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ASIAN CURRENCY CRISIS OF 1997**

A. Razzaghipour*

G.A. Fleming**

R.A. Heaney**

**Reserve Bank of Australia*

***Department of Commerce, Australian National University*

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Contact author:

Richard Heaney

Department of Commerce

The Australian National University

Canberra ACT 0200 AUSTRALIA

Telephone: 02 6249 4726 (International +61 2 6249 4726)

Facsimile: 02 6249 5005 (International +61 2 6249 5005)

Email: Richard.Heaney@anu.edu.au

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ASIAN CURRENCY CRISIS OF 1997**

A. Razzaghipour*

G.A. Fleming**

R.A. Heaney**

**Reserve Bank of Australia*

***Department of Commerce, Australian National University*

Abstract

We analyse the process of mean reversion towards purchasing power parity (PPP) for a sample of Asian countries around the 1997 crisis. It is found that appreciation relative to PPP is evident prior to the 1997 crash period. Correction occurs from 1997 onwards, a period marked by extreme movements in exchange rates with both appreciation and depreciation relative to the PPP rate over relatively short periods. The key result of this paper is that although reversion towards PPP is apparent for mean, though not statistically significant, it is clear that there is a substantial, statistically significant change in variance from 1997 onwards. This result has implications both for economic modelling of crash periods and for appropriate choice of statistical tests.

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1. Introduction

Recent examination of the causes of the Asian currency crisis highlights the complex nature of exchange rate movements. The International Monetary Fund (1997, 1998a, 1998b) has stressed no less than five major features of the crisis: high volumes of “unproductive” capital inflows, low yields elsewhere pushing funds into the region, shortcomings and inconsistencies in domestic macroeconomic and exchange rate policies, various structural weaknesses particularly in the financial sector, failure of business to hedge interest rate and foreign exchange rate exposures and competitive devaluations. Other researchers such as Radelet and Sachs (1998) and Wyplosz (1998) suggest that financial panic must also be considered as a cause of the crisis. It is argued that the increased general uncertainty associated with investing in Asian markets resulted in the severity of the crisis being greater than was warranted by the economic fundamentals. Political uncertainty was precipitated by cabinet reshuffles, changes in government in Thailand and South Korea, the health of the President of Indonesia and continual change and reversal of policy direction. Furthermore, the International Monetary Fund’s insistence on the immediate closure of insolvent financial corporations added to the risk associated with transacting in the region (Radelet and Sachs 1998).

The use of purchasing power parity (PPP) theory to examine the Asian currency crisis countries provides a longer run view on exchange rate adjustments, and places some of the above arguments in perspective. There is a general consensus in the international finance literature that PPP holds in the long run for developed, and many developing, countries (see Rogoff 1996). In addition, since the mid 1980s, tests for mean

reversion indicate that the half-life of PPP deviations (the expected number of years for the exchange rate to decay by 50 percent) is between three and five years (Frankel 1986; Abuaf and Jorian 1990; Diebold, Husted and Rush 1991; Goldfajn and Valdes 1999). The question we examine in this paper is whether or not the Asian currency crisis countries fit the traditional mean reversion literature. Was there evidence of overvaluation of the South East Asian country foreign exchange rate prior to the crash followed by reversion to PPP after the crash? Is the focus on the mean alone warranted?

2. Discussion

2.1 Divergences and Mean Reversion

Research to date has focused on the time series nature of real exchange rates, the ratio of the relevant price indices. Analysis generally focuses on the duration of the divergence in exchange rates, measuring the time it takes for exchange rate to revert half of the way to the expected level, the half-life reversion or speed of adjustment. Half-life estimates obtained from different sample periods include 4.6 years (Frankel, 1986), 3.3 years (Abuaf and Jorian, 1990) and 2.8 years (Diebold, Husted and Rush, 1991). Rogoff (1996) suggests these estimates are too large to be explained purely by transitory theories.

More recently, Goldfajn and Valdes (1999) explored the mechanism by which divergences (appreciation relative to PPP) from expected level are corrected using 93 countries during the period 1960-1994. Goldfajn and Valdes provided evidence of asymmetry between the duration of the initial divergence and the subsequent reversion.

They found that, on average, the time it takes for reversion is about half the time of the initial divergence. Furthermore, the greater the divergence the greater the probability of reversion. These researchers concluded that the probability of collapse is an increasing function of the degree of appreciation. In only 10 percent of cases where the divergence reached 25 percent was there a smooth reversion. There is evidence of statistically significant mean reversion though there is evidence that the period of correction decreases with the magnitude of the initial divergence. There is also evidence of correction occurring at almost twice the rate of the initial divergence.

2.2 The Asian Crisis Divergence

It is proposed that in the lead-up to the crisis the currencies at its centre experienced departures from the PPP. The main cause of these deviations was a combination of exchange rate restrictions and government policies aimed at attracting capital inflow.

First, the currencies (with the exception of the Philippines Peso which operated under a clean float) were effectively pegged to the United States Dollar under managed float systems. This restriction tended to prevent an alignment of the exchange rate with the changes in the price levels. Table 1 provides a summary of the exchange rate regimes in place over the period.

[Insert Table 1 here]

Second, there were government-induced pressures that resulted in the currencies being stronger than if left to market forces. The governments actively encouraged foreign capital inflows through initiatives such as tax concessions and awarding of government contracts. In addition, the stability of the currencies relative to the United States Dollar reduced exchange rate risk for investors and, given the attractive interest rate differentials, artificially increased capital inflows (Corsetti et al. 1998). Finally, the implicit guarantees of government bailouts of financial institutions resulted in a misperception of the risk-return profile of investment in these countries resulting in the possibility of an “oversupply” of foreign capital (Krugman 1998).¹

The transitory departures from long run PPP levels created arbitrage opportunities that induced pressure on the exchange rate and price levels to realign. Either the exchange rate had to depreciate or domestic price levels had to decrease relative to the foreign price level. Given that exchange rates were generally pegged prior to the crisis, the only mechanism for adjustment was the price level; but as has been persuasively argued elsewhere, price levels tend to be relatively sticky in the short term (Rogoff, 1996).

The removal of the peg during the crisis period permitted exchange rate adjustments to eliminate the arbitrage opportunity. Furthermore, a change in the perceived exchange rate risk, as well as the general risk-return profile of investments in the crisis countries, led to a reversal of the capital flows. The result was depreciation of the currencies with respect to the USA and a period of extreme variation in the

¹ Given the level of government involvement in the private sector, this misperception may have carried across to general lending to corporations as well.

divergence between PPP and actual exchange rates over a number of years mainly driven by changes in exchange rates.

2.3 The PPP Model and Hypothesis Formulation

In order to examine the extent of divergences in Asian country exchange rates we first must define PPP. We start with the standard statement of relative purchasing power as being determined by the following:

$$[P_{t+1}/P_t] = [S_{t+1}/S_t][P_{t+1}^*/P_t^*] \quad [1]$$

where P_t is the domestic price index at time t ;
 P_t^* is the foreign price index at time t ; and
 S_t is the exchange rate (units of domestic currency per foreign currency).

An alternative representation of equation [1] can be obtained by taking logs.

$$\begin{aligned} p_{t+1} &= s_{t+1} + p_{t+1}^* \\ s_{t+1} &= p_{t+1} - p_{t+1}^* \end{aligned} \quad [2]$$

where s_{t+1} = natural log of S_{t+1}/S_t , ($\ln(S_{t+1}/S_t)$);
 $p_{t+1} = \ln(P_{t+1}/P_t)$; and
 $p_{t+1}^* = \ln(P_{t+1}^*/P_t^*)$.

Finally, we can re-define [2] as the divergence series according to the following equation:

$$\begin{aligned} d_{t+1} &= s_{t+1} - p_{t+1} + p_{t+1}^* \\ &= \ln(S_{t+1}) - \ln(S_t) - p_{t+1} + p_{t+1}^* \\ &= \ln(S_{t+1}) - \ln(S_{t+1}^a) \end{aligned} \quad [3]$$

where $\ln(S_{t+1}^a)$ = the PPP prediction of the exchange rate at $t+1$, ($\ln(S_t) - p_{t+1} + p_{t+1}^*$).

In terms of the model presented in equation [3], if the actual exchange rate (S_{t+1}) is less than the PPP equilibrium exchange rate (S_{t+1}^a) in the lead-up to the currency crisis, then $d_{t+1} < 0$ (indicating an appreciation of the actual exchange rate relative to the PPP level in terms of USDs) . If this were observed to occur over the lead-up period then the cumulative representation of d_t , cd_t , would have a negative slope. A structural break is then expected in 1997 when massive foreign exchange rate corrections were reported in the financial literature. This should result in a change in slope of cd_t from negative to positive with the positive slope reflecting exchange rate correction. Once correction is complete the cd_t term should exhibit zero slope on average as PPP pricing divergence returns to a fairly random pattern. Alternatively, if overshooting is evident the rise will be followed by a decrease in the cd_t term to correct for the impact of overshooting. Of course, as a result of the initial exchange rate shock there could be a series of structural changes driven by various economic and political changes that results in a rather drawn out period of adjustment rather than a simple overshooting argument.

Figure 1 provides a graph of the cumulative PPP divergence over the 30-year period from 1970 to 1999. There is evidence of fairly long cycles with periods of appreciation (negative sloped curve) followed by periods of depreciation (positive sloped curve) for each of the countries, except for Indonesia. The crash of 1997 marks an abrupt change to this generally smooth relationship. While it is difficult to draw conclusions about the PPP divergence for Indonesia, Figure 1 does suggest mean reversion in PPP over the period 1970 to 1999 for the remaining countries in the sample. This applies even though the countries, excluding the Philippines, had pegged currencies.

[Insert Figure 1 here]

Given the previous discussion about mean reversion and given Figures 1, 2 and 3 the period June 1992 to November 1999 is used in an attempt to capture the impact of the initial overvaluation followed by the crash and reversion to PPP for the countries in the sample. The PPP divergence is fairly consistent for each of the five countries over the 5-year sample period as is evident from Figures 2 and 3. There was a transitory departure from the PPP exchange rate (appreciation) for the Asian countries selected for analysis prior to the crash period that is reversed over the period 1997-1999. When a period of 10 years is selected for analysis (not reported here) there is evidence of steady appreciation for Indonesia and Thailand while this longer period is marked by periods of both appreciation and depreciation for South Korea, Malaysia and the Philippines.

[Insert Figures 2 and 3 here]

It is important to note that the proposition is not that PPP provides the sole explanation of the currency crisis, rather it is argued that one of the factors contributing to the currency depreciation was pressure by arbitrageurs in accordance with PPP theory. In effect PPP provides an indication of problems with emphasis on direction, rather than magnitude. This is investigated by exploring the slope of cumulative deviations (cd_t) graphically. A statistical test is also undertaken to assess the impact of the crash on the mean and variance of the PPP monthly divergence.

3. Data

Bilateral exchange rates between the crisis country currencies and the United States Dollar. The time series spanned varying periods according to availability with the period June 1992 to November 1999 for Indonesia and South Korea, June 1992 to July 1999 for Malaysia and June 1992 to September 1999 for both the Philippines and Thailand. These were extracted from the International Monetary Fund's *International Financial Statistics* using Datastream. Specifically, the United States Dollar series refer to end of month in units of national currency per United States Dollar. This variable is a standard choice in the literature (Frankel and Rose 1996). Datastream was also used to extract the required consumer price series from the International Monetary Fund's *International Financial Statistics*.² Again this is a standard choice in the literature (Frankel and Rose 1996; Li 1998). Summary statistics are reported in Table 2. Although there is evidence of skewness and kurtosis, the Phillips-Perron t-test suggests stationary processes. Further, there is little evidence of serial correlation though there is evidence of ARCH effects for Malaysia, the Philippines and Thailand.

[Insert Table 2 here]

4. Analysis

4.1 Graphical Analysis

Prior to statistical testing of the PPP divergence an inspection of the PPP divergence and cumulative PPP divergence is undertaken. Figures 2 and 3 present the observed deviations and cumulative deviations for the period, June 1992 to November 1999. When examining the graphs, it is important to remember that the reversions need not be driven by changes in the exchange rate alone. Changes in the price level could also explain some of the divergence though over much of the crisis period it is the foreign exchange rate that exhibits most volatility.

Figures 1 and 3 highlight increasing pressures, as explained by PPP theory, for a devaluation of the currencies in the lead-up period to 1997. These pressures, however, do not go very far in explaining the magnitude of the subsequent reversions. Figure 3 suggests that initially there was a fairly smooth appreciation in currencies relative to the USD over the 5 year period, June 1992 to 1997, but it offers little indication of the magnitude of changes observed after from 1997 onwards.

The Philippines had accumulated the greatest percentage of overvaluation at the time of the crisis amounting to approximately 20% cumulative deviation from PPP. Given that the Peso had relatively few regulatory restrictions, it is somewhat surprising that it should deviate more than the other currencies. One explanation for this finding is the close trading relationship that exists between the Philippines and other South East

² The Consumer Price Index is employed in this research because it is likely to be the most accurately calculated, given the greater overall emphasis placed on this index. Further, the Wholesale Price Index seems to produce similar results. The data series are not seasonally adjusted

Asian nations though capital flowed more freely into and out of the country leading to regular exchange rate adjustments both prior to and after the crash. It is difficult to provide a clear explanation for this effect. Furthermore, the volatility of PPP divergence after May 1997 was less severe for the Philippines. This may have resulted from the fact that the Philippines financial system was better equipped to deal with the crisis as its currency had floated independently for some time prior to the crash.

The cumulative deviations of the Thai Baht, Malaysian Ringgit and Indonesian Ruppee, as portrayed in Figure 3 also demonstrates the increased competitive pressures in the 5 years preceding the crisis. Nevertheless, there is evidence of appreciation in the currency relative to the USD in the immediate period before the crash followed by a period of volatility and depreciation of the currencies relative to the USD from 1997 to 1999.

The results for the South Korean Won, as indicated in Figure 3, suggest long term overvaluation prior to 1997 though there is evidence of some correction occurring late in 1996 and early in 1997, with further adjustment in line with the other countries late in 1997. Figure 3 seems to indicate that competitive pressures did result in the Won depreciating, but this took place in the months preceding the crisis as well as after June 1997. This result supports the notion that the underlying pressures for the collapse of the Won stemmed from other factors such as the financial distress faced by major conglomerates (Corsetti et al. 1998 and Lee, 1999).

To analyse the competitive devaluation argument (Corsetti et al. 1998; International Monetary Fund 1998a; 1998b), Figure 4 presents the cumulative deviations of the Malaysian Ringgit relative to the Thai Baht. The proposition is that the

depreciation of the Thai Baht contributed to pressures for other countries in the region to devalue. The intuition is that the Thai Baht depreciation against the United States Dollar in late 1997 also resulted in it depreciating against the Malaysian Ringgit (since the Ringgit was effectively pegged to the United States Dollar), which in turn increased competitiveness pressures on the Ringgit. In terms of PPP theory, the realigning of the Baht-Dollar exchange rate led to arbitrage opportunities between Thailand and Malaysia after May 1997, further adding to realignment pressures.

[Insert Figure 4 here]

The pre-June 1997 lead-up period is marked by pressure for the currencies to devalue (appreciation relative to PPP) in all cases but South Korea where over-valuation relative to PPP is less obvious at June 1997. In South Korea's case there is slow adjustment apparent from 1996 to 1997 as well as the major adjustment late in 1997. The period following May 1997 is one of extreme volatility with evidence of both appreciation and depreciation over short periods accompanied by a tendency in each of the currencies for reduced volatility and a reversion to PPP by early 1999.

4.2 Statistical Analysis

If PPP pricing divergences are to explain the 1997 corrections then there should be evidence of overvaluation relative to PPP in the pre-1997 period followed by correction in 1997. The statistical test for the impact of the crash involves estimation of both mean PPP divergence and variance in PPP divergence with a dummy variable to

capture the impact of the break in 1997. The actual break point is set at June 1997 for Indonesia, Malaysia, the Philippines and Thailand while the break point for South Korea is set at January 1997 as there is some evidence of major changes in the Korean economy by the start of 1997. Two equations are estimated simultaneously for each country using maximum likelihood estimation.

$$\begin{aligned} d_t &= a_1 + a_2 I_t + e_t \\ s_t^2 &= b_1 + b_2 I_t \end{aligned} \quad [4]$$

where a, b = parameters

I_t = variable with value of one if date exceeds May 1997 (December 1997 for Korea) and zero otherwise

d_t = PPP divergence

s_t^2 = variance in PPP divergence

The results of these regressions are reported in Table 3. In all cases the average PPP divergence suggests appreciation of the currencies during the 5-year period prior to the 1997 break point. The average PPP divergence ranges from 0.01% per month for Korea to 0.3% per month for the Philippines. The average monthly depreciation of the currencies relative to PPP after the selected 1997 break point ranged from 0.7% per month for the Philippines to 2% per month for Indonesia. The asymmetry in the rates of appreciation and depreciation appear consistent with the findings of Goldfajn and Valdes (1999). Although the results suggest correction of PPP pricing divergence after the 1997 break point the difference between the average pre-crash PPP divergence and the average post-crash PPP divergence (estimated by the dummy variable parameter, a_2) is not statistically significant in the regressions. Cursory analysis of Figure 3 suggests that the

actual crash period may not extend to 1999. The analysis was also conducted using a dummy variable set to one from 1997 to the end of 1998. There was no change in the statistical test results though parameter estimates varied somewhat.

The most statistically important result concerns the variance. There is evidence of greater than a one hundred-fold increase in variance of the PPP pricing divergence between the pre-crash period and 1997-1999 period for the countries excluding the Philippines. This result highlights the extremely volatile nature of the foreign exchange markets during and after 1997. The Philippines was the only country where there was evidence of time changing variance in the PPP divergence. The Philippines regression was re-estimated with an additional ARCH(1) term and, though there was some change in the parameter estimates, the results were consistent with the remainder of the sample.³

It could be argued that much of this change in volatility was due to the freeing up of the currencies (Table 1) but the Philippines was operating under a floating exchange rate regime throughout this period and it also exhibited a statistically significant change in volatility in 1997.

[Insert Table 3 Here]

One result apparent in Figure 3, after the initial burst of extreme variation in 1997 and later, is the tendency for each of the currencies to depreciate beyond the levels observed at the beginning of the 5-year period selected for the study. Figure 3 identifies

³ The ARCH model used for the Philippines is $s_t^2 = b_1 + b_2 I_t + b_3 e_t^2$ with $b_1 = 0.000194$ (4.32*), $b_2 = 0.001722$ (2.29*), $b_3 = 0.658088$ (2.27*). The mean equation is $d_t = a_1 + a_2 I_t + e_t$ with $a_1 = -0.001831$ (-0.88), and $a_2 = 0.015649$ (1.60). The t-statistics are reported in parentheses.

the build up of cumulative PPP divergence prior to June 1997 at varying levels followed by the dramatic adjustment after May 1997. For all the countries excluding Indonesia, the cumulative PPP divergence had begun to level by February 1999, indicating greater stability though at substantially depreciated rates relative to the pre-crash period (from around 50% depreciation for the Indonesian rupiah to essentially zero for the Philippines Peso). The Philippines is particularly interesting in that the PPP divergence cumulated from June 1992 to May 1997 was essentially reversed by February 1999.

Two important points that remain unexplained by the theory are the timing and magnitude of the reversions. Chinn (1998) suggests that the duration of the overvaluation may matter as much as the magnitude. He argues that long periods of overvaluation could have qualitatively different effects on the economy such as contemporaneous trade deficits. As previously stated, this research is not an attempt to explain the optimal or equilibrium level of exchange rates at a given point in time since there are many factors which may be involved in such a proposition. Rather, this paper sets out to analyse the time series behaviour of the relationship between PPP predicted exchange rates and observed exchange rates to focus on the question of whether mean reversion is apparent in crisis period exchange rate movements.

One factor which may have an influence on the graphical comparisons, is that the international competitiveness pressures began building up over a long period of time (at least 5 years) and that this build up period varies across countries. From Figure 1 it is apparent that changes in base year will affect the consistency of the cumulative PPP divergence and the average PPP divergence estimates for some countries (Malaysia and

Korea for example) and not for other countries (Indonesia, Philippines and Thailand). It is for this reason that the sample period of 5 years was selected.

Finally, it is important to note that while there is some evidence of mean reversion in PPP divergence there is also strong statistical evidence of changes in the variance of the PPP divergence. The major economic changes, including political changes, IMF reaction and slow rating agency reaction may help to explain the increase in volatility of the PPP divergence from June 1997 though this does not fit well with a simple mean reversion model which generally assumes constant variance. Given the results in this paper it would appear that PPP analysis should allow for the possibility of both changes in mean and variance.

5. Summary

We have adopted both graphical and statistical approaches in analysis. The graphical analysis suggests four points. First, the countries experienced a build-up of international competitiveness pressures in the lead-up to the 1997 Asian currency crisis. Second, reversion to PPP was marked by a change in variance, not entirely explained by the decision to float exchange rates. Third, although the graphical approach indicated that in the five years leading up to the crisis there was a consistent increase in the competitiveness pressures for all the countries, the same level of consistency is not evident over longer periods. Finally, the graphical analysis with respect to Thailand and Malaysia provided some support for the competitive devaluation argument as it suggests that the depreciation of one currency may place increased pressure on other currencies to

also depreciate. It is apparent that the theory does not explain the magnitude or timing of the reversions.

Statistical analysis suggests that there was evidence of a build-up of international competitiveness pressures over the period 1992-1997 with negative PPP pricing divergence observed on average. This is followed by the crisis period, a period of extreme volatility coupled with currency depreciation. A key finding in this paper is the change in both the mean PPP divergence and the volatility of PPP divergence over the crisis period. This suggests that a simple constant variance, mean reverting process may be inadequate in explaining severe crises similar to the 1997 Asian crisis. This has implications both for model building and for statistical testing.

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Table 1
Exchange Rate Regimes 1996-1999

Regime	Indonesia	South Korea	Malaysia	Philippines	Thailand
September 1980	other	other	peg to composite basket	other	peg to composite basket
September 1985	man. float	man. float	peg to composite basket	indep. float	peg to composite basket
September 1990	man. float	man. float	peg to composite basket	indep. float	peg to composite basket
March 1996	man. float	man. float	man. float	indep. float	peg to composite basket
September 1996	man. float	man. float	man. float	indep. float	peg to composite basket
March 1997	man. float	man. float	man. float	indep. float	peg to composite basket
June 1997	man. float	man. float	man. float	indep. float	indep. float
September 1997	indep. float	man. float	man. float	indep. float	man. float
March 1998	indep. float	indep. float	man. float	indep. float	indep. float
September 1998	indep. float	indep. float	peg to USD	indep. float	indep. float
January 1999	indep. float	indep. float	peg to USD	indep. float	indep. float
April 1999	indep. float	indep. float	peg to USD	indep. float	indep. float

Source: *International Financial Statistics* (International Monetary Fund, Washington D.C.), various years. We have used the IMF characterisation of country exchange rate regimes as managed, independently floating, and pegged. The term “other” is used in 1980 where either the rate was independent or where it did not fall into the standard categories. Similar details were not available from this source for 1975 or 1970.

Table 2
Summary Statistics - PPP Divergence

Statistic	Indonesia	South Korea	Malaysia	Philippines	Thailand
Number	90	90	86	88	88
Mean	0.0058	0.0027	0.0037	0.0010	0.0037
Std. Dev.	0.1198	0.0532	0.0402	0.0357	0.0479
Skewness	2.3328	3.0977	-1.4046	0.9336	-0.2371
Kurtosis	16.4250	22.4022	15.7520	3.0244	14.1030
Phillips-Perron Test (12 lags)	-8.79*	-8.78*	-8.74*	-8.55*	-7.34*
Autocorrelation -PPP error, $X^2(12)$	17.10	12.27	4.98	4.72	13.79
-PPP error sqrd., $X^2(12)$	15.50	15.91	23.36*	44.62*	37.19*

Note:

Number = number of monthly PPP divergence observations available over the chosen study periods, Mean = average of the monthly PPP pricing divergence over the period, Std. Dev. = standard deviation of the monthly PPP pricing divergence, Skewness and Kurtosis = distribution characteristics, Phillips-Perron Test = unit root test, Autocorrelation = chi square test with 12 lags for autocorrelation for both the pricing divergence and the squared pricing divergence (an indication of the possibility of GARCH effects).

Table 3

**Tests for Change in Average PPP Divergence and Change in Variance in PPP
Divergence with the Emerging Market Collapse of 1997**

Statistic	Indonesia	South Korea	Malaysia	Philippines	Thailand
Mean equation – intercept	-0.001182 (-1.25)	-0.000195 (-0.17)	-0.000793 (-0.48)	-0.003793 (-1.27)	-0.001164 (-1.29)
Mean equation – dummy	0.020200 (0.48)	0.007583 (0.42)	0.014380 (0.93)	0.014489 (1.40)	0.014900 (0.95)
Variance equation – intercept	0.000043 (7.70*)	0.000069 (7.47*)	0.000157 (9.18*)	0.000510 (7.70*)	0.000044 (5.12*)
Variance equation – dummy	0.040800 (5.40*)	0.006987 (6.63*)	0.004460 (5.42*)	0.002135 (3.03*)	0.006612 (5.75*)
- ARCH test, $X^2(1)$	1.13	2.96	0.25	9.00*	1.42
- PPP error, $X^2(12)$	17.01	12.25	5.77	4.26	14.47
- PPP adj error, $X^2(12)$	12.48	7.74	5.71	5.34	8.20
- PPP adj error sqrd. $X^2(12)$	5.94	5.60	7.65	15.99	6.29

Note:

The model estimated is $d_t = \alpha_1 + \alpha_2 I_t + e_t$ with the variance defined as $\sigma_t^2 = \beta_1 + \beta_2 I_t$. Maximum likelihood is used to obtain estimates of the parameters in the mean and variance equations and these are estimated simultaneously. d_t is the PPP divergence for the month t , σ_t^2 is the variance in PPP monthly divergence, I_t is a vector consisting of ones for the period June 1997 to April 1999 (January 1997 to April 1999 for Korea) and zeros otherwise, error (e_t) refers to the regression residuals, adj error refers to the regression residuals adjusted for the change in variance over the study period.

Figure 1: Cumulative PPP Deviations – February 1970 to November 1999

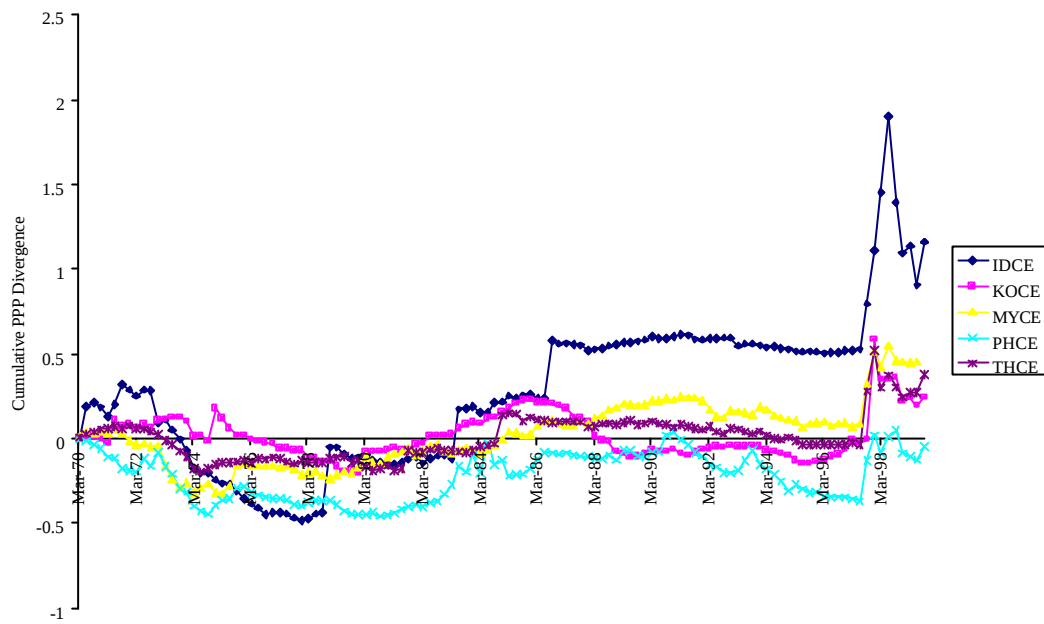


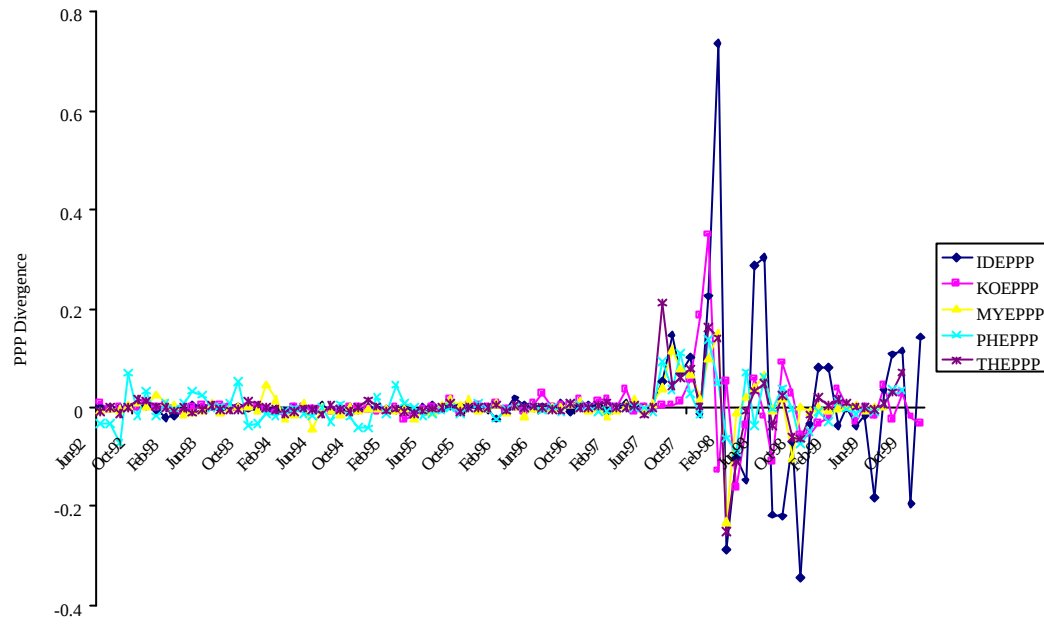
Figure 2: PPP Deviations – June 1992 to November 1999

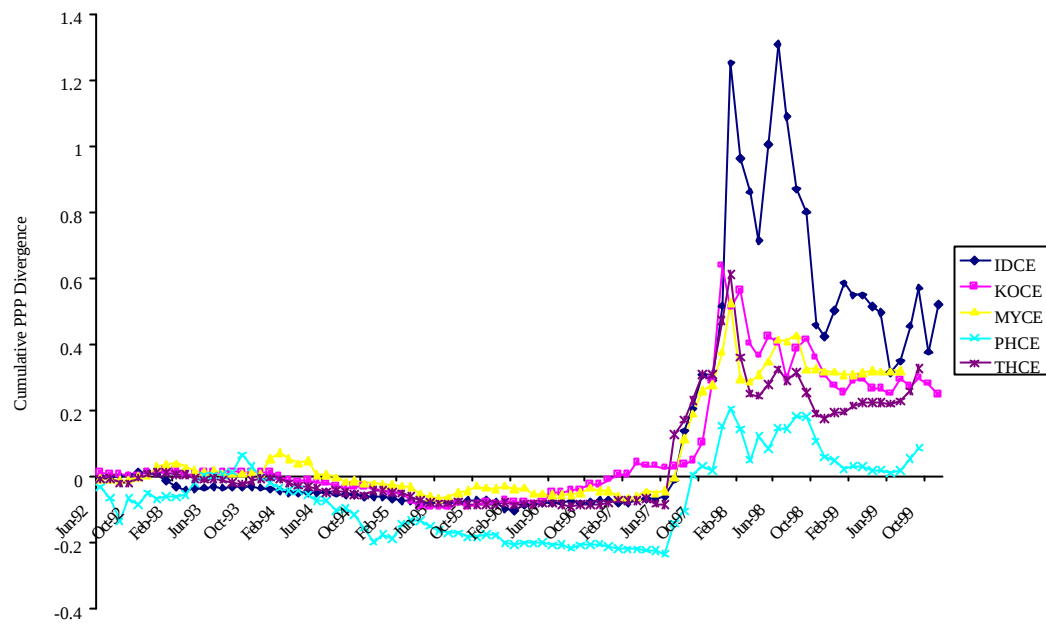
Figure 3: Cumulative PPP Deviations– June 1992 to November 1999

Figure 4: Malaysia Cumulative Deviations - Relative to Thailand