Staff Paper No. 75

The US Sub-prime Crises and Extreme Exchange Market Pressures in Asia

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June 2010

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Abstract

The primary objective of this study is to examine the evidence of occurrences of extreme market pressure of currencies of a number of Asian economies against the US dollar during the period of 2000-2009. In particular, we are interested in investigating the severity of these pressures during the recent US sub-prime crisis of 2007-2009. Were the currencies of these economies subjected to indiscriminate selling pressures during the period of the crisis? Was the heightened severity of the selling pressures associated with a particular event during the sub-prime crisis, such as the collapse of the Lehman-Brothers? Our findings confirm the globally indiscriminate impacts of the sub-prime crisis on the countries examined and the greatest impact was felt and experienced by these economies around the time of the Lehman-Brothers' collapse during the last quarter of 2008. Our findings offer far-reaching implications in terms of the linkages between macroeconomic and financial stability.

Key Words: *Currency Crisis; Exchange Market Pressure; SEACEN; Extreme Value Theory*

JEL Classification: F31; F41

1. Introduction

Despite the uncertainties and the fear of another round of the financial crisis that occurred in 1997 in Asia, the emerging markets of Asia have emerged relatively well from the recent sub-prime global financial crisis. By the third and fourth quarter of 2009, the Asian economies in general, reported positive trade balances and net current account balances. Signs that rapid economic recovery is on course can also be traced from their GDP growth rates. Moreover, the return of a continual inflow of portfolio capital starting in late 2009 confirmed the renewal of market confidence in the near term outlook of these Asian economies. Unprecedented fiscal and monetary policy stimulus packages in 2008 and early 2009 have contributed significantly to their rapid recoveries (Tables 1 and 2). The ability of the policy makers to maintain financial stability and prevent a severe credit crunch from taking place, has also given a major boost to their overall economic performances (Siregar and Lim (2010)).

Among many aspects of a financial crisis, the sudden rise in exchange rate volatility has always been a major source of concern for policy makers. For instance, during the 1997 Asian financial crisis, the large swings that involved severe depreciations of the local currencies exacerbated the fundamental weaknesses of the affected economies. The weak currencies forced many financial institutions and their clients into debilitating insolvencies (Lane (1999)). In tandem with the credit crunch, particularly sharp falls in trade credits, volatile local currencies were responsible for the collapse of the trade and other sectors of the economies in several major East and Southeast Asian economies such as Korea, Indonesia and Thailand during the 1997 crisis.

The sub-prime crisis is no exception. The fear of another round of meltdowns of local currencies, which would then be followed by episodes of volatile swings in the rates, was particularly prevalent following the collapse of Lehman Brothers in last quarter of 2008. The past and recent economic and financial crises have underscored the role of exchange rate volatility as a key transmission channel of a financial sector meltdown to a wide spread slowdown in the real sector. The exchange rate volatility has also undermined the ability of monetary authorities and central banks to manage price stability. Evidences based on their

monetary policy reaction functions demonstrate that inflation-targeting economies around the globe, including those in Asia, has in fact, paid close attention to the volatilities of the local currencies before making necessary adjustments in their key policy rates (Aizenman, et.al. (2008) and Siregar and Goo (2010)).

To manage the exchange rate volatility, central banks have often resorted to multiple policy instruments. Buying and selling foreign exchange reserves and policy rate adjustments are arguably two of the most frequently adopted instruments. Any excess demand for foreign exchange, responsible for the volatility, can be fulfilled through non-mutually exclusive conduits. If the market or currency pressure is successful, there will be a sharp depreciation of the domestic currency. However, at other times, the market pressure can be repelled or warded off through raising interest rates and/or running down on the foreign exchange reserves. Combining the information on exchange rate fluctuation, interest rate adjustment and reserve movement should convey a more informative and reasonable measure of the extent of pressures on a currency - referred to as the index of exchange market pressure. This concept of exchange market pressure and its application have been elaborated in numerous studies, especially around the pre- and post-1997 Asian financial crisis (Eichengreen, Rose, and Wyplosz (ERW) (1995, 1996), Pozo and Dorantes (2003), and ADB (2005)).

The primary objective of this study is to examine evidences of occurrences of extreme market pressure against the local currencies of a number of major Asian economies of the SEACEN group against the US dollar during the period of 2000-2009. In particular, we are interested to investigate the severity of these pressures during the recent sub-prime crisis of 2007-2009. Have the currencies of these economies been indiscriminately under selling pressure during the period of the recent global financial crisis? Has the height of the selling pressures been associated with a particular event during the recent sub-prime crisis, such as the collapse of Lehman Brothers? Lastly, are there lessons to be learned in light of our findings with regard to the supposed linkages between macroeconomic stability and financial stability, otherwise known as macro-financial links?

The rest of the paper is organised as follows. Section 2 briefly reviews the basic construction of the EMP index as proposed by Eichengreen et al (1995, 1996). The extreme value theory and the Huisman et al (2001) estimator will be discussed in Section 3. Section 4 presents the constructed EMP index for the individual countries and some basic statistical properties of the EMP indices. Section 5 discusses the empirical results of the implementation of the extreme value approach. Section 6 reports the episodes of extreme pressures against the local currencies of the Asian economies under study. Section 7 examines the close association of the Lehman-Brothers' collapse to the identified episodes of extreme market pressures during the recent sub-prime crisis. Section 8 concludes the paper.

2. Eichengreen, Rose and Wyplosz (1995, 1996)

In this paper, we employ the exchange market pressure index adopted by Eichengreen, Rose and Wyplosz (ERW) (1995, 1996) by taking a weighted average of the changes in exchange rates, international reserves and interest rates. This allows us to completely capture successful as well as unsuccessful currency pressures. More recent constructions of indices such as by Kaminsky et al (1998), Kaminsky and Reinhart (1999), while following the ERW (1995, 1996) very closely, however, excludes the interest rate differentials in their original construction of the indices. The exchange market pressure index of Eichengreen, Rose, and Wyplosz (ERW) (1995, 1996) uses all three variables of the EMP index relative to a reference country. The US is used as our reference country. The EMP index using this method is expressed as:

$$EMP_{i,t} = \frac{1}{\sigma_e}\frac{\Delta e_{i,t}}{e_{i,t}} - \frac{1}{\sigma_{res}}\left(\frac{\Delta res_{i,t}}{res_{i,t}} - \frac{\Delta res_{US,t}}{res_{US,t}}\right) + \frac{1}{\sigma_i}(i_{i,t} - i_{US,t}) \qquad (1)$$

where $\mathrm{EMP}_{i,t}$ is the exchange rate market pressure index for country *i* in period *t*; $\mathrm{e}_{i,t}$ the units of country *i*'s currency per U.S. dollar in period *t*; σ_e the standard deviation of the relative change in the exchange rate ($\frac{\Delta \mathrm{e}_{i,t}}{\mathrm{e}_{i,t}}$); $\mathrm{res}_{i,t}$ the gross foreign reserves of country *i* in period *t*; and σ_{res} is the standard deviation of the difference between the relative changes in foreign reserves in country *i* and the reference country (US) $\left(\frac{\Delta \mathrm{res}_{i,t}}{\mathrm{res}_{i,t}} - \frac{\Delta \mathrm{res}_{US,t}}{\mathrm{res}_{US,t}}\right)$; $\mathrm{i}_{i,t}$ the nominal interest rate for

country i in period t; $i_{US,t}$ the nominal interest rate for the reference country (U.S.) in period t; σ_i the standard deviation of the nominal interest rate differential $(i_{i,t} - i_{US,t})$.

As earlier emphasised, the EMP index increases with a depreciation of the domestic currency, a loss of international reserves and a rise in the domestic interest rate. A rise in the index reflects stronger selling pressure on the domestic currency. Similarly, when the index becomes negative, it signals rising buying pressure on the local economy. In addition, the breakdown of the EMP components may also reveal the policy preferences of the local central bank/monetary authority. Frequent adjustments in the interest rate or/and buying/selling of the foreign exchange reserves could be argued as evidences of 'against (or with) the wind' exchange rate policy of the local central bank.

3. Extreme Value Theory

The conventional approach employed in the literature is that an extreme market pressure is identified when the EMP index exceeds some upper bound:

$$\text{Crisis} = \begin{cases} 1 & \text{if } EMP_{i,t} > \beta\sigma_{EMP} + \mu_{EMP} \\ 0 & \text{otherwise} \end{cases}$$

where: σ_{EMP} equals the sample standard deviation of EMP index and μ_{EMP} is the sample mean of the EMP index. As noted, an extreme market pressure is identified if the EMP index crosses a threshold, defined in terms of an arbitrary multiple of standard deviations above the mean. The problem with this threshold is that it conveniently assumes that the EMP index is characterised by a well-behaved standard normal probability density function. However, the normality assumption is at odds with the substantial literature that characterises the statistical probability distribution function of financial asset returns, which describe such series as being fat-tailed. As an alternative, Pozo and Dorantes (2003), Lestano and Jacobs (2007) and Pontines (2010) suggest the use of the extreme value theory in exploiting information in the tails of the distribution by locating the threshold that separates the normal values of the EMP index (corresponds to normal periods) from that of extreme values of the index (corresponds to extreme pressure periods) without the need to set an arbitrary threshold value for the EMP index.

The estimation of the parameter (α), the tail index of the distribution of the EMP index, is crucial as it determines the degree of tail fatness the distribution exhibits. The tail index measures the speed at which the distribution's tail approaches zero—the higher (α), the faster the speed and the less fat-tailed the distribution. In addition, the tail index (α) has the attractive feature that it is equal to the maximum number of existing finite moments in the distribution. Unfortunately, the estimation of the tail index is not a simple task, although there are a few available estimators in the literature. The most common of these is the Hill (1975) estimator, which is given as:

$$\gamma(\mathrm{k}) = \frac{1}{\mathrm{k}} \sum_{\mathrm{j}=1}^{\mathrm{k}} \ln(\mathrm{x}(\mathrm{n}-\mathrm{j}+1) - \ln(\mathrm{x}(\mathrm{n}-\mathrm{k}) \qquad (2)$$

We assume that there is a sample of n positive independent observations drawn from some unknown fat-tailed distribution. Letting the parameter (γ) be the inverse of the tail index (α), and $x(i)$ be the ith-order statistic such that $x(i-1) \leq x(i)$ for $i = 2,\ldots, n$. k is the pre-specified number of tail observations. The choice of k is crucial to obtain an unbiased estimate of the tail index. The intuition behind this critical choice of k is that there is an uncomfortable variance and bias trade-off. If we employ a k that is too low, we are not using all of the tail observations, and would thus obtain an estimate of the tail index with a large variance. In contrast, if we employ a k that is large, we bias the estimate of the tail index by including observations in the sample from the centre of the distribution.

In an important paper, Huisman et al. (2001) introduces an estimator that overcomes the need to select a 'single' optimal k in small samples, by accounting for the bias in the Hill estimator. They showed that for values of k smaller than some threshold κ, the bias of the Hill estimate of γ increases almost linearly in k and can be approximated by:

$$\gamma(\mathrm{k}) = \beta_0 + \beta_1 \mathrm{k} + \varepsilon(\mathrm{k}), \qquad k = 1,2, \ldots, \kappa \qquad (3)$$

The above equation has to be estimated by weighted least squares (WLS) to deal with the heteroscedasticity in the error term $\varepsilon(k)$. The weight has ($\sqrt{1}, \sqrt{2}, \ldots, \sqrt{k}$) as diagonal elements

and zeros elsewhere. The bias corrected estimate of γ is the intercept β_0 and the estimate of the optimal tail index α would be given by $\hat{\alpha} = 1/\beta_0$.

4. Basic Trends and Statistical Properties of the EMP Indices

The main sources of the data are the International Financial Statistics of the International Monetary Fund- and the CEIC database. We use monthly data for the period from January 1999 to December 2009, covering twelve Asian countries, viz., Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam), Hong Kong, Korea, Sri Lanka, Taiwan and Australia. With the exception of Australia, the rest of the economies included in our study are the SEACEN member countries.[3] Australia, however, is one of the long standing partner countries of the SEACEN group. In the construction of the EMP index using the ERW method, the changes in reserves as well as the domestic policy rate, when available, are measured relative to the changes in reserves and the federal funds rate in the US, respectively. The key policy rates are reported in Table (3).

Figures (1a-1c) illustrate the diverging volatility and severity of extreme market pressure in the individual SEACEN member countries. A few observations are worth highlighting. Prior to 2008, the Malaysian ringgit, the Thai baht, the Korean won, the New Taiwan dollar and the Singapore dollar had actually been under buying pressure for a couple of years or more. In contrast, the EMPs for Hong Kong, Sri Lanka, Australia and Vietnam have, generally been in positive levels prior to 2008, suggesting that these countries' currencies had experienced selling pressures. Nonetheless, it is clear that the year 2008 marked the period of heavy selling pressures for all the currencies of the countries in our study. Furthermore, the EMP series on average, peaked around the final quarter of 2008 ---about the period of the Lehman Brothers' collapse.

[3] The South East Asian Central Banks (SEACEN) Research and Training Centre was established by a group of central banks and monetary authorities in 1982. Presently, the group has 16 members, namely Ministry of Finance, Brunei Darussalam, National Bank of Cambodia, Reserve Bank of Fiji, Bank Indonesia, The Bank of Korea, Bank Negara Malaysia, The Bank of Mongolia, Central Bank of Myanmar, Nepal Rastra Bank, Bank of Papua New Guinea, Bangko Sentral ng Pilipinas, Monetary Authority of Singapore, Central Bank of Sri Lanka, Central Bank of the Republic of China (Taiwan), Bank of Thailand and State Bank of Vietnam.

With the exception of Australia and Vietnam, the selling pressures have subsided markedly in 2009.

Examining the components of the EMP index for each country during 2008, it is apparent that the central banks of some countries, such as Indonesia, Korea and Sri Lanka, had to sell-off some of their foreign exchange reserves. Among these three economies, Korea had suffered the most substantial loss of its reserve of around US$42 billion from August 2008 to December 2008, or roughly about 21 percent of its reserves at the end of 2008. In addition, it is also apparent, with a possible exception of Hong Kong, the central banks/monetary authorities of these countries have, on average, kept their policy rates at increasingly higher spreads against that of the US federal funds rate during the final quarter of 2008 (Figures 2a-2c). Despite these efforts, the massive selling pressures during that final quarter of 2008, following the demise of Lehman Brothers, had eventually led to severe depreciations of these currencies. All of these Asian currencies had, on average, depreciated during that gloomy final quarter of 2008. The Indonesian rupiah and the Korean won depreciated the most at an average of 10 percent per month from September to November 2008.

For the most part of 2009, the levels of EMP have declined across the countries, albeit remaining at a positive range, suggesting the selling pressures in the market had subsided or eased. From close observation of the components of the EMP index, it is apparent that most of the currencies included in this study have gained back some of the losses in their nominal values against the US dollar incurred in 2008, by second half of 2009. Similarly, the foreign exchange reserve position of these economies gradually increased, a reflection of the strengthening balance of payment position. However, the interest rate differentials remained positive for the most part, although they had declined sharply from the peaks of end 2008. With the exception of Australia, the central banks of these economies maintained soft monetary policy stances amidst concerns of fragile economic recoveries.

Table 4 presents some descriptive statistics for the EMP indices across the eleven SEACEN countries. The means and standard deviations diverge considerably across countries, and indicate that Sri Lanka and Vietnam suffered the largest market turbulence, whereas Hong

Kong suffered the smallest. Most of the series are skewed to the right and exhibit excess kurtosis which reflects fat-tailedness.[4] These observations are most evident particularly in Taiwan and Vietnam. These are further substantiated by the histogram of the EMP series for each of the eleven countries overlaid by its corresponding normal probability density functions in Figures 3a-3c. In all cases, it is obvious that the EMP indices depart significantly from the normal distribution – the mass of observation in the tails and the observed regularity of a great number of peak observations at the centre of the distribution. Thus, this brings into question the conventional approach of using the mean and standard deviation in forming thresholds to identify extreme market pressures. To deal with the non-normality of the series, the extreme value approach will be considered next.

The Extreme Value Theory, in particular the Hill estimator, requires the use of stationary and uncorrelated data. Table 5 presents the combined results from the commonly used ADF unit-root test as well as from the alternative Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) unit-root test. The ADF procedure tests the null that the index of EMP has a unit root against the alternative of stationarity, whereas the KPSS procedure tests the null of stationarity against the alternative of unit root. In general, the EMP indices are $I(0)$ variables at the 10 percent significance level or stronger according to the ADF test. In addition, confirmatory results from the KPSS unit-root test support the null hypothesis that, in general, the EMP indices are stationary.

5. Extreme Values

In order to capture the tail mass or extreme values, the so-called tail index (α) has to be estimated, and as earlier mentioned, we use the Hill estimator for this purpose. The Hill estimator proceeds by ordering the values of the EMP index from lowest to highest denoted by $x(i)$. Although asymptotically unbiased, the Hill estimator is biased in relatively small samples. In accordance with the suggestion of Huisman et al. (2001), to deal with the estimation of the tail

[4] Excess with respect to the normal distribution which has a kurtosis equal to 3.

index with a small sample size,[5] we use Equation (3) in estimating a weighted least squares (WLS) regression for the EMP index for each individual country, after computing the γ(inverse of α) for a range of values of *k*. The essence is to identify the 'extreme right-tail' observations from an ordered distribution of the EMP index as the number and incidence of extreme market pressure episodes that individual countries experienced are determined in the right-tail distribution. Accordingly, Diebold, Schuermann and Stroughhair (2000) suggested, (also similarly employed by Pozo and Dorantes (2003) and Lestano and Jacobs (2007)), that recursive residuals be derived from the weighted least squares regression to diagnose structural changes, which will guide us in the selection of the optimal *k*.

Figures 4a-4c show the recursive residuals for individual countries and these are plotted against the bandwidth of plus and minus two standard errors. When we consider the empirical distribution of the EMP indices, the apparent break around the right-hand side of the plots of the recursive residuals appropriately correspond to the optimal choice of *k*, or equivalently, the number of 'extreme right-tail' observations have now been identified. For example, the recursive residual in the case of Indonesia crosses the confidence band at the 11thlargest observation, such that the optimal *k* in this case is 11.

Table 6 lists the optimal values of *k* as well as the values of ($\hat{\alpha}$). The extreme market pressure episodes are then identified from these optimal values of *k*. The next section will discuss these results in detail. The estimates of the tail index (α) range from 1.70 to 9.79 for the case of Singapore and Hong Kong, respectively.[6] The foregoing estimates of the tail index suggests that the statistical distribution that can adequately capture the observed distribution of the EMP values is the Student's *t*-distribution as nine of the twelve countries reported tail index estimates that are above 2.

[5] It should be noted that we are dealing with a small sample as the entire sample period only covers at most 126 months.

[6] As a point of comparison, Huisman et al. (2002) obtained tail index estimates that are between 3 and 8 for different exchange rates. Likewise, Pontines (2010) obtained tail index estimates of OECD house prices that are between 3 and 9.

6. Episodes and Incidence of Extreme Market Pressures

Based on the optimal values of k reported in Table 6, a six-month exclusion window is then adopted to derive the number of extreme market pressure episodes.[7] This window is adopted to avoid counting the same market pressure more than once especially since a market pressure often lasts for over a month and more market pressure occurs in successive months. Table 7 reports the extreme market pressure episodes and the rate of incidence of extreme market pressures experienced in all twelve SEACEN member countries. The incidence rate is the percentage of the ratio of the number of extreme market pressure episodes over the total number of EMP observations.

Table 8 lists the actual chronological dates of extreme market pressure episodes identified by the extreme value approach. The Table shows that the extreme value approach is able to pick-up the adverse impact of the global financial crisis of 2008-09 in almost all countries with the exception of Hong Kong. This result is consistent with the widely acknowledged possibility of contagion of crisis across countries. In addition to the global financial crisis, the extreme value approach is able to capture the effect of the information technology (IT) sector slump in the US in early 2000 to mid-2001, the collapse in 2001 of Argentina's convertibility plan as well as some of the domestic political uncertainties in Indonesia in the aftermath of the 1997-98 Asian Crisis until mid-2002 and the late-2000 impeachment of former President Joseph Estrada in the Philippines.

7. The Extreme Pressures of the Lehman-Brothers and Macro-Financial Links

Our findings confirm the indiscriminate impacts of the recent sub-prime crisis on our Asian currencies (Tables 7 and 8). With the exception of Hong Kong, the currencies of these Asian economies began to suffer extreme selling pressures only in second quarter of 2008. The Hong Kong dollar, on the other hand, was already under heavy selling pressure since the early stage of the sub-prime crisis in late 2006 and early 2007. A number of banks and financial institutions in the US and Europe had reported massive losses starting 2006.

[7] Note that ERW (1996) employed a six-month exclusion window.

Nonetheless, it is clear from our test results that the significant shock to our Asian currencies was only fully felt around the period of the Lehman Brothers' collapse in September 2008. The stock market indices of the major Asian economies included in the study dropped on average, by about 22 percent between September and October 2008. Undoubtedly, the stock market of Vietnam endured the most volatile and drastic collapse among the SEG economies. The fast growing economy, privatisation of state-owned companies, and liberalisation measures that allowed foreigners to hold up to 49% of public companies, catapulted the stock exchange index of Vietnam to more than double between the last quarter of 2006 and first quarter of 2007. However, by the end of first quarter of 2009, the index had plummeted back to the level of January 2006.

Tightening of the interbank markets across Asia was reported, and the fear of bank-runs forced central banks around the region to either expand the size of their deposit guarantees or to adopt a full blanket guarantee, such as in the case of Australia, Hong Kong, Malaysia and Singapore. In addition, various regulations on capital flows have been implemented. In Indonesia for instance, Bank Indonesia, issued a regulation whereby any transfer of cash to banks outside of the country amounting to US$100,000 or more, requires to be reported to the central bank on the motive and reason for the transfer.

The crisis which highlighted the close linkage and deep-rooted integration of the local banking sector to that of the global financial system was another wake-up call for regulators and supervisors of financial institutions around the world and more specifically in Asia, for the urgent need to strengthen their capacities. The adverse shock in the global financial system was transmitted to the local economy by several channels. We have seen the deterioration of the global financial market had adversely affected the balance sheet of local financial institutions in Asia, and raised the perceived risk premium. This condition triggered credit rationing and resulted in further deterioration in bank lending, investment and economic growth in some parts of Asia, especially from the last quarter of 2008 to the first quarter of 2009. The strong links from balance sheet deterioration to the slowdown in the economic growth have been often underlined as one portion of the macro-financial linkages (Bayoumi and Melander (2008)).

A more obvious presence of macro-financial linkages can be traced from the sharp fall in the exports of many economies globally, including Asia, during the peak of the sub-prime crisis. The global financial slowdown weakened the demand of developed economies, in particular, for export products of Asian economies, at the rate that was worse than during the 1997 financial crisis (Table 9). The weak purchasing power was very rapidly translated into sharp falls in demand for exports of major Asian economies (Siregar (2010)). In addition to weak purchasing power, the increase in exchange rate volatilities following massive losses experienced by major financial institutions, especially during the height of economic and financial crises, had also been blamed for weak demand for export products (Rahmatsyah, et.al. (2002), Siregar and Rajan (2004) and Ronci (2005)).

8. Brief Concluding Remarks

Exchange rate volatility has long been touted as one of the key features of economic and financial crisis around the globe. In their recent work, Reinhart and Rogoff (2008) demonstrated that the recent US sub-prime financial crisis is hardly unique, and like past economic and financial crisis of the past eight centuries, the recent sub-prime crisis was accompanied by exchange rate crashes. During the 1997 financial meltdown in East Asia, the volatile local exchange rates were partly blamed for the severity of the crisis, particularly on the tradable sectors. Therefore, studies have been undertaken to capture and measure the presence and the extensiveness of pressures, especially selling pressures, on the foreign exchange markets.

Our study constructs the exchange market pressure index and investigates the presence of extreme market pressures for twelve SEACEN economies during the past decade. Instead of the frequently applied mean and standard deviation criteria, the application of the extreme value theory has been adopted in this study to estimate the thresholds of the extreme selling points. The results are conclusive across the economies under study. Despite of the strength of the local financial institutions in the years leading up to the crisis, the currencies of these economies have been hit hard nonetheless. In addition, we find that the major blow came specifically around the period of the Lehman Brothers' collapse. This chain of events underscores the global scale of the recent sub-prime crisis and the globalised nature of the financial markets around the world,

including those in Asia. This exposure to external shocks has not only complicated the recovery efforts, but will likely pose challenges for the conduct of macroeconomic policies in these Asian economies in the near future.

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Table 1: Fiscal Stimulus Packages in Selected SEACEN Countries

Korea		
Fiscal expenditure and tax cuts under "2009 Budget and Public Fund Operations Plan to Overcome Economic Difficulties" (KRW 35.6 trillion, USD 26 billion, 4% of GDP)	- Creation of more jobs by providing better job training through expansion of the internship system, vitalising venture enterprises, increased job positions for the underprivileged - Increase welfare support to stabilise livelihoods of low-income classes and provide aggressive support in reducing childcare costs - Increase social overhead capital investment with focus on investments in construction projects including leading projects for advancement of the metropolitan economy and provincial traffic network expansion - Support stabilisation of SMEs and the financial markets by increasing SME guarantees - Support regional finances to offset reduced real estate tax	Dec 13, 2008
Fiscal expenditure under "Green New Deal Job Creation Plan" - measure expected to generate 950,000 jobs over 4 years (consolidation of previous plans) (KRW 50 trillion, USD 37 billion)	- Energy conservation, recycling and clean energy development to build an energy-saving economy - Green transportation networks and clean water supplies to upgrade the quality of life and environment - Carbon reduction and stable supply of water resources to protect the earth and future generations - Building of industrial and information infrastructure and technology development to use energy efficient in the future	Jan 2009
Fiscal expenditure (supplementary budget bill) KRW 29 trillion	-Maintaining job security and revitalizing provincial economies & supporting industries with future growth potential (17 trillion Won) - Remaining amounts to plug tax revenue shortfalls	Mar 2009
Indonesia		
Fiscal expenditure and tax cuts (IDR 73.3 trillion USD 6.7 billion 1.4% of GDP)	- General income tax cut (43 trillion) - Government borne-tax and import duties (13.3 trillion) - Infrastructure spending (9.7 trillion) - Energy subsidy and financing for the support of small business activities (7.3 trillion)	Jan 2009
Second stimulus spending (IDR 61.2 trillion USD 6 billion) (2010)	- Poverty reduction - Infrastructure spending - Education and health development	Aug 2009

Fiscal expenditure (MYR 7 billion, USD 1.9 billion 1% of GDP)	- Investment funds to promote strategic industries and high-speed broadband (1.9 billion) - Small-scale infrastructure projects (1.6 billion) - Education and skills training programmes (1 billion) - Public transport and military facilities (1 billion)	Nov 2008
Fiscal expenditure (MYR 60 billion, USD 16.2 billion 9% of GDP)	- Fiscal injection (15 billion) - Equity investment (10 billion) - Tax incentives (3 billion) - Guarantee funds (25 billion) - Private finance initiatives and off-budget projects (7 billion)	Mar 2009
Malaysia		
Fiscal expenditure (MYR 7 billion, USD 1.9 billion 1% of GDP)	- Investment funds to promote strategic industries and high-speed broadband (1.9 billion) - Small-scale infrastructure projects (1.6 billion) - Education and skills training programmes (1 billion) - Public transport and military facilities (1 billion)	Nov 2008
Fiscal expenditure (MYR 60 billion, USD 16.2 billion 9% of GDP)	- Fiscal injection (15 billion) - Equity investment (10 billion) - Tax incentives (3 billion) - Guarantee funds (25 billion) - Private finance initiatives and off-budget projects (7 billion)	Mar 2009
Philippines		
Fiscal expenditure and tax cuts (PHP 330 billion, USD 6.5 billion, 4.6% of GDP)	- Job creation programme expected to provide 824,000 temporary jobs at government departments by July 2009 - Tax reduction in corporate income tax and waiver of personal income tax for minimum wage earners - Infrastructure projects - Waiver of penalties on loans from social security institutions	Jan 2009
Singapore		
Fiscal expenditure and tax cuts (SGD 20.5 billion, USD 13.7 billion, 8% of GDP)	- "Job Credit Programme"; cash transfers for employers to cover part of their wage bills and avoid massive lay-offs - "Special Risk Sharing Initiative"; government guarantees working capital loans to individual firms to stimulate bank lending - Tax cuts; corporate tax rate from 18% to 17% and personal income tax rebates of 20% of taxes due.	Jan 22, 2009

Sri Lanka		
Package to support export sectors (LKR 16 billion USD 141 million 0.3 % of GDP	-Incentives for the agricultural and industrial export sectors (tea, textiles, tourism, leather, rubber) -Reduction in fuel prices -Waiver on 15% electricity surcharge	Dec 30, 2008
Thailand		
Supplementary budget (THB 116.7 billion, USD 3.3 billion, 1.3% of GDP)	- One time living cost allowance of THB 2000 for those earning < THB 15,000 per month - Extension of 5 public service subsidies programmes for 6 months - Support given to unemployed workers - Free education for students - "Sufficient Economy Fund for Improvement in Quality of Life" fund for rural villages - Old-age support payment of THB 500 per month - Infrastructure projects - Tax measures to boost real estate sector, SMEs and the tourism industry	Jan 2009
Thai Khem Khang (or Thai Strength) (THB 1.43 trillion, USD 42 billion) (2010-2012)	-Infrastructure investment in mass transit; transportation and communication; energy; education; healthcare; housing; water resources	Jun 2009
Vietnam		
Fiscal expenditure (VND 17 trillion, USD 1 billion, 1.1% of GDP)	- 4% interest subsidy on loans to SMEs - Reduction in corporate income tax for SMEs - Exemption on personal income tax from Jan to May 2009	Dec 2008
Fiscal expenditure (VND 300 trillion, USD 17.6 billion, 21% of GDP)	- Infrastructure projects - Measures to support manufacturing and export sectors - Projects designed to support social security and welfare	Mar 2009

Source: ESCAP (2009)

Table 2: A Summary of Selected Central Banks' Main Policy Responses to the Crisis

	Indonesia	Korea	Malaysia	Philippines	Singapore	Sri Lanka	Taiwan	Thailand	Vietnam
DOMESTIC FINANCIAL POLICIES									
Deposit Guarantee	●	●	●	●	●	●[1/]	●	●	●
Government Stake in Banks		●							
Regulatory Forbearance and Surveillance	●	●	●	●	●	●	●	●	●
MONETARY POLICY									
Policy Rate	●	●	●	●		●	●	●	●
Reserve Ratio	●		●	●		●	●		●
Liquidity Intervention	●	●	●	●	●	●	●	●	●
OTHERS									
Exchange Rate Management	●	●		●	●	●	●		●
International Swap Agreements [3/]	●	●	●	●	●			●	●

Notes:

1/ New scheme to be introduced in 2010.

2 /Increase in policy rate due to inflationary concerns.

3/ ASEAN+3 (Japan, China and Korea) nations have officially signed an agreement to set up a US$120 billion currency swap fund under the Chiang Mai Initiative Multilateralization (CMIM). CMIM is to be launched on 24 March 2010 (Bank of Japan website).

Sources: Siregar and Lim (2010)

Table 3: Key Interest Rates

Country	Interest Rate
1. Australia	Cash Rate
2. Hong Kong	Window Discount Base Rate
3. Indonesia	BI-rate*
4. Korea	Base Rate
5. Malaysia	Overnight Policy Rate
6. Philippines	Overnight Reverse Repo Rate
7. Singapore	3-month Interbank Rate
8. Sri Lanka	Central Bank Reverse Repo Rate
9. Taiwan	Discount Rate
10. Thailand	Repurchase Rate
11. Vietnam	Prime Lending Rate
12. US	Federal Funds Rate

*/ BI-rate is only available starting M 2005. Prior to that the SBI-1 month rate was the primary policy rate of Bank Indonesia.

Source: CEIC database

Table 4: Some Basic Descriptive Statistics of the EMP Index

	Mean	St. Deviation	Skewness	Kurtosis
Australia	1.173	1.807	0.596	4.542
Hong Kong	3.502	1.586	-0.008	6.543
Indonesia	1.680	1.691	1.394	8.062
Korea	0.539	1.939	2.080	10.982
Malaysia	-0.114	1.831	2.079	13.192
Philippines	2.729	1.967	1.076	7.866
Singapore	-1.174	1.825	2.293	16.452
Sri Lanka	3.322	1.976	1.232	7.097
Taiwan	-0.466	1.747	2.360	16.730
Thailand	-0.427	1.668	2.253	16.712
Vietnam	2.794	2.059	2.232	11.001

Source: Authors' own calculation.

Table 5: Unit Root Tests

EMP index	ADF test without trend	ADF test with trend	KPSS test without trend	KPSS test with trend
Australia	-7.26***	-7.92***	0.33	0.08
Hong Kong	-8.16***	-9.04***	0.36*	0.14*
Indonesia	-9.10***	-9.41***	0.33	0.11
Korea	-3.15**	-3.29*	0.34	0.14*
Malaysia	-2.91**	-3.23*	0.33	0.14*
Philippines	-4.28***	-4.61***	0.24	0.09
Singapore	-3.51***	-3.87**	0.26	0.09
Sri Lanka	-3.80***	-3.83**	0.13	0.11
Taiwan	-4.51***	-6.74***	0.15	0.10
Thailand	-7.28***	-7.66***	0.24	0.09
Vietnam	-5.08***	-5.19***	0.16	0.12*

* indicate rejection of the null hypothesis at 10 percent.
** indicate rejection of the null hypothesis at 5 percent.
*** indicate rejection of the null hypothesis at 1 percent.

Source: Authors' own calculation.

Table 6: Corresponding Parameter Estimates

EMP index	k	$\hat{\gamma}$	$\hat{\alpha}$
Australia	4	0.30	3.35
Hong Kong	16	0.10	9.79
Indonesia	11	0.30	3.28
Korea	9	0.42	2.37
Malaysia	6	0.50	2.00
Philippines	18	0.17	5.97
Singapore	7	0.59	1.70
Sri Lanka	12	0.22	4.45
Taiwan	8	0.48	2.07
Thailand	6	0.57	1.75
Vietnam	14	0.27	3.76

Source: Authors' own calculation.

Table 7: Episodes and Incidences of Extreme Market Pressures

Country	Number of Episodes*	Rate of Incidences**
Australia	1	0.75
Hong Kong	7	5.30
Indonesia	5	3.79
Korea	3	2.33
Malaysia	2	1.52
Philippines	7	5.30
Singapore	2	1.52
Sri Lanka	4	3.28
Taiwan	2	1.52
Thailand	2	1.71
Vietnam	5	4.72

*/ Market pressure episodes are based on 6-month exclusion window. That is an episode of pressure is reported when we have 6-consecutive months of extreme pressures. **/Incidence is calculated by dividing the number of episodes with the number of observation (in %).

Source: Author's own calculation

Table 8: Dates of Crises*

Country	Dates
Australia	*August 2008*
Hong Kong	*January 2000, June 2002, October 2003, January 2005, June 2006, January 2007, November 2007*
Indonesia	*February 1999, September 1999, September 2000, April 2001, October 2008*
Korea	*March 2003, March 2008, October 2008*
Malaysia	*May 2008 and January 2009*
Philippines	*May 2000, December 2000, July 2001, June 2002, February 2003, September 2003, and October 2008.*
Singapore	*September 2001 and August 2008*
Sri Lanka	*June 2000, January 2001, March 2002 and November 2008*
Taiwan	*May 2001 and August 2008*
Thailand	*September 2002 and May 2008*
Vietnam	*June 2001, June 2002, May 2008, December 2008 and July 2009*

*/ These dates are starting dates of the 6 month exclusion window. For instance, August 2008 suggests that the next 6 month starting August 2008, the local currency is facing an extreme selling pressure.

Source: Authors' own calculation

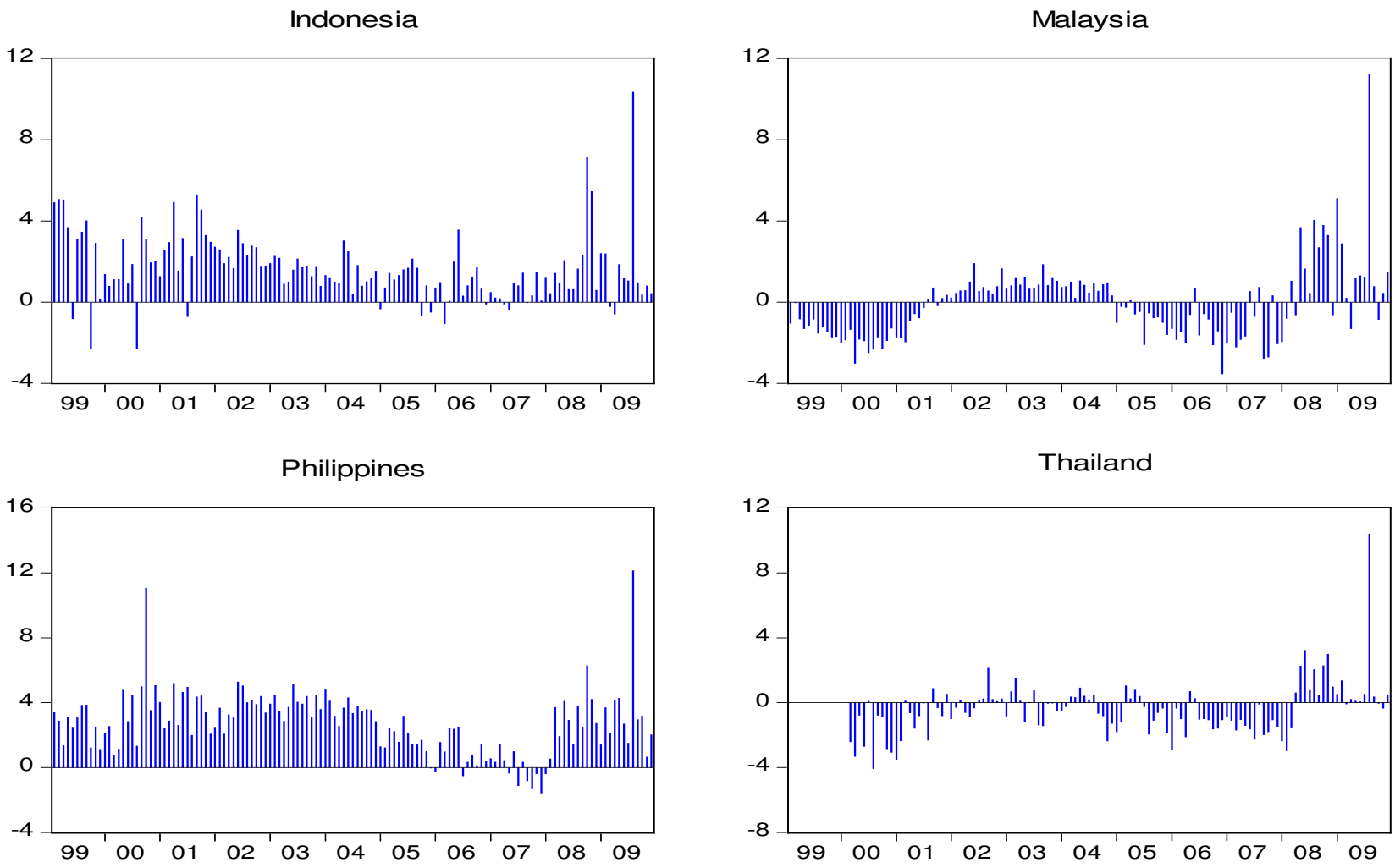
Table 9: The Tales of Exports' Contractions During Two Crises*

	The 1997 Financial crisis	**The Sub-prime Crisis**
Indonesia	-27% (Quarter 3, 1997- Quarter 1, 1999)	-38% (Quarter 3, 2008- Quarter 1, 2009)
Korea	-17% (Quarter 4, 1997- Quarter 3, 1998)	-35% (Quarter 3, 2008 – Quarter 1, 2009)
Thailand	-11% (Quarter 4, 1997- Quarter 2, 1998)	-31% (Quarter 3, 2008- Quarter 1, 2009)

*/ Note: we limit our observation period to 8 quarters span following the peak amount prior to the outbreak of the crisis.

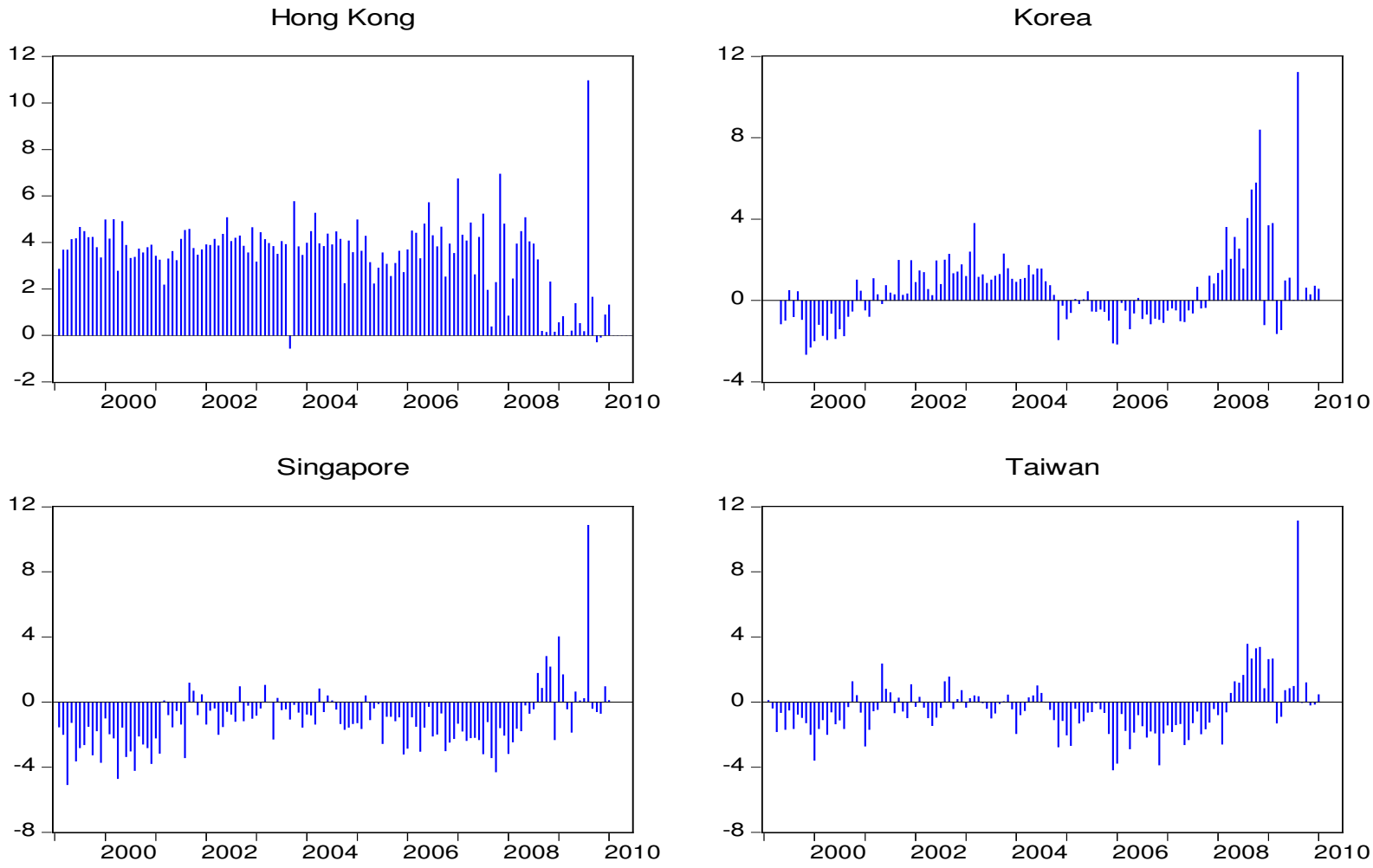
Source: CEIC database, the websites of Bank Indonesia, Bank of Korea and Bank of Thailand, and the author's own calculation.

Figure 1a: Exchange Market Pressure (EMP) Index



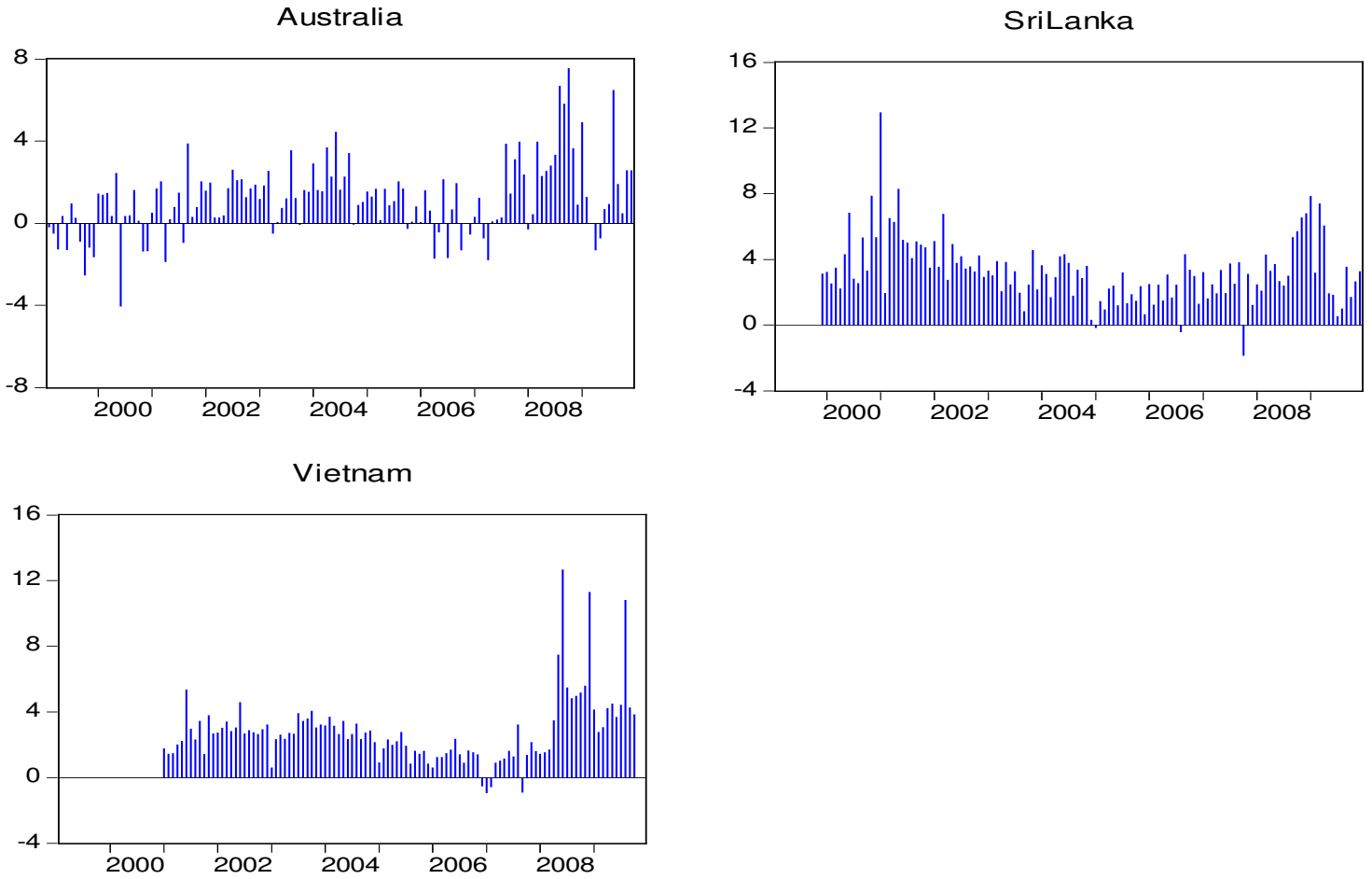
Source: Authors' own calculation

Figure 1b: Exchange Market Pressure (EMP) Index



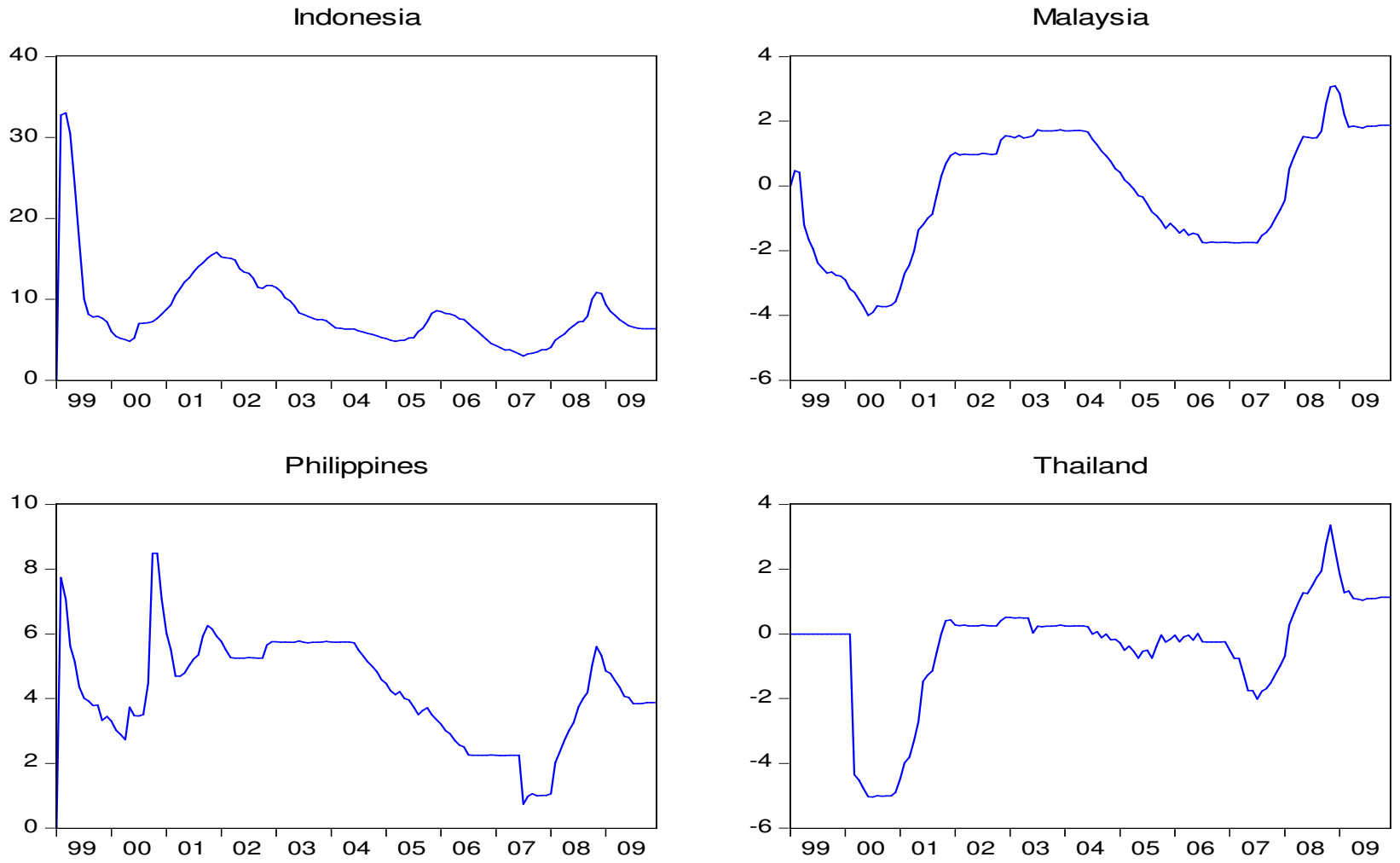
Source: Authors' own calculation.

Figure 1c: Exchange Market Pressure (EMP) Index



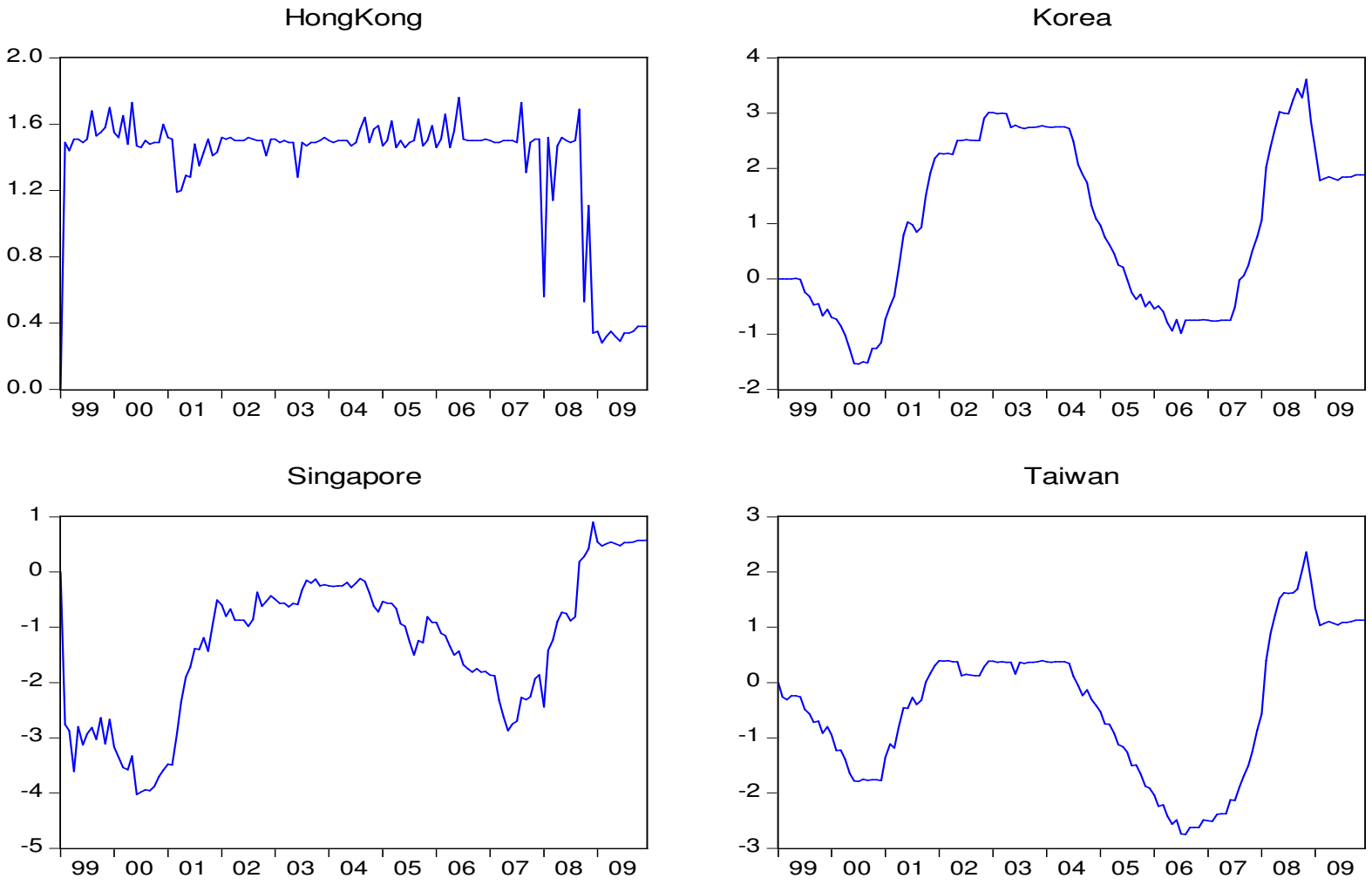
Source: Authors' own calculation

Figure 2a: Policy Rate Differentials with the US Federal Funds Rate



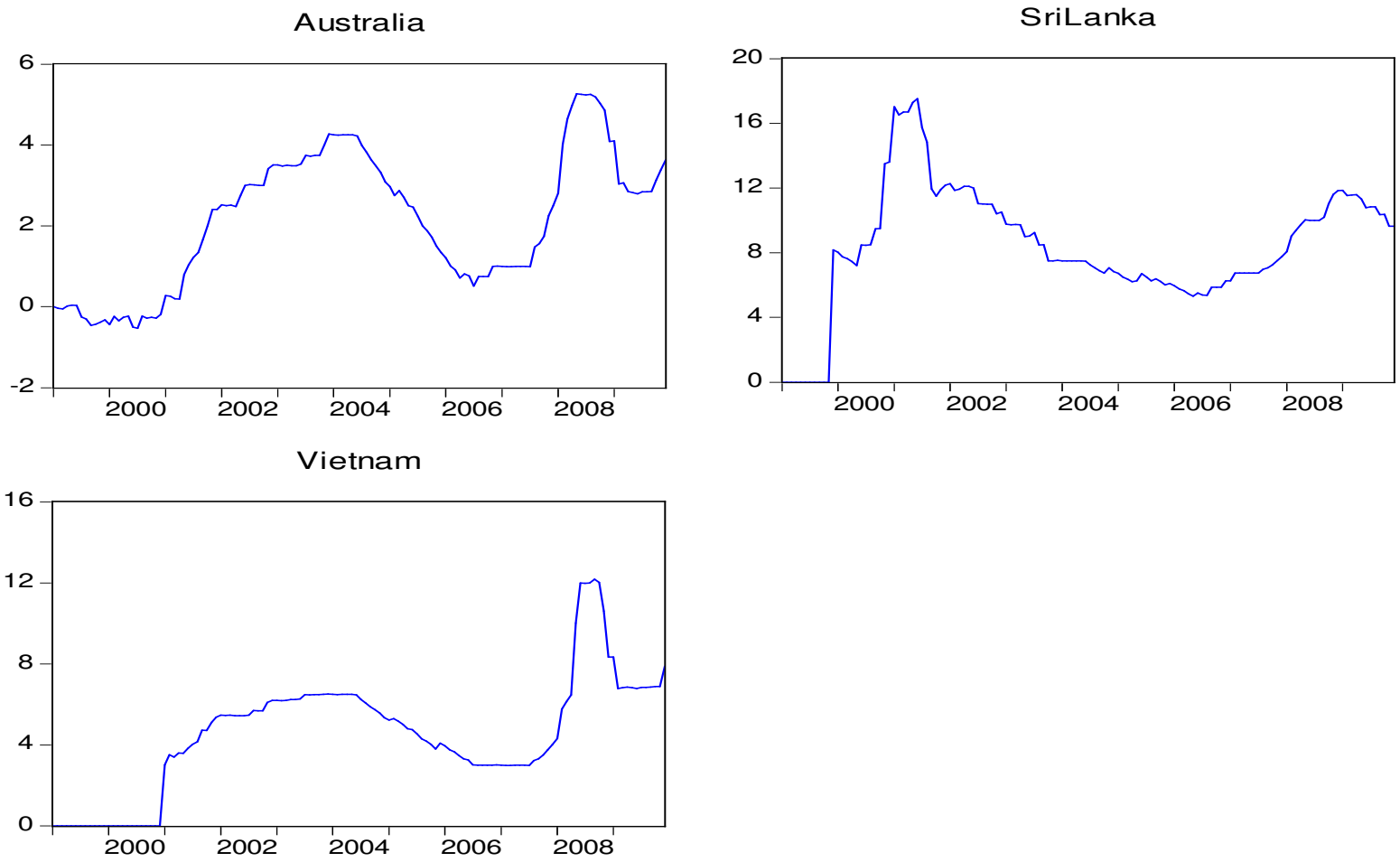
Source: Authors' own calculation

Figure 2b: Policy Rate Differentials with the US Federal Funds Rate



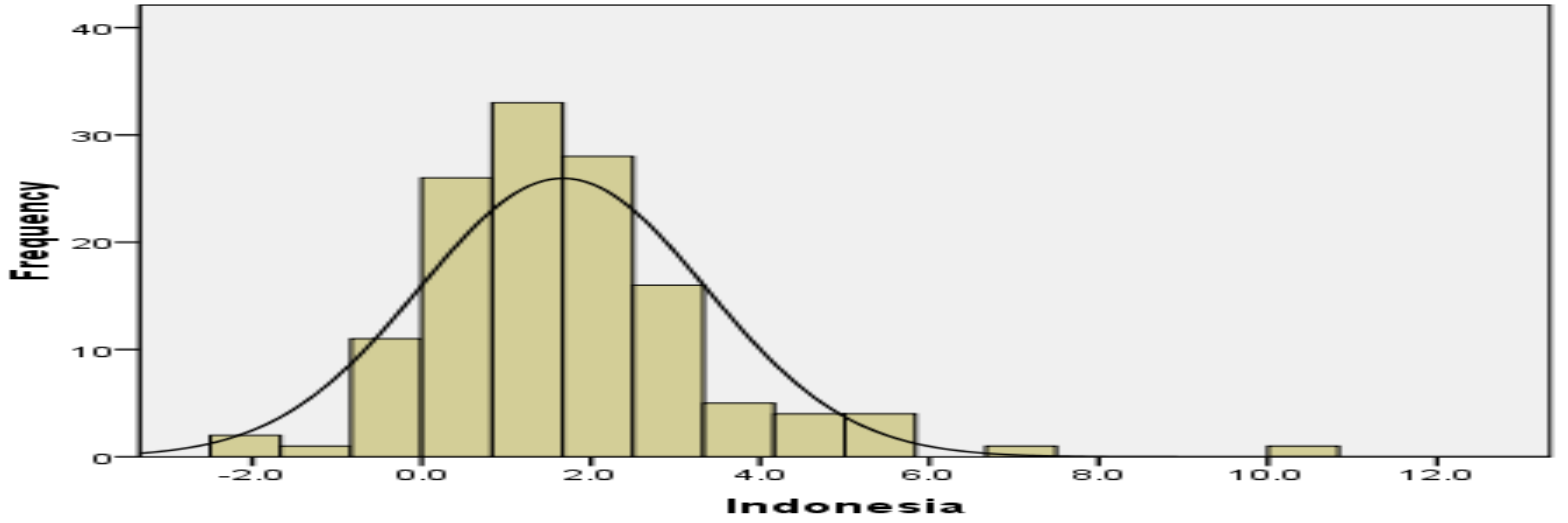
Source: Author's own calculation

Figure 2c: Policy Rate Differentials with the US Federal Funds Rate



Source: Author's own calculation

Figure 3a: Normal Density Distribution



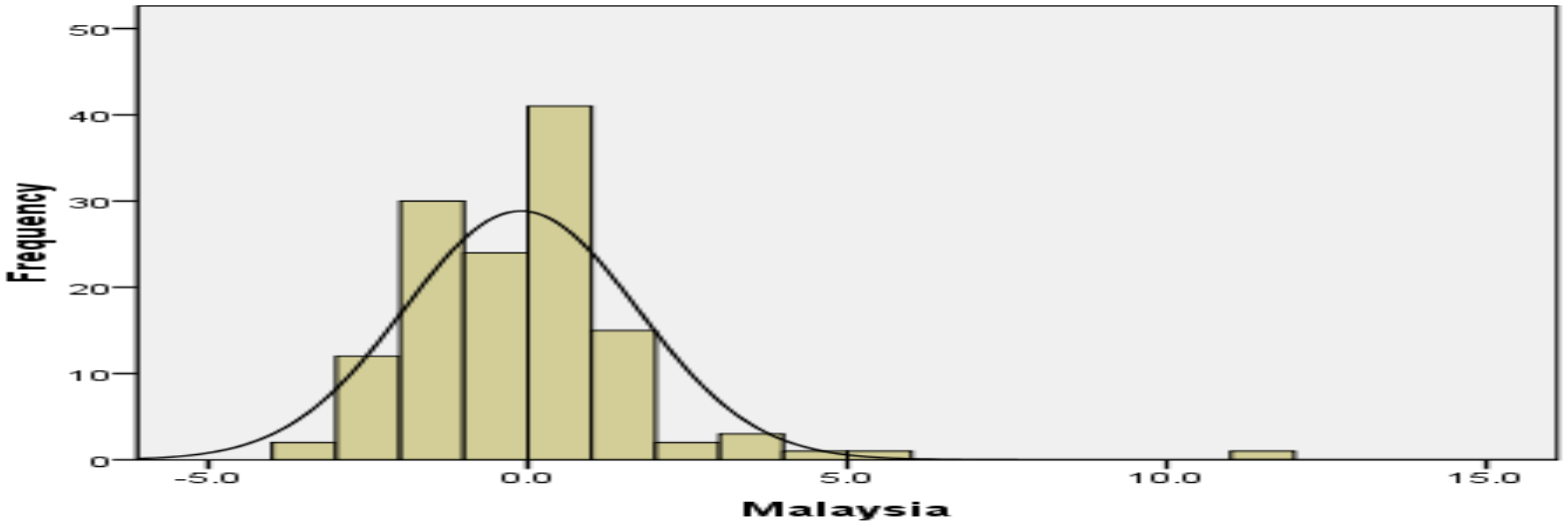
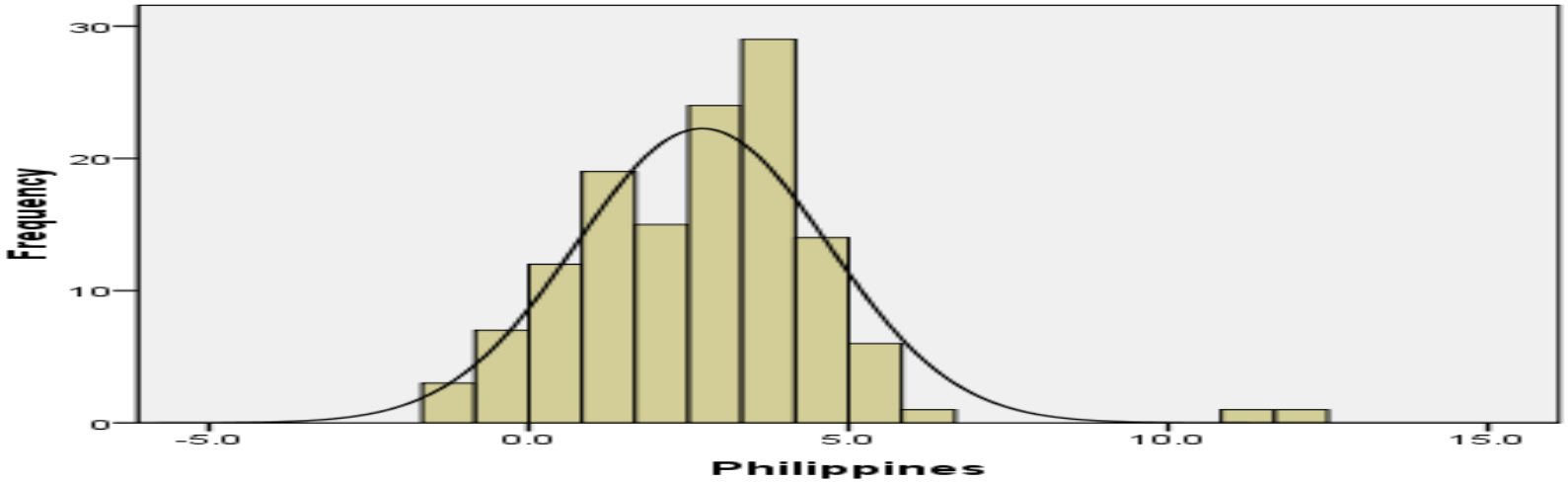


Figure 3a (cont'd)



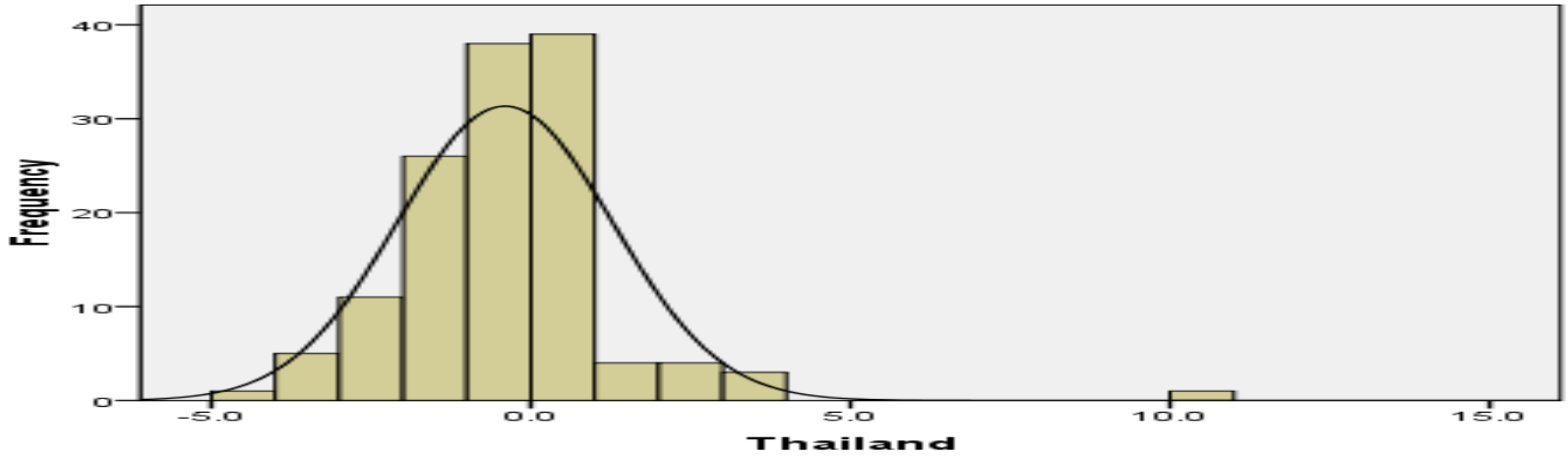
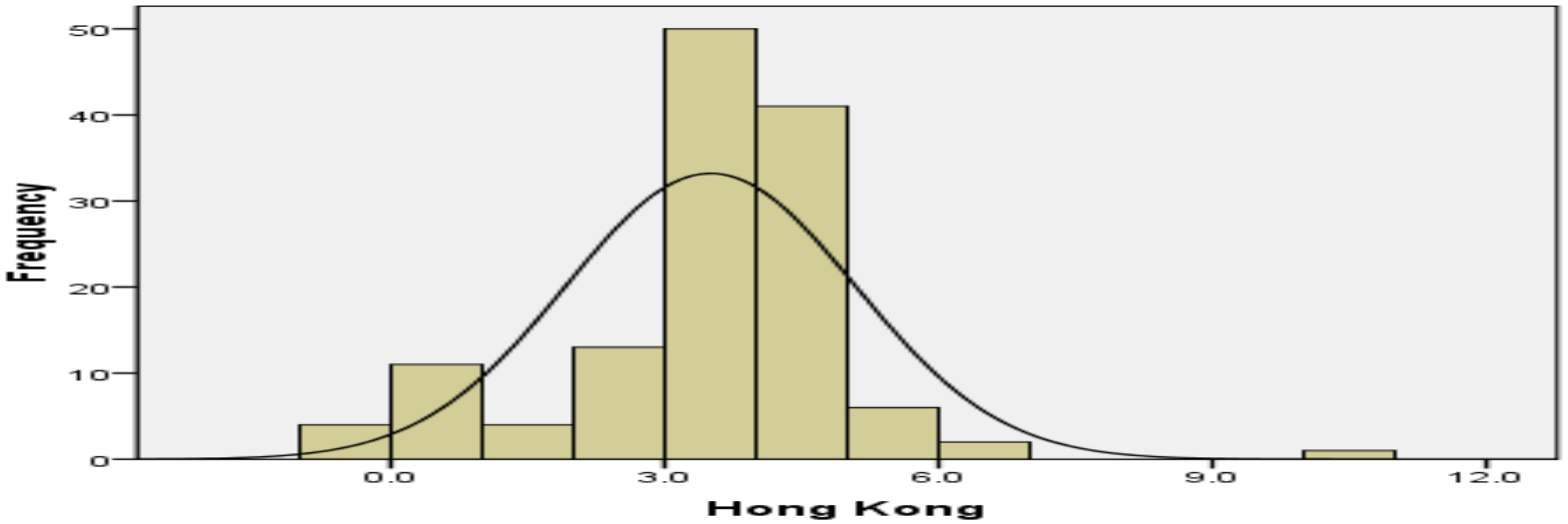
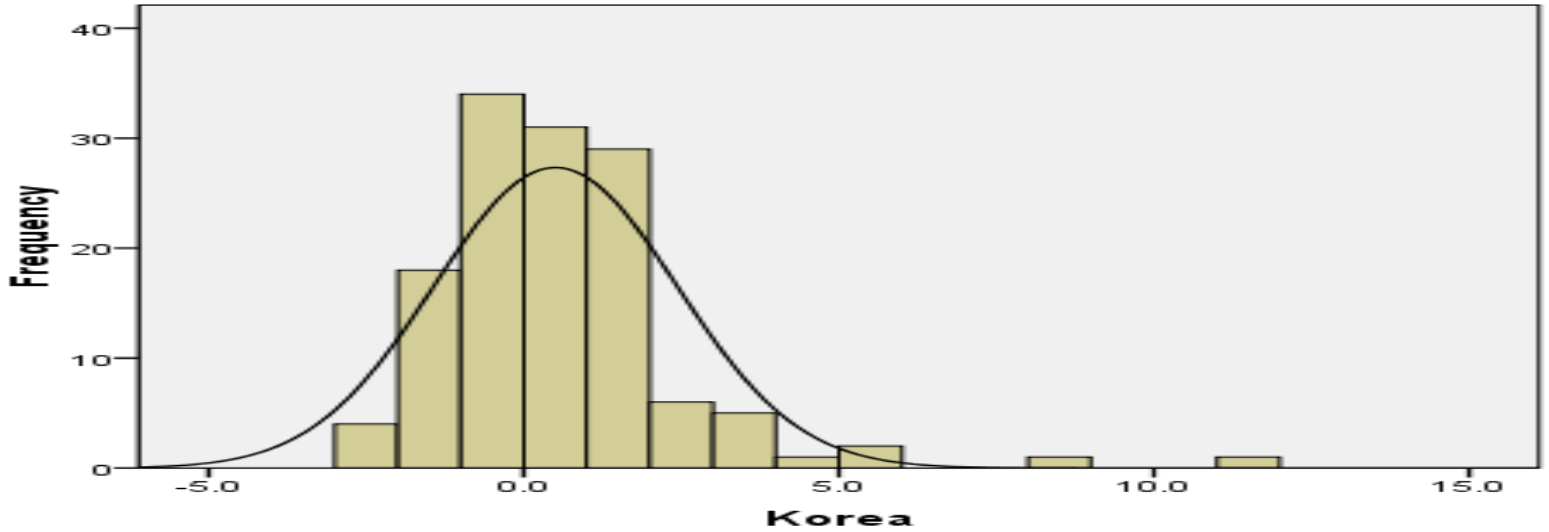


Figure 3b: Normal Density Distribution





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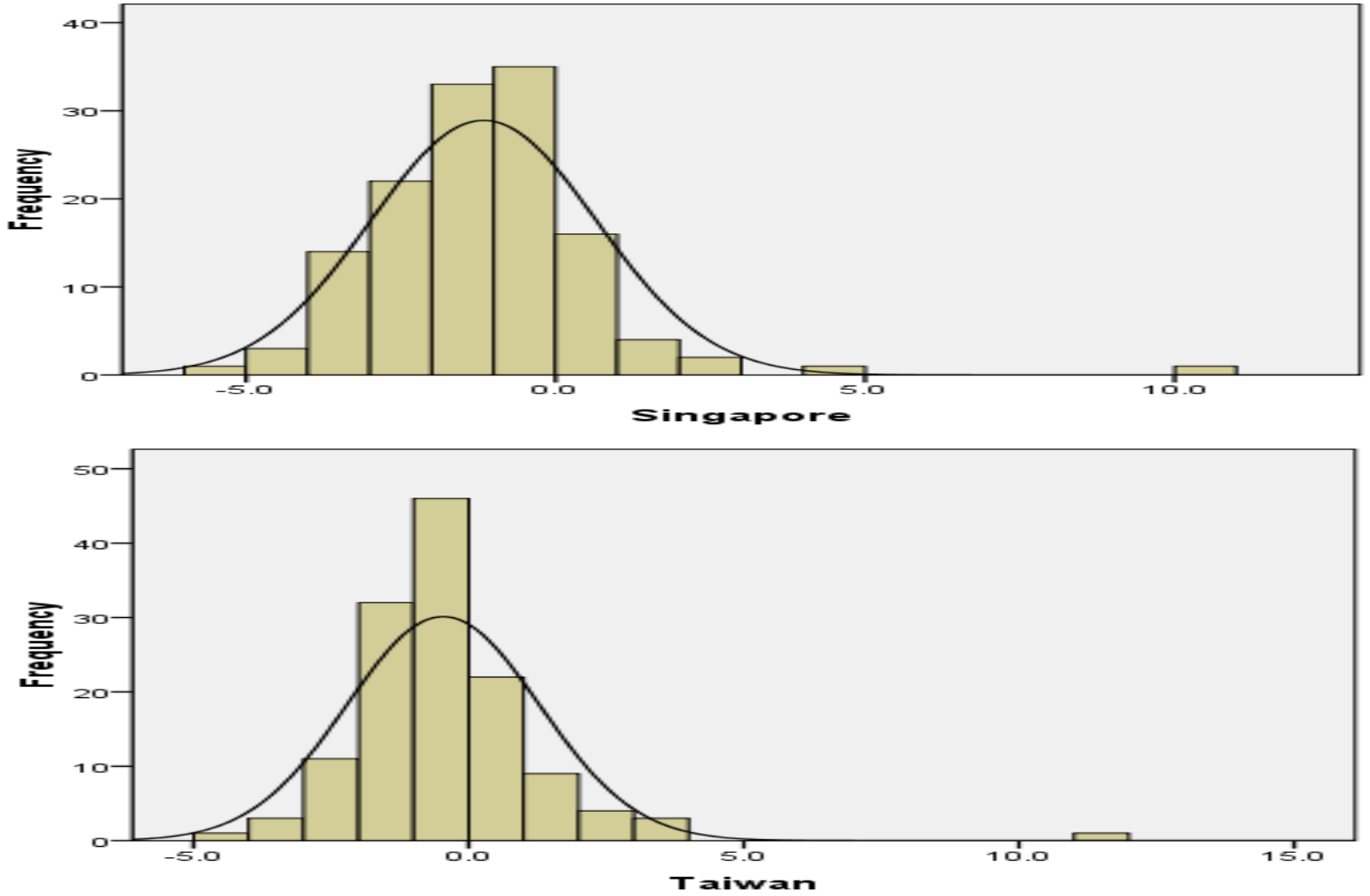
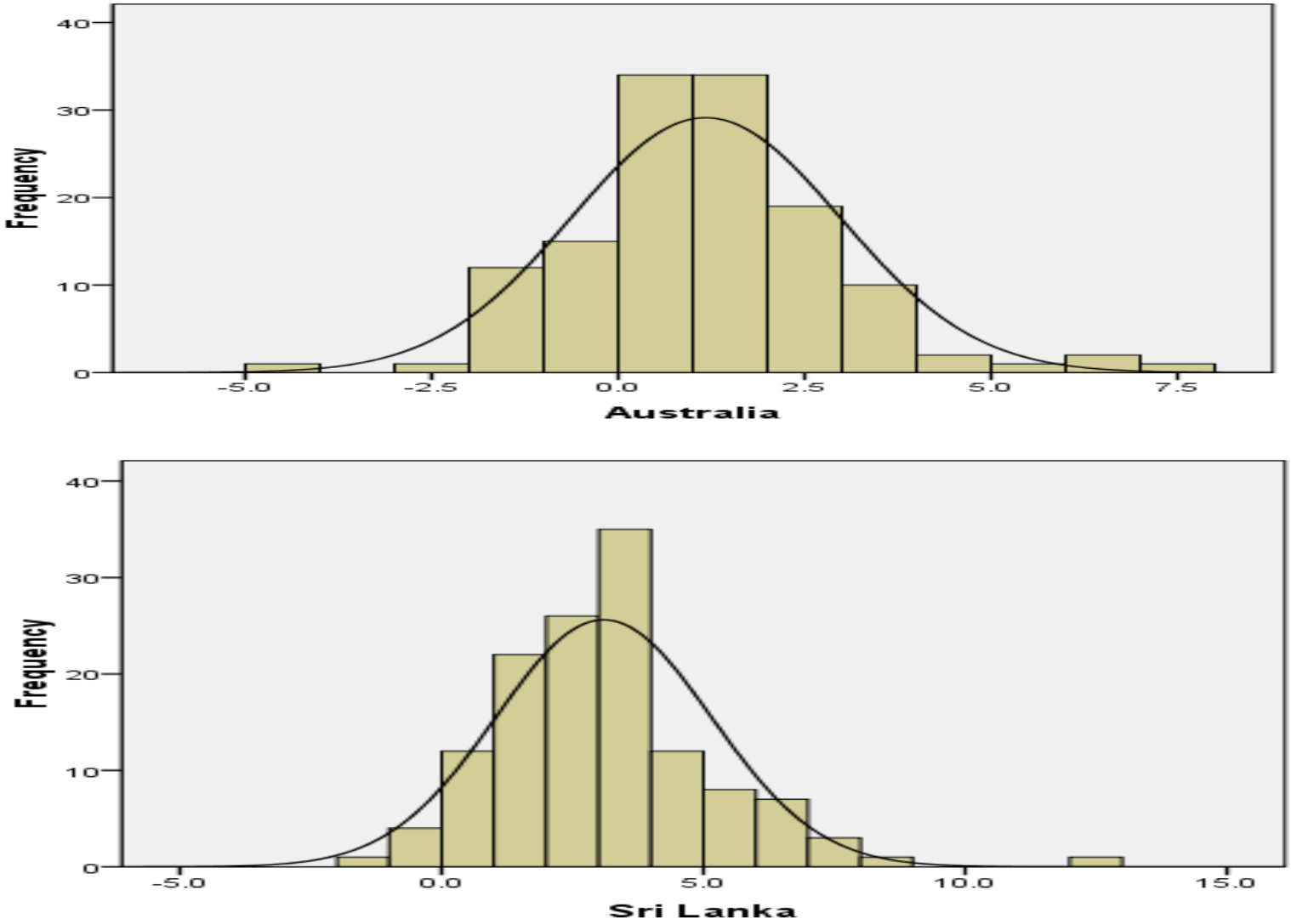


Figure 3c: Normal Density Distribution



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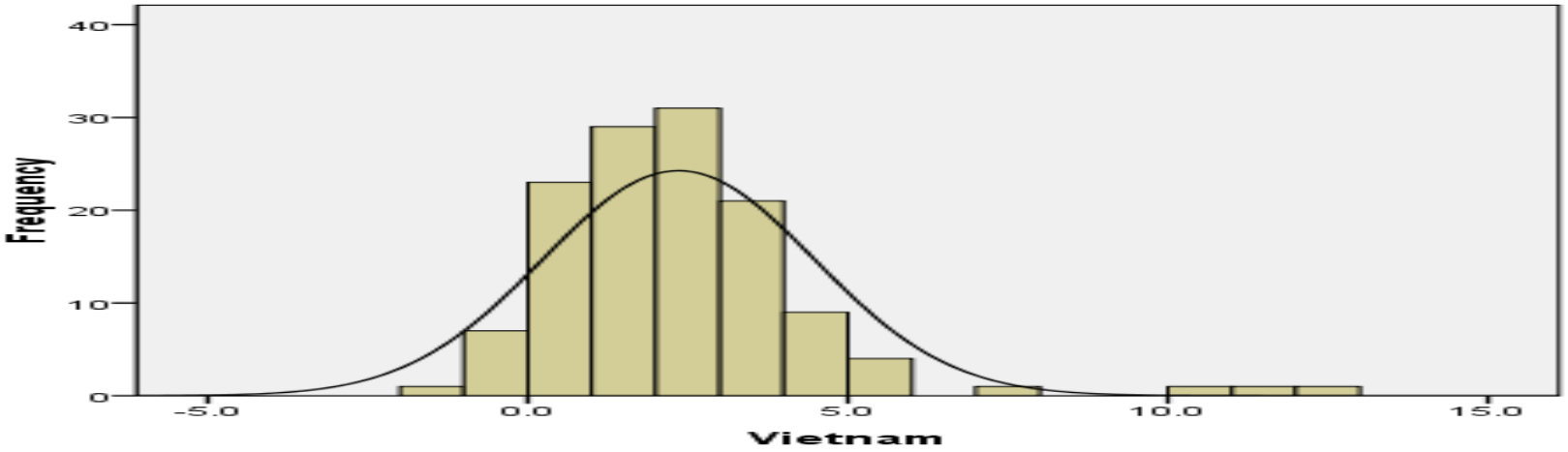
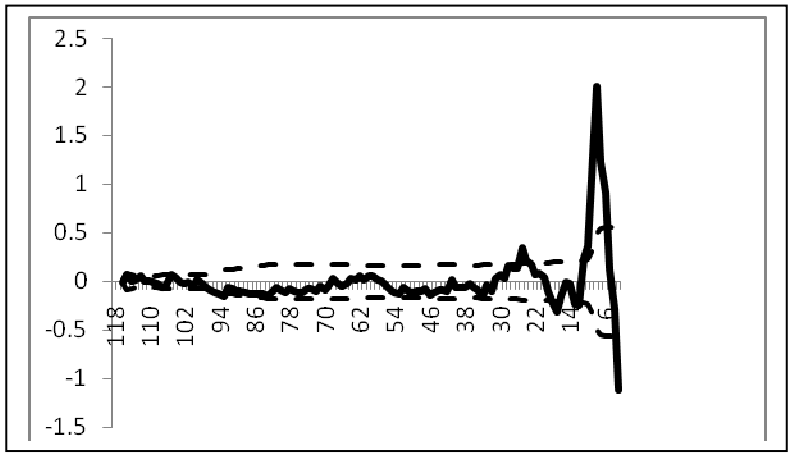
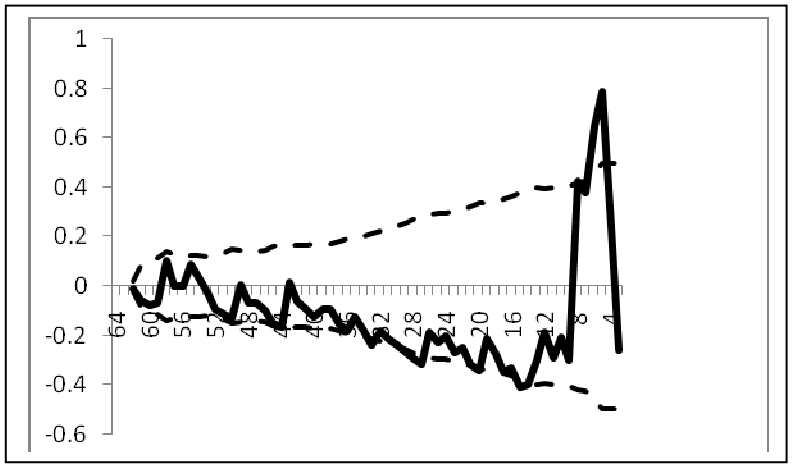


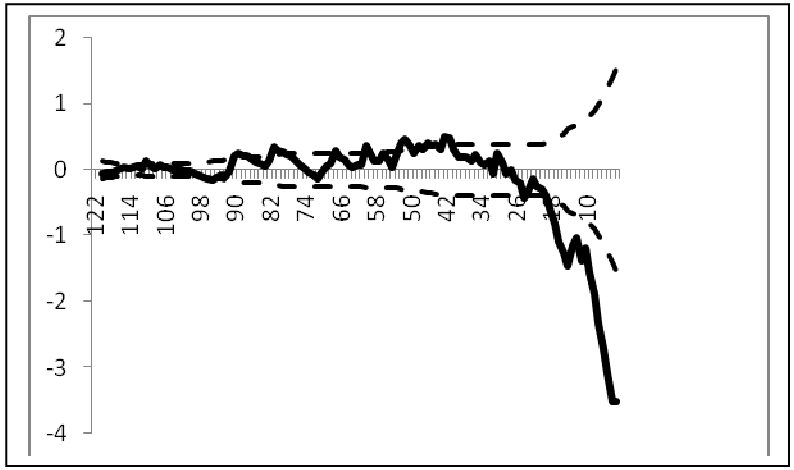
Figure 4a: Recursive Residuals



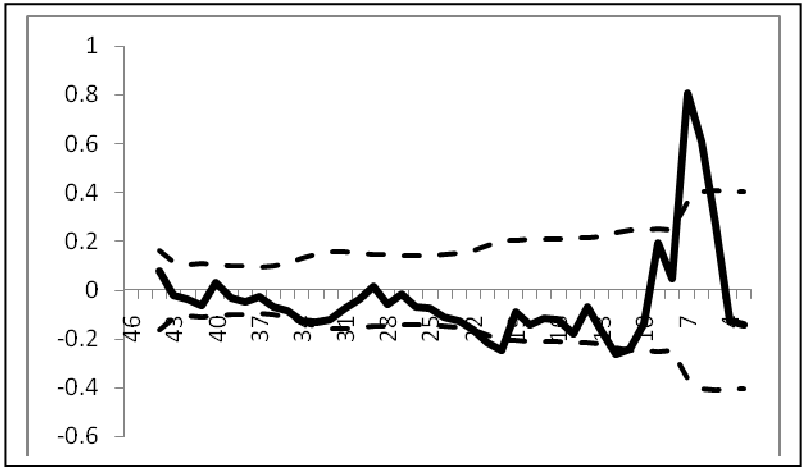
INDONESIA



MALAYSIA



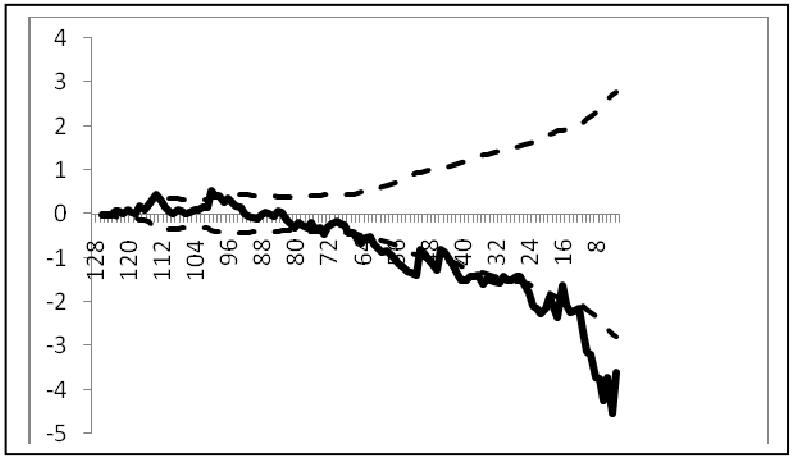
PHILIPPINES



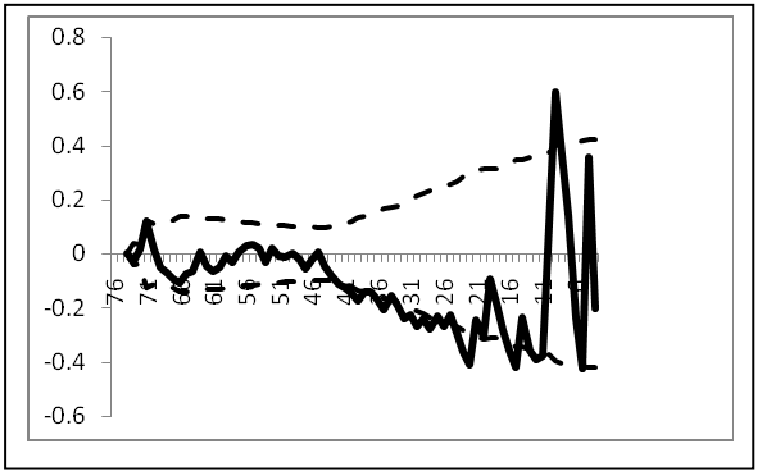
THAILAND

Note: Vertical Axis: recursive residuals (bold line) and ± two standard errors (dash lines). Horizontal axis: number of observations corresponding to *k*.

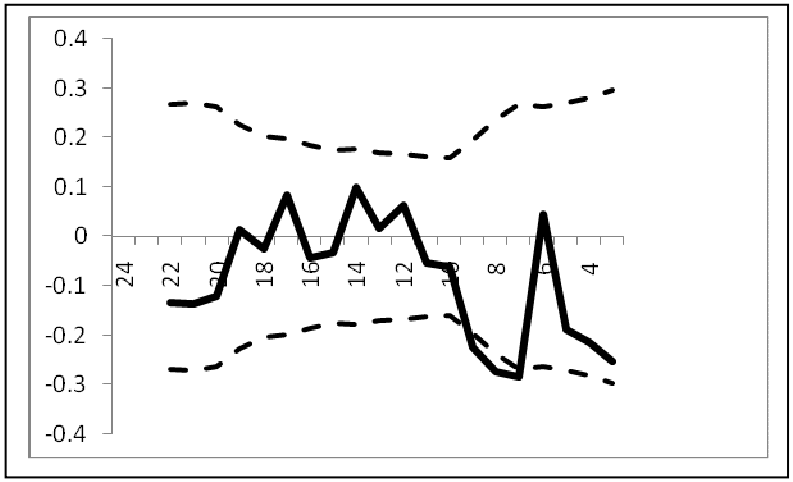
Figure 4b: Recursive Residual



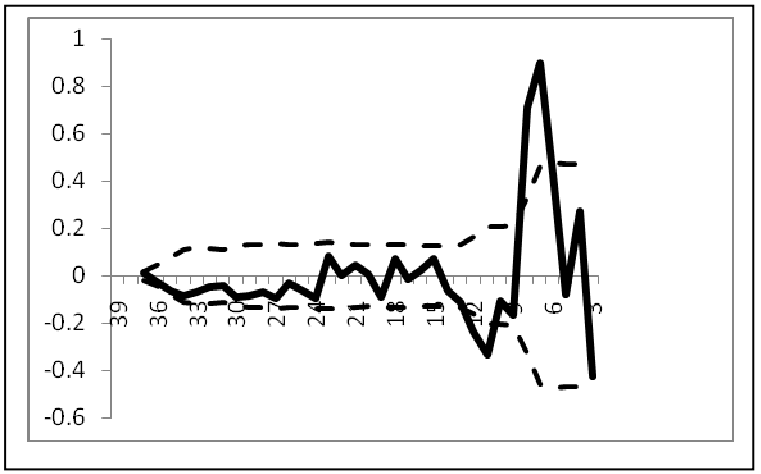
HONG KONG



KOREA



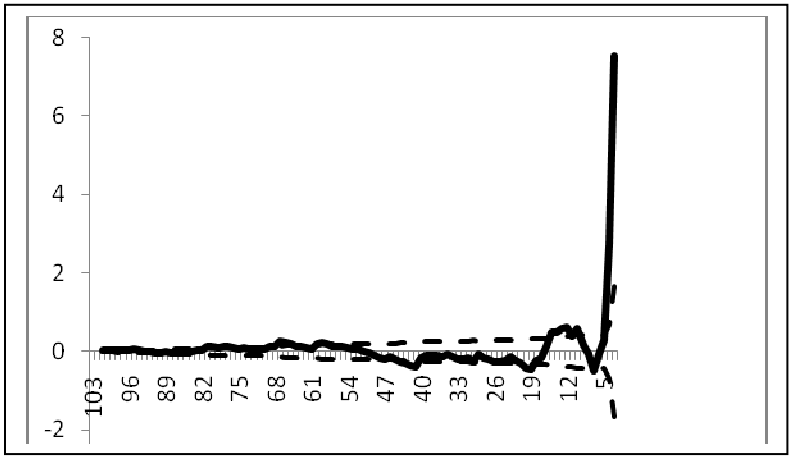
SINGAPORE



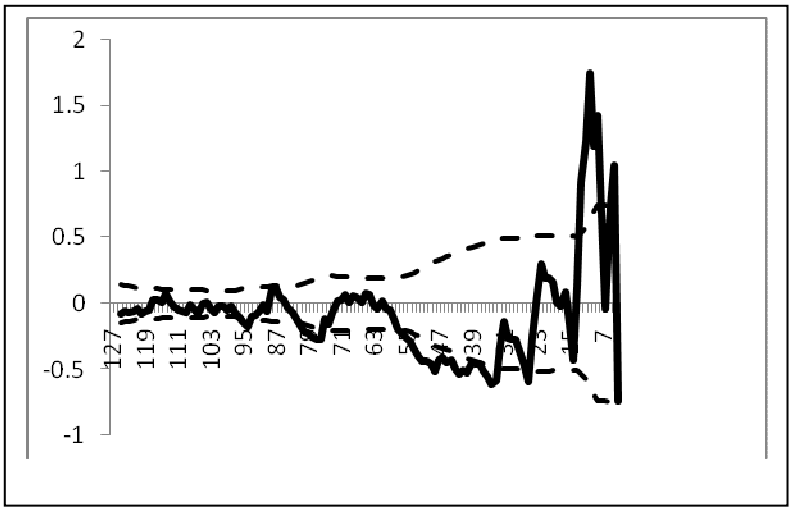
TAIWAN

Note: Vertical Axis: recursive residuals (bold line) and ± two standard errors (dash lines). Horizontal axis: number of observations corresponding to *k*.

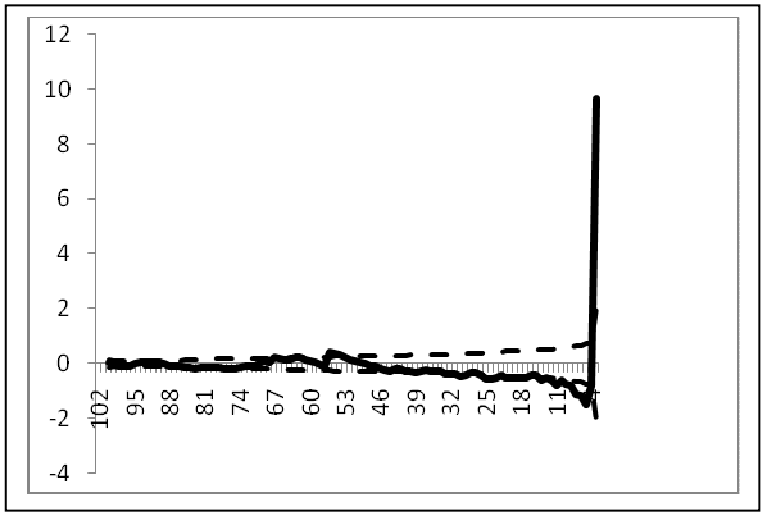
Figure 4c: Recursive Residual



AUSTRALIA



SRI LANKA



VIETNAM

Note: Vertical Axis: recursive residuals (bold line) and ± two standard errors (dash lines). Horizontal axis: number of observations corresponding to *k*.