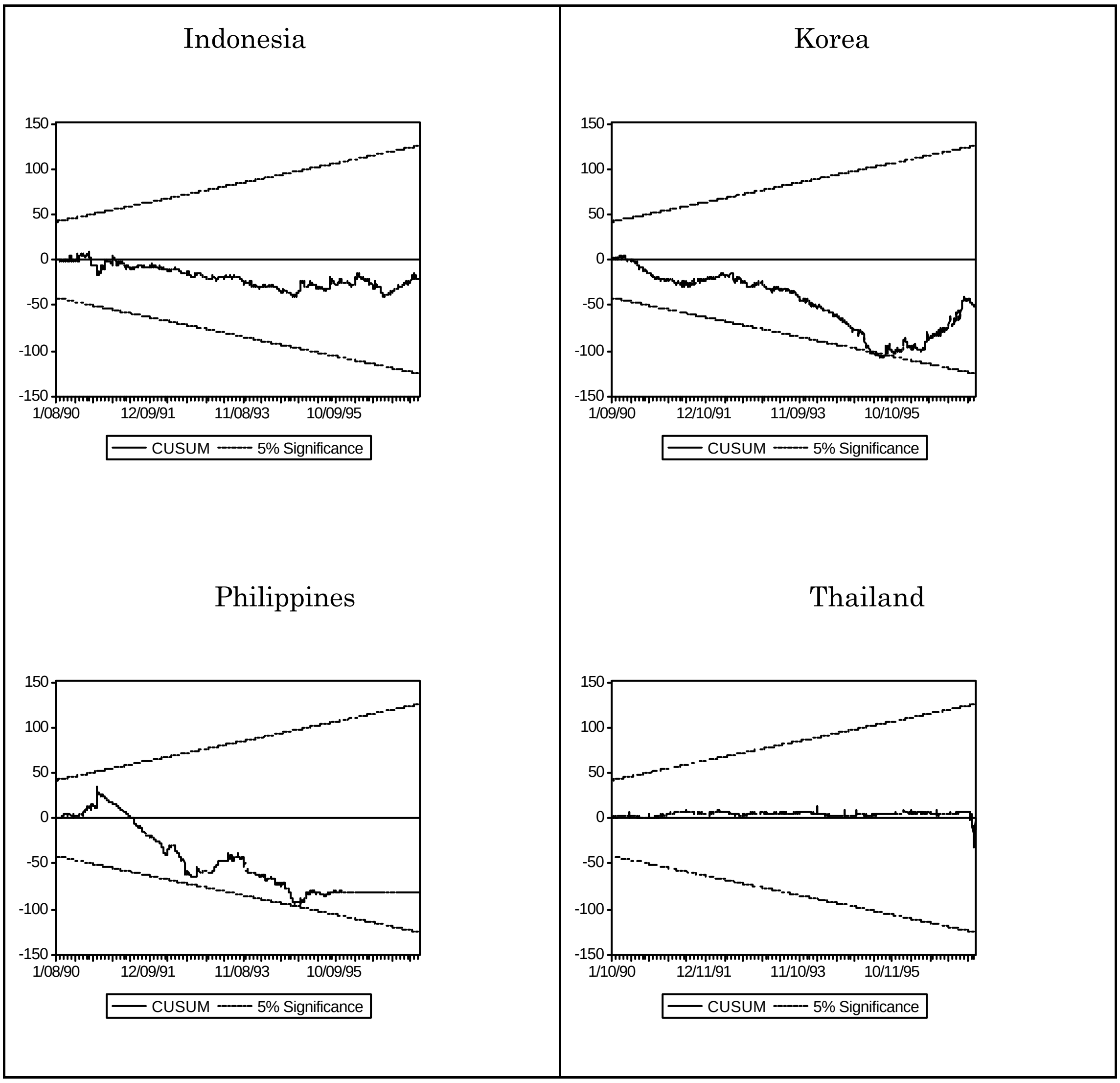


KO= EX_t^K ; JA= EX_t^J ; US= EX_t^U

[Figure 2] CUSUM tests for the whole period



[Figure 3] CUSUM tests for the pre-crisis period



[Figure 4] CUSUM tests for the post-crisis period