Discussion Paper
No. 0404

Successful and Unsuccessful Attacks: Evaluating the Stability of the East Asian Currencies

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August 2004

International Macroeconomics and Finance Program

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ISSN 1444-4534 series, electronic publication

CIES DISCUSSION PAPER 0404

Successful and Unsuccessful Attacks: Evaluating the Stability of the East Asian Currencies*

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August 2004

* This study is funded by a Research Grant from the School of Economics, University of Adelaide. The usual disclaimers apply.

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Abstract:

The key objective of our study is to re-examine again the stability of selected East Asian currencies. Had there been any other attacks on these currencies prior to their meltdowns in 1997? Equally important, have the currencies stabilized during the post-1997 crisis? To address these questions, we adopt the concept of exchange market pressure (EMP) index of Kaminsky, Lizondo, and Reinhart (1998). Due to non-normality of the statistical distribution of the EMP indices in general, this study applies the Extreme Value Theory (EVT) as proposed by Huisman, Koedijk, Kool, and Palm (2001). Lastly, we document events that arguably contribute to speculative attacks on these currencies.

JEL Classification: F31, F41

Key Words: Currency Crisis; Exchange Market Pressure; Extreme Value Theory; East Asia.

1. Introduction

The remarkable achievement of high and sustained economic growth in the East Asian countries prior to the 1997-financial crises has long been the subject of many studies. A number of independent (and even contradictory) analyses have been proposed to explain the economic success of these economies (Sarel (1996)). Yet, most of these studies agree that the East Asian economies have achieved rapid growth through an astonishing mobilisation of resources.

The drive towards financial liberalisation in the late 1980s, further opening of the capital account, and the stability of macroeconomic indicators have been frequently underlined as key pull factors for the massive inflows of foreign capitals in both of the banking and the stock exchanges of these economies, especially in 1990s. The World Bank report on the East-Asian miracle points out that "the macroeconomic management was unusually good, providing the stable environment essential for private investment" (page 5 of the World Bank (1993))[1,2]. Among a number of sound macroeconomic policy managements, the study has specifically underlined the success of the policy makers of these economies in maintaining stable exchange rates of the local currencies, particularly against the US dollar.[3]

We wish to revisit and re-examine again this widely accepted notion of stable currencies in five key crisis-effected East Asian economies, namely Indonesia, Malaysia, Philippines, Thailand and South Korea. Two fundamental questions are posted here. Had there been any evidences of other attacks on these currencies prior to their meltdowns in 1997? If there had in fact been a large number of attacks, then we would argue that these currencies were vulnerable and unstable.

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[1] See Rajan and Siregar (2002) on the estimation of the size of capital inflows to different East Asian economies, particularly in early to mid-1990s.

[2] It should be noted at this point that among the five East East countries covered in this study, the Philippines was not included in the World Bank (1993) study.

[3] Most of the East Asian economies in 1990s have actively intervened its foreign exchange market to manage the fluctuations of the local currencies, particularly against the US dollar (Hernandez and Montiel (2003), McKinnon (2001), (Bubula and Otket-Robe (2002)) and Calvo and Reinhart (2002)).

Equally important, have the currencies stabilized during the post-1997 crisis? Given the re-occurrences of currency crises in other parts of the world, particularly, in different Latin American countries in the past two decades, a more in-depth understanding of the East Asian currencies during the post 1997-crisis period are called for and considered vital to prevent future currency crises in this region.

In addressing these questions, this study will expose two fundamental weaknesses of early analyses/evaluations on whether a currency is stable (strong) or unstable (vulnerable). Firstly, it is arguably inadequate to generally conclude that a currency is stable by solely observing the changes in its nominal exchange rate. As this study will show, past experiences of different countries in the world, including those of the East Asian economies, have illustrated time and again that incidences of currency attacks do occur despite the nominal exchange rate of a currency remaining stable. The incidence of speculative attacks, especially when the frequency is quite high within a relatively short period of time, arguably suggests that the currency is vulnerable and under continuous selling pressures.

Secondly, one important lesson that can be distilled out of studies emanating from leading indicators of currency crises is that the way the studies defined on how big (small) a change in nominal exchange rates is needed to qualify as unstable (stable) has largely been of an arbitrary process. For instance, in the context of defining a currency crash, Frankel and Rose (1996) apply a nominal exchange rate depreciations of 25 percent or more and exceeding last year's depreciation by at least 10 per cent. The adoption of arbitrary variations in thresholds of 1-3 standard deviations above the mean value of an exchange market pressure index is also quite frequent.[4] However, as we will show, the problem with these measures of thresholds that exclusively rely on standard deviations as a measure of the extent of volatility is usually based on the basic assumption of a normal distribution on the index of

[4] See Eichengreen-Rose-Wyplosz ((1994), (1995), (1996)); Berg-Patillo (1998); Kaminsky-Lizondo-Reinhart (1998); Kaminsky-Reinhart (1999); Edison (2003), and among others.

exchange market pressure and its corresponding components. Studies as early as the 1960s have clearly established, however, that short-term foreign currency fluctuations/returns and interest rates are non-normal, displayed fat and heavy-tails. [5]

To better measure the incidence of speculative attacks on a currency, we will adopt a version of the concept of exchange market pressure (EMP) index as employed by Kaminsky, Lizondo, and Reinhart (1998 and 1999)---henceforth KLR index. As will be described further in section 2 of the paper, this index is constructed as a weighted average of the rate of depreciation of the local currency (mostly against the US dollar in either nominal or real terms), the monthly percentage changes in international reserves, and the monthly change in the interest rate.

It is important to immediately underscore at this point that an exchange market pressure (EMP) is not only defined as capturing instances of successful attacks, i.e., when a significantly large depreciation of the currency occurs, but as well as instances of unsuccessful attacks (pressure rebuffed by loss in reserves and/or rise in interest rates) (Kaminsky, Lizondo, and Reinhart, 1998; Goldstein, Kaminsky, and Reinhart, 2000).

Furthermore, due to the non-normality of the statistical distribution of the EMP indices in general, we have to avoid relying too much on parametric assumptions in identifying the threshold. Accordingly, our study will apply the Extreme Value Theory (EVT) and adopt a modified estimator proposed by Huisman, Koedijk, Kool, and Palm (2001) ---henceforth HKKP.

To our knowledge, hardly any studies have applied the EVT methodology to understand the rise and fall of the EMP in the case of the East Asian currencies. A recent one is by Pozo and Dorantes (2003). Their study applied the EVT to a version of the EMP index employed by Eichengreen-Rose-Wyplosz (1996) to identify periods

[5] (Mandelbrot (1963), (1964), (1967), Roll (1970); Rogalski and Vinso (1978); McFarland, Petit, and Sung (1982); Boothe and Glassman (1987) and Koedijk, Schafgans and de Vries (1990); Brenner, Harjes, and Kronner (1996); Andersen and Lund (1997); Koedijk, Nissen, Schotman, and Wolff (1997)).

of currency crisis in three regions: Asia, Europe and Latin America countries from the mid-1960s to 1997. Pozo and Dorantes (2003) opted to pool the countries' EMPs and estimate the regional values of the tail parameter (instead of individual countries) to avoid the potential problem of small sample sizes. The pooling of the countries on a regional basis, however, is arguably a statistically inappropriate measure. Even during the pre-1997 financial crisis period that they cover, we can immediately capture the wide divergences of the EMP mean and the standard deviations among the Asian and the Latin American countries, with Indonesia and Paraguay having the total absolute value of mean and one standard deviation of the EMP about twice as much as that of Singapore and Bolivia, respectively.[6] As shown in Table 1, the statistical divergence continues to be quite significant when we include the currency-crisis period of 1998-2003.

To generate more consistent analyses, we adopt the HKKP tail index estimator, which is unbiased in small sample cases. The application of HKKP methodology allows us to examine five East Asian economies individually (Indonesia, Malaysia, Philippines, Thailand and South Korea) with a relatively small sample size.

Our study covers the period from 1985 to 2003. Given the extended period of observations, we aim to capture the most recent episodes of crises in the region and to conduct comparative analyses between the pre-1997 and post-1997 crisis periods.

Based on the empirical findings, we then document events that may have arguably contributed to the rise in the EMP index during those two periods. The chronological listing of both economic and political events, which may be suggestive of events that have contributed to currency 'stress' in these economies, allow us to understand more the nature of different episodes of high currency pressures in these economies. These events allude to the susceptibility of these economies to currency crises. In the presence of a lingering vulnerability, the occurrence of any random

[6] Refer to Table 2 of Pozo and Dorantes (2003), pp. 598.

shock or trigger event can precipitate any crisis. This elaborated listing of the events is another main contribution of this paper to the current literature in this field.

The outline of the paper is as follows. Section 2 will briefly review the basic constructions of the exchange market pressure index suggested by Kaminsky, Lizondo and Reinhart (1998). The Extreme Value Theory and the HKKP methodology will be discussed in section 3. The empiric section covering the data and the testing will then follow (section 4). Section 5 presents and discusses different events that may have arguably been responsible for the currency attacks. This paper ends with brief concluding remarks (section 6).

2. The Exchange Market Pressure Index

Considering large movements in nominal exchange rates accounts for the most dramatic forms of currency crises, e.g., episodes of forced devaluation which emanate from a sharp break from a historical regime of fixity and accelerations of depreciations from a regime of more flexible rates, volatility alone in the nominal exchange rate understate the magnitude of crises as this excludes episodes of unsuccessful attacks. Government policies manifested through monetary policy actions and intervention in the foreign exchange market, moderate supposed large movements in exchange rates. In the same manner, considering in isolation, movements in reserves and interest rate aside from exchange rates also offer only a partial view of the severity of shocks in the economy. Nonetheless, combining them should convey a more informative and reasonable measure of the extent of currency crises, and referred to as the index of exchange market pressure.

The seminal idea comes from the early work of Girton-Roper (1977) that any excess demand for foreign exchange can be fulfilled through non-mutually exclusive conduits. If the speculative attack (currency pressure) is successful, there is a sharp depreciation of the domestic currency. However, at other times, the attack can be

repelled or warded off through raising interest rates and/or running down on the foreign exchange reserves.

In so doing, a measure of the extent of currency pressure can be constructed as a weighted average of the changes in exchange rate, in foreign exchange reserves, and in interest rates. The exchange rate is said to be under 'stress' (there is selling pressure) if there is a significant increase in the exchange market pressure index.

The question is how to weigh the three components of the index of speculative pressure. An unweighted index is simpler to construct, but the major drawback is that an unweighted index will be driven or dominated by the most volatile variable, and usually it is the movements in reserves. Next, we will briefly review a recently commonly adopted construction of the EMP index that will then be employed for our empirics.

2.1 Kaminsky, Lizondo and Reinhart (1998 and 1999)

The original construction of the EMP index of Kaminsky, Lizondo, and Reinhart (KLR) (1998 and 1999) can be expressed as a following:

$$EMPI_{i,t} = \frac{\Delta e_{i,t}}{e_{i,t}} - \frac{\sigma_e}{\sigma_r}\frac{\Delta r_{i,t}}{r_{i,t}} \qquad (1)$$

where: $EMPI_{i,t}$ is the exchange rate market pressure index for country *i* in period *t*; $e_{i,t}$ the units of country *i*'s currency per U.S. dollars in period *t*; and σ_e the standard deviation of the rate of change in the exchange rate ($\frac{\Delta e_{i,t}}{e_{i,t}}$); $r_{i,t}$ gross foreign reserves of country *i* in period *t*; σ_r is the standard deviation of the rate of change in reserves $\left(\frac{\Delta r_{i,t}}{r_{i,t}}\right)$.

However, they also noted the important role of interest rate in capturing the market pressures on exchange rate at any particular period of time.[7] Hence for our study, we will apply the following modified KLR index:

$$EMPI_{i,t} = \frac{\Delta e_{i,t}}{e_{i,t}} - \frac{\sigma_e}{\sigma_r}\frac{\Delta r_{i,t}}{r_{i,t}} + \frac{\sigma_e}{\sigma_{\text{int}}}\Delta \text{int}_{i,t} \qquad (1b)$$

where, in addition to the basic variables listed in equation (1), we have $\text{int}_{i,t}$ the nominal interest rate for country *i* in period *t*; and σ_{int} the standard deviation of the change in the nominal interest rate, $\Delta \text{int}_{i,t}$.

From equation (1b), one can observe the different weights given to these three key components of exchange market pressures. In particular, the weights for the interest rate and reserve fluctuations depend on the relative size of their standard deviations (σ_{int} and σ_r, respectively) against that of the exchange rate (σ_e). The EMP index increases with a depreciation of the domestic currency, a loss of international reserve and a rise in the domestic interest rate. A rise in index reflects stronger selling pressure on the domestic currency.

3. The Extreme Value Theory and The HKKP (2001)

3.1 Extreme Value Theory[8]

Consider a stationary sequence $X_1, X_2, \ldots, X_n$ of iid random variables with a common distribution function *F* (d.f.*F*). Suppose one is interested in the probability that the maximum

$$M_n = \max(X_1, X_2, \ldots, X_n) \qquad (2)$$

of the first *n* random variables is below a certain level *x*. As is well known, this probability is given by

[7] KLR (1999) argue that they did not include the interest rate component in their application because of the lack of complete interest rate data for the countries that they studied (pg.498).
[8] This section draws heavily from de Vries (1994), Koedijk and Kool (1992), Koedijk, Stork, and de Vries (1992); Huisman, Koedijk, Kool and Palm (2001).

$$P(M_n \leq x) = F^n(x) \qquad (3)$$

Extreme value theory studies the limiting distribution of the order statistic M_n appropriately scaled. That is, one is interested under which conditions there exist suitable two normalising constants $a_n > 0$ and b_n, such that:

$$P(M_n - b_n \leq a_n x) \xrightarrow{d} G(x) \qquad (4)$$

where $G(x)$ is a so-called a extreme value distribution and the superscript d indicates convergence in distribution. If $1 - F(x)$ is regularly varying at infinity, choosing $b_n = 0$ and $a_n = F^{-1}(1 - 1/n)$ we have

$$G(x) = \exp(-x^{-\alpha}) \qquad \alpha > 0 \qquad (5)$$

where α is the tail index. The tail index is a good indicator of the tail fatness as it is related to the number of moments that exist.

The advantage of the extreme value approach is that all fat-tailed models are nested with respect to their tail index into one model. The tail index, given a number of observations X_i can be estimated by parametric and nonparametric methods. The latter method is presented. Assume that $X_1, \ldots, X_n$ is a sample of independent realisations from a distribution $F(x)$ with a regularly varying tail. Thus,

$$\lim_{t \to \infty} \frac{1 - F(tx)}{1 - F(t)} = x^{-\alpha} \qquad \alpha > 0 \qquad (6)$$

Suppose the density $f(x)$ exists. Through integration by parts we have the following equivalence:

$$\int_1^\infty \frac{1 - F(tu)}{u} du = \log u [1 - F(tu)] \Big|_1^\infty + \int_1^\infty \log u \, f(tu) t \, du$$

$$= \int_1^\infty [\log(tu) - \log t] f(tu) t \, du$$

$$= \int_t^\infty (\log x - \log t) f(x) \, dx \qquad (7)$$

Combining equation (5) and (6) and applying the Lebesque convergence theorem (interchanging the limit of the integral with the integral of the limit):

$$\frac{\int_t^{\infty}(\log x-\log t)\,f(x)dx}{1-F(t)}=\int_1^{\infty}\frac{1-F(tu)}{1-F(t)}\frac{du}{u}\rightarrow\int_1^{\infty}u^{-\alpha}\frac{du}{u}=\frac{1}{\alpha} \qquad (8)$$

Let $X_{(n)}\geq X_{(n\text{-}1)}\geq\ldots\geq X_{(1)}$ denote the ascending order statistics from the sample $X_1,\ldots,X_n$. Replace the left-hand side expression of equation (7) by its simple analog in order to estimate the inverse tail index $\gamma = 1/\alpha$. Let $F_n(.)$ denote the empirical distribution function. Thus, for some k, which is the number of tail observations used to estimate α and n represents the total number of return observations, take $t = X_{(n-k)}$ and hence:

$$\hat{\gamma}=\frac{1}{k}\sum_{i=0}^{k-1}\frac{\log X_{(n-i)}}{X_{(n-m)}} \qquad (9)$$

is the estimator first proposed by Hill (1975). Mason (1982) proved that under some regularity conditions $\hat{\gamma}$ is a consistent estimator for γ. Goldie and Smith (1987) showed that $(\hat{\gamma}-\gamma)k^{1/2}$ is asymptotically normal with mean 0 and variance γ^2. Consequently, $\hat{\alpha}$ is also asymptotically normal with mean α and variance α^2/k.

3.2 The Hill and the HKKP Estimator

However, given the relatively small observation size that we have for this study, the Hill estimator will suffer from small sample bias. To deal with this, we apply the tail index estimator proposed by Huisman, Koedijk, Kool, and Palm (2001) --- henceforth HKKP---, which is unbiased in small sample cases. The HKKP methodology starts with the Hill (1975) estimator presented earlier (Eq.9) with a slightly different expression:

$$\gamma(k)=\frac{1}{k}\sum_{j=1}^{k}\ln(x(n-j+1)-\ln(x(n-k)) \qquad (10)$$

where, as discussed early, we assume that there is a sample of n positive independent observations drawn from some unknown fat-tailed distribution. Let the parameter γ be the tail-index of the distribution, and $x(i)$ be the ith-order statistic

such that $x(i-1) \le x(i)$ for $i = 2,.....,n.$ k is the pre-specified number of tail observations. Note by ordering the observation by its size and not by the original dates, the sample observations are arguably becoming independently distributed. Naturally, the choice of k is crucial to obtain an unbiased estimate of the tail-index.

HKKP (2001) shows that for a general class of distribution functions the asymptotic expected value of the conventional hill estimator to be biased and increasing monotonically with k. Similarly, the asymptotic variance of the Hill estimator to be proportional to $\left(\frac{1}{k}\right)$. Generally, this problem will only be resolved when the sample size goes to infinity for given k.

For our small sample observations, HKKP (2001) introduces an estimator that overcomes the problem of the need to select a "single" optimal k in small sample observations. HKKP (2001) proposes that for values of k smaller than some threshold value κ, the bias of the conventional Hill estimate of γ increases almost linearly in k and can be approximated by:

$$\gamma(k) = \beta_0 + \beta_1 k + \varepsilon(k), \qquad k = 1,2,...., \ \kappa \qquad (11)$$

where: β_0 and β_1 are the intercept and the estimate coefficient. $\varepsilon(k)$ is a disturbance term. HKKP (2001) also shows that the modified Hill estimator is quite robust with the choice of κ to be around $\left(\frac{n}{2}\right)$. Accordingly, for our empirics, we propose to compute $\gamma(k)$ for a range value of k from 1 to κ (roughly equal to $\left(\frac{n}{2}\right)$).

To estimate Equation (11), HKKP (2001) adopt the Weighed Least Squares (WLS), instead of the Ordinary Least Squares (OLS), to deal with the potential heteroscedasticity in the error term $(\varepsilon(k))$ of Equation (11). The weight has $\left(\sqrt{1},\sqrt{2},.....\sqrt{k}\right)$ as diagonal elements and zeros elsewhere. The estimate of γ from the WLS regression is an approximately unbiased estimate of the tail-index.

4. Data and Empirical Testing

4.1 Data

All data in monthly frequencies were drawn from the IMF International Financial Statistics database covering the period from 1985 to 2003. We considered a number of East Asian countries (Indonesia, Korea, Malaysia, Philippines, and Thailand). The exchange rate is expressed in local currency per U.S. dollar. To avoid the issue in some countries of treating separately high-inflation episodes with regard to the construction of the exchange market pressure (EMP) indices, a measure of the real exchange rate is calculated by multiplying the nominal exchange rate by the relative price given as:[9]

$$RER_t^{local/U.S.} = NER_t^{local/U.S.} \frac{P_t^*}{P_t} \qquad (12)$$

where P_t is the domestic consumer price index, and P^* is the U.S. consumer price index. An increase in RER_t (real exchange rate) or NER_t (nominal exchange rate) implies an appreciation of the U.S. dollar against the relevant local currency.

The remaining data requirements in the construction of the exchange market pressure indices are as follows. The overnight money market rates used as the measure of domestic interest rate, except in the cases of the Philippines (91-day Treasury bill rate). Line 11 of the IMF-IFS database (foreign assets of the monetary authorities) was used as the measure of foreign exchange reserves.

4.2 Empirical Testing

4.2.1 EMP Index, Unit-Root Test and Ljung-Box Q-statistic Test

Table 1 presents summary statistics of the EMP index for the individual countries. The following observations can be generated. First, in almost all of the countries in East Asia, the EMP index is skewed to the right. Second, the EMP index

[9] Similar results were obtained when the nominal exchange rate is used.

exhibit excess kurtosis which reflects fat-tailedness.[10] Third, the Jarque-Bera statistics are highly significant for all countries which further confirms the non-normality of the EMP index.[11] This outcome is further substantiated by visual evidence in Figure 1 with the histogram of the EMP series for each countries overlaid by its corresponding normal probability density functions. In all cases, it is obvious that the EMP index depart significantly from the normal distribution—mass of observations in the tails and the observed regularity of a great number of peak observations at the centre of the distribution.

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Table 1 and Figure 1

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A preliminary step in proceeding with extreme value analysis is to examine the unit-root property of the EMP index. Table 2 presents the combined results from the commonly used ADF unit root test as well as from alternative unit root tests—the DF-GLS and the KPSS tests. In all, the EMP index for all countries are *I*(*0*) variables at the 1 per cent significance level according to the ADF test. Confirmatory results from the DF-GLS test and the KPSS unit-root test show that the EMP index is stationary at the 10 percent significance level or even stronger. We also report the Ljung-Box Q-statistic tests with the null hypothesis of no autocorrelation. With the exception for Korea, we cannot reject the null hypothesis for the rest of the countries listed in our study (Table 2B).

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Tables 2 and 2B

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[10] Excess with respect to the normal distribution which has a kurtosis equal to 3.
[11] Kolmogorov-Smirnov and Shapiro-Wilk statistics further support this result. The results can be made available upon request.

4.2.2 The Hill and HKKP Estimators

In order to capture the tail mass or outliers it is mandatory to estimate the so-called tail index (γ), and as earlier mentioned, we use the Hill estimator for this purpose.[12] The Hill estimator requires that the EMP series are rank-ordered from lowest to highest denoted as (x_i), and uses maximum likelihood estimation of the tail index (γ). In accordance with the suggestion of HKPP (2001), to deal with the estimation of the tail with a small sample size, we use equation (11) in estimating a weighted least squares (WLS) regression for the individual countries, after computing the $\gamma(k)$ for a range of values of k.[13] Consequently, the essence is to identify the right-tail outliers or 'extreme value' observations since the right-tail distribution of any EMP index ordered distribution will automatically determine the number and incidence of currency pressure episodes that individual countries experienced. Accordingly, Diebold, Schuermann, and Stroughair (DSS) (2000) suggested, similarly employed by Pozo and Dorantes (2003), recursive residuals were derived from the weighted least squares regression to diagnose structural change which will guide us in the selection of the optimal k.

Figure 2 depicts the recursive residuals for the KLR EMP indices across the countries in East Asia. The recursive residuals are plotted against the bandwith of plus and minus two standard errors, and examination of the recursive residuals in relation to the standard errors show an evident instability, generally, starting at the right-hand side of the plots. When we consider the empirical distribution of the individual ordered EMP indices, the apparent break around the right-hand side of the recursive residual plots appropriately correspond to the optimal choice of k, or equivalently, the number of 'extreme' or right-tail observations have now been identified.

[12] γ also equals $1/\alpha$, where α refers to the maximum number of existing finite moments. As is customary in the literature, the tail index is either referred to as γ or α, it is used here interchangeably.
[13] The WLS results are not reported here, but they can be made available upon request.

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Figure 2

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5. Results and Analyses

5.1 EVT and Conventional Approach

Prior to identifying the crisis episodes according to EVT, Table 3 reports the crisis incidence for each country over the period 1985 to 2003 using the conventional method of selecting an arbitrary threshold of 1.5 - 3 standard deviations for the values of the EMP index. The choices of three-month and six-month exclusion windows are adopted to calculate the number of crisis episodes, while at the same time avoiding counting the same crisis more than once, due to the fact that crisis often last for over a month and more crises occur in successive months. The incidence rate is a percentage ratio of the number of crises episodes over the total number of EMP observations. Clearly, the number and incidence of crises episodes are sensitive to the arbitrary choice of the threshold and to the length of the exclusion window, i.e., a relatively lower threshold and short exclusion window represent higher incidences of crisis episodes, vice-versa.

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TABLE 3

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Tables 4 presents the identification of crises according to EVT, and for comparative purposes, we also include the result using the conventional method where we include the threshold that has the most number (incidence) of identified crisis episodes from table 3 (this is at one and a half standard deviations above the mean). The third column of table 4 also reports the optimal *k* values which were derived from the recursive residuals discussed earlier, and the reported values clearly show the contrast in the number of extreme right-tail observations, or in the

number of crises which occurred prior to imposing an exclusion window for individual countries.

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TABLE 4

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From Table 4, it is clear that using an alternative approach such as an EVT leads to more incidence of crises episodes identified compared to the standard approach in the literature. This finding holds across country-specific cases, irrespective of the length of the exclusion or crisis window used. In average, the EVT results report twice as many crisis incidences as the number captured by the conventional method. For Indonesia, arguably one of the most severely effected countries by the 1997 financial crisis, the EVT incidence rates of crisis are more than three times of the conventional rates.

More importantly, the overall message derived from the EVT numbers is robust and conclusive. Regardless of the exclusion windows (3 months or 6 months) for the EVT results the Philippines has the highest incidence rate, followed by Indonesia, Malaysia, Korea and Thailand (Table 4). In contrast, the ordering based on the incidence rates for the conventional method is highly sensitive to the size of the exclusion windows and the arbitrary choice of the standard deviations for the threshold (Tables 3 and 4).

Once the crisis incidence episodes have been computed, it is now conveniently easy to appropriately date the timing of the currency pressure (crises). Accordingly, tables 5 and 6 summarised the dates of the attack episodes captured by the conventional method and by the EVT, respectively. As expected, the EVT list a more comprehensive dating of actual episodes of currency crises for the countries investigated during the time period covered by the data (1985-2003).

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TABLES 5-6

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5.2 Currency Stability, Political and Economic Events

The last, but interesting task, that we have conducted in this study is to try to associate the dates listed in Table 6 with economic and political events, local or international, that may explain or contribute to the rise in the EMP levels.[14] We break the analyses into two periods: the pre-and post-1997 crisis.

5.2.1 The Pre-1997 Crisis Period

From tables 6 and 7, it is apparent that about 10 years before the break of the 1997 financial crises, all five East Asian currencies were attacked a number of times. With the exception of Thai baht, the rest of them have in fact been attacked between six to eight different periods. In general, these speculative attacks were not successful in causing major depreciations of these currencies. But clearly with almost one attack per year between 1985-1996, the results indicate that these currencies were continuously under high "selling" pressures. It is also interesting to note that these attacks were associated with both political and economic events occurring in domestic and international fronts (Table 7).

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TABLE 7

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There are however interesting differences across countries that are worth highlighted here. Speculative attacks on the Indonesian rupiah and the Malaysian ringgits during the pre-1997 crisis were largely associated with economic events. Under the strong rules of President Soeharto and Prime Minister Mahatir

[14] As also indicated by Pozo and Dorantes (2003), the listing of political and economic events here is only suggestive of events that may have initiated financial distress. But we have not attempted any causation test in any formal way.

Mohammad, the political fronts of Indonesia and Malaysia, respectively, were relatively stable.

The rapid reforms of the financial sector and the trade sector in Indonesia, particularly since mid-to-late 1980s with the opening of the banking sector and the capital market have arguably contributed to the rise in speculative attacks on the rupiah. With the lack of transparency, due largely to lack of political reforms, the rapid opening of the capital account side led to a number of banking failures/scandals in early 1990s, with the two major ones occurred in 1990 and 1994. As for Malaysia, the 'commodity-price shock' of the mid-1980s and a number of events related to weaknesses in its foreign exchange operations, e.g., the 1994 foreign exchange scandal, its short flirtation with capital controls in early 1994 seemed to play significant role in triggering currency 'stress' in the ringgit in the late 1980s and early to mid-1990s.

In contrast, Korea and the Philippines appeared to follow similar sequential events. In the 1980s, the attacks in their currencies were, in general, largely driven by political events. For instance, most of the speculative attacks on the won seem to be largely effected by the labour strikes that occurred especially between 1985-1989. In the Philippines, the fall of the Marcos regime and the assumption into office of a politically-inexperienced leader left the Philippines on very shaky political grounds. The presidency of Corazon Aquino, eventually, experienced numerous political coups that created weak confidence and uncertainty on the local currency. While in the 90s for Korea and the Philippines, the economic shocks contributed more to the rise on their respective exchange market pressures.

In the 1990s, we start to see concerns over economic events in Korea, such as the Hanbo scandal in 1991 and the soaring current account deficit in 1996 due to the adverse drop in semiconductor prices, as factors that had largely exposed the won to more speculative attacks. Late 1980s and early 1990s in the Philippines saw

a worsening in both the trade deficit and the energy crisis in the country, which triggered higher exchange market pressures on the Philippines peso.

Interestingly, the Thailand bath experienced the least number of attacks prior to 1997. As in the case of Malaysia, Korea and the Philippines, Thailand had, however, also experienced a worsening of its current account deficit in 1995 and 1996. Concerns over the high consumer spending of luxury imports in Thailand heightened uncertainties over the sustainability of the current account deficit and the subsequent adverse implication of the deficit on economic growth (Limpaphayom, 2001).

One final note on the pre-1997 crisis period is that major global events such as the Gulf War of 1990 and the Mexican crisis of 1995 also created market pressures on the East Asian currencies. These external events confirmed the increasingly high degree of integration of the East Asian markets with global markets, and with it the increasing susceptibility of these economies to adverse developments in the international markets.

5.2.2 The 1997 Crisis and The Post-Crisis Period

The collapse of the Thai bath on that fateful day of July 2, 1997 and the subsequent collapse of the other neighbouring regional currencies had been well documented. All currencies observed in this study experienced massive attacks and depreciation in mid to late 1997. Several observations are worth highlighting for the post-1997 period.

First, only the Philippine peso, the Indonesian rupiah, and to a lesser extent, the Malaysian ringgit, continued to experience bouts of “mini-crises” until early 2000s. Korea and Thailand had successfully contained speculative attacks on their currencies by 1998.

Second, unlike the pre-crisis experiences, the post-1997 attacks were largely driven by political events. The story of the mini-attack on the Malaysian ringgit in

early 2001, was largely political which emanated from the aftermath of the controversy on the Anwar Ibrahim case. Meanwhile, the story of the attack episodes in Indonesia and the Philippines were largely triggered by events, such as the long-drawn impeachment process against President Estrada and his eventual overthrow in 2001, the brief mutiny against President Arroyo in 2003 in the Philippines, and in Indonesia, the dismissal of President Habibie and President Wahid in 1999 and 2001, respectively, worsened an already politically tense situation. Hence, one can argue that the difficult struggle of these two countries for political stability has contributed significantly to weak market confidences on their currencies during the last several years.

6. Brief Concluding Remarks

One key objective of our study is to revisit and re-examine the stability of a selected key East Asian currencies prior to the 1997 crisis. Had the currencies been stable as frequently documented by early studies? Given the re-occurrences of currency crises in different Latin American countries in the last two decades, it is undoubtedly important to have a more in-depth understanding of these currencies during the post 1997-crisis period. To address these issues, we apply the HKKP-Extreme Value Theory to a version of the exchange market pressure index employed by KLR (1998).

The adoption of KLR-EMP index is vital here to get a better estimate of market pressures on these currencies, as changes in nominal exchange rate alone is arguably an inadequate measure. The study has shown that by employing the HKKP-Extreme Value Theory approach that takes into account the basic statistical properties of the KLR-EMP index, we can substantially improve the conventional approach in the literature, by capturing more incidences of speculative attacks on the five key East Asian currencies during the pre- and post-1997 crisis.

Another contribution of the study is with the documentation of the events that can be argued to be associated with the speculative attack dates identified in this study. Not only that the unfolding economic and political events both in domestic and international markets help us enriched our understanding of the similarities and diversities of the potential roots of the currency attacks in East Asia, the chronological detailing of key economic and political events in this paper are also broadly in line with emerging evidence in recent literatures that not only economic variables explain the vulnerability of countries to speculative attacks, but also the role of politics, especially the role of political uncertainty (Leblang, 2001).

The findings suggest that despite the reported stable spot nominal exchange rates (particularly against the US dollar), the East Asian currencies were under frequent attacks since the mid-1980s. Combinations of different events and factors such as domestic economic reforms, key global events and a host of political factors had arguably been responsible for the high exchange market pressures in the 1980s for these currencies. The large number of incidences of high exchange market pressures on these currencies pre-1997 crisis clearly challenges the previously commonly adopted perception that the 1997 currency crisis in this region was largely an unforeseen event. Given a host of mutually-reinforcing factors that validly support the susceptibility of these countries to a major currency crises on the eve of July 1997, such as the gradual build-up of macroeconomic vulnerabilities, e.g., the increased size of current account deficits financed by volatile, short-term capital flows, and the weak or fragile financial institutions in these countries, these "persistent attacks" would eventually be strong enough to bring down the currencies in this region as we witnessed in mid-to-late 1997.

Lastly, we also find that the speculative attacks on the Indonesian rupiah and the Philippines peso remain high during the post-1997 financial crisis. Our findings suggest that the root of the problem lies with the high political uncertainties in these two economies. Needless to say, without stable and strong governments, these two

currencies are at risk of future collapse as we have witnessed with the experiences of the Latin American countries during the post two decades.

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Table 1
Basic Descriptive Statistics

	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Bera Statistic
Indonesia	-1.00	9.71	1.17	27.10	5448.91*
Korea	-1.05	6.22	1.66	18.24	2272.20*
Malaysia	-0.45	4.61	-0.78	16.91	1837.17*
Philippines	-0.43	4.58	-0.22	10.35	508.09*
Thailand	-0.86	4.17	1.30	11.08	675.49*

Note: *****The null hypothesis of a normally distributed EMP measure is rejected.

Table 2
Unit Root Tests

	ADF test[a] without trend	ADF test[a] with trend	DF-GLS[a] without trend	DF-GLS[a] with trend	KPSS test[b] without trend	KPSS test[b] with trend
Indonesia	-14.791***	-14.778***	-2.611***	-13.947***	0.075	0.044
Korea	-10.107***	-10.087***	-10.100***	-10.113***	0.039	0.035
Malaysia	-12.952***	-12.951***	-1.537	-2.979**	0.062	0.043
Philippines	-8.879***	-8.560***	-8.727***	-8.791***	0.250	0.049
Thailand	-9.649***	-10.027***	-0.833	-2.006	0.512**	0.066

Notes: ***, **, * indicate rejection of the null hypothesis at the 1%, 5% and 10%, respectively.

[a] The ADF/DF-GLS procedure test the null that H_0: $y_t \sim I(1)$ against the alternative H_a: $y_t \sim I(0)$.

[b] The KPSS procedure test null that H_0: $y_t \sim I(0)$ against the alternative H_a: $y_t \sim I(1)$.

Table 2.B
Ljung-Box Q-statistic

Indonesia	Korea	Malaysia	Philippines	Thailand
16.2	53.34*	9.49	9.07	4.13

Notes: the Ljung-Box Q-statistic tests the null hypothesis of no autocorrelation at the relevant lag. * denotes rejection of the null hypothesis.

Table 3

Number and Proportion of crisis episodes

		Country-Specific Standard Deviation and Mean															
		μ+1.5σ				*μ+2.0σ*				*μ+2.5σ*				*μ+3.0σ*			
	n	*3-month window*	*Incidence*	*6-month window*	*Incidence*	*3-month window*	*Incidence*	*6-month window*	*Incidence*	*3-month window*	*Incidence*	*6-month window*	*Incidence*	*3-month window*	*Incidence*	*6-month window*	*Incidence*
East Asia																	
Indonesia	223	5	2.2	4	1.8	4	1.8	3	1.3	2	0.9	1	0.4	2	0.9	1	0.4
Korea	224	6	2.7	6	2.7	2	0.9	2	0.9	1	0.4	1	0.4	1	0.4	1	0.4
Malaysia	225	6	2.7	4	1.8	4	1.8	3	1.3	3	1.3	2	0.9	3	1.3	2	0.9
Philippines	225	9	4.0	8	3.6	6	2.7	6	2.7	4	1.8	4	1.8	2	0.9	2	0.9
Thailand	225	6	2.7	5	2.2	5	2.2	4	1.8	2	0.9	2	0.9	1	0.4	1	0.4

Table 4

Number of monthly episodes of crises and incidence of crises using the extreme value theory and conventional methods.

		Extreme Value Theory (EVT)						*Conventional Method*			
								Country-Specific Standard Deviation and Mean			
								μ + 1.5σ			
	n	*Optimal k*	*No. of Crises Episodes*		*No. of Crises Episodes*			*3-month window*	*Incidence*	*6-month window*	*Incidence*
			3-month window	*Incidence*	*6-month window*	*Incidence*					
East Asia											
Indonesia	223	26	16	7.2	13	5.8		5	2.2	4	1.8
Korea	224	14	12	5.4	11	4.9		6	2.7	6	2.7
Malaysia	225	21	15	6.7	12	5.3		6	2.7	4	1.8
Philippines	225	35	21	9.3	15	6.7		9	4.0	8	3.6
Thailand	225	15	9	4.0	7	3.1		6	2.7	5	2.2

Table 5
Crisis Episodes According to Conventional Method

Indonesia	Korea	Malaysia	Philippines	Thailand
Dec. 1986	March 1985	Feb.1985	March 1985	Feb.1985
Aug. 1997	Jan. 1986	April 1986	Feb. 1986	Jan. 1995
July 1998	June 1991	May, Dec. 1997	March 1987	Feb., Sept. 1997
Feb. 2001	Aug. 1996		Jan., Sept. 1990	June 1998
	March, Nov. 1997		March 1995	
			July 1997	
			Nov. 2000	

Table 6
Crisis Episodes According to Extreme Value Theory (EVT)

Indonesia	Korea	Malaysia	Philippines	Thailand
Feb., Sept. 1985	March 1985	Feb., Nov. 1985	March, Oct. 1985	Feb., Oct. 1985
Nov. 1986	Jan. 1986	Aug. 1986	Sept. 1987	April 1990
June 1987	March, Dec. 1987	Feb., Sept. 1988	Oct. 1988	Jan. 1995
July 1988	Feb. 1989	Dec. 1992	July 1989	Feb., Sept. 1997
June 1989	April 1990	Dec. 1994	March, Nov. 1990	June 1998
April 1990	June 1991	Sept. 1995	May 1992	
April 1994	Aug. 1994	April, Nov. 1997	May 1993	
Sept. 1995	Aug. 1996	June 1998	Feb. 1995	
Aug. 1997	March, Nov. 1997	March 2001	July 1997	
April 1998			July 1998	
Feb., Nov. 2001			July 2000	
			April 2001	
			March 2003	

Table 7
Crisis Episodes Using Conventional and EVT Methods with Corresponding Chronologies of Political and Economic Events/Factors

Country	Conventional Method	Extreme Value Theory (EVT)	Chronology of economic and political events
Indonesia			
		Feb., Sept. 1985	Accelerated slump in world oil prices
	Dec. 1986	Nov. 1986	Worsening trade balance and increase in external debt due to drastic drop in world oil prices
		June 1987	Capital flight precipitates monetary crisis, and first *Gebrakan Sumarlin* results in interbank rates of up to 45 per cent; foreign investment regulations liberalised
		July 1988	Major financial sector reforms enacted—entry provisions liberalised, reserve requirements reduced, and a withholding tax on bank deposits imposed
		June 1989	Rumours that government would let the rupiah to float; limit set on the rupiah's depreciation
		April 1990	A further trade reform package; Bank Duta, one of the largest private banks, announces foreign exchange losses of $420 million
		April 1994	Another scandal rocks the financial system, the Bapindo scandal; slowdown in the growth of non-oil/gas exports; eruption of labour unrest
		Sept. 1995	Fallout from the Mexican peso crisis
	Aug. 1997	Aug. 1997	Contagion effect from the depreciation of the Thai baht hits

	July 1998	April 1998	Signs new IMF letter of intent; President Suharto steps down and Vice President Habibie takes over, amidst violent protests; plans to implement currency board system; IMF threatens to cut funding if currency board system implemented
	Feb. 2001	Feb., Nov. 2001	Dismissal of Abdurrahman Wahid and sworning in of Megawati Sukarnoputri as President; continuing political uncertainty and serious security concerns
Korea			
	March 1985	March 1985	Exiled opposition leader Kim Dae Jung returns home after a two-year exile in the U.S.; mounting labour disputes and strikes
	Jan. 1986	Jan. 1986	Widespread student protests over Chun Doo Hwan's government; reports that overseas construction and shipbuilding, former top industry foreign exchange earners are in chronic decline
		March, Dec. 1987	Roh Tae Woo elected president amidst widespread protests of election fraud; widespread labour strife worsens
		Feb. 1989	Signs of an impending economic crisis; Continued labour strikes; double-digit rise in wages; speculation that several foreign companies including foreign banks are planning to eliminate or drastically cut back their operations; Chun Doo Hwan, former military supporters, and relatives accused of a wide range of crimes, misrule, and corruption

		April 1990	The won allowed to float on a narrow band; the Gulf War crisis hits
	June 1991	June 1991	The Hanbo scandal hits; further violent student riots; growing current account deficit
		Aug. 1994	Mounting opposition demands on President Kim Young Sam to replace his entire cabinet or step down himself
	Aug. 1996	Aug. 1996	Soaring current account deficit due to the so-called 'semiconductor shock'; mounting foreign debt; firing of Deputy Prime Minister and Minister of Finance and Economy
	March, Nov. 1997	March, Nov. 1997	Watered-down labour reform bill sparked nationwide protests; fall-out from the devaluation of the Thai baht hits
Malaysia			
	Feb. 1985	Feb., Nov. 1985	Fall in most world commodity prices; bank runs on one of the largest bank, Public Bank; collapse of the Overseas Trust Bank; sacking of the entire top management of another large bank, Perwira Habib
	April 1986	Aug. 1986	Political uncertainty with the resignation of the deputy prime minister Datuk Musa Hitam; unprecedented fall in the prices of nearly all of the major export commodities continues
		Feb., Sept. 1988	Foreign exchange earnings from export commodities not being remitted back due to higher interest rates available outside Malaysia
		Dec. 1992	Public announcement by

			Prime Minister Mahathir that the ringgit is undervalued
		Dec. 1994	Central bank governor resigns after admission that bank Negara had racked up foreign exchange losses in its foreign exchange operations over two years; tax on capital inflows slapped
		Sept. 1995	Vulnerability in its huge current account deficit, the highest in Asia
	May, Dec. 1997	April, Nov. 1997	Central bank restrict loans to property and stocks to head off a crisis; fallout from the devaluation of the Thai baht
		June 1998	Deputy Prime Minister and Finance Minister Anwar Ibrahim, accused of sexual misconduct and sacked from government; pegs the ringgit at 3.8 to a U.S. dollar; demonstrations in Kuala Lumpur demanding the resignation of Prime Minister Mahathir
		March 2001	Highest court throws out former deputy prime minister Anwar Ibrahim's defamation suit against Prime Minister Mahathir; Finance minister Daim Zainuddin resigns, and Prime Minister Mahathir, in turn, assumes post of Finance Minister
Philippines			
	March 1985, Feb. 1986	March, Oct. 1985	Intensification of disenchantment with President Ferdinand Marcos and increased worries with the inevitable transfer of power
	March 1987	Sept. 1987	Worries about the political situation such as the first failed coup against the Corazon

		Aquino government and increased activity by communists insurgents
	Oct. 1988	Continued political weakness; huge debt overhang; effect of trade liberalisation measures
	July 1989	Another coup attempt against the Aquino administration; energy crisis; sharp rise in crude oil prices
Jan, Sept. 1990	March, Nov. 1990	Worsening trade deficit; huge debt service burden; Gulf War crisis
	May 1992	Severe energy crisis; large fiscal deficits
	May 1993	Powerful lobby of exporters, politicians, and economists asked the Ramos government for a sharp depreciation of the peso; large capital outflows due to increased kidnapping of ethnic Chinese businessmen and the government crackdown on tax evaders
March 1995	Feb. 1995	Fallout from the Mexican peso crisis hits; worsening current account deficit
July 1997	July 1997	Fallout from the devaluation of the Thai baht
	July 1998	Movie actor, Joseph Estrada becomes 13th Philippine President
Nov. 2000	July 2000	President Joseph Estrada impeached on charges of corruption
	April 2001	President Estrada ousted, charged with graft and economic plunder, arrested and jailed
	March 2003	Fighting escalates with the MILF; mutiny in

			Manila against the Macapagal-Arroyo administration
Thailand			
	Feb. 1985	Feb., Oct. 1985	Failed 15th coup attempt; declining world commodity prices; Gen. Arthit Kamlang-ek's emotional attack on TV against the government; collapse of several high-yielding pyramid fund schemes, e.g., Mae Chamoy
		April 1990	The Gulf crisis hits
	Jan. 1995	Jan. 1995	Fall out from the Mexican peso devaluation; ensuing capital flight of foreign investors from the Bangkok stock exchange
	Feb., Sept. 1997	Feb., Sept. 1997	Somprasong, first Thai company to miss payments on foreign debt; devaluation of the Thai baht set off the so-called East Asian financial crisis;
	June 1998	June 1998	Prime Minister Chuan Leekpai defeats parliamentary vote of no confidence

Note: **A 6-month exclusion window was used.**

Sources: Economist Intelligence Unit (EIU). Country Report published by The Economist (various years); Bulletin of Indonesian Economic Studies (various years); Hill, Hal. 2000. The Indonesian Economy. Cambridge University Press, U.K; http://www.encyclopedia.com; http://www.duke.edu/~charvey/Country_risk/couindex.htm; http://asiapacific.ca/data/chronology/index.cfm; Asia Yearbook published by the Far Eastern Economic Review (various years); http://news.bbc.co.uk/1/hi/world.default.stm

Figure 1 Histogram of Country EMP and Corresponding Normal Probability Density Function

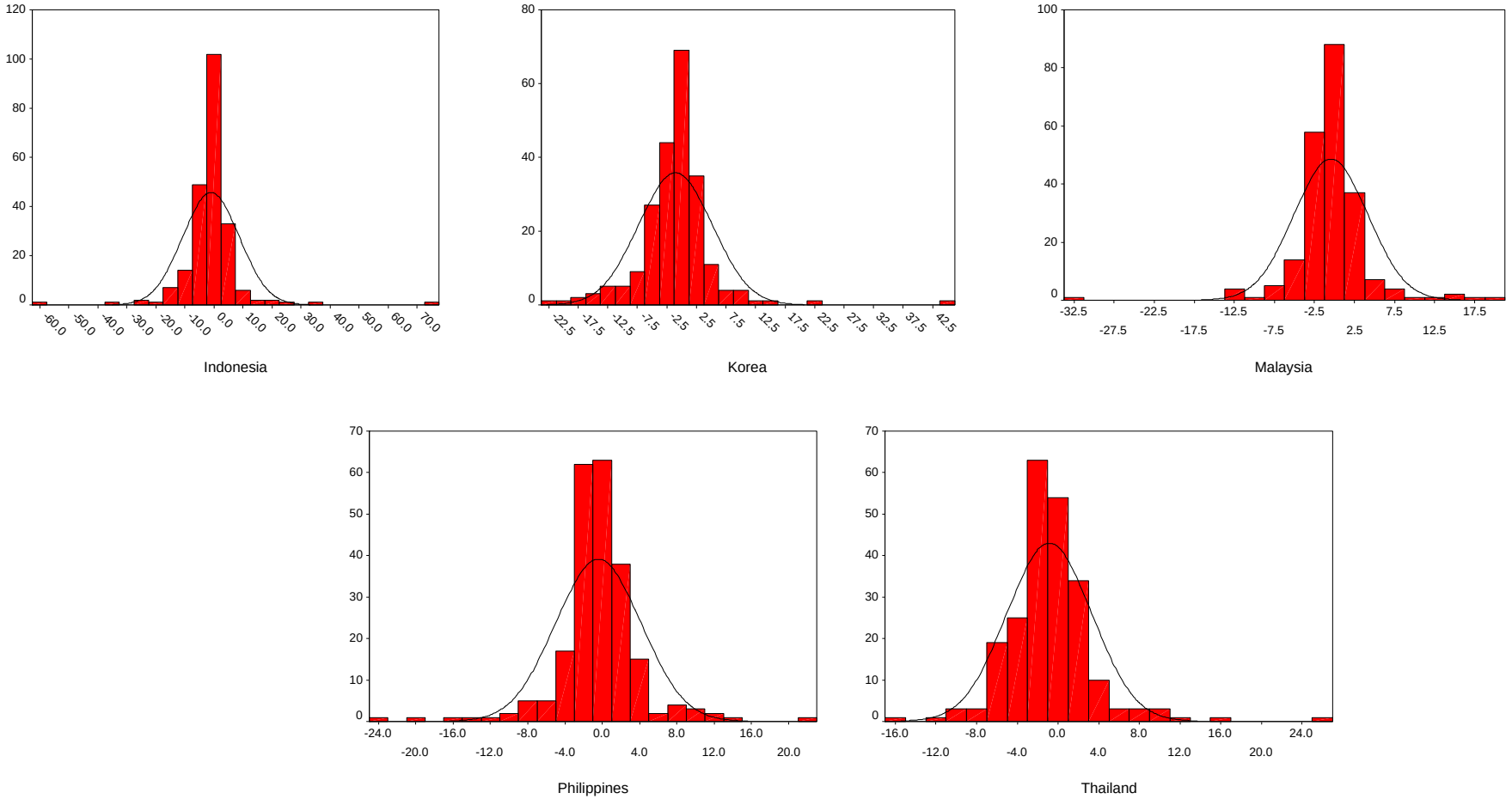
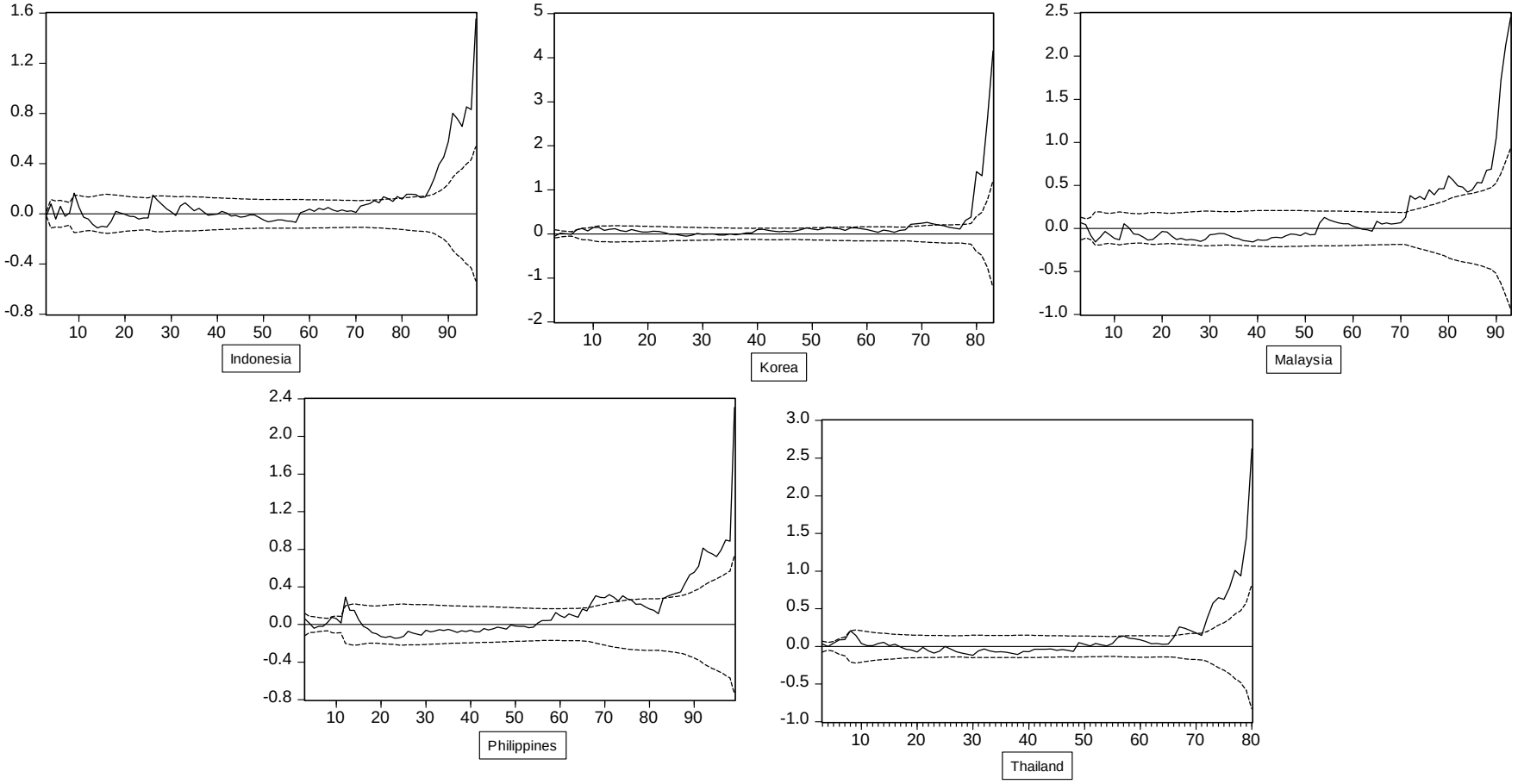


Figure 2 Recursive Residuals



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