Econometric Analysis of the Exchange Rate Regimes for Asia-5 Countries during Pre and Post-Asian Economic Crisis in 1997

Dissertation

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To Rifqi, Safira
& Vitra

Preface

This dissertation is submitted for the degree of Doctor of Philosophy from Graduate School of Economics, Hiroshima University of Economics. The research conducted in this dissertation was under the supervision of Professor Koichi Maekawa, between April 2012 and June 2015.

The main topic of this dissertation is to obtain statistical evidences for inferring *de facto* exchange rate regime with mainly focus on the Indonesian rupiah exchange rate and other Asia countries currency. To develop another method for the inferring technique of the exchange rate regime, the method of estimating single change point and the method of estimating causal order through Independent Component Analysis are proposed through Monte Carlo simulation, as discussed in Chapters 4 and 5 respectively. These methods have been applied for real data, particularly for investigating the exchange rate arrangement in Indonesia after the Asian crisis in 1997.

The finding in Chapters 2 and 3 verify that the US dollar still become main reference for the Indonesian rupiah as well as other Asia countries after the Asian crisis 1997 although the degree of the US dollar peg was not as tight as pre-Asian crisis. It may indicate that *de facto* exchange rate regime deviate from *de jure* exchange rate regime. Since there was no official announcement regarding to the regime change after the Asian crisis, the deviation of the de facto from de jure regime may came from the exchange rate policy change. The empirical study in Chapter 4 demonstrate that the Indonesian rupiah became less volatile and more pegged to the US dollar during March 2002 to August 2008. Meanwhile during January 2000 to February 2002, the Indonesian rupiah was more volatile and there was no statistical evidence that rupiah moving together with the US dollar.

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Contents

List of Figures

List of Tables

Summary of Chapters

Summary of Chapters

Chapter 1 The Nature and Classification Methods of the Exchange Rate Regimes

Mundell (1963) proposed the “impossible trinity” that becomes one of prominent theories that explain the role of the exchange rate in the economy. As described in the theory, it is impossible for a country to have all three conditions at the same time i.e. (i) a fixed exchange rate; (ii) free capital movement (or absence of capital control); and (iii) an independent monetary policy. In the "impossible trinity", the exchange rate policy implies the choice of exchange rate regime in which a country determines their exchange rate regime either following the free exchange rate regime or fixed regime. In fact, during the twentieth century the possible choice of exchange rate regime was not only either fix or free-floating but also something in between, e.g. adjustable rates, crawling peg, etc. The exchange rate regime other than fix and free-floating regimes have also been widely implemented by many countries especially emerging market.

In his chapter we review studies on taxonomy of the exchange rate regime as well as the description of the types of exchange rate regime which is usually adopted in many countries. The rest of this chapter will be divided into several sections; section 1.2 describes a short history of the exchange rate regime development during pre and post of the Bretton Wood Agreement. Section 1.3 explains a definition of exchange rate in term of nominal and real as well as the determination of the exchange rate. International Monetary Funds (IMF) has considerable influence in the development of the exchange rate regime, besides IMF play important role as the world's financial institutions that provide financial support for its member countries. Related to the exchange rate regime, since 1970's the IMF recorded the official announcement (or usually known as "*de jure*") exchange rate regime in member countries. However, in the late 1990s the IMF changed the classification method of the exchange rate regime in member country and put more emphasis to observe on what member country actually conducted to their exchange rate regime (or known as "*de facto*"). The taxonomy of the exchange rate regime according to the IMF is described in section 1.4. In section 1.5, the difference between what a country formally announced about their exchange rate regime and what they actually implemented in practice, or in short *de jure* vs. *de facto* regime, will be described. In section 1.6, the classification of the exchange rate regimes based on Frankel (1999 and 2003) will be presented. Finally, section 1.7 summarizes several prominent studies on the alternative classification methods of the exchange rate regimes.

Chapter 2 Indonesian Exchange Rate Regime Post-Asian Crisis: Managed or Free-Floating?

Since 1970's, the official announcement regarding the exchange rate regimes in Indonesia has been conducted 3 times. Therefore, until recently the *de jure* exchange rate regime in Indonesia can be divided into 3 periods as follows:

1. 1966 – 10.1978: rupiah was under fixed regime (fixed to the US dollar)
2. 11.1978 – 7.1997: rupiah was under managed-floating with basket currencies under several adjustment including widening band intervention during 1992 – 7.1997

3. 8.1997 - present: regime changed to free-floating (rupiah was highly volatile against the US dollar during the Asian Crisis)

It is obvious that by observing the rupiah movement during period 1, the evidence shows that rupiah was really fixed to the US dollar. The same thing also happened during the period 2, where the movement of rupiah was no longer fixed as in previous period. However, some evidences are needed to exactly understand about what is really happening with Indonesian currency movement during period 3. Since the exchange rate regime was officially announced as free-floating but the rupiah movement in reality does not really reflect high volatile movement, since the rupiah movement, theoretically, should be determined mainly by market mechanism. The purpose of this chapter is to obtain statistical evidence related to the de facto exchange rate regime, particularly during the post-Asian crisis 1997.

We organize this chapter as follows: In section 2.2, we describe data and methodology to examine the actual movement of the Indonesian rupiah whether it follows the *de jure* regime in each period. In section 2.3 we examine *de facto* regime which is conducted by Bank Indonesia. By examining *de facto* regime we will obtain statistical evidence that explains the exchange rate management conducted by Bank Indonesia during pre-Asian crisis. The estimation result shows that there was no deviation between *de jure* and *de facto* in period 1. Although the estimation results show that during period 2 rupiah was under managed-floating but the US dollar still became main reference to the Indonesian rupiah. Section 2.4 is the main focus of this study, in which we put more emphasis on examining the post-Asian crisis of the *de facto* regime. We have found that the actual movement of rupiah in the period 3 was still tightly pegged mainly to the US dollar except in several periods with different degree of pegging depend on the market pressures. Section 2.5

discusses about the interpretation of maintaining stability of rupiah value which become the single objective of the Bank Indonesia regarding to the new law of Bank Indonesia (UU No.23/1999 amended by UU No.3/2004). Finally, Section 2.6 concludes that the post-Asian crisis, there is little evidence to support that rupiah really follow the free-floating regime. The Indonesia rupiah seems to have free movement only when the market pressure increased or getting stronger. Meanwhile, when the Indonesian economy is relatively stable then rupiah will be more pegged to the US dollar.

We modified and applied Frankel-Wei (2008) model to infer the *de facto* exchange rate regime in Indonesia. This model is regression equation and used as a technique for inferring implicit basket weight and exchange rate flexibility (or inflexibility) in several countries under the assumption that the home currency is determined by a basket of currency. In this study, we assign the US dollar (USD), Japanese yen (JPY), Germany mark (DEM) or Euro (EUR), and exchange market pressure (EMP) as explanatory variables to the Indonesian rupiah movement. In addition, the Swiss franc (CHF) is chosen as *numeraire*. In addition, we also follow Baig (2001) to observe characteristics of the exchange rate regime measured by index of flexibility which is defined as ratio of standard deviation of the percentage change of home currency and sum of percentage change of home currency and percentage change of foreign reserve of home country. The index of flexibility range from 0 to 1, the higher the index means more flexible the exchange rate of home country.

By applying these methods, we found that during the fixed regime, the exchange rate was consistently followed fixed exchange rates, in other words *de jure* equal to the *de facto* regime. During the *de jure* managed-floating regime, our finding shows that rupiah was still heavily managed and tightly pegged to the USD (although the official statement of the regime was the rupiah will be pegged on a basket currencies). Therefore, we classify the *de facto* regime as adjustable peg or crawling peg. We conclude that under *de jure* managed-floating, the actual rupiah movement was more volatile but still heavily pegged to single hard currency rather than to basket of currencies.

Our estimation results show that during the post-Asian crisis period, the exchange rate regime can be classified as managed-floating rather than free-floating. In addition, the regression results clearly reveal a situation where intervention might be taken to maintain the rupiah movement. During the "tranquil" period, an intervention was taken by accumulating foreign reserve to avoid appreciation of the rupiah, while during the "turbulent" period the intervention was taken by dis-accumulating foreign reserve to avoid further depreciation. Since the movement of rupiah during the post-Asian crisis seems to have a particular pattern, it indicates that rupiah is not merely determined by market mechanism. The rupiah was highly volatile in early 2000's and become less volatile afterward except during the year with large domestic or external shocks as in 2005 and 2008. In other words, we may say that the movement of rupiah does not fully reflect the *de jure* free-floating regime.

However, using the entire period of 2001–2013 the statistical evidence shows that the rupiah was heavily managed and mostly pegged to the US dollar although with lower degree of pegging. During 2008-2009, the estimation results indicate that when market pressure on the rupiah increased, the US dollar and the Euro were used as reference for the movement of the rupiah with more pegged to the Euro. Yet, if the economy was relatively stable (or under weak market pressure), the rupiah moves together with the US dollar. Based on our statistical evidences, the *de facto* rupiah in period 2 and 3 can be classified as managed-floating, but under the *de jure* free-floating regime (period 3) the degree of linkage between the rupiah and the US dollar was relatively low (See Table 2.2 and 2.4).

Chapter 3 Returning to the Dollar Peg in Asia-5 Exchange Rate Regimes Post-Asian Crisis

During the onset of Asian crisis 1997, five Asian countries i.e. Indonesia, Malaysia, Philippines, Thailand and South Korea (later, it is called as Asia-5) officially announced to switch their exchange rate regimes. Malaysia decided to change their regime to fixed regime (Malaysia ringgit was perfectly pegged to the US dollar), while other four Asia-5 countries decided to adopt free-floating regimes. However, in July 2005 Malaysia announced that Malaysia ringgit was no longer perfectly pegged to the US dollar. Although the official exchange rate regimes announced to follow free-floating regime but realization of the nominal exchange rate of the Asia-5 currencies during 2000-2013 (see Figure 3.1) did not fully reflect this condition. It seems that these Asia-5 currencies were not only determined by market mechanism there were strong intentions to bring the exchange rate of their currencies in a particular direction or particular level.

This chapter examines the arrangement of exchange rate in Asia-5 countries after the Asian Crisis of 1997 with the main intention to obtain statistical evidences that the surveyed currencies is still pegged to the US dollar although the central banks of these countries has already officially announced to allow their currency to move freely. If the US dollar still becoming the main reference for these currencies to move, do these countries tightly pegged their currencies to the US dollar or they frequently adjust the degree of pegged of their currency toward the US dollar over time.

The rest of this chapter is organized as follows — Section 3.2 describes the bipolar view in the exchange rate regime. In the bipolar view, a country needs to choose either to peg their currency (i.e. currency board) or to allow their currency to float, and during the Asian crisis the Asia-5 countries decided to move into this extreme polar. Section 3.3 describes data and methodology. There are several statistical tests conducted in this chapter, including regression model developed by Frankel-Wei (2008), index of flexibility as in Baig (2001), recursive regression analysis, asymmetric response model, scatterplot analysis, and Wald test. The estimation using of mentioned statistical tests as well as the comparison analysis among the surveyed countries will be conducted in section 3.4. Section 3.5 verifies whether the exchange rate arrangements revert to the regime as before the 1997 crisis. Finally, Section 3.6 concludes that the exchange rate of the Asia-5 currencies revert pegged to the US dollar with slightly lower degree of pegging compare to the pre-Asian crisis.

Figure 3.3 shows that the scatterplot of the percentage change of exchange rate and percentage change of foreign reserves have changed in all Asia-5 countries during pre and post-Asian crisis. The scatterplots were more scattered around the origin during post-Asian crisis compared to the pre-Asian crisis period. The coefficient of correlation between the percentage change of the exchange rate and foreign reserve for Asia-5 countries during post-Asian crisis were negative and higher than during the pre-Asian crisis. This may suggests that the arrangement of the exchange rate in Asia-5 countries mostly represented by quadrant II and IV in which the percentage change of the exchange rate was negatively correlated with the percentage change of the foreign reserves.

Table 3.3 presents characteristic of the exchange rate regime in Asia-5 countries 1990-2013 and we characterize that the volatility of the exchange rate as well as the foreign reserves have changed for all Asia-5 countries in pre, during, and post-Asian crisis. The characteristics of the exchange rate and foreign reserve during the crisis period (1997-1999) show that the volatility of the exchange rate in all surveyed countries increased as a consequence of changes in the exchange rate regime. In general, the exchange rates as well as the foreign reserve were less volatile after the Asian crisis than during the crisis period, but it still more volatile compare to the pre-Asian crisis period.

Table 3.4 provides the estimation results for Asia-5 countries during the pre-crisis period, and it indicate that the exchange rate of the Asia-5 countries was mainly pegged to the US dollar. Thailand used the Japanese yen as reference during this period. Similar to Thailand, Malaysia and South Korea also used the Japanese yen was used as reference for the before the onset of the Asian crisis. Meanwhile, as shown in Appendix-B Table A.1-A.5, the regression results show that during the post-Asian crisis the exchange rate of Asia-5 currencies still pegged mainly to the US dollar although these countries allow their exchange rate value to move flexibly. Compared to the pre-Asian crisis, there are two different conditions can be verified, i.e. lower degree of pegging to the US dollar and higher flexibility of the exchange rate movements in each country surveyed. In addition, we also found that the estimated coefficient of the US dollar and EMP has different patterns among the surveyed countries. As it is shown in Figure 3.4, the coefficients of these two variables for Indonesia and Malaysia become (more) stable were after 2008 where this condition different from other three Asia-5 countries.

We examine the response of the local currency of each Asia-5 currency toward depreciation and appreciation of the US dollar and the asymmetric response model is applied for this purpose. The estimation results for the asymmetric response are presented in Appendix-B Table B.1-B.5. During pre-Asian crisis, the Asia-5 currencies were highly pegged to the U.S dollar and responded symmetrically toward depreciation as well as appreciation of the US dollars. However, the respond toward the US dollar movement has changed during the post-Asian crisis period where the Asia-5 countries do not tightly peg their currencies to the US dollar all the time and respond asymmetrically or differently toward the change of the US dollar movement.

Based on the statistical evidences, it can be concluded that the Asia-5 exchange rate arrangement during the post-Asian crisis 1997 did not fully follow the floating regime, rather it more likely to be managed float with the US dollar as the main reference. In addition, the Asia-5 countries allow their currencies to move more flexibly as indicated by the index of flexibility. These findings suggest that returning to the US dollar pegged is inevitable but in slightly lower degree of pegging.

Chapter 4 Change Point Analysis of Exchange Rate Using Bootstrapping Methods: An Application to the Indonesian Rupiah 2000-2008

This chapter investigates the most commonly used test statistics designed for detecting single change point namely, the sum of squares of the least squares residuals (SSR) test and the log-likelihood ratio (LR) test. However, because an estimated change point will suffer from sampling error, it is desirable to calculate its confidence interval, for which we need to know the sampling distribution. Given that it is generally difficult to obtain this information, we instead calculate the confidence interval using Monte Carlo simulation based on a bootstrap method.

We consider a structural change in a linear time-series regression model where a structural change implies the change in the regression coefficients at time m. Then we detect the time of the structural change by testing the null of H_0: no structural change at time m against the alternative H_1: there is structural change at time m. The most common test for this is the Chow test based on the F-statistic.

It is generally difficult to obtain a theoretical distribution of the estimated change point regardless the statistical test we used. To overcome this difficulty, we consider the use of a bootstrap method to obtain the sampling distribution of $\hat{m}$ and use this to construct confidence intervals. Bootstrap method is initially proposed by Efron (1979) for independent data. But data in economic time series are usually dependent on the past data. To reflect dependency of data in time series, various modifications of bootstrap method are proposed to deal with dependent data by resampling from the collection of blocks of data. These methods are called as block bootstrap (BB) method. Later Politis and Romano (1991) proposed circular block bootstrap (CBB) methods. BB and CBB will be explained in the next section. Lahiri (1999) described various BB methods and compared them.

The rest of the chapter is organized as follows. In Section 4.2, we present a linear regression model with GARCH errors and describe the steps involved in deriving the confidence interval of a change point in the model using CBB. In Section 4.3, we present two DGPs for Monte Carlo experiments and report the simulation results of the performance of the CBB. In Section 4.4, we conduct an empirical analysis of the Indonesian Rupiah using the CBB and successfully detect a change point. In Section 4.5, we conclude that both SSR and LR together with CBB work well in detecting a single change point and constructing the confidence intervals. The LR with CBB is generally better than the SSR with CBB in many respects. In our empirical study, we estimated a change point in March 22, 2002 and found different pattern of the movement of rupiah against the US dollar. This result indicates that there was different policy regarding to the exchange rate policy in Indonesia during 2000-2008.

We consider a simple regression model with GARCH (1,1) errors as expressed in equation 4.1. It is assumed that there exists a single change point at unknown time *t* = *m* when parameters change as follows:

$$t \leq \mathrm{m}; c_1, a_1, \omega_1,\ \alpha_1, \beta_1;$$

$$t > m; c_2, a_2, \omega_2,\ \alpha_2, \beta_2.$$

Hereafter, we refer to *m* as the true change point. There are many statistical methods for estimating the true change point *m*. Of these, we focus on the CBB method based on the cumulative sum of squares of residual (SSR) and log-likelihood ratio (LR) tests, respectively abbreviated as SSR-based CBB and LR-based CBB or SSR/CBB and LR/CBB.

We evaluate the performance of the SSR/CBB and LR/CBB methods using Monte Carlo experiments based on the equation (4.1). The Monte Carlo experiment is assigned into two models, namely Model 1 and Model 2. Mode1 1 assumes that there exists a change point at a time *m* and that the parameters of the mean equation change as specified above, but the GARCH parameters are the same in the first and the second subsample periods. While Model 2 assumes that there exists a change point at a time *m* and that the parameters in the mean equation and the GARCH process change as specified.

Under the SSR/CBB method, the simulation results for Model 1 and Model 2 show good accuracy in estimating the change point. In addition, using block length of 5, the SSR/CBB works fairly well in constructing confidence interval. Meanwhile, the LR/CBB does not work well compared to the SSR/CBB. The simulation under LR/CBB show better result when the true change point is located in the middle (T/2) and using longer block length. In addition, LR/CBB is more accurate for Model 2 than for Model 1.

We observe the arrangement of the daily Indonesian rupiah exchange rate during 2000-2008 and assume that the US dollar (USD) determines the rupiah (IDR). In order to observe the movement of the IDR against the USD, we choose the Special Drawing Right (SDR) as the *numeraire* and apply model as in equation 4.2. In this equation, α is coefficient of the USD, if α is non-zero significantly large then it indicates that the IDR tends to follow the movement of the dollar. And if this happen, then it may contradict the assertion of a free exchange rate regime as announced by the Bank Indonesian, the central bank of Indonesia. Conversely, if α is not significant, it indicates that IDR does not move with the USD. In addition, u_t also needs to be considered, because the u_t often follows a GARCH (1,1) process. We select sample period from January 4, 2000 to August 29, 2008.

Using the SSR/CBB method, we detect a single structural change point on March 22, 2002. From the empirical distribution, we obtained the lower and upper bounds of the confidence interval as October 05, 2001 and August 28, 2002, respectively (see Figure 4.3). Based on the estimated point we split our sample into two sub-periods. The first sub-period suggests that the IDR was relatively more volatile and it can be interpreted this as less official intervention has been conducted to reduce the volatility of the IDR. The second sub-period suggests that the IDR moved with the USD and became less volatile. This provides some statistical evidence that the IDR/SDR maintains some relationship with the USD/SDR.

We estimated a single change point in a time series regression model with GARCH (1,1) error using SSR/CBB and LR/CBB methods and compared these using Monte Carlo simulation under Models 1 and 2. In our Monte

Carlo simulation, we observed that both the SSR/CBB and LR/CBB methods worked well in detecting a single change point and calculating confidence intervals. While the LR/CB is generally better than the SSR/CBB in many respects, the performance of the LR/CBB is more sensitive than the SSR/CBB to the location of the true change point, the block length specified in the CBB, and the number of parameters to be estimated. Our empirical study, the SSR/CBB detect a change point and drew a reasonable economic interpretation that even though the Indonesian government had officially announced a floating exchange rate regime, the IDR was not floating throughout the whole sample period but has moved with the USD since March 2002 and has also become less volatile.

Chapter 5 Estimation of Causal Order in SVAR(1) Model by Independent Component Analysis: A Monte Carlo Simulation and Real Data Analysis on Exchange Rates

The economic phenomena can be described by explaining a relationship of several variables that shows cause and effect among the variables. To scrutiny the relationship among these variables, economics theories are needed as a basis to describe the relationship among observable variables as required in the theory. Unfortunately, not all economic variables are observable but some of them are unobservable, and consequently the data of the unobservable variables cannot be provided. To overcome this problem, a measurement of relationship among the variables is needed. There are two important issues arise here, i.e. theory and measurement.

This chapter describes the SVAR models and the use of Independent Component Analysis in the economic field. The causal order of hard and soft currencies will be presented as an example of the application of ICA with real data analysis. Several hard currencies such as US dollar, Japanese yen, Germany mark as well as soft currencies such as Singapore dollar and Indonesian rupiah is selected to be analyzed in term of its causal order. Our conjecture is that the soft currencies will be highly affected by fluctuation of the hard currencies value. The rest of this chapter is structured as follows. Section 5.2 describe the SVAR model and discuss identification problems. In section 5.3, the Independent Component Analysis in SVAR model is shortly explained. Estimating the causal order by using Monte Carlo experiment is presented in section 5.4, while using real data of exchange rate in the application of ICA for a simple example is given in section 5.5. Finally, section 5.6 concludes that the ICA work well under the case of contemporaneous with lagged variable and does not work well under the case of contemporaneous with slightly lagged variable and higher degree of freedom in the error term. In our empirical study, the ICA successfully estimate the causal order since the hard currency influences the soft currency.

In this chapter we consider a bivariate $Y_t = (y_{1t}, y_{2t})$ in first order structural vector auto regression, SVAR(1) as expressed in equation 5.1 and 5.2. A set of variables (y_{1t}, y_{2t}) measured at regular time intervals at time t. The SVAR(1) model as expressed in equation (5.1) and (5.2) show that the value of each variable y_{it}, $i = 1,2$, has linear combination of all variables with 1 lag and the contemporaneous values of the other variables. The error terms or structural shocks ε_{1t} and $\varepsilon_{2t}$are white noise with zero means and variance σ_1^2 and σ_2^2 and a zero covariance. Note that the error term of ε_{1t} affecting y_{1t} directly and effecting y_{2t} indirectly. In this case, all variables are endogenous and there are 10 parameters to be estimated. The equation (5.1) and (5.2) can be rewritten in reduce form as in equation 5.5.a and 5.5.b.

Our experiment study cover 4 cases and for each cases we assign different value in the coefficient of matrix $\boldsymbol{B}$ and $\boldsymbol{\Gamma_1}$. The 4 different cases are assigned as follows: (i) Case A, represent SVAR(1) model with contemporaneous and lagged causal order, (ii) Case B, similar to the case A but there is no lagged causal order which is indicated by coefficient of lagged variable as in matrix Γ_1, (iii) Case C provides a scenario where there is no contemporaneous, since matrix B does not show lower triangular and slightly lagged causal order as indicated by zero value in some element in matrix Γ_1, (iv) Case D, similar to the case C but no zero element in matrix Γ_1.

The simulation results show that estimating causal order under non-Gaussian is heavily affected by the degree of coefficient of the lagged variables as well as the degree of freedom of the centered non-central t-distribution. When the coefficient of lagged variables is slightly low and the degree of freedom is quite high, then the ICA estimate the causal order less accurately since we still obtain the true causal order although in low frequency.

The chapter 2 concludes that the exchange rate arrangement in Indonesia during the post-Asian crisis is managed-floating since the Indonesian rupiah is still pegged mainly to the US dollar although the central bank officially announced to adopt free floating regime in 1997. Hence, our empirical study in this chapter estimates the causal order based on four nominal exchange rates of the US dollar (USD/SDR), Euro (EUR/SDR), Japanese yen (JPY/SDR), and Indonesian rupiah (IDR/SDR). We collect monthly data from January 2000 to December 2014 and divided into 2 periods, i.e. pre-Lehman shock (January 2000 – August 2008) and post-Lehman shock (September 2008 – December 2014). The estimation result (see Table 5.4) show that the causal order before Lehman shock is $USDSDR \rightarrow EURSDR \rightarrow JPYSDR \rightarrow IDRSDR$ and the causal order after Lehman shock is $EURSDR \rightarrow USASDR \rightarrow JPYSDR \rightarrow IDRSDR$.

In the experiment study, our simulation results show that the ICA successfully estimated the true causal order except under case A and B, but fail to estimate the causal order under Case C and D since there is no contemporaneous in the model. While, our empirical study found that the causal order of the four currencies are different during before and after the Lehman shock. Before the Lehman shock the estimated causal order was $USDSDR \rightarrow EURSDR \rightarrow JPYSDR \rightarrow IDRSDR$ and after the Lehman shock the estimated causal order was $EURSDR \rightarrow USDSDR \rightarrow JPYSDR \rightarrow IDRSDR$.

Chapter 6 Block Size Selection on Circular Block Bootstrap Method in Constructing Confidence Interval: A Monte Carlo Experiment

The circular block bootstrap (CBB) method has been applied to construct a confidence interval for the estimated single change point, as have been discussed in the chapter 4. To apply the CBB, it requires user to specify the length of block length. Our simulation results have shown that under the same scenario, the use of different block length lead to construct different confidence interval. In some cases, using short block length obtained better results, and in other cases longer block length also produced better result in constructing the confidence interval.

This chapter examines the use of different block length in constructing confidence interval under different error process, i.e. AR(1) and ARFIMA(0,d,0). We propose our hypothesis that when there is a strong time dependency longer block size is appropriate. This chapter is organized as follows; section 6.2 describes an introduction to long memory. Section 6.3 assigns the Monte Carlo experiment including data generating process and model to be tested in the simulation. Section 6.4 analyses the simulation results. Then, section 6.5 concludes that the block length is very sensitive in constructing confidence interval, especially when CBB method is applied. In addition, time dependent in the error term must be considered when choosing the block length. We obtain some evidences that the short block size should be chosen when the series is less time dependent as well as for strong time dependency data.

We generate a series of data with a single structural break at certain point, i.e. T/4, T/2, and 3T/4, namely y_t. The data generating process is based on the 4 different cases which is classified into Model A and Model B. Under Model A, the series of y_t have small structural change and the error term follows AR(1) and ARFIMA(0,d,0) or called as Model A.1 and Model A.2 respectively. While, under Model B the series of y_t have a large structural change with the error term also follows AR(1) and ARFIMA(0,d,0) r called as Model B.1 and Model B.2 respectively. Using the sum of square of residual (SSR) method, we estimate the change point under Model A and Model B. After obtain the estimated change point, we apply Circular Block Bootstrap to construct the confidence interval.

The simulation results show that the SSR method works well to estimate the change point mostly under Model B, due to large structural break. However, the SSR method also works well under Model A only when the coefficient of AR(1) and ARFIMA(0,d,0) is small enough (i.e. it represent less dependency data) (see Table 6.1.A, 6.1.B, 6.2.A and 6.2.B). The confidence interval is well constructed using the SSR/CBB method for Model A when short block size is chosen. But, under Model A the SSR/CBB method only work well when the true change point is T/4 for Model A.1 and T/2 for Model A.2. Meanwhile, under Model B, the SSR/CBB method works well to construct confidence interval when short block size is selected.

In general, our simulation result suggests that the block length is very sensitive in constructing confidence interval, especially when CBB method is applied. In addition, time dependent in the error term must be considered when choosing the block length. In this simulation study, we obtain some evidences that the short block length should be chosen when the series is less time dependent as well as for strong time dependency data

Chapter 1

The Nature and Classification Methods of the Exchange Rate Regimes

The Nature and Classification Methods of the Exchange Rate Regimes

1.1. Introduction

A rapid growing activity on international trade as well as international capital movement increases role of the exchange rate. Thus, the exchange rate turns to be one of important factor in determining value of the international transaction, both exports and imports of goods and services that will ultimately affect a country's balance of payment. For instance, in order to increase export competitiveness, a country decided to weaken their currency against other country's currency (or usually toward hard currency, i.e. the US dollar). Hold everything constant, this policy lowers their export product price in the international market and as a result, the export (as it is expected) will increase. In the same time, the weakening of the home currency also resulted in increasing prices of the imported goods, and therefore increases spending that deplete the foreign reserves. This simple example shows that the exchange rate policy has a wide impact to the national economy.

Among others, the "impossible trinity" by Mundell (1963) becomes one of prominent theories that explain the role of the exchange rate in the economy. As described in the theory, it is impossible for a country to have all three conditions i.e. (i) a fixed exchange rate; (ii) free capital movement (or absence of capital control); and (iii) an independent monetary policy, at the same time. This theory suggested that a country have to choose only two out of the three, or at least they must select optimum combination policies to reach their economic goals. The choice of policy combination may be shifted over time to response the change of the economic policies.

In the "impossible trinity", the exchange rate policy implies the choice of exchange rate regime in which a country determines their exchange rate regime either following the free exchange rate regime or fixed regime. In fact, during the twentieth century the possible choice of exchange rate regime was not only either fix or free-floating but also something in between, e.g. adjustable rates, crawling peg, etc. The exchange rate regime other than fix and free-floating regimes have also been widely implemented by many countries especially emerging market.

The dissimilarity in economic character and condition for each country around the world causes difference way in managing the exchange rate. In managing the exchange rate, a country usually chooses a particular exchange rate regime and determines set of policies to support the implementation of the exchange rate regime. Therefore, this chapter surveys the studies on the classification of the exchange rate regime as well as the description of the types of exchange rate regime which is adopted in many countries.

The rest of this chapter will be divided into several sections; section 1.2 describes a short history of the exchange rate regime development during pre and post of the Bretton Wood Agreement. Section 1.3 explains a definition of exchange rate in term of nominal and real as well as the determination of the exchange rate. International Monetary Funds (IMF) has considerable influence in the development of the exchange rate regime, besides IMF play important role as the world's financial institutions that provide financial support for its member countries. Related to the exchange rate regime, since 1970's the IMF recorded the official announcement (or usually known as "*de jure*") exchange rate regime in member countries. However, in the late 1990s the IMF changed the classification method of the exchange rate regime in member country and give more emphasis to observe what a member country actually conducted to their exchange rate regime (or known as "*de facto*"). The taxonomy of the exchange rate regime according to the IMF is described in section 1.4.

According to the IMF observations, there are many cases where difference between what a country formally announced about their exchange rate regime and what they actually implemented in practice usually occur. This issue will be described in the section 1.5. In section 1.6, the classification of the exchange rate regimes based on Frankel (1999 and 2003) will be presented. Finally, section 1.7 summarizes several prominent studies on the alternative classification methods of the exchange rate regimes.

1.2. A Brief History of the Exchange Rate Regimes

In the International Economics textbook, an international monetary system or it is also referred as an international monetary *regime* or order is defined as rules, instruments, customs, facilities as well as organization that effecting international payments. Besides, an international monetary regime is also related to the classification to which an exchange rate determined and according to the form that international reserve assets taken. The spectrums of the exchange rate ranging from a fixed to a free floating exchange rate system. While, several classification under the international reserve such as a gold standard (with gold as the only international reserve asset), a pure fiduciary standard (a pure dollar or exchange standard without any connection with gold), or a gold-exchange standard (a combination of the previous two). The various combinations (for example; fixed exchange rate system with gold standard, or fixed exchange rate system with U.S dollar reserve, etc.) can be selected by a country to determine the exchange rate arrangement, especially after the collapse of the Bretton Wood in 1971.

Nevertheless, the exchange rate has a long history that began with the adoption of the gold standard in 1880 to 1914. At that time, the exchange rate was determined by market mechanism of the gold and there was an effort to prevent the gold from moving outside the gold point by gold shipments. Under the gold standard, since each nation's currency consisted of either gold or paper currency backed by gold, then the money supply will fall/rise following deficit/surplus of nation's balance of payment. In this case, a deficit nation would be able to encourage their export and discourage their import until the deficit of the balance of payment was eliminated. The opposite case occurs for the surplus nation. This adjusted mechanism was explained by Hume which also known as the automatic price-specie-flow mechanism. The gold standard worked well during this period since there was great economic expansion and stability throughout most of the world. But to the outbreak of the First World War (WW-I) became the collapse of the gold standard.

The failure of the gold standard at the time of the WW-I was caused by the unpreparedness of the system to deal with the crisis and economic depression. Crockett (2003) explained several causes that made the gold standard failed: (i) the smoothness of price-specie-flow automatic mechanism that worked in the late of nineteenth century was an illusion, (ii) this system had not prevented periodic banking crises, nor had it avoided cycles of economic expansion and recession, (iii) the credibility and cooperation were strong during the gold standard period, but it had disappeared by the late of 1930s.

The impact of collapsing the gold standard was wild fluctuation of the global exchange rate. Therefore it appeared the desire to return to the gold standard. As a result, in 1925 the United Kingdom and followed by other countries, reestablished the convertibility of the pound into gold at the pre-war price and lifted the embargo on the gold export as prevailed at the outbreak of the WW-I. However, the new system was more in the nature of a gold-exchange standard than pure gold standard as previously adopted. During the WW-I period as well as the great depression in 1930s, the global exchange rate was instable and largely fluctuated. Several meetings had been held to discuss this issue, for example, the Brussels conference in 1920, the Genoa conference of 1922 and the London conference of 1933, but they all failed to agree on effort to overcome the exchange rate fluctuations at the time.

At the moment of the end of the Second World War (WW-II), the Allies considered to establish an international monetary system with some flexibility but with a heavy emphasis on fixity. Thus, in the end of 1944 the representative of 44 countries, led by the United State, met at Bretton Woods, New Hampshire, to decide the establishment post-war international monetary system. This meeting was also a forerunner for the establishment of the International Monetary Fund (IMF)[1] to achieve the following purposes: (1) overseeing that nations followed a set of agreed upon rules of conduct in international trade and finance and (2) providing borrowing facilities for nation in temporary balance of payment difficulties.

In general, the Bretton Woods system was similar to the interwar exchange rate system, i.e. gold-exchange standard. In this system, the United States maintained the price of gold fixed at $35 per ounce and be ready to exchange on demand dollar for gold at that price without restriction or limitation. Meanwhile, other countries fixed their currencies in term of the U.S dollar and maintained the value within ± 1 percent of the par value by foreign exchange market

[1] The IMF opened membership for other countries on March 1, 1947 and there were 30 nations joined as new members. By September 2014, 188 nations become member of the IMF.

intervention. The movement of the exchange rate within the band was determined by market. Since many currencies were fully converted into the U.S dollar until early of 1960s, the U.S dollar became the only intervention currency and in practical it indicated the gold-dollar standard.

Crockett (*ibid.*) states that there were precondition as basic of the successful implementation of the Bretton Woods: (i) modest capital flow, (ii) limited international inflationary and deflationary pressures, (iii) accepted obligation to direct domestic macroeconomic policies toward achieving external balance. These preconditions began to disappearing in the late of 1960s where the capital flows increased and new market were developed. This condition also caused high pressures in international inflationary and finally affected the core countries in the system that became unwilling to subordinate their domestic goals to the disciplines of the balance of payment.

The Bretton Woods system allowed a member country to change the par value in the case of fundamental disequilibrium. But in reality, many industrial countries are reluctant to do so and chose to keep par value within a relatively long time. As a result, speculation appeared and caused destabilization of the exchange rate. There was no attempt made by these countries to maintain the exchange rate stability, for example by devaluation or revaluation of their currency. In addition, the worsening of the United State balance of payments deficit was caused by several things including huge of capital outflow and increasing inflation due to the Vietnam War. This condition had declined the United State gold reserves from $25 million in 1949 to $11 million in 1970.

Since the US dollar was an international currency at the time of the Bretton Woods, it was not possible to reduce the US balance of payments deficit through devaluation of the US dollar. Therefore, several attempts were made to reduce the US balance of payments deficit of which keeping the short-term interest rates to remain high as efforts to reduce capital outflow and at the same time maintaining the long-term interest rates to remain low in order to stimulate economic growth. Besides, intervention in the foreign exchange market was also carried out on the spot market to keep the value of the US dollar as well as by selling forward strong currency such as the German mark. However, such efforts could not break up deficit of the balance payments. After all, on August 15, 1971 President Nixon terminated the conversion of the US dollar against gold and therefore the Bretton Woods system ended.

After the collapse of the Bretton Woods, since 1973 global exchange rate system has been determined by managed floating exchange rate system. This system led to the exchange rate to fluctuate over time following market pressures. Compared to the previous system, this system will be largely determined by market mechanism, hence there were fears that the exchange market conditions will be chaotic and increase speculation action against the exchange rate. Therefore, preventive actions are needed. The monetary authorities need to adopt appropriate policies that are considered necessary to maintain the exchange rate stability, either through direct intervention to the exchange market or through other monetary policy instrument such as interest rates.

The fluctuation of the global exchange rate after the collapse of the Bretton Woods had also effected to the international trade and international capital flows. Trade competitiveness is not only determined by the quality of the product but also affected by the exchange rates. A nation may weaken their exchange rate against hard currency in order to increase export competitiveness. However, if this policy was adopted by many countries to increase the trade competitiveness then this would endanger the global economy. Therefore, in January 1976 Jamaica Accords has been conducted. This agreement formally recognized the managed floating system and abolished the official price of gold. Besides, this agreement also allows countries to decide their exchange rate policy as long as the policy did not threaten their trading partner as well as global economy. After being ratified, the Jamaica Accords took effect in April 1978.

1.3. Definition of the Exchange Rate

In an open economy, the exchange rate plays important role in bridging domestic to world economy. It is the key of relative price in international finance related to rapid pace of internationalization in goods and asset market. Economist define exchange rate as the price of one currency in term of another currency. As it might be known that the important fact related to the international economy is that the exchange rate among the major countries are fluctuate, and the fluctuation is determined by many factors such as economic and other non-economic factors.

1.3.1 Nominal Exchange Rate

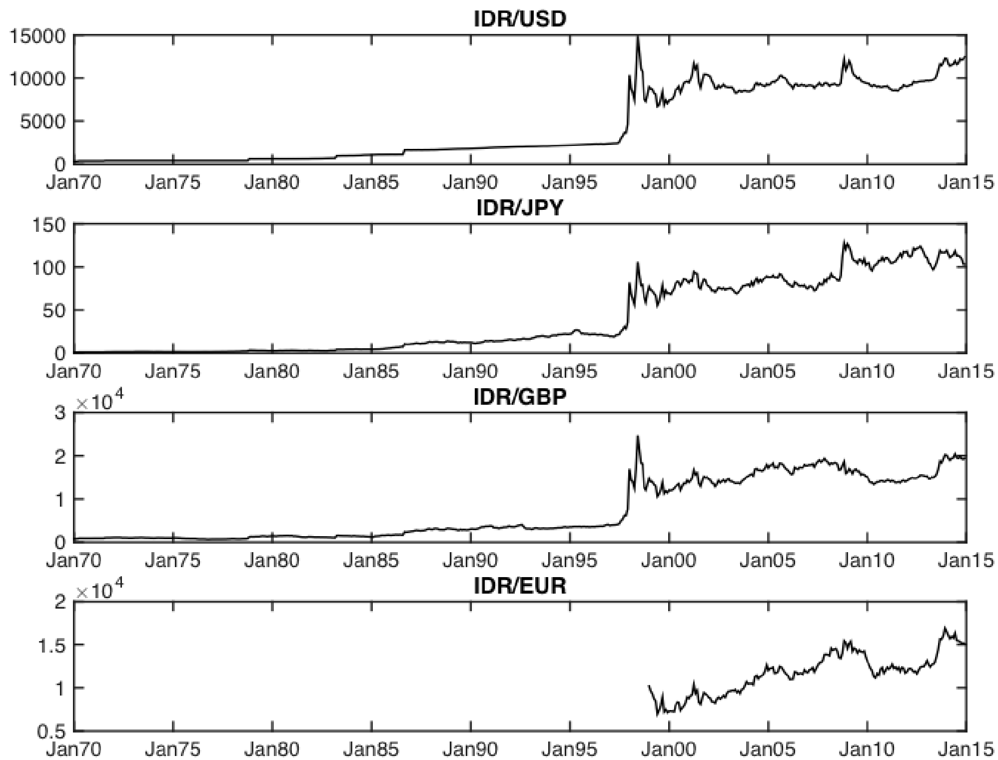
The word of exchange rate is usually referred to nominal exchange rate, which means the price of one currency in term of another currency, or it just like a price as another price of goods. In general, nominal exchange rate can be expressed as:

$$R = \frac{E}{E^*} \tag{1.1}$$

In equation (1.1), the nominal exchange rate, *R*, is determined by ratio of unit domestic currency (E) to unit of foreign currency (E*). It shows the number of unit of the domestic currency in terms of a unit of given foreign currency. A decrease (increase) in *R* can be interpreted as nominal appreciation (depreciation) of the currency and under the fixed exchange rate regime, a downward (upward) adjustment of the rate *R* is termed revaluation (devaluation). The information of nominal exchange rate publicly publishes in newspaper or other source of information (i.e. homepage of commercial bank as well as central bank).

For example, on December 29, 2013 Bank Indonesia (the central bank of Indonesia) reported that mid-rate of Indonesian rupiah against the U.S dollar was Rp12,250/US$ (or US$1= Rp12,250) which means that 1 unit US dollar can purchase 12,250 unit of Indonesia rupiah. On the next day, December 30, 2013 Bank Indonesia announced the mid-rate of the Indonesia rupiah against the US dollar was Rp12,331/US$. In this case, the Indonesia rupiah depreciated (or appreciation of the U.S dollar) by 0.66%; (12331-12250)/12250 = 0.0066. Sometimes, this expression might be counterintuitive, for instance when inverted expression is preferred e.g. presenting appreciation of the domestic currency on graph by its rise rather than its fall. In this example, the inverted expression is the U.S dollar against Indonesia Rupiah or US$/Rp (e.g. Rp1 = US$0.00008163 on December 29, 2013 and Rp1 = US$0.0000811 on December 30, 2013). But now, return of the exchange rate exhibit negative value, i.e. (0.0000811-0.00008163)/0.0000811 = -0.0066, which indicate dollar appreciation (rupiah depreciation). Inverted expression of the exchange rate will be employed in Chapter 2 and 3 to infer *de facto* exchange rate regime.

Figure 1.1: Nominal Exchange Rate Movement of Indonesian Rupiah



Source: International Financial Statistic-International Monetary Fund

There are two ways how is the exchange rate being recorded; first, it is based on spot transaction (known as spot exchange rate) which involves the immediate (2-days) exchange of other foreign currencies. Second, forward transaction (or forward exchange rate) involves the exchange of other foreign currencies at some specified date in the future. Figure 1.1 exhibits monthly movement of the nominal spot exchange rate of the rupiah against hard currencies[2]; such as the U.S dollar, the Japanese yen, the British pound and euro, from 1970 to 2014. During long-term observation, in general, Indonesia rupiah experienced weakening (depreciation) trend. However, under short-term observation, e.g. one year observation, the movements of rupiah value did not merely show depreciation trend but trend of appreciation also appeared in some period of time

[2] Also known as safe-haven or strong currency which mean the most widely traded currencies with high reliability and stable in store of value

(e.g. when there is no or low market pressures). In next chapters, analysis of the exchange rate movement of selected currencies against the strong currencies will be examined.

1.3.2 Real Exchange Rate

Another exchange rate measurement is real exchange rate. This is the rate at which good and services in the country can be exchanged for good and services in another country. In this case we are not only focus on the price of unit currency but we included the purchasing power of each currency. In other word, the real exchange rate measures the ratio of level of price in two difference countries in term of domestic currency. In general, the real exchange rate can be written as:

$$Q = R\left(\frac{P^*}{P}\right) \qquad (1.2)$$

Equation (1.2) shows that real exchange rate, Q, is just nominal exchange rate multiply by ratio of level of price in foreign country (P^*) and level of price of domestic country (P). This rate tells us how many times goods and services can be purchased in domestic country (after conversion into a domestic currency) than in the foreign market for a given amount. The change of value in Q could be interpreted as in nominal exchange rate but in the different way. An increase (decrease) in the real exchange rate is termed appreciation (depreciation). In contrast to the nominal exchange rate, the real exchange rate could be more fluctuate even in the regime of a fixed exchange rate, because it depends on the price-level changes. The real exchange rate increases (decreases) if: (1) the nominal exchange rate increases (decreases), (2) the level of price in foreign country increases (decreases), or (3) the level of price in domestic country decreases (increases). Take a simple example, assume that the domestic price level rises by 5 %, while the foreign price level remains unchanged and the domestic currency depreciates nominally by 5 %. Then the real exchange rate, i.e. the ratio of prices abroad (in term of domestic currency) and domestic remains unchanged, although nominal exchange rate changed.

1.3.3 Exchange Rate Determination

In the previous section, the exchange rate is said just a price, as another price of goods. In the economics, the price consists of some components to determine its level. Usually, under free market mechanism it simply said that the price will be determined by interaction of supply and demand. This section will examine purchasing power parity (PPP) to explaining the exchange rate determination. Referred to the economics textbook, the PPP theory was elaborated by Gustav Cassel, the Swedish economist, to estimate the equilibrium exchange rate at which a country could return to the gold standard after the disruption of international trade and the large change in relative commodity price in the various nations. The theory of PPP can be divided into two different concepts, absolute and relative PPP.

The absolute PPP theory postulates that the equilibrium exchange rate between two currencies is equal to the ratio of the price levels in two different countries. This can be stated as:

$$R = \frac{P}{P^*} \tag{1.3}$$

There is similarity between equation (1.1) and (1.3), where nominal exchange rate is equal to the ratio of unit of domestic currency to unit of foreign currency. The only difference is, in equation (1.3) the exchange rate, R, is determined by the ratio of general price in the domestic country (P) to general price in foreign country (P*). According to the Law of One Price (LOOP), the price of a given commodity should be equal in both countries when expressed in term of the same currency (the purchasing power is said to be at parity). If the price of commodity differs in those two countries, commodity arbitrage may emerge and this process will equalize commodity price in those countries through market mechanism. Since the general price level in each country includes tradable and non-tradable goods and services, the price of non-tradable could not be equalized by international trade. In addition, the concept of absolute PPP will only pay attention on the price of tradable goods and services while disregarding capital mobility, the capital inflow and outflow of a nation. This situation may cause the absolute PPP be misleading.

The second concept of PPP theory is relative PPP. The relative PPP theory postulates that the change in the exchange rate over a period of time should be proportional to the relative change in the price levels in the two countries over the same period of time. In this case, it is assumed that the subscript 0 refer to the base period and 1 to a subsequent period. Then the relative PPP theory could be expressed as:

$$\frac{R_1}{R_0} = \frac{P_1/P_0}{P_1^*/P_0^*}$$

$$R_1 = \frac{P_1/P_0}{P_1^*/P_0^*} R_0 \qquad (1.4)$$

where R1 and R0 are the nominal exchange rate at time 1 and in the base period, consecutively. From this point of view, it can be noted that if the absolute PPP held then the relative PPP would also hold, but if the relative PPP holds then the absolute PPP need not hold. In the open economy, the price can be divided into traded and non-traded price. According to Balassa and Samuelson (1964), the ratio of the price of non-traded to the price of traded goods and services is systematically being higher in developed countries rather than in developing countries. This suggests that beside determined by the price level, the exchange rate of currency is also determined by the level of economy of a country. The relationship between the level of price and real exchange rate will be described by extending equation (1.2). Suppose we take logarithmic in the both side of equation (1.2), hence the equation (1.2) will be:

$$log(Q) = log(R).log\left(\frac{P^*}{P}\right)$$

$$q = r + p^* - p \qquad (1.5)$$

where lower case letters denotes log of corresponding uppercase letters; real exchange rate (q), log of nominal exchange rate (r), and log of price in domestic country (p) and foreign country (p*). Suppose the price is a geometric average of traded and non-traded prices, then we define the level of price in each country as:

$$p = \alpha p^N + (1-\alpha)p^T$$

$$p^* = \alpha^* p^{N*} + (1-\alpha^*)p^{T*} \qquad (1.6)$$

where the * denotes foreign country and domestic price (p) can be decomposed as non-traded price (p^N) and traded price (p^T). Then substituting (6) into (5) and re-arranging yields:

$$q = r + (\alpha^* p^{N*} + (1-\alpha^*)p^{T*}) - (\alpha p^N + (1-\alpha)p^T)$$

$$q = r + \alpha^* p^{N*} + p^{T*} - \alpha^* p^{T*} - \alpha p^N - p^T + \alpha p^T$$

$$q = (r + p^{T*} - p^{T}) + \alpha^{*}(p^{N*} - p^{T*}) - \alpha(p^{N} - p^{T}) \quad (7)$$

Equation (7) shows that the real exchange rate can be determined by three components: (i) the relative traded price$\left(\frac{p^{T*}}{p}\right)$, (ii) the relative price of non-traded in term of traded price in foreign country$\left(\frac{p^{N*}}{p^{T*}}\right)$, and (iii) the relative price in domestic country$\left(\frac{p^{N}}{p^{T}}\right)$.

1.4. The IMF's Exchange Rate Taxonomies

As already explained in the previous section, the IMF was established in conjunction with a meeting in Bretton Woods, New Hampshire in 1944 to decide the international monetary system after the war period. This section is not intended to discuss the history of the IMF but to describe the role of the IMF related to the application of the exchange rate regime in member countries. There are at least two purposes in the establishment of the IMF, i.e. (1) overseeing the member countries in international trade and finance, (2) providing borrowing facilities for nations in temporary difficulties of balance-of-payment. In line with the first purpose, the IMF oversees the activities of international trade, including the movement of international finance where the exchange rate of a currency plays important role. Thus, the Fund also concern about the exchange rate movement as well as the exchange rate regimes.

During 1945 to 1971, the member countries agreed to keep their exchange rates pegged at certain rates. The member maintained their exchange rate within ± 1 percent around *vis-á-vis* its par value[3]. As being agreed, the exchange rate could be adjusted only to correct a "fundamental disequilibrium" in the balance of payments, and only with the IMF's agreement. This system prevailed until 1971, when the U.S. government suspended the convertibility of the dollar into gold. In the next period, from December 1971 to January 1974, the IMF member countries maintained their exchange rate within ±2.25 percent around its par value (any member's

[3] Par values are vis-á-vis the U.S dollar or gold of certain weight and fineness

currency, gold, or the SDR) under the Smithsonian Realignment. Therefore, the prevailing exchange rate system during this period was fixed or pegged.

As already explained, after the collapse of the Bretton Woods system, the IMF members have been free to choose any form of exchange arrangement and allowing their currency to float, pegging it to single currency or a basket of currencies, adopting the currency of another country, participating in a currency bloc, or forming part of a monetary union.

In June 1975, the IMF classified the exchange rate regime adopted by the member countries. Following the 1975 taxonomy, the exchange rate regime was classified into; (i) **pegged to a single currency**, (ii) **pegged to a composite** (including the Special Drawing Right – SDR[4]), (iii) **floating and adjusted** according to a set of indicators, (iv) **floating with common margin**, (v) **floating independently**. Under classification of (i) – (iv), the IMF member maintained their exchange rate within ±2.25 percent around a central rate vis-à-vis a single currency or a basket of currencies, while under (v) the exchange rate was allowed to deviate from a central rate greater than ±2.25 percent. This taxonomy prevailed until September 1976 because the IMF simplified their classification in November 1976, and this classification was called 1977 taxonomy. In 1977 taxonomy, the first two regimes remain unchanged but the rest was changed into "**adjusted according to a set of indicators**" and "**cooperative exchange arrangements**". As the previous taxonomy, the 1977 taxonomy ended on December 1981.

The 1982 taxonomy was arranged by the IMF and had been applied from January 1982 to October 1998. In this new arrangement, several new classifications of the exchange rate regimes have been introduced. There were 7 classifications under the 1982 taxonomy, viz. (i) **pegged to a single currency**, maintaining the exchange rate within zero or very narrow margins seldom exceeding ±1 percent around a central rate vis-à-vis a single currency[5], (ii) **pegged to a composite** (including the SDR), (iii) **flexibility limited vis-à-vis a single currency** and

[4] International reserve created by the IMF in 1969 to supplement other international reserves and distributed to member countries according to their quotas. Its value is based on a basket of four key international currencies, and SDRs can be exchanged for freely usable currencies.

[5] Beginning in July 1992, countries that are fully dollarized are included in this category (previously, they were classified according to the arrangement of the foreign currency giving rise to the dollarization—e.g., the U.S. dollar).

maintaining the exchange rate within margins of ±2.25 percent vis-à-vis another member's currency or the SDR, (iv) **flexibility limited vis-à-vis a cooperative arrangement**, (v) adjusted according to a set of indicators, (vi) **other managed floating**, (vii) **independently floating**, in this case the authorities allow the exchange rate to move continuously over time to reflect market forces.

During 1975 to 1998, the IMF classifying the exchange rate regimes that pursued by its member countries was based on their official or *de jure* notification to the IMF. This method may cause misclassification of the exchange rate regime pursued by a country since there was possibility that the member countries reported their regime differently with what they were actually doing in practice. To overcome these shortcomings, the IMF modified the classification method by abandoning the passive way (i.e. obtaining the information of exchange rate regime from the official announcement) to the active way. Bubula and Ötker (2002) describe that the new classification method are based primarily on information obtained through bilateral discussions with or provision of technical assistance to IMF member countries and from regular contact with IMF economist. Besides, other information is also gathered from news articles, press reports, and other relevant papers then all this information will be analyzed to observe the movement in exchange rate.

The new classification method has been adopted by the IMF since January 1999. New nomenclature is also introduced in this new scheme and the following categories have been classified as (i) **exchange arrangement with no separate legal tender**, the member country has legislatively surrendered sole control over domestic monetary policy[6], (ii) **currency board arrangement**, (iii) **conventional pegged arrangement**, the country fixes its exchange rate to an anchor currency or basket within margins of less than ±1 percent, (iv) **pegged exchange rate within horizontal bands**, the value of the currency is maintained within a band, but the range was at least 2 percent (or ±1 percent around a central rate), (v) **crawling peg**, (vi) **crawling band**, the exchange rate is adjusted in small amounts, but the rate may fluctuate in a range of ±1 percent or more or a range of 2 percent, (vii) **managed floating with no preannounced path**

[6] Under this category, there are two types of arrangements: (1) another currency as legal tender, in which the country has adopted a foreign currency as the sole legal tender, and (2) currency union. In January 2007, countries in the second group were classified on the basis of the arrangement governing the joint currency.

for the exchange rate (in 2005, the word preannounced was replaced with predetermined), (viii) **independently floating**, the exchange rate is market-determined and followed by any official foreign exchange market intervention.

1.5. The Discrepancies of *De Jure* and *De Facto* Exchange Rate Regime

One of the reasons why the IMF developed significant changes to the exchange rate regime classification method for its member is due to the difference between the exchange rate regime that officially announced (*de jure*) and what was actually did in the reality (*de facto*). The classification of the exchange rate regimes shows that since the late of 1970s the majority of member countries notified that they adopted fixed or floating regime. This certainly supports the bipolar view. Bubula and Ötker (2002) state that the proportion of IMF member countries with officially pegged exchange rates has halved, whereas that of floating countries has doubled. Furthermore, the declining number of countries with pegged regime followed by increasing number of countries with hard peg regime over the last decade since growing number of countries with a currency board, joined currency unions, or dollarization.

It is uneasy task to determine and understand the exchange rate regime adopted by a country due to the difference between what is announced with what is actually done related to exchange rate regime. There are many studies concerning to this issue, among others, the study of Calvo and Reinhart (2002) states that many countries announced to adopt a floating regime, but in reality they do not run it or it can be referred as "fear of floating". When a country declares to adopt a floating exchange rate regime, the exchange rate fluctuations will not be followed by fluctuations in foreign exchange reserves. This means that no attempt was made to influence the exchange rate by changing the position of foreign reserves from time to time. However, the studies conducted by Calvo and Reinhart (2002) showed that the variability of foreign exchange reserves relative to the variability of the exchange rate does not only happen in a country that claimed to run a floating regime, but the same is also found in countries that officially declared running fixed regime. The other conditions otherwise stated by Levy-Yeyati and Sturzenegger (2005) which shows that many countries are running fixed regime but they announced that they adopted more flexible exchange rate regime, or this phenomenon is referred to "fear of pegging".

Fischer (2001) conducted a study to examine the transition of exchange rate regime that adopted by IMF member countries by comparing the distribution of the exchange rate regime in 1991 and 1999 based on the classification made by the IMF. The results showed an increase in the number of countries adopting fixed regime, which is 12% for all countries and 3% for emerging countries. The increase also occurred in countries that adopt a floating regime, 19% for all countries and 18% for emerging countries. Along with an increasing number of countries adopting the regime of fixed and floating regimes, the number of countries adopting intermediate regimes has declined by 30%. This fact shows that many countries left the intermediate exchange rate regime and switch to a fixed or floating regime. In other words it is also become evidence to the "bipolar view" or "hollowing-out" hypothesis.

1.6. Types of the Exchange Rate Regimes

The currency regime is not only composed of two (extreme) choices as mentioned in the "impossible trinity", i.e., (pure) fixed and (pure) floating. Along with the developments taking place, more particularly after the collapse of the Bretton Woods system, each nation determines its own policy of managing the exchange rate in achieving economic objective(s). Thus there are various possible types of exchange rate regime, not only at the two extremes but rather spread in a spectrum. Each type of regime in this spectrum can be distinguished since they has unique characteristics.

Frankel (2003) classifies exchange rate regime into 9 categories and grouped into 3 broad categories of floating, intermediate, and firmly fixed. In this classification there are two extreme cases, i.e. free-floating and fixed which are called corner solutions. This classification is sometimes called as bipolar system. Table 1.1 comprises the exchange rate regime classification according to Frankel:

Table 1.1: Classification of Exchange Rate Regimes

A. Floating Corner	B. Intermediate Regime	C. Firm Fix Corner
1. Free Floating 2. Managed Floating	3. Band 3.a. Bergsten-Williamson Target Zone 3.b. Krugman-ERM Target Zone 4. Crawling Peg 4.a. Indexed 4.b. Preannounced Crawl 5. Basket Peg 6. Adjustable Peg	7. Currency Board 8. Dollarization (or Euro-ization) 9. Monetary Union

Source: Frankel (2003)

In general, Frankel started his taxonomy with floating categories and ended with fixed. But there is complexity in classifying regimes under intermediate regime, therefore Frankel put band (or target zone) as first category in the intermediate regime and ended with adjusted peg. Band and crawl are distinguished to emphasis that the classifications also consider parity adjustments in line with ex post inflation. There are several relevant parameters for each regime under the intermediate regimes; (i) the width of the margin (for band case), (ii) the speed of crawl (for crawl case), (iii) the number of currencies in the basket and the extent to which the weights are publicly announced (for basket case), and (iv) the magnitude of the shock necessary to trigger the change in the parity (for the case of the adjustable peg). Under the intermediate regime, categories of 3 to 6 are not exclusive but rather are regularly mixed and matched, hence there is another possibility of the regime called basket-band-crawl (constitutes a single regime) or abbreviated as BBC.

More specifically, Frankel stated that it being worth to distinguish between categories A and B as well as B and C. The best way to classify managed float is to put it in category B, if and only if there is an explicit target of the central bank intervention. For a central bank that occasionally intervenes in the foreign exchange market without announcing a specific target, it can be classified into category A. Meanwhile, for countries that committed to adopt a fixed exchange rate regime, it should be classified in category C, if and only if there is an official announcement of institutional commitment to adopt fixed regime, for instance by issuing law or regulations on adopting currency board.

Frankel (1999) characterize each regime, but he started the regime classification from the most rigid arrangement and becoming increasingly inflexible as follows:

1. **Currency union**. The currency that circulates domestically is literally the same as that circulating in one or more major neighbors or partners. Dollarization has been proposed in several Latin American countries. This is the strongest commitment to adopt fixed exchange rate.
2. **Currency board**. A credibility of monetary authority that is required to maintain a fixed exchange rate with a foreign currency.
3. **"Truly fixed"**. Fixing a domestic currency to a specified hard currency. Members of the francophone West African and Central African currency unions fix to the French franc, while many countries fix to the dollar.
4. **Adjustable peg**. Also known as "fixed but adjustable" as prevail under the Bretton Woods regime.
5. **Crawling peg**. The peg can be regularly reset in a series of mini-devaluations, for instance in the high inflation country.
6. **Basket peg**. The exchange rate is fixed in terms of a weighted basket of currencies instead of any one major currency. Most countries that announce to adopt a basket peg keep the weights secret.
7. **Target zone or band**. The authorities pledge to intervene when the exchange rate hits pre-announced margins on either side of a central parity.
8. **Managed float**. Also known as a "dirty float" and it is defined as a readiness to intervene in the foreign exchange market, without defending any particular parity. Most intervention is intended to lean against the wind -- buying the currency when it is rising (or is already high) and selling when it is falling (or is already low).
9. **Free float**. There is no intervention in the foreign exchange market, but rather follows market mechanism.

1.7. The Exchange Rate Regimes: Alternative Classifications

The efforts to determine the exchange rate regime adopted by a country became concern for international financial institutions like the International Monetary Fund (IMF) since 1975. Up to 1998 the IMF gathered information of *de jure* exchange rate regime from each member countries by self-reporting methods. Based on this report, the IMF then classified the exchange rate regime of the member countries in several classifications. This information is then collected in the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Beside, this topic is very attractive so that there are many studies concerning the true exchange rate regime that actually followed by a country (de facto). Among others, there are several prominent study in this field including Ghosh, Gulde and Wolf (2003), Reinhart and Rogoff (2004), Shambaugh (2004), and Levi-Yeyati and Sturzenegger (2005).

Ghosh.*et.al* (*ibid*) proposed a classification of the exchange rate regime that started from an intuitive approach that a pegged exchange rate is one whose value referred to reference currency or commodity (traditionally gold) and does not vary or varies only within narrow or predefined limits. Since the central bank has a commitment to adopt this regime then the parity will be maintained through foreign exchange intervention and, ultimately, through the subordination of its monetary policy to the exchange rate objective if necessary. In a floating regime, by contrast, the central bank undertakes no such commitment. Ghosh *et.al* classified the exchange rate regimes into 10 regimes and grouped into 3 board categories, as presented in Table 1.2.

Ghosh *et.al* Classification is similar to the Frankel's classification since both these classifications based on 3 broad categories. However, the sub-classification proposed by Ghosh provides more detail picture of the classification regime. Using sub-classification, Ghosh include the basket peg into pegged (fixed) corner and the managed floating into intermediate regime. Compared to the Frankel classification in Table 1, this part has slightly differences. The basket peg is one of the most popular exchange rate regimes that has been chosen and adopted by emerging market countries, as will be discussed in subsequent chapters. It seems that adopting basket peg regime is a strategy to maintain the exchange rate at a certain level without announcing regime change.

Bubula and Ötker (2002) following the new IMF classification system and arranging the classification based on historical database on de facto regimes. This classification system is based on the information obtained by supporting and supervision of technical assistance to each IMF member country as well as regular contacts with the IMF country economist. In their study, monthly and annual data are used. There are thirteen categories under Bubula and Ötker classification; i.e. (1) formal dollarization, (2) currency union, (3) currency board, (4) conventional fixed peg to single currency, (5) conventional fixed peg to basket currency, (6) pegged within a horizontal band, (7) forward-looking crawling peg, (8) backward-looking crawling peg, (9) forward-looking crawling band, (10) backward-looking crawling band, (11) tightly managed floating, (12) other managed float with no predetermined exchange rate path, and (13) independently floating.

Table 1.2: Classification of Currency Regimes – Ghosh.*et.al* (2003)

Classification	Sub-classification	Regime	Main Characteristics
Pegged	Hard Pegs	Dollarization	A foreign currency is used as legal tender. Monetary policy is delegated to the anchor country. Seigniorage accrues to the issuing country
		Currency Boards	The exchange rate is pegged to a foreign (anchor) currency, with the regime and the parity enshrined in law. Seigniorage accrues to the home country
		Monetary Union	A group of countries uses a common currency issued by a common regional central bank. Monetary policy is determined at the regional level. Seigniorage accrues to the region.
	Traditional Pegs	Single Currency Pegs	The exchange rate is pegged to a fixed par-value to a single foreign currency. Credibility is greater the higher the level of central bank reserves, but generally reserves do not fully cover all domestic monetary liabilities, leaving some room for discretionary monetary policy.
		Basket Pegs	The exchange rate is pegged to basket currencies. For country-specific baskets, basket weights may be publicly known or be secret, and may be fixed or variable
Intermediate Regimes	Floats with Rule-Based Intervention	Cooperative Regimes	Cooperating central banks agree to keep the bilateral exchange rates of their currencies within a preset range of each other.
		Crawling Peg	The exchange rate is typically adjusting at a predetermined rate or as a function of inflation differentials. It can be set with regard to a single currency or a basket of currencies. In some cases, crawling pegs are combined with bands.
		Target Zones and Bands	Exchange rate is allowed to fluctuate within a preset range; endpoints defended through intervention. Degree of exchange rate flexibility is determined by the width of the band or target zone.
	Floating with Discretionary Intervention	Managed Floating	Exchange rates are free to move according to supply and demand. Authorities have a view on the desired level and path of the exchange rate and intervene, but are not bound by any intervention rule. Often accompanied by a separate nominal anchor, such as an inflation target
Floating Regimes	Free Floats	Float	The exchange rate is determined in the foreign exchange market based on daily supply and demand with minor or no official intervention. Requires little or no official reserves. Exchange rate regime places no restrictions on monetary policy, which often follows an inflation-targeting framework

Source: Ghosh *et.al* (2003)

Reinhart and Rogoff (2004) develop a system of reclassifying historical exchange rate regimes. They employ monthly data on market-determined parallel exchange rates going back to 1946 for 153 countries. Beside, several measures of exchange rate variability as well as 12 month rate of inflation also have been employed. Based on rate of inflation, this classification separates a country with high inflation rate (i.e. more than 40%) and classified this country as freely falling. Their study also considered detailed country chronologies and a board variety of descriptive statistics. As a result, they provide fourteen categories in their classification, i.e. (1) no separate legal tender, (2) pre-announced peg or currency board arrangement, (3) pre-announced horizontal band that is narrower than or equal to ± 2%, (4) de facto peg, (5) pre-announced crawling peg, (6) pre-announced crawling band that is narrower than or equal to ± 2%, (7) de facto crawling peg, (8) pre-announced crawling band that is wider than or equal to ± 2%, (9) de facto crawling band that is narrower than or equal to ± 2%, (10) de facto crawling band that is narrower than or equal to ± 5%, (11) moving band that is narrower than or equal to ± 2%, (12) managed floating, (13) freely floating, and (14) freely falling.

Levi-Yeyati and Stuzenegger (2005) construct a de facto classification based on data on exchange rates, international reserves, and monetary bases from 183 countries over the period 1974–2000. This study employed 3 classification variables, i.e. (i) exchange rate volatility, (ii) volatility of exchange rate changes, (iii) reserve volatility and using cluster analysis to classify those variables. The classification is constructed based on the following criterion:

Table 1.3: Levi-Yeyati and Sturzenegger Criterion on Regimes Classification

Regime	Exchange Rate Volatility (σ_e)	Volatility of Exchange Rate Changes ($\sigma_{\Delta e}$)	Volatility of Reserve (σ_r)
Inconclusive	Low	Low	Low
Flexible	High	High	Low
Dirty Float	High	High	High
Crawling Peg	High	Low	High
Fixed	Low	Low	High

Source: Levi-Yeyati and Sturzenegger (2005, Table 1)

As presented in the Table 1.3, there are four categories in Levi-Yeyati and Sturzengger classification, i.e. (1) flexible, (2) Dirty float, (3) crawling peg, and (4) fixed. The category of "inconclusive" is also provided to classify a country's regime when all variables have low magnitude. In this study, they found that the de facto pegs have remained stable throughout the last decade, although an increasing number of them away from an explicit commitment to a fixed regime and confirmed the hollowing out hypothesis applied only to countries with access to capital markets. In addition, they also found that pure floats are associated with only relatively minor nominal exchange rate volatility and that the recent increase in the number of de jure floats goes hand in hand with an increase in the number of de facto dirty floats ("fear of floating").

Shambaugh (2004) investigate how a fixed exchange rate affects monetary policy. This study classifies countries as pegged or non-pegged and examines whether a pegged country must follow the interest rate changes in the base country. He employ monthly data of exchange rate for 155 countries from 1973 – 2000 and apply simple statistical analysis. As a result, there are five categories in his classification, i.e. (1) 0% change in the exchange rate, (2) stay within 1% bands, (3) stay within 2% bands, (4) realignment but zero change in 11 of 12 months, (5) no peg. In his study, the 3 de facto classification methods (i.e. Ghosh, Gulde and Wolf (2002), Levi-Yeyati and Sturzenegger (2005), and Reinhart and Rogoff (2004)) have been compared to de jure IMF classification. As a result, he found that these three de facto classifications hardly correspond closely each other than to the IMF official classifications, since the coefficient of correlation shows relatively low, i.e. less than 0.5, except the correlation between de jure IMF classification and de facto classification by Ghosh, Gulde and Wolf. The difference in classification may appear due to various aspects, for instance differences in methodology, differences in observation period of the data, and so forth.

Tavlas, Dellas and Stockman (2006) conducted their survey study based on 11 studies and divide classification methodology into two board approaches: (1) mixed de jure-de facto classification based on revisions to, and/or corrections of, the IMF de jure classification; and (2) pure de facto classification. Although the first approach is rely on de jure IMF classification, but another classification could be arranged with wide range of different across the classification. In the first approach, the classification can be viewed as "mixed" classifications because the self-declared regimes are adjusted by the divisor for anomalies (e.g., floating rates that display no exchange-rate volatility) on the basis of such factors as judgment, statistical algorithms, and developments in parallel (black) markets. Meanwhile, the second approach emphasis the classification regime is based solely on statistical algorithm and/or econometric estimation and independent of the official classification.

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Chapter 2

Indonesian Exchange Rate Regime Post-Asian Crisis: Managed or Free-Floating?

Indonesian Exchange Rate Regime Post-Asian Crisis: Managed or Free-Floating?

2.1. Introduction

The currency crises experienced by Thailand in May 1997 spread to their neighbor countries including Indonesia. As a result, the Indonesian rupiah suffered from high pressures and led to the weakening of the rupiah against the US dollar. During the pre-Asian crisis, officially Indonesia was under a managed-floating regime. By the time when the pressure to the rupiah was increasing, Bank Indonesia (the central bank of Indonesia) widened the band-intervention to control the rupiah value. Inasmuch as the pressure to the Indonesia remained high, the widening of the band-intervention has reduced the foreign reserves. To avoid the severe declining of the foreign reserve, the central bank of Indonesia decided to abandon the prevailing managed-floating regime and switched to floating regime on August 14, 1997. The new regime caused the movement of rupiah value change dramatically and wildly fluctuated at least until the end of 1999. In 1998, The International Monetary Fund classified Indonesia into free-falling regime since the rupiah experienced wild fluctuation.

Since 1970's, Bank Indonesia had changed the official (*de jure*) exchange rate regime several times. This change had been made to respond the situations in particular periods to maintain the stability of rupiah value as well as to attain economic objectives i.e. increasing export competitiveness, attracting foreign capital inflow, etc. Regarding to the exchange rate regime change in 1997, Bank Indonesia explicitly stated that "With the stronger pressure on the rupiah, on August 14, 1997 Bank Indonesia decided to change the exchange rate system of the managed-floating system to become free-floating system. However, at certain times Bank Indonesia intervened to dampen volatility..."[1]. As officially stated, under the new regime the rupiah will be determined only by the market mechanism, but in the same time Bank Indonesia also declared to

[1] Annual Report 1997/1998 page 7, Bank Indonesia

intervene the rupiah in the exchange market to dampen the exchange rate volatility. Theoretically, when Bank Indonesia officially announced that the free-floating regime was adopted, the rupiah value will be determined mainly by market mechanisms; therefore the value of the rupiah should be more volatile than under the managed-floating regime.

The purpose of this chapter is to find statistical evidence for the actual movement of the Indonesia rupiah especially during the post-Asian Crisis of 1997. The main question is whether during the post-Asian crisis, the Indonesia rupiah still following the official regime or deviating from it. By finding statistical evidence on this matter, we have no intention to assess Bank Indonesia policy regarding to maintain the stability of the rupiah value. In addition, some questions are raised in this chapter: (i) Does rupiah still tightly pegged to the US dollar during the post-Asian crisis? (ii) Is rupiah allowed to move flexibly as during the post-Asian crisis period? (iii) How is the volatility of the rupiah during the pre and post-Asian crisis? (iv) How Bank Indonesia maintains the rupiah stability?

The rest of this chapter is organized as follows: In section 2.2, we describe data and methodology to verify whether the actual (*de facto*) movement of the Indonesia rupiah follows the official exchange rate regime. Section 2.3 presents statistical evidence about the actual movement of the Indonesia rupiah during pre-Asian crisis (1970–1996). Based on this evidence, we confirm whether the official (*de jure*) exchange rate regime really implemented or it deviated in practice. Section 2.4 examines whether the *de facto* exchange rate regime follows *de jure* regime, i.e. free-floating regime, after the onset of the Asian crisis 1997. Section 2.5 describes the efforts of Bank Indonesia in maintaining the rupiah stability from internal and/or external shocks. As noted, there are several internal or external (economic) shocks during 2000-2013, e.g. domestic shock due to revoking oil subsidy in 2005, Lehman shock in 2008, etc. Finally, section 2.6 offers a conclusion.

2.2. Data and Methodology

To obtain the statistical evidences, we collect monthly nominal exchange rate of the rupiah (IDR), Japanese yen (JPY), Deutsch mark (DEM), Euro (EUR), and Swiss franc (CHF) against the US dollar (USD). In addition, a monthly foreign exchange reserve for Indonesia is also collected. The data were taken from the International Financial Statistics (IFS-IMF) from January 1970 to December 2013. In this chapter, we select the CHF as *numeraire*, therefore all the currencies will be expressed in inverted way, for example CHF/IDR. In this case, increasing (decreasing) movement of CHF/IDR reflect appreciation (depreciation) of the Indonesia rupiah against the Swiss franc. This expression is also applied to the other currencies, i.e. CHF/JPY for the Japanese yen, CHF/DEM for the Germany mark, CHF/EUR for the Euro, and CHF/USD for the US dollar,

Frankel-Wei (2008) developed regression equation as a technique for inferring implicit basket weight and incorporating exchange rate flexibility (or inflexibility) in several countries under the assumption that the home currency is determined by a basket of currency. In this study, we apply this technique to infer the *de facto* exchange rate regime in Indonesia and assume that the movement of the rupiah is determined by G3 currencies (USD, JPY, DEM, or EUR). Using the Swiss Franc (CHF) as *numeraire*[2], we estimate the following equations for pre and post-Asian crisis:

Pre-Asian crisis

$$\Delta(e_{IDR})_t = c + \alpha_1 \Delta(e_{USD})_t + \alpha_2 \Delta(e_{JPY})_t + \alpha_3 \Delta(e_{DEM})_t + \beta \Delta emp_t + \varepsilon_t \qquad (2.1)$$

Post-Asian crisis

$$\Delta(e_{IDR})_t = c + \alpha_1 \Delta(e_{USD})_t + \alpha_2 \Delta(e_{JPY})_t + \alpha_3 \Delta(e_{EUR})_t + \beta \Delta emp_t + \varepsilon_t \qquad (2.2)$$

where each variables are defined as follows:

(i) $\Delta(e_{IDR})_t$ is log difference of the Indonesian rupiah exchange rate (CHF/IDR) at month t

(ii) c is a constant term

[2] Several *numeraire* are used in similar studies, among others : Frankel (1993) uses purchasing power over a consumer basket of domestic goods; Frankel and Wei (1995) use SDR; Frankel and Wei (1994, 2006) use Swiss Franc; Bénassy-Quéré (1999) use dollar

(iii) $\alpha_k (k = 1,2,3)$ are the coefficients of the hard currencies for currency k, i.e. USD, JPY, and DEM or EUR respectively

(iv) β is the coefficient of the exchange market pressure

(v) Δemp_t is defined as the sum of log difference of CHF/IDR and log different of the Indonesian foreign reserve at month t. We discuss the definition about EMP at the end of this section.

(vi) ε_t is the residual term

The coefficients of $\alpha_1, \alpha_2, \alpha_3$ in the equation (2.1) and (2.2) can be interpreted as degree of influence of G3 currencies to the rupiah. Since the basket of currency never officially announced, it is difficult to conclude whether the high and significant of these coefficients imply potential basket currency or if it is only caused by market conditions. Unlike in the original paper of Frankel-Wei (2008), in our estimation we do not restrict the sum of $\alpha_k (k = 1,2,3)$ equals 1. Therefore the magnitude of the coefficient may exceed 1. As stated in *ibid* (page 23), the coefficient of exchange market pressure can be interpreted as flexibility or inflexibility of the rupiah. If the β is significant (i.e. reject the null hypothesis of β equal zero), it can be interpreted that the rupiah is allowed to move flexibly. Meanwhile, if the β is not significant (i.e. fail to reject the null hypothesis of β equal zero) can be interpreted that the rupiah is not allowed to move flexibly.[3] We interpret the β in different way since the Δemp_t is the exchange market pressure. Therefore, if the coefficient β is equal to 0 then home currency is fixed and if β is significantly not equal to 0 then home currency is floating.

Baig (2001) observed the characteristics of the exchange rate regime in some countries in Asia after the economic crisis in 1997 by looking at the volatility of exchange rate, which is defined as standard deviation of the percentage changes of the exchange rate of home currency against the US dollar. In addition, the volatility of interest rate and foreign reserve for each surveyed countries are also observed in Baig's study since the exchange rate volatility may not be sufficient to characterize the exchange rate regime. The authorities have targeted rate through monetary policy and intervention in the foreign exchange market, hence it should be considered

[3] All the coefficients in equation (2.1) are not restricted, hence the value could be more than 1 or less than 0

in characterizing the exchange rate regime. The volatility of the exchange rate, interest rate, and foreign reserve only provide a partial picture of an exchange rate regime. But using the combination of the standard deviation of the exchange rate and the foreign reserve will produce a more informative indicator of exchange rate flexibility that can be used to analyze the exchange rate regime behavior. Bayoumi and Eichengreen (1998) created an index of exchange market flexibility. The flexibility index is constructed by dividing the standard deviation of exchange rate movement by a measure of exchange market pressure. The formula of the index is as follows:

$$Index = \frac{SDEX}{(SDEX + SDREV)} \quad (2.3)$$

where each variables are defined as:

(i) SDEX is standard deviation of exchange rate changes (log difference)

(ii) SDREV is standard deviation of the ratio of changes in reserves, divided by lagged stock of base money

The range of the index is from 0 to 1. A lower (higher) index indicates that the exchange rate is relatively inflexible (flexible).

In this chapter, we compare volatility of the exchange rate of the rupiah by observing standard deviation of percentage changes of the rupiah against the G3 currencies i.e. the US dollar, the Japanese yen, and European currencies i.e. the German marks and the Euro. In addition, the standard deviation of the percentage change of Indonesian foreign reserve is also observed. High (low) standard deviation indicates high (low) volatility. As this chapter focuses only to observe the Indonesian rupiah movement, the period of observation will be divided into 2 sub-periods to obtain information and characteristics of the Indonesia rupiah movement during the pre and post-Asian crisis. Therefore, we define the pre-Asian crisis as from April 1971 to July 1997 and the post-Asian crisis is from January 2001 to December 2013. We exclude during the crisis period, from August 1997 to December 2000, due to the high volatility of rupiah movement.[4]

In each sub-period, we examine the characteristic of rupiah movement using standard deviation and estimate the coefficient under equation (2.1). Since the *de jure* exchange rate regimes have

[4] We provide Table A and B in Appendix-A to show the estimated parameters and the characteristic of rupiah during the crisis period

been changed in each sub-period, therefore we expect that the estimated coefficients of the equation (2.1) as well as the standard deviation of the exchange rate and foreign reserve will be different for each period. In addition, during the pre-Asian crisis period we estimate the equation (2.1) using different number of observations that correspond to the devaluation period. For instance, under the *de jure* fixed regime we estimate the equation (2.1) using observation period of September 1971 to October 1978. The devaluation policy taken by Bank Indonesia during pre-Asian crisis is explained in next section. While to estimate the equation (2.2) for post-Asian crisis, the number of observation is 24 months and it will start from January 2000 – December 2001 to January 2012 – December 2013.

2.2.1 A Note on the Exchange Market Pressure (EMP)

To discuss about the definition of EMP, first we quote explanation about EMP from Frankel-Wei (2008) in page 9 as follows:

> "…The question is: when there is a shock that increases international demand for korona, to what extent do the authorities allow it to show up as an appreciation, and to what extent as an increase in reserves. In this paper, we frame the issue in terms of the Exchange Market Pressure variable, which is defined as the percentage increase in the value of the currency plus the percentage increase in reserves (or the monetary base, or M1). When this variable appears on the right-hand side of an equation and the percentage increase in the value of the currency appears on the left, a coefficient of 0 signifies a completely fixed exchange rate (no changes in the value of the currency), a coefficient of 1 signifies a freely floating rate (no changes in reserves) and a coefficient somewhere in between indicates a correspondingly flexible/stable intermediate regime."

From this part we can easily follow what is meant by exchange market pressure, i.e. sum of percentage increase in the value of home currency plus the percentage increase in reserves. In addition, the definition of EMP is also given in mathematical expression as in *ibid* (page 12):

$$\{emp_{t+s} - emp_t\} \equiv \{\log EMP_{t+s} - \log EMP_t\}$$
$$\equiv \{\log H_{t+s} - \log H_t\} + \{\log R_{t+s} - \log R_t\}$$

We can rewrite this equation by:

$$\Delta emp_t \equiv \Delta h_t + \Delta r_t$$

where:

(i) Δemp_t is log difference of EMP at time t or $\left\{\log \frac{EMP_{t+s}}{EMP_t}\right\}$

(ii) Δh_t is log difference of home currency exchange rate (H) at time t

(iii) Δr_t is log difference of home country's foreign reserve (R) at time t

Increasing (decreasing) value of Δh_t indicates appreciation (depreciation) - when the exchange rate is expressed in inverse way, e.g. CHF/IDR for Indonesian case. On the other hand, increasing (decreasing) value of Δr_t indicates reserve accumulation (dis-accumulation). Therefore, there will be the following four possible changes in Δemp_t:

1. $\Delta h_t(\uparrow) + \Delta r_t(\uparrow)$; market pressure due to home currency appreciation followed by accumulation of foreign reserve (good time to increase foreign reserve through market operation)
2. $\Delta h_t(\downarrow) + \Delta r_t(\downarrow)$; market pressure due to home currency depreciation followed by dis-accumulation of foreign reserve (selling foreign reserve through market operation)
3. $\Delta h_t(\uparrow) + \Delta r_t(\downarrow)$; Opposite direction of the percentage change on these variables may lead market pressure when $|\Delta h_t| > |\Delta r_t|$ (i.e. appreciation of home currency continues) or $|\Delta h_t| < |\Delta r_t|$ (i.e. continuing dis-accumulation of reserves). This condition reflect "leaning in line the wind" which causes acceleration of the appreciation.
4. $\Delta h_t(\downarrow) + \Delta r_t(\uparrow)$; When this combination happen, the depreciation process will continue if $|\Delta h_t| > |\Delta r_t|$. While, if $|\Delta h_t| < |\Delta r_t|$ the accumulation reserves become market pressure to home currency for further depreciation.

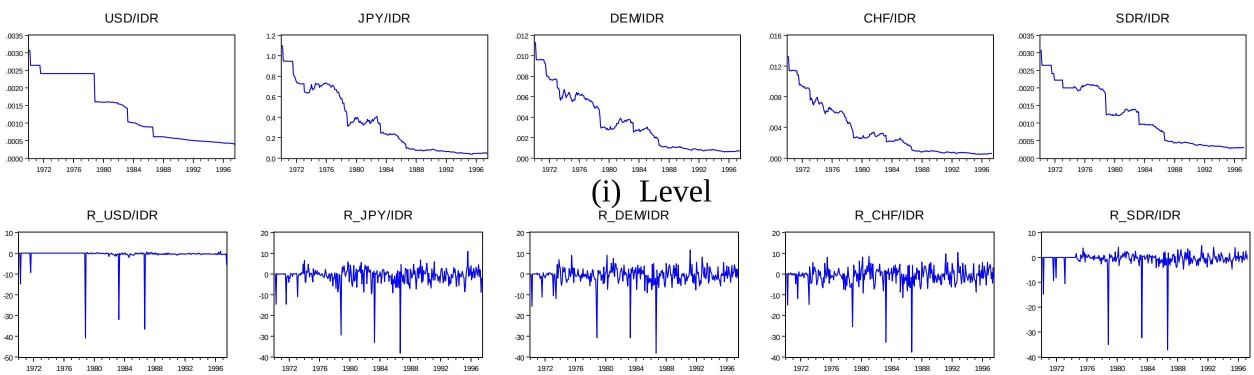
The coefficient of this exchange market pressure (β) must be interpreted as sensitivity of home currency toward market pressure. If the coefficient β is equal to 0, then home currency is fixed and if β is significantly not equal to 0 then home currency is floating.

2.3. *De facto* Exchange Rate Regimes: Pre-Asian Crisis

During the pre-Asian crisis, Bank Indonesia officially announced to adopt fixed exchange rate regime in April 1970 and switched to the managed-floating regime in November 1978. To verify the official announcement to the actual movement of rupiah during this period, we estimate the equation (2.1) using ordinary least square methods and present the estimation results in Table 2.1 and Table 2.2.

We provide Figure 2.1 to observe the actual movement of the Indonesia rupiah during pre-Asian crisis. This figure presents the movement of the Indonesia rupiah against several currencies (in inverted expression, i.e. USD/IDR, JPY/IDR, etc.) from January 1970 to July 1997 at level and percentage change. In general, as shown in the Figure 2.1.(i), the value of rupiah during 1970 to July 1997 has depreciation trend toward all currencies under consideration. However, using percentage change as shown in the Figure 2.1.(ii), the volatility of the rupiah against the US dollar was lower than against other currencies in consideration, which implies that the rupiah have been pegged to the US dollar.

Figure 2.1.: Rupiah Value during Pre-Crisis (1970.1-1997.7)



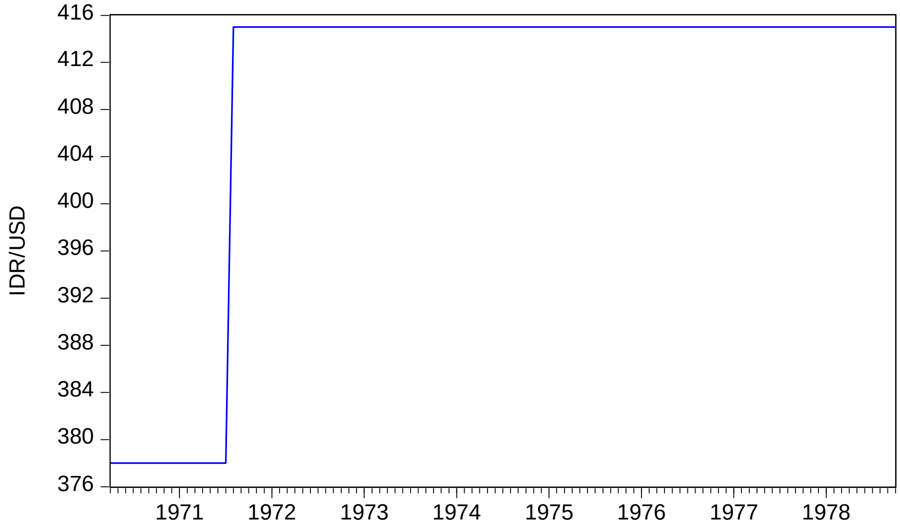
(i) Level

(ii) Percentage Change

Source: International Financial Statistics, IMF

The prevailing *de jure* exchange rate regime in early 1970's was fixed. As presented in Figure 2.2, it is obvious that the value of rupiah was fixed. Until August 1971, the rupiah exchange rate was fixed to Rp378 per US$1. In 1971, the International Monetary Fund annual meeting approved a resolution on the international monetary crisis management, with a request to all IMF member countries to work together and realign their currencies. Therefore, Bank Indonesia devalued the rupiah by 9.7% in August 1971 and the new rupiah value at that time became Rp414.66 per US$1 as shown in Figure 2.2.

Figure 2.2.: The Movement of IDR/USD under Fixed Regime
(April 1971 – October 1978)



Source: International Financial Statistics, IMF

The estimated coefficient of the equation (2.1) as presented in Table 2.1 show that after the devaluation of August 1971 (i.e. September 197 - October 1978) the rupiah was perfectly pegged to the US dollar since the coefficient of the US dollar and the adjusted R^2 were equal to 1. In addition, the coefficient of exchange market pressure also equal to 0 which indicate that rupiah was fixed. This is strong evidence that during this period the central bank consistently conducted the fixed regime as had been officially announced. On other hand, when the devaluation was neglected then we regress the equation (2.1) using the entire period of observation (i.e. April 1970 - October 1978), we obtain slightly different result. The US dollar and the Japanese yen influenced the rupiah in different magnitude and direction, although the coefficient of the Japanese yen significant at 10% with magnitude less than 0.1. In this case, the estimation results fail to detect that the US dollar became the main reference currency of the rupiah. This result suggests that structural change (e.g. due to devaluation) must be considered when applying Frankel-Wei's model as in the equation (2.1).

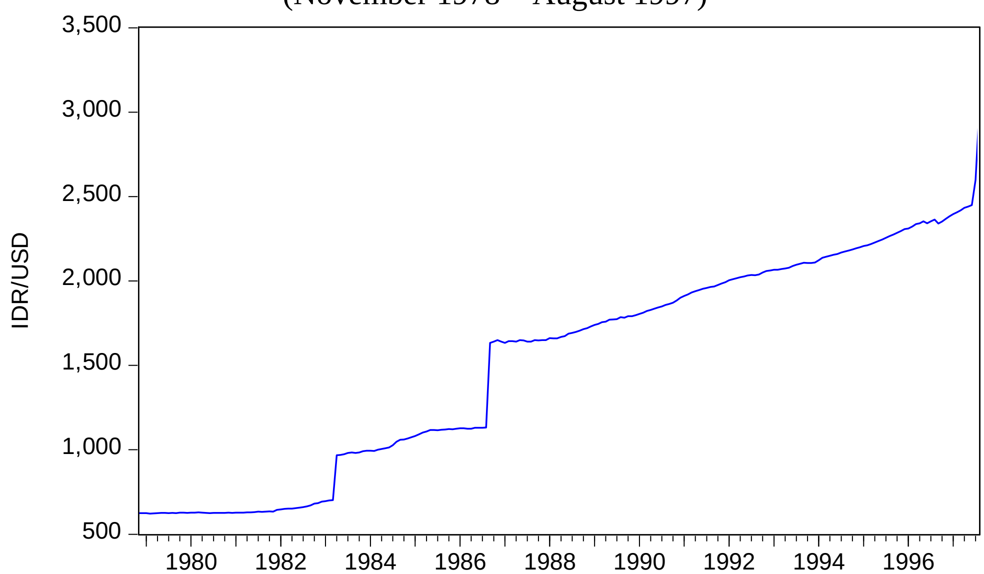
Table 2.1.: Regression Results (1971 – 1978) – Under *de jure* Fixed Regime

Period	Constant	Coefficient				Adj. R^2
		USD	JPY	DEM	EMP	
1971.9 - 1978.10 [After Devaluation Aug. 1971]	2.99E-18 (4.64E-17)	1.000*** (1.79E-15)	1.39E-17 (1.98E-15)	1.05E-15 (2.33E-15)	-5.45E-17 (2.20E-16)	1.000
1970.4 - 1978.10 [Entire Period]	-0.0006 (0.001)	1.057*** (0.043)	-0.083* (0.048)	0.021 (0.057)	0.003 (0.005)	0.915

Data Source: IFS-IMF; Author's calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively.
(…) Standard Error

As the market pressure to the rupiah increased, the effective exchange rate of rupiah was no longer relevant or overvalued due to large fluctuations on the US dollar. Therefore, in November 1978, Bank Indonesia took two actions: (i) devalued the rupiah against the US dollar 33.6% from Rp415 to Rp625 per US$1, and (ii) announced to abandon the fixed regime and switched to managed-floating regime that linked to a basket of currencies of major trading partner countries. Therefore we provide Figure 2.3 that exhibit the actual movement of the rupiah during November 1978 – August 1997 and shows that the rupiah was no longer perfectly pegged to the US dollar. During this period, the rupiah against the US dollar seemed to have a crawling movement with depreciation trend.

Figure 2.3.: The Movement of IDR/USD under Managed-Floating Regime
(November 1978 – August 1997)



Source: International Financial Statistics, IMF

In the Figure 2.3, the structural change appeared twice in the rupiah movement due to the devaluation policy taken by Bank Indonesia in March 1983 and September 1986. In March 1986, Bank Indonesia devalued the rupiah against the US dollar 38.1% from Rp702.5 to Rp970 per US$1. The objectives of the rupiah devaluation in March 1983 were to increase the Indonesian economy competitiveness and to improve the balance of payment. The declining of the export revenue due to the fall of oil prices in the beginning of 1986 and reduction of the pressure toward balance of payment became the main reasons for the government to devalue rupiah against the US dollar in 1986. Therefore, the devaluation was inevitable and taken by Bank Indonesia on September 1986 to weaken the value of rupiah against the US dollar 45% from Rp1,134 to Rp1,644 per US$1 and it is noted as the biggest devaluation since the 1970s. By weakening the value of rupiah against the US dollar on this time, the government of Indonesia expected to increase the non-oil export competitiveness in the international market, attracting foreign investors and avoiding capital outflow.

By considering the time of devaluation, we divided the period under the managed-floating regime into 3 sub-periods: i) November 1978 to March 1983, ii) April 1983 to August 1986, and iii) September 1986 to July 1997. Table 2.2 presents the regression results under the managed-floating. In general, the estimation results show that the US dollar is positively high and significant in all sub-periods under the managed-floating regime. Meanwhile, the coefficient of EMP is also significant and close to 0 except during May 1983 to August 1986, indicate that rupiah was more flexible. These results indicate that the rupiah was tightly pegged only to the US dollar and there was no evidence that non-US currency was used as reference to the rupiah and allowed to move more flexible. The high values of adjusted R2 for each sub-period under the managed-floating regime indicate that the US dollar and the EMP explain almost 99% of rupiah movement. As in the Table 2.1, neglecting the structural change due to devaluation causes the equation (2.1) less robust as indicated by lower adjusted R^2, 0.58. In addition, the estimated coefficient of the US dollar is lower while the coefficient of EMP is slightly higher. The estimation result of the equation (2.1) using the entire period of observation under managed-floating regime without considering the structural break is given in the last row of the Table 2.2.

Table 2.2.: Regression Results (1983 – 1997) – under *de jure* Managed-Floating Regime

Period	Constant	Coefficient				Adj. R^2
		USD	JPY	DEM	EMP	
1978.12 - 1983.3 [After Devaluation Nov. 1978]	-0.002*** (0.001)	0.957*** (0.019)	0.024 (0.016)	0.018 (0.036)	0.009* (0.005)	0.990
1983.5 - 1986.8 [After Devaluation April. 1983]	-0.004*** (0.001)	0.930*** (0.028)	0.046 (0.040)	0.078 (0.053)	0.002 (0.015)	0.988
1986.10 - 1997.7 [After Devaluation Sep. 1986]	-0.003*** (0.0004)	0.940*** (0.017)	0.025 (0.018)	0.084 (0.043)	0.002*** (0.008)	0.976
1978.12 - 1997.7 [Entire Period]	-0.007*** (0.002)	0.884*** (0.075)	0.008 (0.081)	0.126 (0.168)	0.093*** (0.027)	0.582

Data Source: IFS-IMF; Author’s calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

The estimated coefficients of the actual condition under fixed and managed-floating regime as shown in Table 2.1 and 2.2 respectively show that the rupiah was remain tightly pegged only to the US dollar and not to the basket currencies. As exhibited in the Figure 2.3, the movement of the rupiah exchange rate weakened over time during the managed-floating regime. According to Frankel (1999), this condition can be classified as adjusted peg (fixed but adjustable) or crawling peg[5].

In addition, after big devaluation on September 1986 the movements of rupiah tend to depreciate over time due to the increasing pressure on the rupiah. Therefore, Bank Indonesia did not take devaluation as a policy but widened band of intervention policy to maintain the stability of the rupiah value. The band was widened several times as follows; (i) widened from Rp6 (0.25%) to Rp10 (0.5%) on September 1992; (ii) to Rp20 (1%) on January 1994 and to Rp30 (1.5%) on September 1994, (iii) to Rp44 (2%) on May and to Rp66 (3%) on December 1995; to Rp118 (5%) on June and to 192 (8%) on September 1996. At last, the band-intervention was widened to Rp304 (12%) on July 1997 just before Bank Indonesia officially announced to adopt free-floating regime. As a result, widening the band-intervention regularly caused the rupiah to move

[5] Frankel (1999) identifies nine exchange rate regimes: currency union, currency board, “truly fixed” exchange rates, adjustable peg, crawling peg, basket peg, target zone or band, managed float and free float.

more freely within the band and caused Bank Indonesia to intervene the exchange market infrequently.

We observe the volatility of the rupiah by measuring the standard deviation of percentage change of the rupiah against the G3 currencies as presented in Table 2.3. As already explained, high (low) standard deviation indicate high (low) volatility. The Table 2.3 shows the characteristics of the rupiah movement during the pre and post-Asian crisis. During the pre-Asian crisis, the standard deviation of the percentage change of the rupiah against the US dollar (σ_{USD}) was lower than to the non-US dollar currencies (σ_{JPY} and σ_{DEM}), except at the time when devaluation was announced, (i.e. 1971, 1978, 1983, and 1986). Under the fixed regime, the σ_{USD} equal zero and σ_{FORES} greater than zero which indicate that the rupiah was perfectly pegged only to the US dollar as also indicated by the index of flexibility which equal zero.

During the managed-floating regime as officially announced in 1978, the σ_{USD} was relatively higher than during the previous regime but still lower than the σ_{JPY} and σ_{DEM}. Meanwhile, the σ_{FORES} was lower than the previous regime. These characteristics indicate that under the managed-floating regime, the value of rupiah against the US dollar was more volatile than the previous regime but still less volatile to the other currencies under consideration. In addition, the index of flexibility during this regime was greater particularly at the time when devaluation was announced.

Thus, our tentative conclusions in this section are as follows; during the fixed regime, Bank Indonesia consistently implemented fixed regime as they officially announced, in other words *de facto* regime equal to the *de jure* regime. Meanwhile, under the managed-floating regime, the facts show that the rupiah was still tightly pegged only to the US dollar although in slightly lower degree, and therefore it can be classified as an adjustable peg or crawling peg. Hence, under the managed-floating regime, what Bank Indonesia officially announced was different from what actually did; or it is simply said that the *de facto* regime was different from the *de jure* regime.

Table 2.3.: Standard Deviation of Percentage Change of Rupiah Value and Foreign Reserve

Pre-Crisis						Post-Crisis					
Year	σ_{USD}	σ_{JPY}	σ_{DEM}	σ_{FORES}	Index	Year	σ_{USD}	σ_{JPY}	σ_{DEM}	σ_{FORES}	Index
1971	2.70	4.19	3.13	22.87	0.11	2000	4.22	4.00	5.52	4.28	0.49
1972	0.00	0.74	0.69	13.74	0.00	2001	8.20	7.92	7.55	1.12	0.88
1973	0.00	3.59	5.53	9.24	0.00	2002	3.04	2.69	3.20	2.15	0.59
1974	0.00	3.03	3.16	17.20	0.00	2003	1.90	2.38	2.58	1.42	0.57
1975	0.00	1.62	3.48	33.67	0.00	2004	2.38	4.13	3.35	2.08	0.53
1976	0.00	1.01	1.36	28.10	0.00	2005	1.93	2.57	2.99	3.88	0.33
1977	0.00	1.74	2.02	12.08	0.00	2006	2.53	2.95	3.08	5.58	0.31
1978	11.82	8.42	8.93	10.91	0.52	2007	1.95	3.60	2.35	1.66	0.54
1979	0.20	2.69	2.46	6.06	0.03	2008	6.49	8.01	4.09	4.31	0.60
1980	0.17	3.61	3.85	8.92	0.02	2009	3.53	4.11	3.59	2.74	0.56
1981	0.42	3.77	3.67	10.20	0.04	2010	1.20	3.34	3.84	3.78	0.24
1982	0.42	4.84	2.86	8.50	0.05	2011	1.83	2.55	3.02	4.32	0.30
1983	9.15	9.56	9.26	21.57	0.30	2012	1.25	3.21	1.95	2.78	0.31
1984	0.59	2.14	3.22	2.23	0.21	2013	2.46	3.90	3.35	3.50	0.41
1985	0.38	2.89	3.56	3.35	0.10						
1986	10.55	11.08	11.18	5.31	0.67						
1987	0.38	3.59	3.01	10.82	0.03						
1988	0.28	3.13	3.27	5.14	0.05						
1989	0.27	3.06	3.76	8.59	0.03						
1990	0.17	3.67	1.51	11.24	0.01						
1991	0.13	2.63	4.90	5.39	0.02						
1992	0.19	2.48	4.14	3.32	0.05						
1993	0.16	2.75	3.03	1.43	0.10						
1994	0.15	2.41	1.82	4.22	0.03						
1995	0.08	5.00	2.85	1.59	0.05						
1996	0.51	2.18	2.41	3.67	0.12						

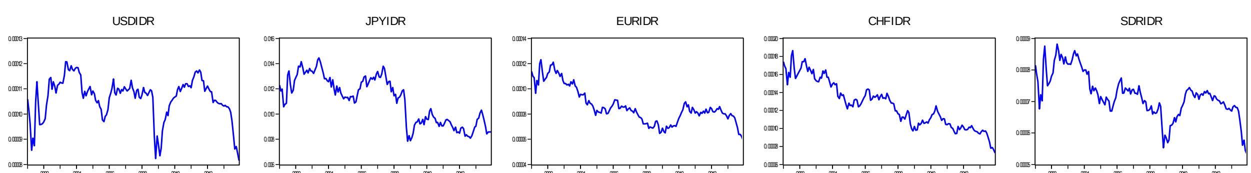
Source: IFS-IMF; Author's calculation. σ_{USD} is standard deviation of the percentage change of the rupiah against the US dollar [Δlog(IDR/USD)]; σ_{JPY} is standard deviation of the percentage change of the rupiah against the Japanese yen [Δlog(IDR/JPY)]; σ_{DEM} is standard deviation of the percentage change of the rupiah against the Germany mark [Δlog(IDR/DEM)]; σ_{EUR} is standard deviation of the percentage change of the rupiah against the Euro [Δlog(IDR/EUR)]; σ_{FORES} is standard deviation of the percentage change of the Indonesian foreign reserve [Δlog(Foreign Reserve]. Highlighted rows: 1978, 1983 and 1986 is the devaluation of rupiah against USD.

2.4. Rupiah Movement of the Post-Crisis Period

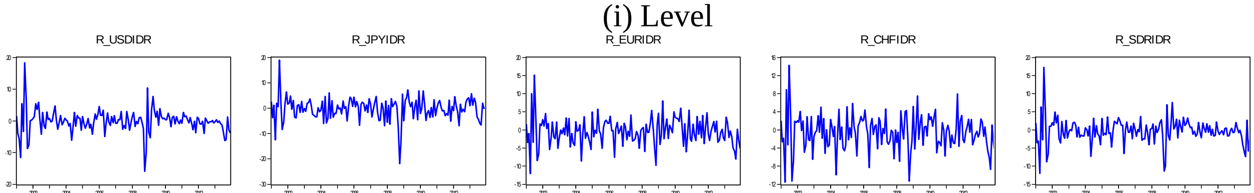
Bank Indonesia took several policies, including widening band intervention, tightening monetary policy, and intervening in the exchange market to reduce the pressure on the value of the rupiah as a result of the exchange rate crisis in mid-1997. However, these efforts did not bring much change as expected. Meanwhile, the foreign reserves began to decline as a result of the interventions in the foreign exchange market. These two factors were considered as main reason of the exchange rate regime change. As a result, after officially announcement of the adoption of new exchange rate regime, i.e. free-floating, on August 1997 the rupiah depreciated sharply afterward, i.e. from Rp3.035,-/USD in August 1997 to Rp10.375,-/USD in January 1998.

Figure 2.4 shows the movement of the rupiah value after the Asian Crisis 1997. As in the previous section, the movement of the value of rupiah is also presented in level and percentage change as shown in Figure 2.4.(i) and 2.4.(ii) respectively. In general, the movements of the rupiah against several currencies still indicate the depreciation trend of the rupiah as in the pre-crisis; however the rupiah against the US dollar became more volatile than that during the pre-Asian crisis.

Figure 2.4.: Development of Rupiah Post-Asian Crisis 1997 (2001.1 – 2013.12)



(i) Level



(ii) Percentage Change

Source: International Financial Statistics, IMF

Since there is no clear and complete information regarding the policy that was taken by Bank Indonesia related to the movement of the rupiah during this period, thus we determined an arbitrary period of observation to estimate the equation (2.2). In this case, we estimated the equation (2.2) by using 24 months, starting from January 2000 – December 2001 to January 2012 – December 2013. In addition, the estimation of the equation (2.2) also using the entire period after the Asian crisis.

Table 2.4.: Regression Results (2001 - 2013) – Under *de jure* Floating Regime

Period	Const.	Coefficient				Adj. R^2	DW Stat.
		USD	JPY	EUR	EMP		
2000.1-2001.12	-0.006	0.205	-0.035	-0.117	0.744***	0.851	2.268
	(0.006)	(0.233)	(0.190)	(0.615)	(0.070)		
2002.1-2003.12	-0.004	0.350**	0.086	0.133	0.727***	0.771	2.167
	(0.004)	(0.160)	(0.198)	(0.383)	(0.143)		
2004.1-2005.12	-0.003	0.831***	0.014	0.083	0.390***	0.863	2.275
	(0.003)	(0.167)	(0.143)	(0.363)	(0.064)		
2006.1-2007.12	-0.007	0.759**	0.013	1.042	0.244**	0.613	2.585
	(0.006)	(0.335)	(0.288)	(1.098)	(0.100)		
2008.1-2009.12	-0.005	0.432***	0.044	-0.523***	0.693***	0.884	1.944
	(0.003)	(0.103)	(0.099)	(0.178)	(0.062)		
2010.1-2011.12	-0.003	0.812***	-0.080	-0.023	0.204***	0.928	2.295
	(0.002)	(0.092)	(0.080)	(0.070)	(0.050)		
2012.1-2013.12	-0.008	0.805***	-0.021	0.484	0.306**	0.579	1.410
	(0.005)	(0.275)	(0.161)	(0.540)	(0.108)		
2000.1-2013.12	-0.005***	0.499***	0.041	-0.009	0.535***	0.744	1.922
	(0.002)	(0.070)	(0.061)	(0.105)	(0.030)		

Data Source: IFS-IMF. Author's calculation; ***, **, * indicate significant at α=1%, 5% and 10% respective

After the official announcement of adoption of the free-floating regime, the value of rupiah became more volatile at least until the end of 1999[6]. The development of the rupiah started to change in 2000 when the economy recovered. As presented in Table 2.4, the regression results show that during January 2000–December 2001, none of the anchor currencies influenced the rupiah and the coefficient of the exchange market pressure was high and significant indicating flexibility of rupiah. In the next period, January 2002-December 2003, the US dollar was significant and positive while the exchange market pressure remains significant although at

[6] We also estimate equation (2.1) for the period during crisis (1997-2000) and the regression result is presented in Table 3. During this period, only the coefficient of EMP is significant and close to 1. Nevertheless, the coefficient of EMP in 1997-1998 is higher than in 1999-200, 0.981 and 0.772 respectively. It indicates that during crisis period, rupiah was flexible, but the degree of flexibility getting lower afterward.

slightly lower magnitude than previous period. The exchange rate policy to float the rupiah was taken by Bank Indonesia to avoid the possibility of greater intervention because increasing pressure to the rupiah due to domestic political turmoil (i.e. impeachment and presidential succession) that occurred in July 2001.

During 2004–2005 and 2006–2007, the regression results look similar where only the US dollar and the exchange market pressure were significant and getting smaller. The coefficient of the US dollar increased from the previous period while the coefficient of the exchange market pressure still significant although the magnitude has decreased. These results indicate that during 2004–2007, the movement of the rupiah was more tightly pegged to the US dollar and became less flexible.

The bankruptcy of Lehman Brothers, which led to the emergence of the global crisis, also affected the Indonesian economy. At that time the rupiah had experienced fairly high depreciation, almost 30%. This condition is captured in the regression results for the period of 2008–2009 where not only the US dollar was significant, but also the Euro became significant although negatively influences the rupiah. In this period, the coefficient of the exchange market pressure was significant and higher than the previous period which indicates that rupiah became more flexible.

For the last two periods (i.e. 2010–2011 and 2012–2013), the estimation results were similar to those that obtained during 2004–2007 where relatively high pegged to the US dollar when market pressure was relatively low. During 2010-2013, the coefficient of the US dollar significant and higher than during 2008-2009 which indicate reverting to the US dollar pegged. In addition, the lower and significant coefficient of the EMP indicates that rupiah became less flexible after experienced market pressure during the Lehman shock in 2008.

We include the regression result that using entire period of observation from January 2000 to December 2013 as presented in the bottom row of Table 2.4. As a result, the coefficient of the US dollar and the exchange market pressure were significant and positive. The relatively low coefficient of the US dollar and moderate market pressure suggest that during this period the rupiah was moderately pegged to the US dollar since the market was relatively stable. Using the entire period of observation in estimating the equation (2.2) only provide us little information about the actual movement of the rupiah. But, more detail information can be obtained when (arbitrary) structural change is considered in estimating the equation (2.2). In our examination, during the "turbulent" periods (i.e., 2001–2002 and 2008–2009, relatively high market pressure) the rupiah appear moved more flexible and softly pegged to the US dollar. However, during the "tranquil" periods i.e. 2002–2005 and 2010-2013 the rupiah more pegged to the US dollar and less flexible.

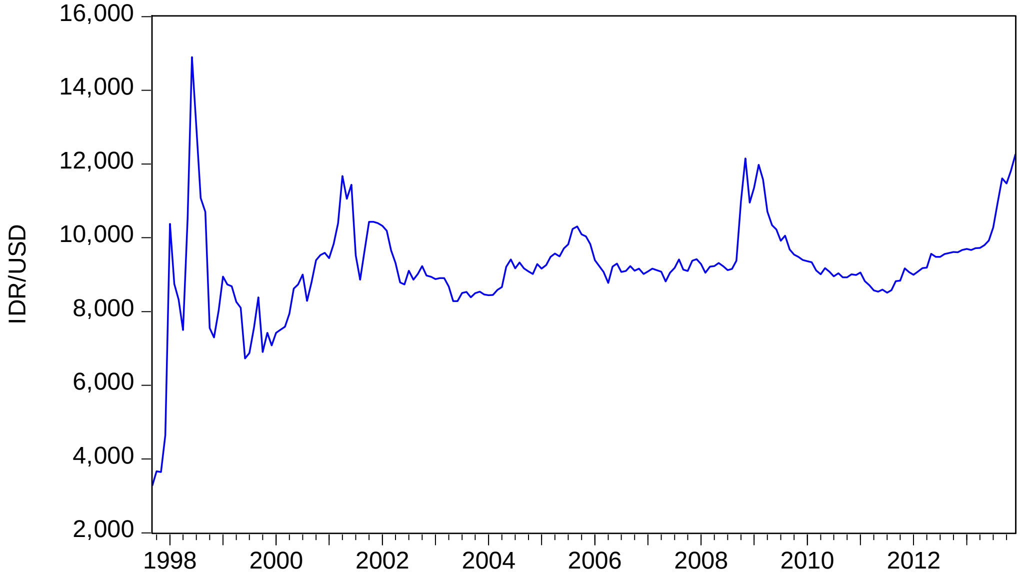
We provide Table A and B in Appendix-A to show the estimated parameters as well as the characteristics of the rupiah during the crisis i.e. 1997–2000. During the crisis period, all hard currencies in the right hand side did not influence the rupiah movement, while the coefficient of EMP was high and significant which indicate flexible movement for rupiah. The characteristics of rupiah during the crisis become more volatile while less volatile for the foreign reserve. The higher index of flexibility during the crisis than the pre-Asian crisis indicates that rupiah moved more flexible. This condition suggests that the rupiah was allowed to float freely.

The characteristics of the rupiah during the post-Asian crisis i.e. 2000–2013 are presented in Table 2.3 and show that the σ_{USD}, σ_{JPY} and σ_{DEM} were smaller than during the crisis period but still larger than the pre-crisis period. Meanwhile, the σ_{FORES} was smaller than pre and during the crisis period. The index of flexibility during the pre-Asian crisis was greater than during the pre-Asian crisis with special attention to the relatively high index for 2001 and 2008. This evidence suggests that in 2001 and 2008 the rupiah moved more flexibly.

Based on the statistical evidences that were obtained from estimating the equation (2.2) under the post-Asian crisis period, it can be concluded that in general the actual exchange rate regime did not fully follow the free-floating but it more reflected to follow managed-floating. As defined by Frankel (1999), a managed float, also known as a "dirty float," is a readiness to intervene in the foreign exchange market with the intervention intended to lean against the wind (i.e., buying the currency when it is appreciating or already appreciated and selling when it is depreciating or already depreciated). Since the information of intervention in the exchange market was not publicly announced, it was therefore not included in our equation; hence it is difficult to analyze the impact of interventions on the rupiah movement. Nonetheless, the regression results clearly reveal a situation where intervention might have been taken to maintain the rupiah movement. During the more stable period, an intervention was taken by accumulating reserves (increasing demand) to avoid further appreciation of the rupiah, but during the unstable period, the intervention was conducted by dis-accumulating reserves (increasing supply) and thus avoid further depreciation.

In other words, the movement of rupiah against the US dollar during the post-Asian was still heavily managed. This does not fully reflect the *de jure* exchange rate regime as had been announced i.e. free-floating regime. In Figure 2.5, we show the movement of the rupiah against the US dollar under *de jure* free-floating regime. The actual movement does not reflect high volatility as occurred during the crisis period instead it show that the rupiah was apparently maintained in certain levels between mid-2002 and mid-2008 and between the end of 2009 and early 2012. Following Alesina and Wagner (2003), we call this situation as “fear of announcing peg” rather than “fear of floating” because we still found evidence that the rupiah was allowed to move more flexibly but heavily managed in certain level.

Figure 2.5.: The Movement of IDR/USD under Floating Regime (September 1997 – December 2013)



Source: International Financial Statistics, IMF

2.5. Maintaining the Rupiah Stability

To support the management of the rupiah exchange rate, the government considered enabling Bank Indonesia to become more independent in order to guarantee maintaining stability of the rupiah value by amending the law of the central bank (UU No.23/1999 on Bank Indonesia has been amended with UU.3/2004 on January 15, 2004). In the new law, Bank Indonesia has single objective: achieve and maintain rupiah stability (article 7:1). Nevertheless, the elucidation of this article explains:

> The stable value of the rupiah referred to in this paragraph is the stable value of the rupiah against goods and services as well as against foreign currencies. Stable value of the rupiah against goods and services is measured by or reflected in the inflation rate. Stable value of the rupiah against foreign currencies is measured by or reflected in the movement in the exchange rate of the rupiah against foreign currencies. The stable value of the rupiah is extremely important for supporting sustainable economic development and improving the living standards of the population at large.

According to this explanation, actually there are two implicit objectives that Bank Indonesia must achieve: (i) stability of the rupiah against goods and services and (ii) stability of the rupiah against other currencies.

In addition, Bank Indonesia shall conduct exchange rate policy in accordance with the adopted exchange rate system (article 12). In the elucidation, the article 12 is described as the exchange rate policy that must be matched to the adopted exchange rate systems, which include: (i) devaluation and revaluation policies in the fixed regime, (ii) market intervention policy in the floating regime, and (iii) determination of daily exchange rate and bandwidth intervention policy in the managed-floating regime. Thus, in the laws of Bank Indonesia there are three possible exchange rate systems that can be adopted, but there is no clear information for whether the change in adopting an exchange rate system needs to be announced.

In the beginning of the enactment of this law, many opinions are expressed related to the interpretation of "the stability of rupiah". As already mentioned, there are two interpretations related to it, i.e. price stability and exchange rate stability. Alamsyah *et al*. (2001) argues that the distinction between two interpretations and any attributed ambiguity is somewhat overstated, as in practice the exchange rate and price stability are usually closely related. In the past, the low inflation in Indonesia has been generally consistent with reasonable exchange rate stability, although during the crisis it raises doubts as whether the same things could still happen in the future.

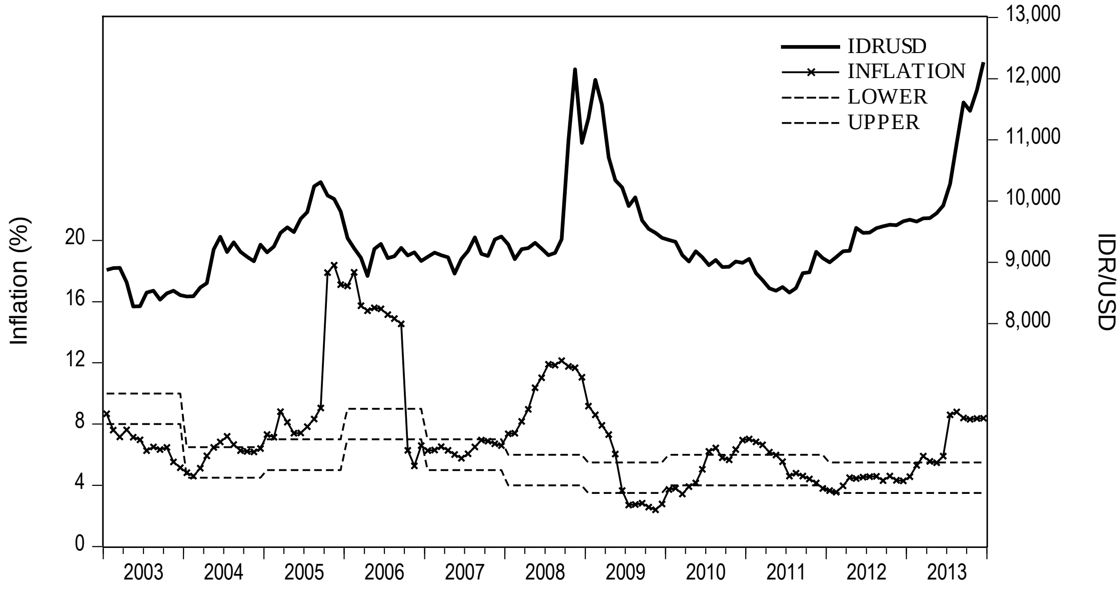
McLeod (2003) has different view on interpreting the term of "stability of the rupiah" that considered ambiguous. He explains that although it might be interpreted as price and exchange rate stability but indeed the elucidation of this article in the law fails to recognize the possibility of a conflict between them. Related to this ambiguity, Bank Indonesia apparently has chosen to interpret the stability of the rupiah in term of purchasing power over goods and services (Alamsyah *et al*., 2001:341).

For some many years prior to the crisis, Bank Indonesia had been using base money as an operational instrument to control inflation and other monetary aggregates. In addition, Bank

Indonesia also had been conducting the exchange rate policy to peg rupiah against the US dollar with depreciative trend. This policy seems to be effective in bringing the economy to the desired target. However, with the onset of the crisis, Bank Indonesia attempted to gradually shift its policy from quantity targeting to price (interest rate) targeting, and has widened the exchange rate tolerance band to ease the conflict with monetary policy (*ibid*., page 312).

The new law of Bank Indonesia provided a strong basis for Bank Indonesia to be more independent in setting monetary targets by taking into account the inflation target (IT). However, Bank Indonesia explicitly announced it would begin implementing the IT policy framework in 2000 and adopting a full IT policy framework by July 2005. In applying this policy, the board of governors of Bank Indonesia set a policy rate, "the BI rate," as a policy instrument that reflected the monetary policy stance. Figure 2.6 shows the monthly exchange rate of the rupiah against the USD and the monthly inflation rate from 2003 to 2013, where both can be seen moving together. During this period the development of actual inflation was recorded to be within the range of the inflation target at only about 37%.

Figure 2.6.: Inflation and IDR/USD (January 2003 – December 2013)



Source: IFS-IMF and Bank Indonesia

Warjiyo[7] (2013) explains that for a small open economy like Indonesia, the exchange rate movement does not always reflect fundamental value. There are several factors that influence the value of rupiah, such as the volatile capital flows, increasing risk appetite among global investors, and news on the progress of crisis resolution in the advanced countries may give rise to increasing exchange rate volatility beyond the fundamental. He also explains that Indonesia regards exchange rate policy as an integral part of an overall monetary and macroprudential policy mix designed to achieve price stability while paying due attention to economic growth as well as monetary and financial system stability. The general thrust of the policy is to stabilize the exchange rate along its fundamental. Under this framework, Bank Indonesia provides five policy instruments; (i) interest rate policy, (ii) exchange rate policy, (iii) management of capital flows, (iv) macroprudential policy, and (v) monetary policy communication. Related to exchange rate development, the exchange rate policy is geared toward maintaining the stability of exchange rate along the chosen fundamental path that is consistent with the inflation and macroeconomic forecast over the policy horizon. The volatility of day-to-day exchange rate movements along the chosen fundamental path is smoothed out by symmetric foreign exchange intervention.

According Mariano and Villanueva (2006) an open economy such as Indonesia, the exchange rate affects inflation in a substantial way. The depreciation of rupiah will be reflected to the higher of import price that raises inflation. Besides, with the large outstanding stocks of external obligations of the Indonesian banking and corporate sectors, the depreciation of rupiah will not only affecting on the inflation and export competitiveness, but also on the servicing of external debt and thus on the future fiscal position. Thus quoted from their communication with BI monetary, fiscal and financial sector team, the IT framework still focuses on inflation, and meeting the inflation target is a priority. Exchange rate movements and their determinants are closely monitored. If exchange rate depreciation is the result of changing portfolios, tighter monetary policy is implemented to prevent higher inflation. But if the depreciation is the result of terms of trade shock, an easier monetary policy is implemented. This statement is in line with our finding related to the exchange rate policy post-crisis. There is a clear signal that Bank Indonesia will let rupiah to moving freely when the pressure to rupiah is high, but they will maintain the rupiah value when the pressure is low.

[7] Deputy Governor of Bank Indonesia

2.6. Conclusions

The purpose of this chapter is to obtain statistical evidence for the actual movement of the Indonesia rupiah during pre and post-Asian economic crisis of 1997. During the pre-crisis period (April 1971–July 1997), Bank Indonesia officially announced the exchange rate regime two times: the fixed regime on April 1971 and the managed-floating regime on November 1978. During the pre-Asian crisis period, a set of policies were taken by Bank Indonesia to maintain the rupiah value, such as devaluation (e.g. in 1971, 1978, 1983, and 1986) and widening band intervention (8 times from 1992 to mid-1997).

The estimation results indicate that under the fixed regime, Bank Indonesia consistently conducted the exchange rate regime by fixing the rupiah value to the US dollar. However, when Bank Indonesia officially announced to adopt managed-floating regime with basket currencies on November 1978, in fact the actual movement of nominal exchange rate of rupiah was adjusted peg or crawling peg. In this case, the rupiah remained tightly pegged only to the US dollar with depreciation (crawling) trends.

As the pressure to the rupiah increased due to the currency crisis in 1997, Bank Indonesia officially announced to abandon the managed-floating regime and switched to the floating regime in August 1997. Afterward, the movement of the rupiah suddenly moved freely—at least until the end of 1999. However, during 2000–2013 the statistical evidence shows that the rupiah was heavily managed despite the central bank declared to follow free-floating regime.

During the post-Asian crisis, the estimation results indicate that when pressure to the rupiah increased, then the rupiah was softly pegged to the US dollar (and sometime also softly pegged to the non-US dollar with different direction and lower degree of pegging). However, when the economy was relatively stable then the rupiah was tightly pegged only to the US dollar. The index of flexibility during post-Asian crisis was larger than the pre-Asian crisis but lower than during the crisis, which indicate that the rupiah was more flexible than the pre-crisis but less flexible than during the crisis period. Overall, by considering all the statistical evidence we may conclude that the actual movement of rupiah during the post-Asian crisis reflects managed-floating rather than free-floating regime.

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Chapter 3

Returning to the Dollar Peg in Asia-5 Exchange Rate Regimes Post-Asian Crisis

Returning to the Dollar Peg in Asia-5 Exchange Rate Regimes Post-Asian Crisis

3.1. Introduction

Some Asian countries such as Indonesia, Malaysia, Philippines, Thailand, and South Korea (later, these countries will be called as Asia-5) decided to change their exchange rate arrangement in order to cope the Asian crisis 1997. The four Asia-5 countries allowed their currency to float according to supply and demand in the foreign exchange market.[1] Meanwhile, Malaysia announced to perfectly peg or fixed their currency to the US dollar until June 2005 and changed the regime to managed-floating in July 2005.[2] It may be said that free-floating exchange rate policy taken by the central bank became prevailing at least for the four countries in Asia-5 except Malaysia to prevent their economy from collapsing during the Asian crisis. This short history is summarized in Table 3.1:

Table 3.1: Official Exchange Rate Regimes

Countries	IMF Classification (1990-1996)	1997/1998 (Asian Crisis)	2005 (Post-Asian Crisis)
Indonesia	Crawling Peg	Free Floating	
Malaysia	Crawling Band	Fixed	Managed-Floating
Philippines	Mix*	Free Floating	
Thailand	Peg	Free Floating	
South Korea	Crawling Peg	Free Floating	

Sources: AREAER IMF. Mix*: Crawling peg (1990-1991), Crawling Band (1992-1995), and Peg (1996)

[1] **On August 14, 1997** the central bank of Indonesia (Bank Indonesia) decided to replace the managed floating exchange regime by a free- floating exchange rate arrangement (IMF 1998, p.439); **March 15, 1998** the Philippines authorities allowed the Philippines Peso to float more freely against the dollar by lifting the volatility bank system - (IMF 1999, p. 683); **July 2, 1997** the Thailand authorities determined the exchange rate of the Thailand Baht on the basis of supply and demand in the foreign exchange market and was allowed to float freely (Independently floating) (IMF 1999, p.866); **December16, 1997** the central bank of South Korea (Bank of Korea) allowed the exchange rate of the Korean Won to float freely which was determined on the basis of supply and demand. (IMF 1998, p. 491)

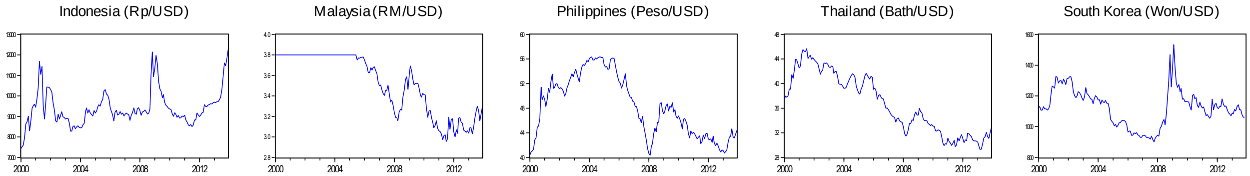
[2] **On September 2, 1998** the central bank of Malaysia (Bank Negara Malaysia) announced that the exchange rate of the Ringgit should be pegged against the U.S. Dollar at RM3.80 = $1 (IMF 1999, p.532). In **July 2005**, the official regime was managed-floating against an undisclosed basket of currencies

During the Asian crisis, the exchange rate of the Asia-5 countries was highly fluctuated as a result of the regime change from intermediate regime to free-floating regime. As the economic condition in the Asia-5 countries recovered, the exchange rate of these countries would become less fluctuated compared to the during crisis period in economic theory. When the actual movement of the exchange rate could be deviated from its official announcement, i.e. it is officially announced to free-floating but in fact it does not float. Refer to Calvo and Reinhart (2002), this phenomenon is called as "fear of floating".

Some studies pointed out the phenomena of "fear of floating" occurred in the Asia-5 countries. Among others, Hernández and Montiel (2001) concluded that the Asia-5 countries preferred to design a managed float (intermediate regime between the two extreme polar) in order to accumulate reserve and resist real appreciation over the free floating. In addition, Baig (2001) explains that though the Asia-5 currencies, based on day-to-day movement, have large weight to the US dollar both pre and post Asian crisis 1997, the exchange rates of these countries are less volatile during pre crisis compare to the post-Asian crisis. These two studies pointed out that after the Asian crisis the monetary authority intentionally managed the exchange rate to be less volatile.

Figure 3.1 show the movement of the monthly exchange rate of the Asia-5 currencies against the US dollar from January 2000 to December 2013. During this period, the exchange rate movements in all countries show appreciation trend except Indonesia. In addition, several global economic shocks have occurred during 2000–2013. It is obvious that Lehman shock in 2008 has affected the global economy significantly and therefore it changed the movement of the exchange rate in the Asia-5 countries where all the currencies experienced depreciation trends at most for one year. This trend of exchange rate depreciation reverted to appreciation trend as during pre-Lehman shock. The European debt crisis or usually known as Eurozone crisis in September 2011 also affected the global economy. However, this crisis has been responded differently in the exchange rate movement of the surveyed currencies. As a result, other than Indonesian currency experienced depreciation trend in different level and the Indonesian rupiah encountered severe depreciation until the end of 2013.

Figure 3.1.: Asia-5 Exchange Rate against US Dollar 2000-2013



Source: International Financial Statistics, IMF

As officially announced, the exchange rate regimes in the Asia-5 countries were floating since the Asian crisis 1997. Theoretically the floating means that the value of home currency is merely determined by supply and demand in the foreign exchange market. However, as presented in Figure 3.1 the movements of the nominal exchange rates for the Asia-5 countries might give an impression that they were not merely determined by market power. Some interventions with a particular intention could be taken by the central banks to achieve their goal. For instance, the Indonesian rupiah had different trend of movement compare to the other four Asia-5 currencies. This may imply that the Bank Indonesia have an intention to maintain the rupiah value (particularly against the US dollar) in a certain level. But time-to-time as the market pressure increased, Bank Indonesia might change their policy in order to maintain the value of rupiah or increasing the foreign reserve by conducting market operation.

Frankel (1999) strongly stated that no single currency regime is best for all countries, and that even for a given country it may be that no single currency regime is best for all time. The appropriate exchange rate regime varies depending on the specific circumstances of the country in question and depending on the circumstances of the time period in question. Corner solution may become good option for some countries, for example floating regime fit to large economy while fixed regime may be desirable for very small open economies or countries with hyperinflation experience or a country with dependent monetary policy. However, intermediate solution is more likely appropriate for some countries e.g. developing countries which are not affected by large-scale capital flows. But, he suggested that for many intermediate emerging market countries with open capital markets, there is no single regime will appropriate.

This chapter examines whether the Asia-5 currencies is still pegged to the US dollar although the central banks of these countries has already officially announced free-floating regime. In addition, we want to answer the following question; if the US dollar is still used as the main reference for these currencies, are these countries constantly or irregularly pegged their currencies to the US dollar?

The rest of this chapter is organized as follows—Section 3.2 describes the corner solution in bipolar of the exchange rate regime (see Chapter 1). In this bipolar view, a country needs to choose either to peg or to float their currency. During the Asian crisis, the Asia-5 countries decided to move into one extreme polar, i.e. free-floating. In our early observation as shown in Figure 3.1, it seem that the Asia-5 countries did not fully allow their currencies to be determined by the market on the contrary to their official announcement. However, the movement of the exchange rate during 2000-2013 might indicate that these countries are conducting the intermediate regime. Section 3.3 describes the data and methodology. In Section 3.4, by using a regression model we infer whether a target period exactly follows the official announcement or not. Since there are 5 surveyed countries, the estimation results of the regression models for these countries will be compared to know the actual arrangement of the exchange rate. Section 3.5 examines a widely accepted view that the exchange rate of the Asia-5 countries revert to the intermediate regime during post-Asia crisis 1997. Finally, Section 3.6 concludes.

3.2. Reverting to the Intermediate Regime

Fischer (2001) examines the proportion of the IMF member countries belonging to three different exchange rate regimes, i.e. fixed, intermediate and free-floating, based on the sample including 159 and 185 countries in 1990 and 1999 respectively[3]. The result shows that the proportion of the member countries that adopted the intermediate regimes[4] decreased from 62% in 1991 to 34% in 1999. Meanwhile the proportion the countries that adopted hard peg increased

[3] Based on the same data, Esaka (2007) found similar result for emerging market countries. The proportion of intermediate regime decreased from 64% in 1991 to 42% in 1999. While the proportion of hard peg and floating regime increased from 6% to 9% and from 30% to 48% in 1991 and 1999 respectively

[4] Economies with conventional fixed pegs, crawling pegs, horizontal bands and crawling bands is classified as intermediate regimes, while hard peg covers economies with no separate legal tender or currency boards. Floating regimes is defined as economies with managed float with no specified central rate or independent floating

from 16% to 24%, besides the proportion of the countries adopted floating regime also increased from 23% to 42% in 1991 and 1999 respectively. This evidence shows that the intermediate regime has been abandoned and move to bipolar views, either hard peg or floating regime.

Obstfeld and Rogoff (1995) predicts that the countries, which integrated their domestic capital markets with global capital markets, will not be able to maintain an intermediate exchange rate regime and will be forced to switch to the two extreme exchange rate regimes. Eichengreen (1994) and Summers (2000) states that only two extreme exchange rate regime to be adopted by many countries, the fixed exchange rate regime (i.e. hard pegs, dollarization, currency board or monetary union) or free floating. This view is called the bipolar view as is already mentioned or known as hollowing-out hypothesis. However, Frankel (1999) concludes that the intermediate solution are more likely to be appropriate for many countries than are corner solution. In addition Williamson (2000) states his belief that an intermediate exchange rate regime is still becoming viable option for emerging markets.

The exchange rate policy a government or a central bank usually deviates from their announcement. Calvo and Reinhart (2002) found that many countries exhibit so called “fear of floating” meaning that the policymakers use monetary policy to restrict exchange rate movement (*de facto*) when the official announcement of exchange rate regime is floating (*de jure*). In other hand, Levy-Yeyati and Sturzenegger (2005) show that many countries adopted fixed regime (*de facto*) but they officially announced a more flexible regime (*de jure*) and they call this finding as “fear of pegging”. The same phenomenon as described in Levy-Yeyati and Sturzenegger (2005) is also found in Alesina and Wagner (2003) but they call this phenomenon as “fear of announcing a peg”.

An inevitable effect of adopting free-floating is large volatility in the exchange rate movement. Some countries, especially emerging countries or developing countries with large amount of foreign debt (usually rated in the US dollar) are reluctant to have high volatility for their currency. High volatility in the exchange rate will cause a country spend more of their currency to pay the debts. This condition may appear as one of multiple reasons behind the phenomenon of "fear of floating". Another reason is found in Lahiri and Végh's (2001) who explain that fear of floating arises because there is an output cost associated with exchange rate fluctuations.

Table 3.2.: Exchange Rate Regime Classification

Year	Indonesia	Malaysia	Philippines	Thailand	South Korea
1990	Crawling Peg	+/-2% Crawling Band	Crawling Peg	Peg	+/-2% Crawling Band
1991	Crawling Peg	+/-2% Crawling Band	Crawling Peg	Peg	+/-2% Crawling Band
1992	Crawling Peg	+/-2% Crawling Band	Crawling Band	Peg	+/-2% Crawling Band
1993	Crawling Peg	+/-2% Crawling Band	+/-5% Crawling Band	Peg	+/-2% Crawling Band
1994	Crawling Peg	+/-2% Crawling Band	+/-5% Crawling Band	Peg	+/-2% Crawling Band
1995	Crawling Peg	+/-2% Crawling Band	+/-5% Crawling Band	Peg	Crawling Peg
1996	Crawling Peg	+/-2% Crawling Band	Peg	Peg	Crawling Peg
1997	Crawling Peg	+/-2% Crawling Band	Peg	Peg	Crawling Peg
1998	Free Falling	Free Floating	Managed Floating	Managed Floating	Free Falling
1999	Managed Floating	Pre Announced Peg	Managed Floating	Managed Floating	Managed Floating
2000	Managed Floating	Pre Announced Peg	Crawling Band	+/-2% Moving Band	Managed Floating
2001	Managed Floating	Pre Announced Peg	Crawling Band	+/-2% Moving Band	Managed Floating
2002	Managed Floating	Pre Announced Peg	Crawling Band	+/-2% Moving Band	Managed Floating
2003	Managed Floating	Pre Announced Peg	Crawling Band	+/-2% Moving Band	Managed Floating
2004	Managed Floating	Pre Announced Peg	Crawling Band	+/-2% Moving Band	Managed Floating
2005	Managed Floating	Pre Announced Peg	Crawling Band	+/-2% Moving Band	Managed Floating
2006	+/-5% Crawling Band	Peg	Crawling Band	+/-2% Moving Band	Managed Floating
2007	+/-5% Crawling Band	Peg	Crawling Band	+/-2% Moving Band	Managed Floating
2008	+/-5% Crawling Band	+/-5% Crawling Band	+/-5% Crawling Band	+/-2% Moving Band	Managed Floating
2009	+/-5% Crawling Band	+/-5% Crawling Band	+/-5% Crawling Band	+/-2% Moving Band	Managed Floating
2010	+/-5% Crawling Band	+/-5% Crawling Band	+/-5% Crawling Band	+/-2% Moving Band	Managed Floating

Source: IMF classification (Annual Report on Exchange Arrangements and Exchange Restrictions) as accessed from http://personal.lse.ac.uk/ilzetzki/IRRBack.htm on January 8th, 2015

Table 3.2 exhibits the classification of exchange rate regimes of the Asia-5 countries from 1990-2010. This information is taken from dataset of Ilzetzki, Reinhart and Rogoff (2011). In this table, the *de facto* exchange rate regime of the Asia-5 countries has been classified into several classifications. During the Asian crisis, for instance, Indonesia has been classified as de facto crawling peg. Switching to the free-floating regime during the crisis period is indicated by changing classification from crawling peg to free falling in 1997-1998. During post-Asian crisis, the prevailing de facto exchange rate regime was no longer free-floating. Taking into account the classification in Table 3.2, it is obvious that during pre-Asian crisis the Asia-5 countries adopted intermediate regime and they switched into floating regime during the Asian crisis.

3.3. Data and Methodologies

To analyze the *de facto* exchange rate regime in the Asia-5 currencies, we collected monthly nominal exchange rate and foreign reserves of these countries during the period of January 1990 to December 2013 from International Financial Statistic – International Monetary Fund (IFS-IMF) database. In addition, we also collected monthly data of the exchange rate of the anchor currencies, i.e. the US dollar (USD), Japanese yen (JPY), Germany mark (DEM), Euro (EUR) and Swiss franc (CHF) from the IFS-IMF database in the same period as mentioned above.

To describe the characteristics of the exchange rate regime in the Asia-5 countries after the Asian crisis, Baig (2001) used standard deviation of the percentage change of home currency against the US dollar and also standard deviation of the percentage change of foreign reserves of each country. High (low) standard deviation indicates high (low) volatility of the exchange rate and foreign reserve. Under managed-floating regime, the volatility of the exchange rate usually low while volatility of reserves usually high. In contrast, under free-floating regime the exchange rate will be more volatile and the foreign reserves will be less volatile. Since the information about intervention in the foreign exchange market by central bank is not publicly announced, we may infer the intervention by the change of foreign reserves. Positive (negative) change in the foreign reserve could be interpreted as a sign of purchasing (selling) foreign currency in the exchange market.

Bayoumi and Eichengreen (1998) created an index of exchange market flexibility. The flexibility index is constructed by dividing the standard deviation of exchange rate movement by a measure of exchange market pressure. The formula of the index is as follows:

$$Index = \frac{SDEX}{(SDEX + SDREV)}$$

where each variables are defined as:

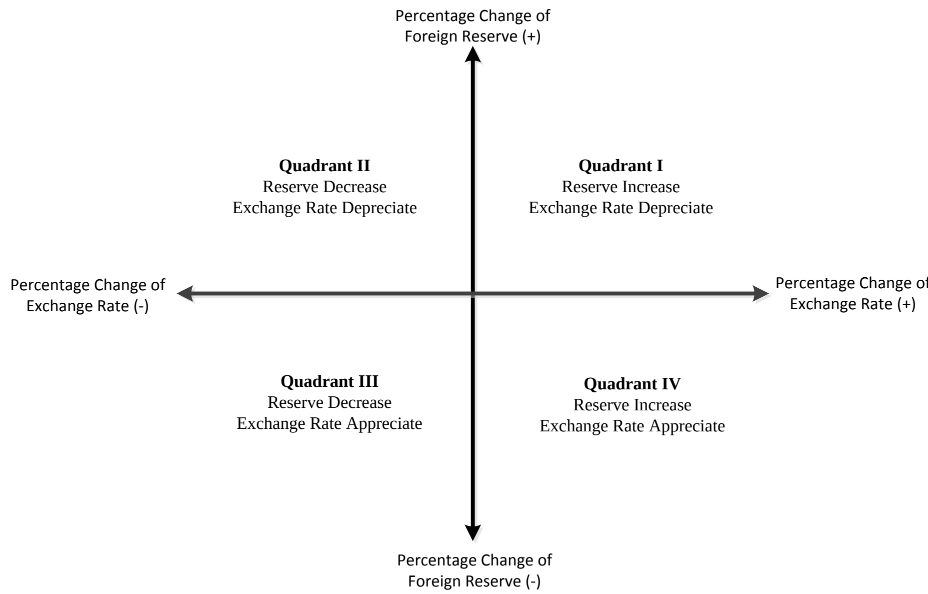
(i) SDEX is standard deviation of exchange rate changes (log difference)
(ii) SDREV is standard deviation of the ratio of changes in reserves, divided by lagged stock of base money

The index is in the range of 0 to 1. A lower index indicates that the exchange rate is relatively inflexible.

Observing the time series of percentage change of exchange rate and foreign reserve, we noticed that there are four different possibilities of the combination of this two series. The four possibilities will be explained below. A countercyclical policy usually conducted by central bank to maintain the exchange rate value i.e. for instance, if the exchange rate tends to weaken then the central bank intervene the exchange market by selling their foreign reserves. Meanwhile, if the exchange rate tends to appreciate but sometimes too strong currency is undesirable, then the central bank intervene exchange market by purchasing foreign currency to accumulate their foreign reserves. This countercyclical policy is also known as "leaning against the wind" that usually used in the exchange rate arrangement. It can be said, that under leaning against the wind, the depreciation (appreciation) of the exchange rate will be followed by a dis-accumulation (accumulation) of the foreign reserves. Conversely, another exchange rate arrangement may be taken in other way i.e. accelerating depreciation as well as appreciation of the exchange rate or as known as "leaning in line the wind". In this case, the depreciation (appreciation) of the exchange rate followed by accumulation (dis-accumulation) of the foreign reserves. Therefore, the four possibilities of the combination of percentage change of exchange rate and foreign reserves are, i.e. (i) positive change in exchange rate and foreign reserves, (ii) positive change in exchange rate and negative change in foreign reserves, (iii) negative change in exchange rate and foreign reserves, (iv) negative change in exchange rate and positive change in foreign reserves. The possibilities of (ii) and (iv) represent "leaning against the wind", while (i) and (iii) represent "leaning in line the wind".

We provide a Cartesian diagram to situate those four possibilities in each quadrant. Figure 3.2 presents a Cartesian diagram with horizontal axis represents percentage change of foreign reserve and vertical axis represents percentage change of exchange rate. As already explained, the 2 different policies (i.e. leaning against the wind and leaning in line the wind) can be represented within each quadrant in the Cartesian diagram. For instance, quadrant I represent a condition when the exchange rates depreciate and foreign reserve increase. This figure can be used as a tool to analyze the changes in exchange rate management.

Figure 3.2.: Pattern of Exchange Rate and Foreign Reserve Change



Frankel-Wei (2008) applied a regression model to infer implicit basket weight and exchange rate flexibility (inflexibility) in several countries under the assumption that the home currency is determined by a basket of currency. In our study, we apply Frankel-Wei's regression model to infer the de facto exchange rate regime for Asia-5 countries. It is assumed that the movement of each surveyed currencies, i.e. Indonesian rupiah (IDR), Malaysian ringgit (MYR), Philippines pesos (PHP), Thailand bath (THB) and South Korean won (KRW) are determined by basket currency of G3 currencies i.e. USD, JPY, and DEM or EUR. In addition, we choose Swiss franc (CHF) as *numeraire*[5]. The equations are used:

Pre-Asian crisis

$$\Delta(e_{LC})_t = c + \alpha_1\Delta(e_{USD})_t + \alpha_2\Delta(e_{JPY})_t + \alpha_3\Delta(e_{DEM})_t + \beta\Delta emp_t + \varepsilon_t \quad (3.1)$$

Post-Asian crisis

$$\Delta(e_{LC})_t = c + \alpha_1\Delta(e_{USD})_t + \alpha_2\Delta(e_{JPY})_t + \alpha_3\Delta(e_{EUR})_t + \beta\Delta emp_t + \varepsilon_t \quad (3.2)$$

[5] Several *numeraire* are used in similar studies, among others : Frankel (1993) uses purchasing power over a consumer basket of domestic goods; Frankel and Wei (1995) use SDR; Frankel and Wei (1994, 2006) use Swiss Franc; Bénassy-Quéré (1999) use dollar

where each variables is defined as:

(i) $\Delta(e_{LC})_t$ is log difference of the CHF against home currencies (i.e. CHF/IDR, CHF/MYR, CHF/PHP, CHF/THB, and CHF/KRW) of the sampled countries at month t;

(ii) c is a constant term;

(iii) $\Delta(e_{USD})_t$, $\Delta(e_{JPY})_t$, and $\Delta(e_{DEM})_t$ is log difference of the CHF against the USD, JPY, and DEM or EUR[6], respectively at month t;

(iv) $\alpha_k(k = 1,2,3)$ is the coefficient on the monthly change in the log exchange rate currency k;

(v) β is the coefficient of Exchange Market Pressure

(vi) Δemp_t is defined as the sum of log difference of exchange rate of the CHF against each Asia-5 currencies and log difference of foreign reserve for each countries in question at month t; and

(vii) ε_t is the residual term.

The coefficients of α in the equation (3.1) and (3.2) can be interpreted as degree of influence of G3 currencies to the movement of currency in surveyed countries. Kawai (2002) noted that Frankel-Wei's model (1994) provides useful information on "observed" exchange rate arrangements for developing countries. The underlying hypothesis is that every country attempts to stabilize the exchange rate to a basket of multiple currencies. There are two information can be obtained from the Frankel-Wei's model, i.e. (i) exchange rate stabilization policy, and (ii) exchange rate flexibility. The Exchange rate stabilization to a single currency can be interpreted as a special case in which only one anchor currency is identified with a significant and large positive coefficient, while other currencies' coefficients are small and statistically insignificant. Meanwhile, the exchange rate flexibility is indicated by the estimated standard error of regression, for instance, large estimated standard error of regression implies that the authorities allow relatively large exchange rate flexibility, while a small size indicates that they attempt to stabilize their exchange rates. The coefficient of EMP can be interpreted as flexibility or inflexibility of currency in question. If the β is significant it means that the exchange rate is

[6] The CHF/DEM is used prior to the 1997 crisis while the CHF/EUR for the post-1997 crisis

inflexible, while if the β is not significant it indicates that the exchange rate moves flexibly.[7] In our study, as already discussed in Chapter 2 the coefficient of EMP (β) will be used to measure sensitivity of the exchange rate toward market pressure. Therefore, if the coefficient β is equal to 0, then home currency is fixed and if β is significantly not equal to 0 then home currency is floating.

In order to obtain statistical evidence of the stability of the estimated coefficients during the post-Asian crisis, we apply recursive regression as follows: First we estimate the regression coefficient in equation (3.2) using the first k observation of the explanatory variables obtained at time $t = 1, \cdots, k$ where k is greater than the number of the explanatory variables. The second regression will be conducted using the first $k + 1$ observation obtained at $t = 1, \cdots, k + 1$. The process of estimation continues until all observation is completely used.

Let denote a set of estimated coefficient obtained by the first n observation by$\left(\hat{\alpha}_1, \hat{\alpha}_1, \hat{\alpha}_1, \widehat{\beta}\right)_n$. Then in the end, we have $T - k + 1$ different sets of estimated coefficients$\left(\hat{\alpha}_1, \hat{\alpha}_1, \hat{\alpha}_1, \widehat{\beta}\right)_n, n = k, k + 1, \cdots, T$. Using these sets of estimated coefficient we will be able to test whether the regression coefficients are stable or unstable overtime. In what follows we focus on the stability of the coefficients of the US dollar and exchange market pressure, i.e. α_1 and β for each surveyed country and simplify the equation (3.2), then we develop new equation as follows:

$$\Delta(e_{LC})_t = c + \alpha_{1t}\Delta(e_{USD})_t + \beta_t \Delta emp_t + \varepsilon_t, \text{ for } t = k, \cdots, T \tag{3.3}$$

where

(i) α_{1t} and β_t are the coefficient of the US dollar and exchange market pressure in varying time respectively

(ii) k is the first 5 observations and

(iii) T is the full sample for each equation.

The equation (3.1) and (3.2) is very sensitive to the observation period selection. Using different observation period, it will lead different estimation result. If irrelevant observation period is included, then some important information on the exchange rate movement may be lost. For

[7] All the coefficients in equation (3.1) are not restricted, hence the value could be more than 1 or less than 0

example, if there is a structural change caused by change of the exchange rate policy conducted without any announcement and if we want to detect the change point by Chow test (1960) our sample should contain the unknown break point. But if we choose irrelevant or inappropriate sample period the important information on structural change may be lost and we cannot detect a change point properly.

It is also important to examine response of the home currency toward the change of the anchor currency movement. Concerning to this problem we pursue, for instance, the following questions: how does the home currency respond to the appreciation or depreciation of the anchor currency? Does the home currency have a symmetric response (equal response to the change of the anchor currency movement in both ways) or asymmetric response (different response to the different movement)? To answer these questions, we only examine the response of the local currency toward the change of the U.S dollar movement. For this purpose, we adopt the following regression equation as known as the asymmetric response model:

$$\Delta(e_{LC})_t = c + \alpha_1 \Delta(e_{USD})_t^{+} + \alpha_2 \Delta(e_{USD})_t^{-} + \varepsilon_t \qquad (3.4)$$

where

(i) $\Delta(e_{LC})_t$ is change of the local currency exchange rate against CHF

(ii) $\Delta(e_{USD})_t^{+} = \max[0, \Delta(e_{USD})_t]$ and it can be interpreted as the US dollar appreciation

(iii) $\Delta(e_{USD})_t^{-} = \Delta(e_{USD})_t^{+} - \Delta(e_{USD})_t$, and it can be interpreted as the US dollar depreciation

(iv) ε_t is error term.

3.4. The Exchange Rate Arrangement: Comparison of Regression Results

3.4.1. The volatility of the Exchange Rate and Foreign Reserve

In Table 3.3, almost all exchange rates in surveyed countries during pre-Asian crisis (1990-1996) show low volatility except for Philippines peso and Malaysia ringgit for several years. On the contrary, the foreign reserves of all the Asia-5 countries indicated high volatility. Among the surveyed countries, Philippines recorded ~~a~~ higher volatility of reserves.

Table 3.3: The Volatility of the Exchange Rate and Foreign Reserve of Asia-5

Year	Exchange Rate					Foreign Reserve					Index of Flexibility				
	σ_{IDR}	σ_{MYR}	σ_{PHP}	σ_{THB}	σ_{KRW}	σ_{IDN}	σ_{MAL}	σ_{PHI}	σ_{THA}	σ_{KOR}	Ind.	Mal.	Phi.	Tha.	Kor.
1990	0.17	0.44	2.51	0.54	0.51	11.24	6.14	27.27	2.97	4.66	0.01	0.07	0.08	0.15	0.10
1991	0.13	0.91	0.81	0.63	0.49	5.39	3	20.88	2.5	3.4	0.02	0.23	0.04	0.20	0.13
1992	0.19	1.72	3.65	0.55	0.47	3.32	7.91	11.97	2.23	3.6	0.05	0.18	0.23	0.20	0.12
1993	0.16	1.76	2.62	0.41	0.27	1.43	8.38	8	1.94	3.34	0.10	0.17	0.25	0.17	0.07
1994	0.15	1.65	1.96	0.38	0.33	4.22	11.23	6.38	1.6	2.17	0.03	0.13	0.24	0.19	0.13
1995	0.08	1.13	1.43	0.56	0.94	1.6	2.67	5.57	2.56	2.86	0.05	0.30	0.20	0.18	0.25
1996	0.51	0.72	0.11	0.37	1	3.67	2.78	3.76	1.41	3.85	0.12	0.21	0.03	0.21	0.21
1997	7.87	4.56	5.27	7.31	11.32	4.92	6.25	7.58	9.34	8.68	0.62	0.42	0.41	0.44	0.57
1998	31.25	9.09	5.55	9.71	7.81	6.6	4.69	6.18	4.22	5.29	0.83	0.66	0.47	0.70	0.60
1999	10.21	0	1.94	3.17	2.67	2.42	3.47	3.13	2.11	1.91	0.81	0.00	0.38	0.60	0.58
2000	4.21	0	3.43	2.27	2.44	4.28	2.9	4.68	2.14	1.62	0.50	0.00	0.42	0.51	0.60
2001	8.2	0	2.46	1.95	2.48	1.12	3.77	3.3	1.32	1.21	0.88	0.00	0.43	0.60	0.67
2002	3.04	0	1.04	1.27	1.98	2.15	1.54	3.34	2.03	0.87	0.59	0.00	0.24	0.38	0.69
2003	1.9	0	1.3	1.21	2.35	1.42	2.2	1.92	2.75	1.63	0.57	0.00	0.40	0.31	0.59
2004	2.38	0	0.46	1.45	2.25	2.07	2.31	2.32	1.54	2.1	0.53	0.00	0.17	0.48	0.52
2005	1.93	0.43	1.37	1.33	1.31	3.88	3.27	2.58	1.61	0.61	0.33	0.12	0.35	0.45	0.68
2006	2.53	1	1.54	1.83	1.75	5.58	1.36	2.96	1.23	1.1	0.31	0.42	0.34	0.60	0.61
2007	1.95	1.3	1.72	0.91	1.48	1.66	2.3	2.41	2.28	0.55	0.54	0.36	0.42	0.29	0.73
2008	6.49	2.21	2.79	2.09	7.3	4.31	5.82	1.63	4.14	3.68	0.60	0.28	0.63	0.34	0.66
2009	3.53	1.88	1.7	1.4	6.14	2.74	1.68	2.22	1.61	1.86	0.56	0.53	0.43	0.47	0.77
2010	1.2	1.81	1.88	1.3	3.24	3.78	2.14	3.09	2.43	1.9	0.24	0.46	0.38	0.35	0.63
2011	1.83	2.72	1.49	2.15	3.85	4.31	4.23	2.41	2.48	1.63	0.30	0.39	0.38	0.46	0.70
2012	1.25	2.24	1.45	1.61	1.98	2.78	0.65	2.14	1.74	0.93	0.31	0.78	0.40	0.48	0.68
2013	2.46	1.96	1.67	2.1	1.87	3.5	1.46	1.11	1.49	0.82	0.41	0.57	0.60	0.58	0.70

Source: IFS-IMF; Author's calculation. Pre-Asia crisis (1990-1996), During crisis (1997-1999), Post-Asia crisis (2000-2013). Standard deviation of percentage change IDR/USD (σ_{IDR}), MYR/USD (σ_{MYR}), PHP/USD (σ_{PHP}), THB/USD (σ_{THB}), KRW/USD (σ_{KRW}). Standard deviation of percentage change of foreign reserve of Indonesia (σ_{IDN}), Malaysia (σ_{MAL}), Philippines (σ_{PHI}), Thailand (σ_{THA}), South Korea (σ_{KOR}).

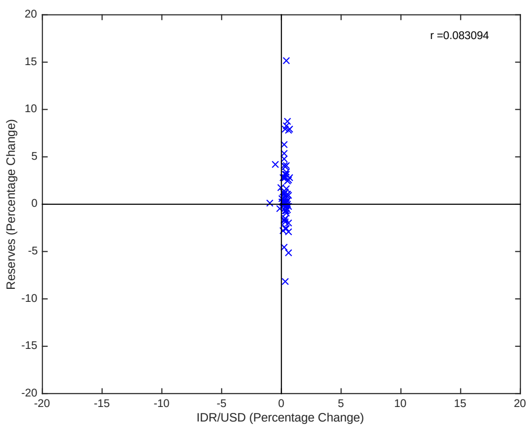
The high volatility on the reserves along with the low volatility of the exchange rate during pre-Asian crisis indicates an intervention to stabilize the exchange rate by conducting market operation on the exchange market.

During the crisis period (1997-1999), the volatility of the exchange rate in all surveyed countries increased as a consequence of the exchange rate regime change, i.e. from intermediate to the free-floating regime. In this period, the volatility of the Indonesian rupiah was higher than other four Asis-5 currencies. Meanwhile, the volatility of foreign reserves also increased compared to the pre-Asian crisis. This phenomenon indicated that the exchange rates were allowed to move more volatile while the foreign reserves to move less volatile. As a result, the Asia-5 currencies experienced severe depreciation, i.e. more than 30% from June 1997 to May 1998 and Indonesia recorded highest depreciation among the other four Asia-5 countries, i.e. more than 70% (Goldstein, 1998).

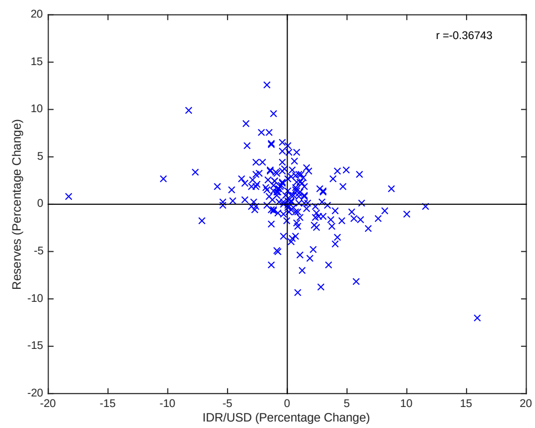
Three years after the onset of the Asian crisis, the exchange rate movements in Asia-5 countries have changed. During the post-crisis period (2000-2013) the volatility of the exchange rates declined although they were still higher than the pre-crisis period. The volatility of the IDR remains higher in 2000-2002 than other four Asia-5 currencies but time-to-time it becomes less volatile and slightly similar to other Asia-5 currencies. The increasing market pressures due to Lehman shock have significant effect to the exchange rate movement in the Asia-5 countries. The exchange rate of the Asia-5 countries became more volatile in 2008 and the IDR and KRW were more volatile than other three Asia-5 countries. Meanwhile, increasing volatility in the exchange rate due to Lehman shock was not followed by high volatility of the foreign reserve.

Using analysis of scatterplot as depicted in the Figure 3.2, the observation for each surveyed country is conducted for pre and post-Asian crisis of 1997 and the results are presented in Figure 3.3 below. Figure 3.3.(i) exhibit the scatterplot for the case of Indonesia during the pre-Asian crisis. It shows that the scatterplot spread around the horizontal axis which indicates that the exchange rate has low volatility while the foreign exchange reserves volatile in both ways. Meanwhile, during the post-Asian crisis as shown in Figure 3.3.(ii) the scatterplot spread around the origin. This indicates that the IDR is more volatile during post-Asian crisis. The coefficient of correlation during the post-Asian crisis is -0.36 which indicate that the percentage change of exchange rate is negatively correlated to the percentage change of foreign reserve. The similar conditions are also shown in Figure 3.3.(vii)-(viii) and Figure 3.3.(ix)-(x), which indicate that Thailand and South Korea have similar experience in arranging their exchange rate during pre and post-Asian crisis. Under this condition, we may say that the exchange rate arrangement in this countries have been conducted by following leaning against the wind policy.

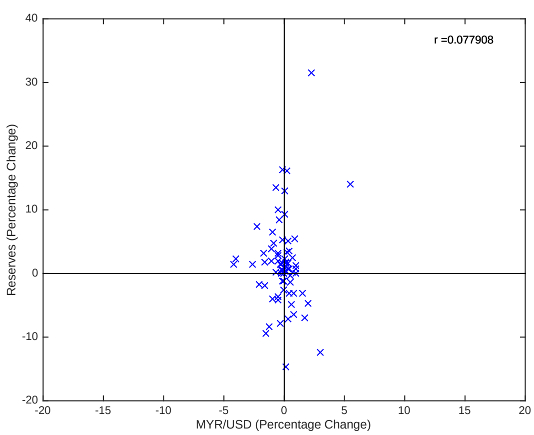
Figure 3.3: Scatterplot of Percentage Change of Exchange Rate and Foreign Reserves Asia-5



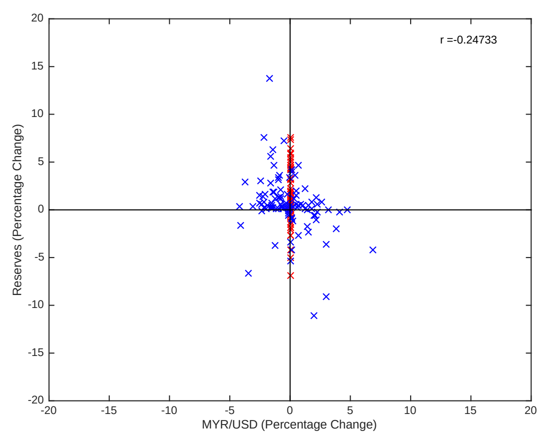
(i) Indonesia (1991.1 – 1996.12)



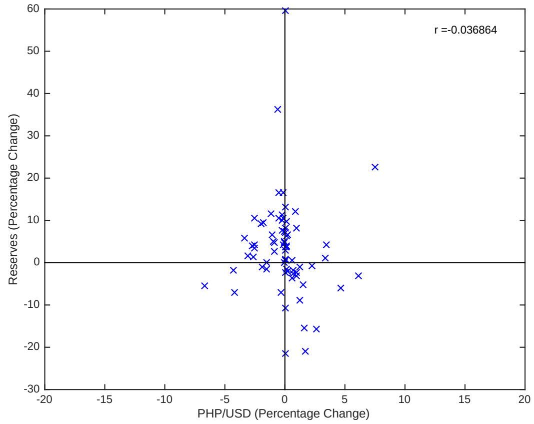
(ii) Indonesia (2000.1 – 2013.12)



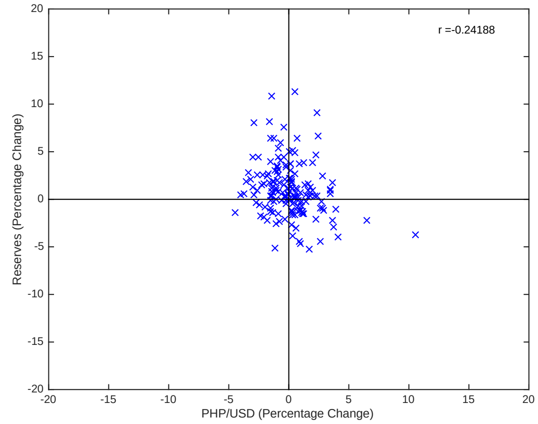
(iii) Malaysia (1991.1 – 1996.12)



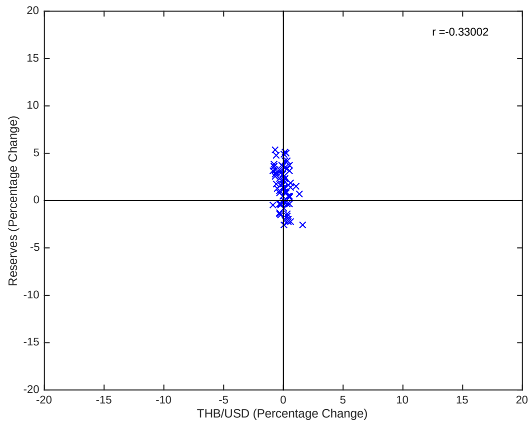
(iv) Malaysia (2000.1 – 2013.12)



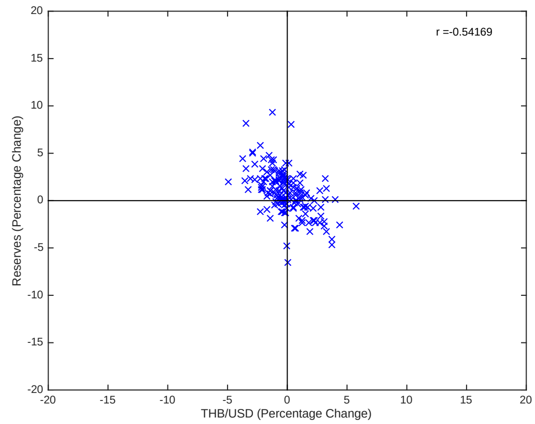
(v) Philippines (1991.1 – 1996.12)



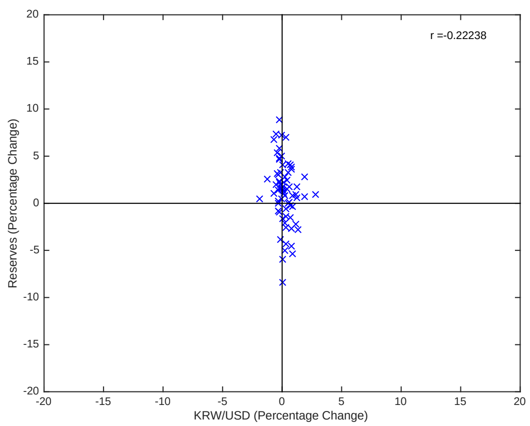
(vi) Philippines (2000.1 – 2013.12)



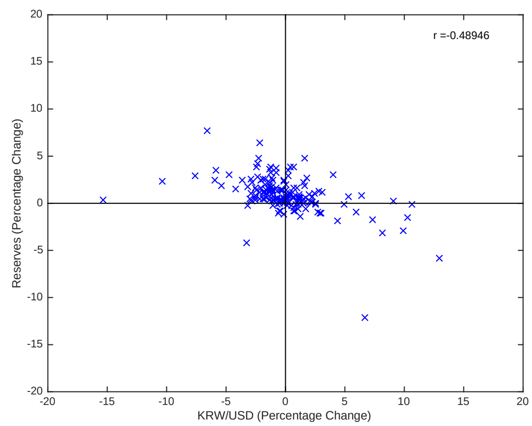
(vii) Thailand (1991.1 – 1996.12)



(viii) Thailand (2000.1 – 2013.12)



(ix) South Korea (1991.1 – 1996.12)



(x) South Korea (2000.1 – 2013.12)

Sources : IFS-IMF

The characteristics of the exchange rate arrangement for Malaysia and Philippines are quite different compare to the other three Asia-5 countries. This condition can be verified by using Cartesian diagram analysis. Figure 3.3.(iii)-(iv) and Figure 3.3.(v)-(vi) present the scatterplot for Malaysia and Philippines respectively. During pre-Asian crisis, the scatterplot of these two countries more spread than other three Asia-5 countries. While during the post-Asian crisis, the spread of the scatterplot were mostly spread around the vertical axis which indicates that change of foreign reserve is less than the change of the exchange rate.

In general, the scatterplots show different pattern of the exchange rate arrangement for pre and post-Asian crisis. Indonesia, Thailand and South Korea have similar experience in arranging their exchange rate, i.e. less volatile in the exchange rate and more volatile in the foreign reserve during pre-Asian crisis, while allowing exchange rate and foreign reserve to volatile during the post-Asian crisis. The similar experience is found in Malaysia and Philippines during pre and post-Asian crisis. The scatterplot during post-Asian crisis looked more congregate around the vertical axis which indicates that the change of the exchange rate is greater than the change of the foreign reserve. During the post-Asian crisis, the percentage change of the exchange rate is fairly correlated to the percentage change of the foreign reserve in different direction as indicated by the coefficient of correlation, i.e. -0.2 to -0.5

3.4.2. Regression Results: Pre-Asian Crisis

The regression results of equation (3.1) for the pre-crisis period is presented to provide information about the arrangement of the exchange rate of each surveyed countries against the G3 currencies. The regression estimation was performed using a 24-month observation period (i.e. from January 1991-December 1992 until January 1995-December 1996) for each surveyed countries. Overall, as shown in Table 3.4, the coefficients of the US dollar for the Asia-5 countries are high and significant. Besides, this model is robust since the adjusted coefficient of determination (Adjusted R^2) was high (i.e. 0.7 to 0.99) for all surveyed countries.

Table 3.4: Regression Result of Exchange Rate Movement for Asia-5: Pre-Crisis

Period	Const.	Coefficient USD	JPY	DEM	EMP	Adj.R^2	DW Stat.
Indonesia							
1991.1-1992.12	-0.003***	0.982***	-0.008	0.021	-0.002	0.999	1.263
	(0.000)	(0.012)	(0.017)	(0.024)	(0.006)		
1993.1-1994.12	-0.003***	1.012***	-0.008	0.012	-0.0003	0.996	1.248
	(0.000)	(0.022)	(0.016)	(0.036)	(0.012)		
1995.1-1996.12	-0.003***	1.022***	0.014	0.022	-0.013	0.988	2.199
	(0.005)	(0.042)	(0.029)	(0.110)	(0.031)		
Malaysia							
1991.1-1992.12	-0.002	0.836***	0.015	0.319	0.101**	0.934	1.604
	(0.003)	(0.107)	(0.151)	(0.199)	(0.039)		
1993.1-1994.12	0.001	0.744***	0.094	0.553	-0.016	0.700	2.343
	(0.003)	(0.200)	(0.157)	(0.381)	(0.043)		
1995.1-1996.12	0.001*	0.875***	0.201***	-0.305***	0.135***	0.987	2.051
	(0.001)	(0.036)	(0.032)	(0.105)	(0.029)		
Philippines							
1991.1-1992.12	0.006	1.185***	-0.511	0.609	0.003	0.761	3.083
	(0.005)	(0.222)	(0.325)	(0.445)	(0.033)		
1993.1-1994.12	0.002	1.292***	-0.166	0.029	0.124*	0.771	1.456
	(0.004)	(0.238)	(0.193)	(0.445)	(0.060)		
1995.1-1996.12	-0.004**	0.941***	0.021	-0.070	0.108***	0.946	1.914
	(0.006)	(0.095)	(0.066)	(0.236)	(0.034)		
Thailand							
1991.1-1992.12	-0.001**	0.815***	0.082***	0.031	0.030**	0.999	2.503
	(0.000)	(0.012)	(0.020)	(0.023)	(0.014)		
1993.1-1994.12	-0.000	0.809***	0.117***	0.079***	-0.002	0.998	2.270
	(0.000)	(0.012)	(0.008)	(0.019)	(0.012)		
1995.1-1996.12	-0.000	0.855***	0.093***	0.050	0.002	0.998	2.222
	(0.000)	(0.017)	(0.010)	(0.034)	(0.013)		
South Korea							
1991.1-1992.12	-0.004***	0.979***	0.002	-0.194**	0.071***	0.993	1.038
	(0.001)	(0.038)	(0.050)	(0.072)	(0.023)		
1993.1-1994.12	-0.001	0.970***	-0.027	-0.043	0.050*	0.984	1.555
	(0.001)	(0.042)	(0.032)	(0.072)	(0.027)		
1995.1-1996.12	-0.002	0.766***	0.169***	-0.277	0.110**	0.949	2.171
	(0.002)	(0.072)	(0.052)	(0.185)	(0.039)		

Data Source: IFS-IMF. Author’s calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

During the pre-crisis period, the exchange rate of rupiah mainly followed the US dollar as it can be seen from the positive high and significant coefficients of the US dollar, and the coefficient of the US dollar getting higher time to time just before the onset of the crisis. Meanwhile the coefficient of EMP was equal to 0 indicates that rupiah was fixed. This suggests that the rupiah was strongly pegged to the US dollar.

Meanwhile, the US dollar also became main reference for the Malaysian ringgit though with relatively lower degree. But during 1995-1996 all variables were high and significant which indicate that before the onset of the crisis, the exchange rate management of ringgit was changed; it was not mainly pegged to the US dollar but pegged to basket of currency. Although the US dollar remains the main reference for the movement of the ringgit, but the Japanese yen and Germany mark were also become reference for ringgit although with different movements, i.e., moving positively against the yen and the negative to the mark. Furthermore, significant EMP coefficient showed ringgit was floating during pre-Asian crisis except in 1993-1994.

The movement of the Philippines peso was also more referred to the US dollar and it seemed that peso was allowed to move more flexible. The Thailand baht movement had a slightly different pattern, although the US dollar became the main reference for the baht, but the Japanese yen was also used as reference for the baht though with smaller weights. During 1993-1994, the regression results show that the Thailand baht was pegged to basket of currency. Meanwhile, the Korean won also used the US dollar as the main reference for the won, but in 1995-1996 the weight of US dollar against the Korean won fell to 0.7 and apparently the Japanese yen was chosen as the anchor despite the relatively small weight. In contrast to the other sample countries, the coefficient of EMP of South Korea showed positively low and significant (i.e. 0.05 during the crisis and to 0.11 in the post crisis), and this indicate flexibility in Korean won movement.

Thus, during the pre-crisis period, the exchange rate of the Asia-5 countries was mainly pegged to the US dollar. Thailand used the Japanese yen as reference during this period. Similar to Thailand, Malaysia and South Korea also used the Japanese yen was used as reference for the before the onset of the 1997 crisis.

3.4.3. Regression Results: Post-Asian Crisis

After observing the arrangement of the exchange rate in the Asia-5 countries during the pre-Asian crisis, the next part is to estimate the post-Asian crisis exchange rate regime. To do that, we estimate the coefficients in the equation (3.2) using 24-months of observation (i.e. from January 2000-December 2001 until January 2012-December 2013) for each regression. Table A.1 – A.5 in the Appendix-B exhibit the regression results for each surveyed countries. We also provide the regression result using the entire sample period from January 2000 to December 2013, as presented in highlighted row of the bottom of each tables.

3.4.3.1. Indonesia

During 2000-2001, the rupiah was very flexible and there was no evidence of G3 currencies' peg. But since 2002-2003 until 2012-2013, the evidence of the US dollars peg has appeared, although the coefficient of the US dollar has been changed over time. Rupiah was pegged to the US dollar with relatively small weight during the period of 2002-2003. But for the next period, the coefficient of the US dollar increased along and became less flexible, except in 2008-2009. The weight of the US dollar declined during 2008-2009 as the effect of Lehman shock in 2008. In general, when the observation period from 2000-2013 (presented on the bottom row of table A.1), the US dollar remains the main reference for the rupiah and move moderately flexible, with the magnitude both coefficients close to 0.5.

3.4.3.2. Malaysia

Unlike the other four countries, Malaysia preferred to implement the fixed regime to solve the exchange rate problem. It is also shown from the regression results in Table A.2, where during 2000-2005 Malaysian ringgit was fixed to the US dollar. Since July 2005, after the Malaysia government announced switching exchange rate regime to floating regime, the regression result still provide evidence that the ringgit has been pegged mainly to the US dollar and less flexible. In addition, during 2012-2013, the Malaysia ringgit moved more flexible than the previous period and no longer referred to G3 currencies. In general, by observing the Malaysian ringgit 2005-2013, the regression results show that the US dollar was the main reference for the Malaysian ringgit.

3.4.3.3. The Philippines

The exchange rate movement of Philippines peso was relatively inflexible during 2000-2001 and at the same time none of the G3 currencies found to be used as a reference. However, for the next period, 2002-2003 to 2012-2013, the US dollar was clearly used as main reference for the pesos since the coefficient of the US dollar was significant and more than 0.5, except in 2008-2009. When there was large external shock in 2008-2009, the Japanese yen was also noted to have a negative and small influence on the Philippines peso. Except in 2004-2005, Philippines peso was floating. Overall, during 2000-2013, the US dollar was the only hard currency that influenced the pesos and flexible (see Table A.3 Appendix-B).

3.4.3.4. Thailand

The Thailand baht move relatively flexible during 2000-2001 and it was mainly influenced moderately by the US dollar. While in the next period, 2002-2003, the baht showed to co-movement not with the US dollar only, but also with the Japanese yen although the weight of the US dollar weight was higher to the Japanese yen. Besides, the movement of the baht became less flexible at this period. For the rest of the observation period, the regression result show the evidence that the US dollar remain became the main reference for the Thailand baht and moderate movement of the Thailand baht show the moderate movement of the Thailand baht. However, during 2010-2011 the Euro was also indicated to have an influence on the movement of the baht though with low weight and negative value. In general, during 2000-2013, the estimation result shows that the US dollar appeared to be the only significant currency with relatively high degree to influence the baht. In addition, during this period the Thailand bath was floating all the time (see Table A.4 Appendix-B).

3.4.3.5. South Korea

The US dollar had a positive and relatively small influence on the movement of the Korean won in all period with exception of 2008-2009. Meanwhile, the Japanese yen and the euro only have a significant influence in 2000-2001, 2004-2005 and 2004-2005, 2012-2013 respectively. As shown in the Table A.5 Appendix-B, the coefficient of Euro was negative while the US dollar and the Japanese yen were positive. The market pressure during the observation period was relatively high since the coefficients of EMP were above 0.5 (with the exception of 2004-2005 where all the variables were significant to the won). By observing the Korean won from 2000 to 2013, the regression results indicate that the US dollar and Euro influenced the won in different directions and it was floating all the time.

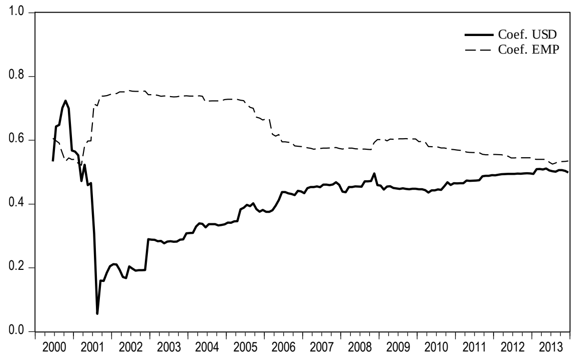
The statistical evidences show that there are different pattern of the exchange rate arrangement among the Asia-5 countries although pegged to the US dollar still become common pattern for the Asia-5 exchange rate management. The impact of Lehman shock in 2008 has been responded differently among the Asia-5 countries. As we can observe from Table A.1-A5 Appendix-B, the magnitudes of market pressure are diver in each country; Indonesia, Philippines and South Korea suffered from the Lehman shock since the β coefficient were higher. Given the different level of suffering from Lehman shock, each Asia-5 countries also had different strategy regarding to maintain their currency. During the Lehman shock, the following responses were taken by each country regarding to the degree of the US dollar pegging; rupiah and peso were less pegged to the US dollar and became more floating; ringgit and bath were more pegged to the US dollar although still let their currency to float; while won freed from the US dollar but and allowed won to float.

3.4.4. Test of Coefficient Stability

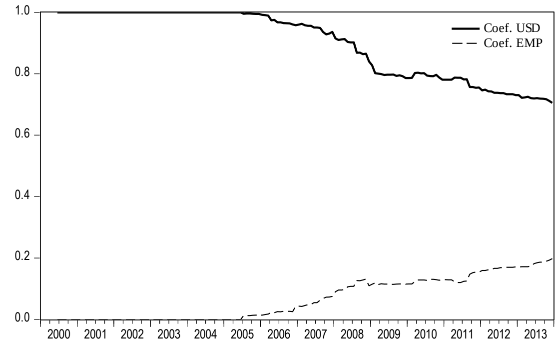
To determine whether the estimated coefficient is stable during the observation period, then recursive OLS as in equation (3.3) is applied. Instead of testing all the variables, this study only focuses on the stability of the US dollar and EMP coefficient over the period 2000-2013. The recursive OLS results are presented in Figure 3.4. The Indonesian rupiah experiencing different coefficient movement compare to other four Asia-5 currencies, where the coefficient of the US dollar increased over time while the coefficient of the EMP decreased over time and this two coefficients converged to 0.5, as shown in Figure 3.4.(i).

During 2000 to the mid of 2005, Malaysia ringgit was fixed to the US dollar. As it can be verified in Figure 3.4.(ii), the coefficient of the US dollar and EMP is 1 and 0 respectively. After 2005 until 2013, the coefficient of the US dollar gradually declined to 0.7 while the coefficient of the EMP increased approaching 0.2. The Philippines pesos and Thailand bath have similar pattern where the coefficients US dollar move stably at 0.8 and the coefficient of moving EMP stable at 0.4. The opposite occurred in South Korea, the coefficient of USD moves stably at a lower value of 0.3 while the coefficients of the EMP are steady at 0.7.

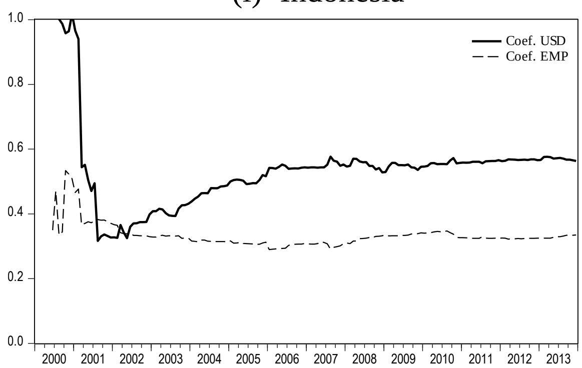
Figure 3.4: Recursive Regression – Stability of the Coefficient of USD and EMP (Post-Crisis)



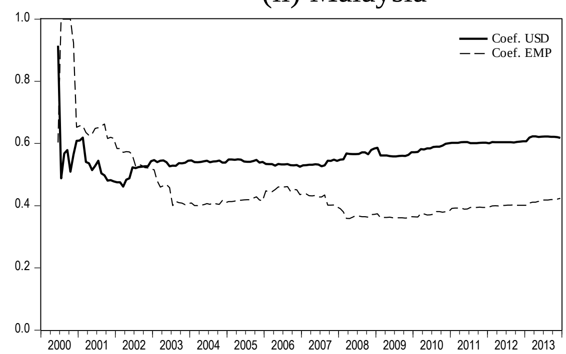
(i) Indonesia



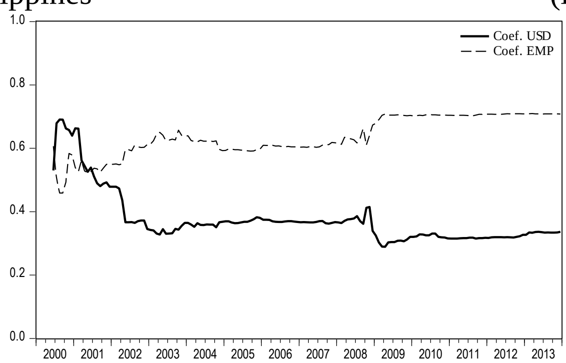
(ii) Malaysia



(iii) Philippines



(iv) Thailand



(v) South Korea

Source: Author's calculation

These results suggest that the US dollar remains the main anchor for the Asia-5 countries in arranging the exchange rates although the degree of pegging of the US dollar was different across the countries. In addition, the degree of flexibility also demonstrated differences among the Asia-5 countries.

3.5. Does the Asia-5 Countries Return to the Dollar Peg?

The question that usually appears related to the study of exchange rate regime is whether the phenomenon of returning back to the US dollar really happens. To answer this question, we use the coefficient of the US dollar and EMP as shown in Table 3.4 and Table B.1-B.5 in the Appendix - B to scrutiny its significance. In addition, we examine whether these two coefficients are equal to zero, therefore the Student-t test will be applied in the equation (3.2). The following null hypotheses are assigned:

$H_A: c(2) = 0$ Versus $H_{\bar{A}}: c(2) \neq 0$ for the coefficients of the US dollars

$H_B: c(5) = 0$ Versus $H_{\bar{B}}: c(5) \neq 0$ for the coefficients of the exchange market pressure

We classify the four hypotheses stated above into the following criteria as shown in Table 3.5.

Table 3.5: Degree of Pegging and Exchange Rate Flexibility

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Degree of Pegging</td></tr>
<tr><td>Non-Dollar Peg</td><td>Dollar Peg</td></tr>
<tr><td rowspan="2">Exchange Rate Flexibility against the EMP</td><td>Inflexible</td><td>$c(2) = 0$
$c(5) = 0$</td><td>$c(2) \neq 0$
$c(5) = 0$</td></tr>
<tr><td>Flexible</td><td>$c(2) = 0$
$c(5) \neq 0$</td><td>$c(2) \neq 0$
$c(5) \neq 0$</td></tr>
</table>

When the null hypothesis of $H_A: c(2) = 0$ is rejected, it means that the exchange rate of the currency in the question country is not tightly pegged to the US dollar. Meanwhile, if the null hypothesis of $H_B: c(5) = 0$ is rejected, the exchange rate of the country's currency is allowed to move flexibly. If it is true that the Asia-5 countries follow floating regime in the post crisis period as officially announced, the Student-t test result should reject the null hypotheses of

$H_A: c(2) = 0$ and should not reject the null hypothesis of $H_B: c(5) = 0$, as represented in Table 3.5 under Non-Dollar peg and Flexible.

Table 3.6: The Student-t Test Results for Asia-5

H_0 / Period	Indonesia		Malaysia		Philippines		Thailand		South Korea	
	c(2)=0	c(5)=0	c(2)=0	c(5)=0	c(2)=0	c(5)=0	c(2)=0	c(5)=0	c(2)=0	c(5)=0
Pre-Asian crisis										
1991-1992	No***	Yes	No***	No**	No***	Yes	No***	No**	No***	No***
1993-1994	No***	Yes	No***	Yes	No***	No*	No***	Yes	No***	No*
1995-1996	No***	Yes	No***	No***	No***	No***	No***	Yes	No***	No**
Post-Asian crisis										
2000-2001	Yes	No***	No***	Yes	Yes	No***	No***	No***	No***	No***
2002-2003	No**	No***	No***	Yes	No***	No**	No***	No**	No**	No***
2004-2005	No***	No***	No***	Yes	No***	Yes	No***	No***	No***	No***
2006-2007	No**	No**	No***	No***	No***	No**	No**	No**	No***	No***
2008-2009	No***	No***	No***	No**	No***	No**	No***	No***	Yes	No***
2010-2011	No***	No***	No***	No*	No***	No***	No***	No***	No***	No***
2012-2013	No***	No**	Yes	No***	No***	No*	No***	No***	No***	No***

Source: Author's calculation. ***; **; * is significant at 1%; 5%; 10% respectively. "Yes" means fail to reject H_A or H_B; "No" means rejecting H_A or H_B.

The results of the Student-t test for each period are presented in Table 3.6. During the pre-Asian crisis, the Student-t test show that the null hypothesis of c(2) = 0 is rejected in all Asia-5 countries, while the null hypothesis of c(5) = 0 differ among the Asia-5 countries. This result indicates that during the pre-Asian crisis, the Asia-5 countries tightly pegged their currencies to the US dollar. But, the flexibility of the movement of exchange rate in the Asia-5 countries show different pattern over time and across the countries.

During the post-Asian crisis, as shown in Table 3.6, the coefficient of the US dollar is significant and not equal to zero as during the pre-Asian crisis, except in several period e.g. for Indonesian rupiah and Philippines peso in 2000-2001; South Korean won during 2008-2009 and Malaysian ringgit in 2012-2013 where the US dollar was not significant to the respective currencies. But, the coefficients of the EMP provide another evidence, where they different from the pre-Asian crisis particularly for Indonesia and Thailand. The Student-t test results show that during the post-Asian crisis the movement of the Indonesian rupiah and Thailand bath is more flexible to the pre-Asian crisis. The central bank of South Korea seems to allow their currency to move flexibly since the pre-Asian crisis. Meanwhile, the Student-t test shows that movements of the Philippines peso and Malaysia ringgit have changed frequently during the post-Asian crisis. Nevertheless, the four Asia-5 countries responded similarly to the occurrence of the Lehmann shock in 2008 by still pegged their currencies to the US dollar except South Korea. At the time when the Lehmann shock occurred, the Korean won was not pegged to the US dollar.

To observe the response of each country's currency to the changes of the U.S dollar, we estimate the equation (3.4) and present the estimation results in Table B.1 - B.5 Appendix-B. Overall, during the pre-crisis, all surveyed countries show a fairly high response to changes in the exchange rate of the US dollar. This is indicated by significant and high magnitude of the coefficient of USD+ (US dollar appreciation) or USD- (US dollar depreciation) (with 0.9 to 1 range) and significant. Besides, the adjusted R^2 also show high values, over 60% for all countries. In addition, during the pre-crisis, each currency in surveyed countries were highly pegged to the U.S dollar and respond symmetrically to the movement of US dollars in both ways (appreciation or depreciation).

During the post-Asian crisis, the response of each currency in the surveyed countries to the change of the US dollar show different pattern compare to the pre-Asian crisis. The estimated results show that the coefficient of USD+ and USD- are no longer high and significant all the time. In addition the adjusted R^2 has declined and lower value especially during the crisis period (e.g. Lehman shock). The Indonesia rupiah and Korea won was no longer pegged to the U.S dollar and did not respond to change of the value of the U.S dollar during the Lehmann shock. Meanwhile, the currency of Malaysia, Philippines and Thailand was still pegged to the U.S dollar (high and significant USD+ and USD- coefficients as well as high adjusted R^2) during the Lehmann shock in 2008.

3.6. Conclusions

We observe the pattern of exchange rate arrangement after the Asian crisis 1997 in the Asia-5 countries and found that these countries had changed their exchange rate policy slightly though in general it still in the managed regime. By applying Frankel-Wei (2008) regression model, we found that the regression results show that the exchange rate of the Asia-5 currencies still pegged mainly to the US dollar but they allowed their exchange rate value to move more flexibly. When compared to the pre-Asia crisis, there are at least two different conditions regarding on the management of the exchange rate i.e., declining degree of pegging to the US dollar and increasing the flexibility of the exchange rate movements in each surveyed country. In addition, the volatility of the Asia-5 currencies exchange rate against the US dollar were greater while the volatility of the foreign reserves of these countries were lower compare to the pre-Asian crisis.

After the Asian crisis of 1997 the Asia-5 counties implicitly changed their exchange rate policy and started conducting managed-floating as the US dollar reverted as main reference and although the movements of the exchange rate become more volatile due to less change in foreign reserves. Using the equation (3.2), we found that the estimated coefficient of the US dollar and EMP has different patterns among the surveyed countries. The coefficients of these two variables converge to 0.5 for the case of Indonesia and this condition is different for other four Asia-5 countries. In addition, the estimation results under the equation (3.3) show that during pre- Asian crisis, the Asia-5 currencies were highly pegged to the U.S dollar and respond symmetrically to the movement of US dollars on the both sides (appreciation or depreciation). Meanwhile, during the post-Asian crisis the Asia-5 countries did not tightly peg their currencies to the US dollar all the time and respond differently to the change of the US dollar movement. Nevertheless, the Student-t test resulted in the rejection of the null hypothesis that the coefficient of the US dollar and EMP is equal to 0. The coefficient of the US dollar remain rejected the null hypothesis of $c(2) = 0$, which indicate that the US dollar is still used as main reference for the Asia-5 currencies in almost all the period after the Asian crisis. While the coefficient of EMP, according to the Student-t test have rejected the null hypothesis of $c(5) = 0$ only in certain period for the case of Malaysia and Philippines. However, Indonesia, Thailand and South Korean, consistently reject the null hypothesis of $c(5) = 0$ which indicate that they allowed their currency to move flexibly.

Thus the Asia-5 exchange rate arrangement during the post-Asian crisis 1997 did not fully follow the floating regime, rather it more likely to be managed float with the US dollar as the main reference. In addition, the Asia-5 countries allowed their currencies to move more flexibly though still being weakly pegged the US dollar with different degree of pegging from time to time. This evidence show that during the post-Asian crisis the US dollar still become a main reference for the Asia-5 exchange rate movement although with lower degree of pegging compare to the pre-Asian crisis. Returning to US dollar pegged is inevitable although slightly lower degree.

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Chapter 4

Change Point Analysis of Exchange Rates Using Bootstrapping Methods: An Application to the Indonesian Rupiah 2000–2008

Change Point Analysis of Exchange Rates Using Bootstrapping Methods: An Application to the Indonesian Rupiah 2000–2008*

4.1. Introduction

Detecting a structural breakpoint is one of the more important issues in econometrics and consequently the subject of many theoretical and empirical studies. This chapter investigates the most commonly used test statistics designed for this purpose; namely, the sum of squares of the least squares residuals (SSR) test and the log-likelihood ratio (LR) test. However, because an estimated change point will suffer from sampling error, it is desirable to calculate its confidence interval, for which we need to know the sampling distribution. Given that it is generally difficult to obtain this information, we instead calculate the confidence interval using Monte Carlo simulation based on a bootstrap method.

As with most analyses of change points, we consider a structural break in a linear time-series regression model where a structural change implies the change in the regression coefficients at time m. We then detect the time of the structural break by testing the null of H_0: no structural change at time m against the alternative H_1: there is structural change at time m. The most common test for this is the Chow test based on the F-statistic. In addition, this test is often used to detect the most probable candidate for a change point by repeatedly calculating the Chow test statistic $T(k)$ for every candidate k of the unknown (true) structural change point m and selecting the maximum value, denoted $\hat{m}$. Formally, this is:

$$\hat{m} = argmax_k T(k)$$

where $T(k)$ is the test statistic, k is a candidate for the unknown (true) structural change point m, and $\hat{m}$ is an estimate of the true structural change point. It is common for the SSR or LR tests to serve as the test statistic $T(k)$.

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Whichever test statistic we adopt, we require the theoretical distribution of the estimate $\hat{m}$ to construct confidence intervals. However, it is generally difficult to obtain such a theoretical distribution. To overcome this difficulty, we consider the use of a bootstrap method to obtain the sampling distribution of $\hat{m}$ and use this to construct confidence intervals.

Bootstrap method is initially proposed by Efron (1979) for independent data. But data in economic time series are usually dependent on the past data. To reflect dependency of data in time series, various modifications of bootstrap method are proposed to deal with dependent data by resampling from the collection of blocks of data. These methods are called as block bootstrap (BB) method. Later, Politis and Romano (1991) proposed circular block bootstrap (CBB) methods. BB and CBB will be explained in the next section. Lahiri (1999) described various BB methods and compared them.

Since economic time series has more or less dependency on past date, BB and CBB are recommended to detect a break point and construct confidence intervals for econometric time series models. Hušková and Kirch (2013) examine the performance of CBB under the simplest linear model containing only a constant term with dependent error process. In this paper we extend their simple model to a linear regression mode with exogenous explanatory variables and with GARCH error and compare CBB based on SSR and LR methods. We also examine the effect of block length which will have an influence on the accuracy of block bootstrap estimator.

The rest of the paper is organized as follows. In Section 4.2, we present a linear regression model with GARCH errors and describe the steps involved in deriving the confidence interval of a change point in the model using CBB. In Section 4.3, we present two DGPs for Monte Carlo experiments and report the simulation results of the performance of the CBB. In Section 4.4, we conduct an empirical analysis of the Indonesian Rupiah using the CBB and successfully detect a change point. In Section 4.5, we provide some concluding remarks. The Appendix includes the details of the simulation results.

4.2. Models and Procedures

We consider a simple regression model with GARCH (1,1) errors

$$y_t = c + ax_t + \varepsilon_t;\ \varepsilon_t \sim N(0, h_t^2),\ \text{t=1,…,n} \quad (4.1)$$

where

$$h_t^2 = \omega + \alpha h_{t-1}^2 + \beta \varepsilon_{t-1}^2;$$

$$\varepsilon_t = \sqrt{h_t^2} u_t;\ u_t \sim N(0,1).$$

It is assumed that there exists a single change point at unknown time $t = m$ when parameters change as follows:

$$t \leq \text{m}; c_1, a_1, \omega_1,\ \alpha_1, \beta_1;$$

$$t > m; c_2, a_2, \omega_2,\ \alpha_2, \beta_2.$$

Hereafter, we refer to *m* as the true change point. There are many statistical methods for estimating the true change point *m*. Of these, we focus on the CBB method based on the cumulative sum of squares of residual (SSR) and log-likelihood ratio (LR) tests, respectively abbreviated as SSR-based and LR-based CBB or SSR/CBB and LR/CBB.

We first describe how to construct a confidence interval using CBB (abbreviated as CI-CBB) based on the SSR test. For a given time series $y_1, y_2, \cdots, y_T,$ the CI-CBB based on the SSR test is calculated as follows.

1. Let *k* denote a candidate of the true breakpoint *m* and calculate the OLS residuals $e_{1,t}$ of regression model (2.1) using the sample t = 1,2,…,k, using say, the first subsample, and $e_{2,t}$ $t = k$+1,…,T using say, the second subsample, where *k* is moving from t = 100 to 900 in order to prevent *k* from being located in the end area of sample periods
2. Calculate SSR defined by
$$SSR(k) = \sum_{t=1}^{k} e_{1,t}^2 + \sum_{t=k+1}^{T} e_{2,t}^2;\ \text{for T given}$$
and estimate the true change point *m* by
$$\hat{m} = argmin_k SSR(k).$$
3. Divide the series into the first and second subsamples, where the first subsample is $(y_1, y_2, \cdots, y_{\hat{m}})$ and the second subsample is $(y_{\hat{m}+1}, y_2, \cdots, y_T)$.
4. Estimate the conditional variance $h_{i,t}^2$ by

$$\hat{h}_{i,t}^2 = \widehat{\omega}_i + \hat{\alpha}_i \hat{h}_{i,t-1}^2 + \hat{\beta}_i e_{i,t-1}^2, i = 1,2$$

where $\widehat{\omega}_i, \hat{\alpha}_i, \hat{\beta}_i, (i = 1,2)$ are estimates of the GARCH parameters in (2.1) for the $i\ th$ subsample.

5. Calculate $\hat{\varepsilon}_{i,t} = \frac{e_{i,t}}{\hat{h}_{i,t}}$ for $i = 1\ or\ 2$ and define the centered residuals by

$$\tilde{\varepsilon}_{i,t} = \hat{\varepsilon}_{i,t} - \bar{\hat{\varepsilon}}_t, where\ \bar{\hat{\varepsilon}}_t = \frac{1}{\widehat{m}} \sum_{j=1}^{\widehat{m}} \hat{\varepsilon}_{1,j} + \frac{1}{n-\widehat{m}} \sum_{j=\widehat{m}+1}^{T} \hat{\varepsilon}_{2,j}.$$

Then arrange $\tilde{\varepsilon}_{i,t}$ in ascending order as

$$\tilde{\varepsilon}_{1,1}, \tilde{\varepsilon}_{1,2}, \tilde{\varepsilon}_{1,3}, \cdots, \tilde{\varepsilon}_{1,\widehat{m}}, \tilde{\varepsilon}_{2,\widehat{m}+1}, \tilde{\varepsilon}_{2,\widehat{m}+2}, \tilde{\varepsilon}_{2,\widehat{m}+3}, \cdots, \tilde{\varepsilon}_{2,T}.$$

Here there are T elements of $\tilde{\varepsilon}_{i,t}$ for i = 1,2 and t = 1,2…,T. Next, by suppressing the suffix i, rename this array as $\tilde{\varepsilon}_1, \tilde{\varepsilon}_2, \tilde{\varepsilon}_3, \cdots, \tilde{\varepsilon}_T$. Furthermore, arrange this array circularly as

$$\tilde{\varepsilon}_1, \tilde{\varepsilon}_2, \tilde{\varepsilon}_3, \cdots, \tilde{\varepsilon}_T, \tilde{\varepsilon}_1, \tilde{\varepsilon}_2, \tilde{\varepsilon}_3, \cdots.$$

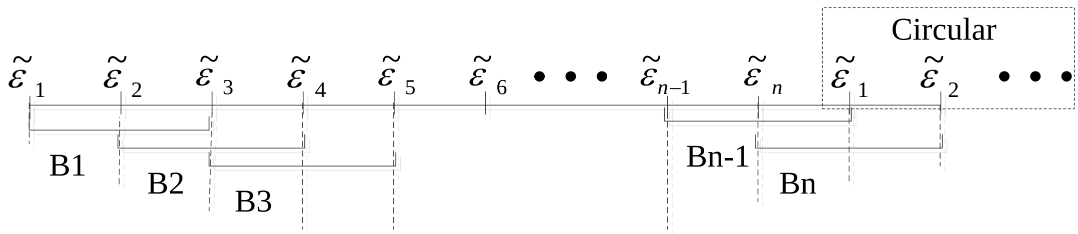
6. After we obtain the centered residuals ($\tilde{\varepsilon}_t$), we apply the CBB. Divide the series of $\tilde{\varepsilon}_t$ into several blocks; B1, B2, …, Bn with block length k. For example, if k = 3, the blocks are constructed as follows.

$$B_1=(\tilde{\varepsilon}_1, \tilde{\varepsilon}_2, \tilde{\varepsilon}_3),\ B_2=(\tilde{\varepsilon}_2, \tilde{\varepsilon}_3, \tilde{\varepsilon}_4),\ B_3=(\tilde{\varepsilon}_3, \tilde{\varepsilon}_4, \tilde{\varepsilon}_5),\ \ldots\ldots,\ B_{n-1}=(\tilde{\varepsilon}_{n-1}, \tilde{\varepsilon}_n, \tilde{\varepsilon}_1),$$

$$B_n = (\tilde{\varepsilon}_n, \tilde{\varepsilon}_1, \tilde{\varepsilon}_2)$$

Note that the last two blocks B_{n-1} and B_n are supplemented by the first two centered residuals $\tilde{\varepsilon}_1$ and $\tilde{\varepsilon}_2$. Because of this, we refer to it as the CBB. Figure 4.1 depicts an illustrative example for the CBB procedure with a block length of three.

Figure 4.1: Circular Block Bootstrap (CBB)—An Illustrative Example



7. Resample L blocks randomly from all blocks B1, B2, …, Bn. Suppose, for example, L=2, and $B3$ and $B1$ are resampled, then construct a vector $(B3, B1) = (\tilde{\varepsilon}_3, \tilde{\varepsilon}_4, \tilde{\varepsilon}_5, \tilde{\varepsilon}_1, \tilde{\varepsilon}_2, \tilde{\varepsilon}_3)$.

8. Next, arrange all elements in all blocks into a sequence. In this example, we have an array as follows: $\tilde{\varepsilon} = (\tilde{\varepsilon}_1, \tilde{\varepsilon}_2, \tilde{\varepsilon}_3, \tilde{\varepsilon}_3, \tilde{\varepsilon}_4, \tilde{\varepsilon}_5)$.
9. By using $\tilde{\varepsilon}_t$, calculate $\tilde{y}_t = \hat{c} + \hat{\gamma} x_t + \tilde{\varepsilon}_t$, where $\hat{c}$ and $\hat{\gamma}$ are OLS estimates for (2.1), and obtain $\tilde{y} = (\tilde{y}_1, \tilde{y}_2, \tilde{y}_3, \tilde{y}_3, \tilde{y}_4, \tilde{y}_5)$. This is our bootstrapping sample.
10. Find a new change point based on $\tilde{y}$ using the same process (1)–(8).
11. Repeat the process (1)–(10), say, 1,000 times, and obtain 1,000 estimated change points $\widehat{m}_i$, $\mathrm{i} = 1,2,\cdots,1000$.
12. Draw a histogram of the estimated change points $\widehat{m}_i$ obtained and find the shortest confidence interval for the true change point from this histogram. Note that we calculate the shortest confidence interval because of the usual skewness of the sampling distributions.

Note that we can replace the SSR with the (LR) in the above procedure. By applying the LR method, we change Step 2 to the following formula to estimate the change point:

$$LR(k) = (LLF_1 + LLF_2) - LLF_0$$

where

LLF_1 = log-likelihood function (LLF) for the first *k* observations,

LLF_2 = LLF for the last *n*–*k* observations, and

LLF_0 = LLF for all observations.

We estimate the change point using

$$\widehat{m} = argmax_k LR(k)$$

Finally, we compare the SSR-based CBB and LR-based CBB confidence intervals.

4.3. Monte Carlo Experiment

4.3.1 Model setting

In this section, we evaluate the performance of the SSR/CBB and LR/CBB methods using Monte Carlo experiments. We carry out the experiment with the following setting. In Model 1, we assume DGP as follows.

$$y_{1,t} = 0.1 + 0.1x_t + e_t;\ t = 1,\cdots,m$$
$$y_{2,t} = 0.2 + 0.2x_t + e_t;\ t = m+1,\cdots,T$$
$$e_t = \sqrt{h_t^2}.u_t;\quad u_t \sim iid\ N(0,1);$$
$$h_t^2 = 0.1 + 0.4e_{t-1}^2 + 0.3h_{t-1}^2$$

Mode1 1 assumes that there exists a change point at a time *m* and that the parameters of the mean equation change as specified above, but the GARCH parameters are the same in the first and the second subsample periods. We also specify Model 2 with a different mean and variance equation in each subseries. In Model 2, we assume DGP as follows

$$y_{1,t} = 0.1 + 0.1x_t + e_t;\ t = 1,\cdots,m$$
$$e_{1,t} = \sqrt{h_{1,t}^2.u_t};\quad u_t \sim iid\ N(0,1);$$
$$h_{1,t}^2 = 0.1 + 0.4e_{1,t-1}^2 + 0.3h_{1,t-1}^2;$$
$$y_{2,t} = 0.2 + 0.2x_t + e_t;\ t = m+1,\cdots,T$$
$$e_{2,t} = \sqrt{h_{2,t}^2.u_t};\quad u_t \sim iid\ N(0,1);$$
$$h_{2,t}^2 = 0.2 + 0.5e_{2,t-1}^2 + 0.4h_{2,t-1}^2$$

Model 2 assumes that there exists a change point at a time *m* and that the parameters in the mean equation and the GARCH process change as specified.

4.3.2 Monte Carlo simulation

We carry out Monte Carlo simulation for Models 1 and 2 in the following setting: (i) Sample size *T* = 1,000; (ii) true change point *m* = T/4, T/2, or 3T/4; (iii) block length = 5, 10, 50 and

100; and (iv) number of iterations = 250[1]. For each combination of point i) – iii) for Models 1 and 2, we generate random numbers $u_t, t = 1,2,\cdots,1000$ and estimate the true (unknown) parameters in the models. After iterating this process 1,000 times using the CBB, we obtain 1,000 estimates, plot the empirical distribution of the estimates, and calculate the root mean square error (RMSE) for the 1,000 estimates. In addition, we provide the range (upper bounds (UB) minus lower bounds (LB) of the shortest confidence interval) to ascertain the distance of the confidence interval. We then calculate the shortest confidence interval at a significance level of 10% for the change point from the empirical distribution.

Table 4.1 provides the summary statistics for the simulation under the SSR method for Models 1 and 2. The first column provides the true change point *m*, and the second column includes the block length. The last three columns detail the LB and UB of the shortest confidence interval at the 10% significance level, the sample mean of the estimated change points $\hat{m}_i$, $\mathrm{i} = 1,2,\cdots,1000$, and the RMSE of the estimated change points $\hat{m}_i$.

Table 4.1: Summary of Simulation Results (SSR/CBB)

No.	True Breakpoint	Parameter	Block Length							
			Model 1				Model 2			
			5	10	50	100	5	10	50	100
1	T/4 (250)	Mean	253.8	249.6	267.8	339.3	260.2	261.4	231.1	297.4
		RMSE	33.6	45.6	180.4	264.4	64	75.5	88.4	206.5
		Lower	202	179	49	95	202	176	97	57
		Upper	305	328	405	898	306	343	387	519
		Range	103	149	356	803	104	167	290	462
2	T/2 (500)	Mean	501.9	498.7	466.2	466.6	512.7	501.2	475.1	453.4
		RMSE	40.4	49.9	113.1	152.4	42.6	53.3	102.5	145.9
		Upper	427	425	250	225	435	420	339	236
		Lower	557	581	616	707	569	585	672	711
		Range	130	156	366	482	134	165	333	475
3	3T/4 (750)	Mean	742.3	739.7	715.5	670.9	766.8	768.4	746.9	703.6
		RMSE	36.7	44.5	95.5	134.4	40.6	52.2	92.4	129.5
		Upper	681	666	573	477	710	682	598	497
		Lower	800	812	861	903	838	845	897	904
		Range	119	146	288	426	128	163	299	407

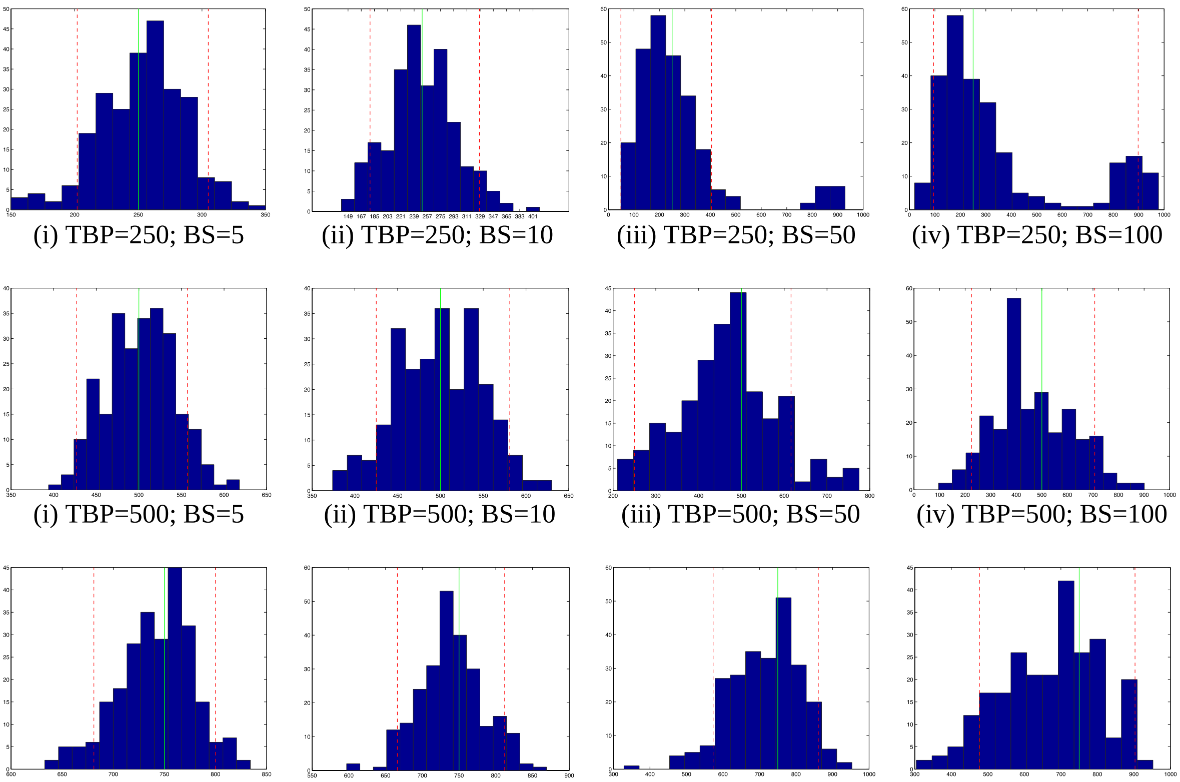
Source: Author's calculation

Figure 4.2.a (for simulation result under Model 1 with SSR method) and Figure 4.2.b (for simulation result under Model 2 with SSR method) show the empirical distribution of the

[1] This study also provides the iteration number of 1000 under SSR for Model 1 and Model 2. The result of this simulation is presented in the Appendix

2500 estimated change points for m = 250, 500, 750. Dashed vertical lines denote the LB and the UB, and we use a solid line to identify the true change point. Under the CBB method based on the SSR, the simulation results for Model 1 for all true change points exhibit good accuracy, as the means of the estimated change points are very close to the true change points. In addition, using lower block length (i.e. block length = 5) the simulation show better result. We also note that the estimated and true change is both within the confidence interval. The similar results are also obtained under Model 2 where all simulation results show good accuracy when estimate true change point. Using lower block length also produces better result in simulation under Model 2 with SSR method.

Figure 4.2.a: Histogram of Estimated Single Breakpoint under SSR Test (Model 1) with 250 Iterations

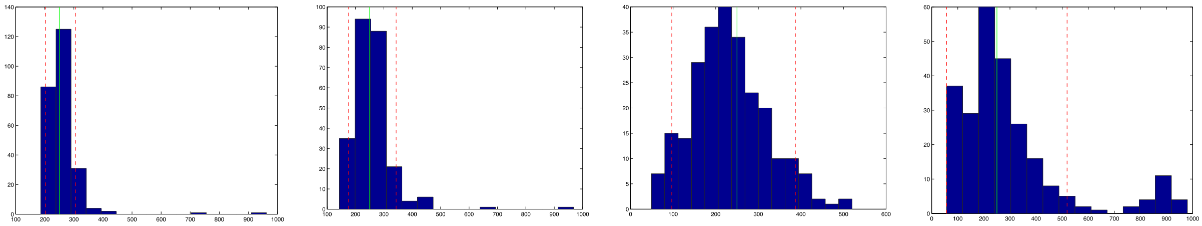


(i) TBP=250; BS=5 (ii) TBP=250; BS=10 (iii) TBP=250; BS=50 (iv) TBP=250; BS=100

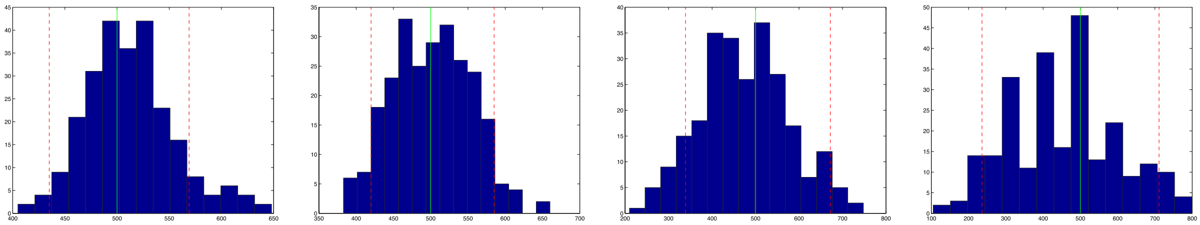
(i) TBP=500; BS=5 (ii) TBP=500; BS=10 (iii) TBP=500; BS=50 (iv) TBP=500; BS=100

(i) TBP=750; BS=5 (ii) TBP=750; BS=10 (iii) TBP=750; BS=50 (iv) TBP=750; BS=100

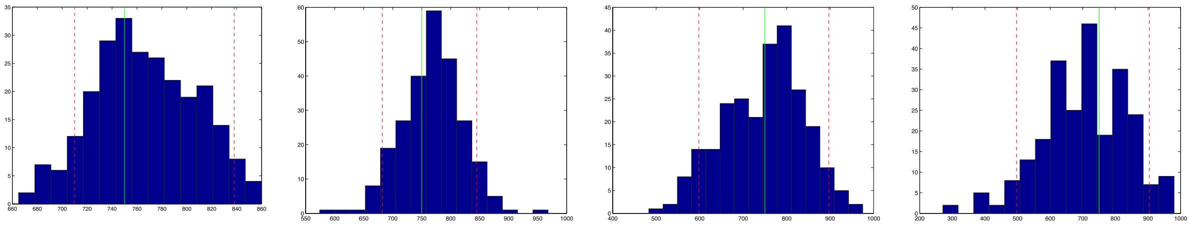
Figure 4.2.b: Histogram of Estimated Single Breakpoint under SSR Test (Model 2) with 250 Iterations



(i) TBP=250; BS=5 (ii) TBP=250; BS=10 (iii) TBP=250; BS=50 (iv) TBP=250; BS=100



(i) TBP=500; BS=5 (ii) TBP=500; BS=10 (iii) TBP=500; BS=50 (iv) TBP=500; BS=100



(i) TBP=750; BS=5 (ii) TBP=750; BS=10 (iii) TBP=750; BS=50 (iv) TBP=750; BS=100

Overall, the SSR/CBB method under Model 1 and Model 2 for block lengths 5 works fairly well and yields good results. Generally, when the number of block length increase, the performance of CBB tends to be distorted.

These experiments show that LR/CBB does not work well compared to the previous simulation. The simulation shows better result when the true change point is located in the middle (T/2) and using longer block length, as the mean of the estimated change point is getting close to the true change point. This suggests that the combination of block length and the location of the change point are influential in determining the performance of LR/CBB. In addition, LR/CBB is more accurate for Model 2 than for Model 1.

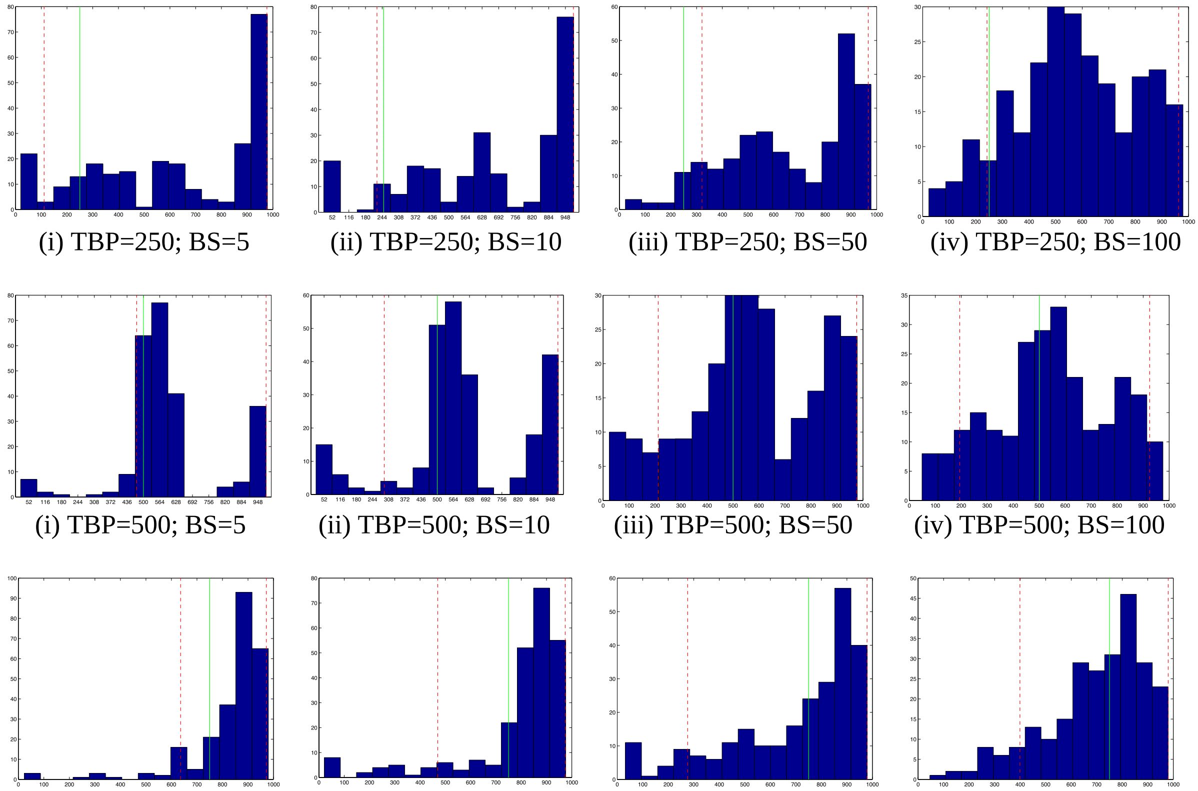
Table 4.2: Simulation Result under LR Test with 250 Iterations

No.	True Breakpoint	Parameter	Block Length							
			Model 1				Model 2			
			5	10	50	100	5	10	50	100
1	T/4 (250)	Mean	609	651.1	662.2	572.1	608.1	642.5	368.9	403.9
		RMSE	320.1	293.6	242.8	228.9	304.8	301.1	209.5	238.2
		Lower	111	224	321	242	221	183	85	94
		Upper	977	979	967	963	974	977	695	824
		Range	866	755	646	721	753	794	610	730
2	T/2 (500)	Mean	600	601.2	577.6	545.4	534.8	527.5	523.3	503.9
		RMSE	191.9	242.6	250.3	230.4	47.8	70.0	140.1	174.1
		Upper	474	290	212	194	465	435	275	258
		Lower	980	978	976	925	617	622	701	825
		Range	506	688	764	731	152	187	426	567
3	3T/4 (750)	Mean	830.1	783.9	696.7	697.4	746.6	717.1	670.8	636.7
		RMSE	151.9	211.4	251.1	194.9	127.6	159.6	190	177.5
		Upper	636	470	276	399	490	417	388	359
		Lower	972	974	979	980	926	919	938	910
		Range	336	504	703	581	436	502	550	551

Source: Author’s estimation.

Furthermore, we note that a longer block length (such as 100) tends to result in better performance (a shorter confidence interval).. However, such a large block length may not be appropriate for a sample size of only 1,000. In addition, we suggest from our experience that LR/CBB may not be practical because it involves significant computational burden. Overall, we conclude that SSR/CBB is generally better than LR/CBB.

Figure 4.3.a: Histogram of Estimated Single Breakpoint under LR Test (Model 1) with 250 Iterations

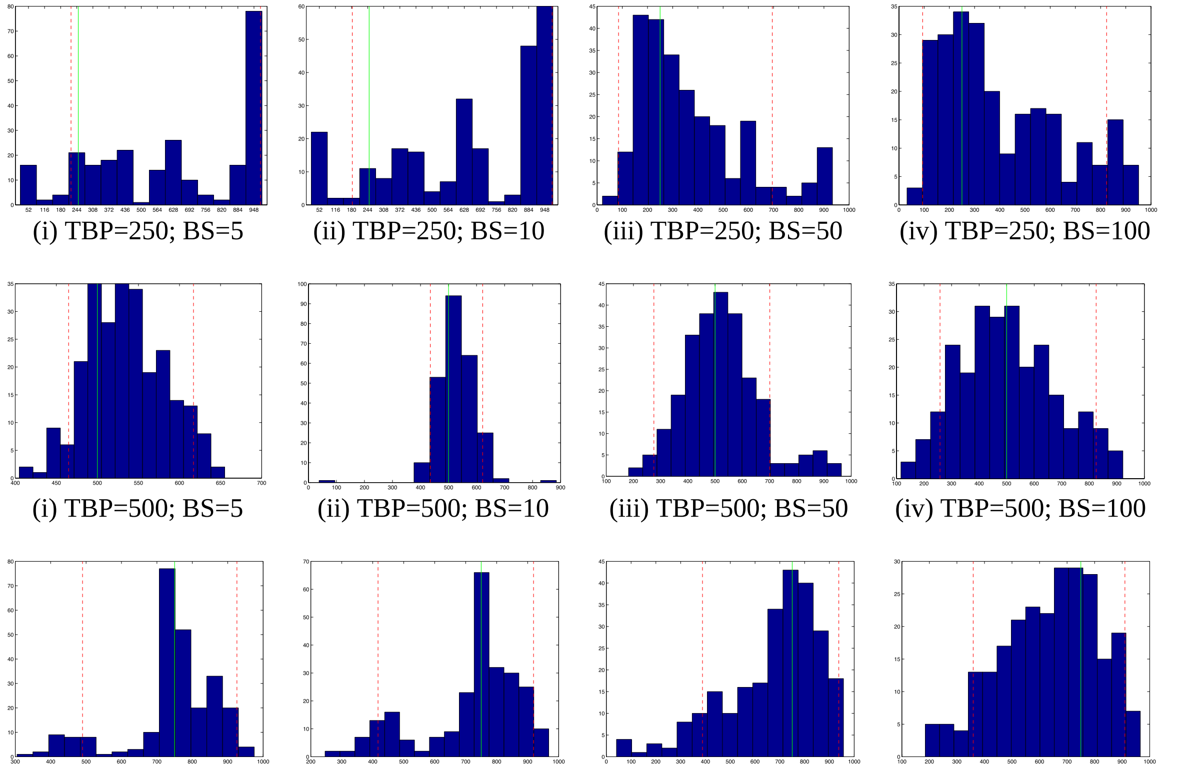


(i) TBP=250; BS=5 (ii) TBP=250; BS=10 (iii) TBP=250; BS=50 (iv) TBP=250; BS=100

(i) TBP=500; BS=5 (ii) TBP=500; BS=10 (iii) TBP=500; BS=50 (iv) TBP=500; BS=100

(i) TBP=750; BS=5 (ii) TBP=750; BS=10 (iii) TBP=750; BS=50 (iv) TBP=750; BS=100

Figure 4.3.b: Histogram of Estimated Single Breakpoint under LR Test (Model 2) with 250 Iterations



(i) TBP=250; BS=5 (ii) TBP=250; BS=10 (iii) TBP=250; BS=50 (iv) TBP=250; BS=100

(i) TBP=500; BS=5 (ii) TBP=500; BS=10 (iii) TBP=500; BS=50 (iv) TBP=500; BS=100

(i) TBP=750; BS=5 (ii) TBP=750; BS=10 (iii) TBP=750; BS=50 (iv) TBP=750; BS=100

4.4. Empirical Study

In this section, we apply the CBB method to a time-series regression model using exchange rate data on the Indonesian Rupiah (IDR) and the US dollar (USD) against the Special Drawing Right (SDR). Before this, we describe the economic background in Indonesia.

4.4.1 Economic background of the example

Bank Indonesia (the central bank of Indonesia) officially announced to abandon managed-floating regime and to adopt free-floating exchange rate regime on August 14, 1997. This meant that the market mechanism would determine the Indonesia rupiah value. We take this announcement as indicating that Indonesia has employed *de jure* floating exchange rate regime since August 1997. Since 1970's, Bank Indonesia has changed the exchange rate regime to maintain the rupiah stability.[2] However, although free-floating regime has been announced to be adopted, Bank Indonesia nevertheless intervenes in the market when necessary to dampen exchange rate volatility.[3] To describe this situation, we could really say that Bank Indonesia has in fact implemented a *de facto* floating exchange rate regime. If true, there may be signs of intervention by the government or the central bank in the foreign exchange market, and we may be able to detect these interventions in the form of structural changes in the time-series data in the foreign exchange market.

Many possible models and methods are available to detect structural change, as reflected by changes in the model parameters. Any structural change found may also imply a change in exchange rate policy (not necessary regime change), despite the official regime is free-floating. In our example, we assume that the USD mainly determines the daily IDR exchange rate. In order to observe the movement of the IDR against the USD, we specify the SDR as the *numeraire* and assume the following equation.

$$\left(\frac{IDR}{SDR}\right)_t = c + \alpha \left(\frac{USD}{SDR}\right)_t + u_t \tag{4.2}$$

[2] The Bank Indonesia adopted a fixed exchange rate regime by pegging the IDR to the USD until November 1978, and then converted it to a managed float regime until 1983. It also attempted to maintain the exchange rate by adopting a managed float system with band intervention from 1983 to July 1997. Besides changing the exchange rate regime, the government also devalued the IDR in 1971, 1974, 1983, and 1986 as well as broadening the band interventions several times up until mid-July 1997.

[3] Annual Report 1998/1999 Bank Indonesia, page 7.

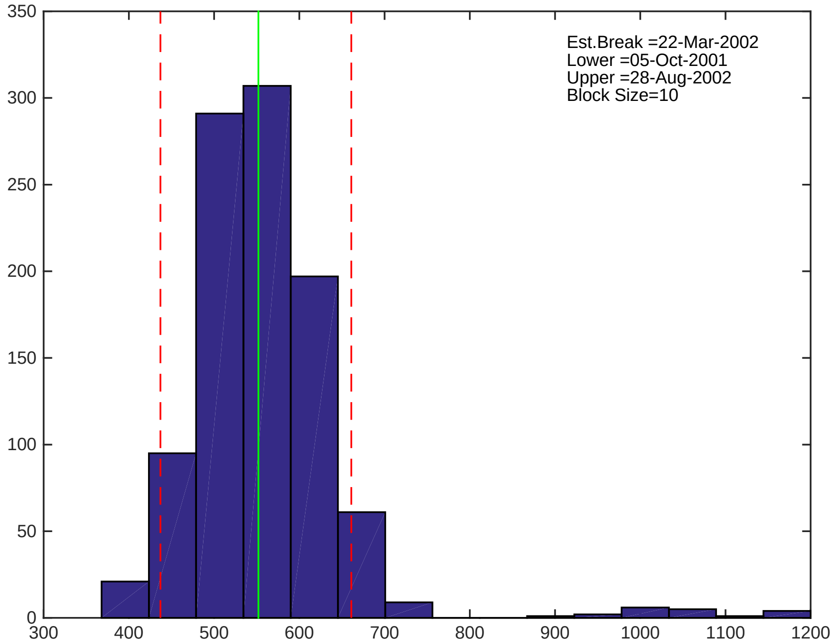
Equation (4.2) shows the movement of the daily nominal exchange rate of Indonesia rupiah to the US dollar. If α is non-zero significantly large, then it indicates that the IDR tends to follow the movement of the USD, and if this happens, then it may contradict the assertion of a free exchange rate regime as officially announced by Bank Indonesian.. Conversely, if α is not significant, then it indicates that IDR does not move with the USD. In addition, u_t also needs to be considered, because the u_t often follows a GARCH (1,1) process.

Before we proceed to estimate the change point, we determine the period of observation for the variables under consideration. As we examine the exchange rate time-series for the IDR since the government's announcement of the free-floating exchange rate regime in August 1997 until recently, we select a sample period from January 4, 2000 to August 29, 2008. The sample period then ends immediately before the Lehman Shock and therefore excludes two transitory periods in the Indonesian exchange rate; that is, the first three years of the floating exchange rate regime between August 14 1997 and January 3, 2000, and the period after the Lehman Shock. In this study, we only apply the SSR/CBB to estimate the change point and to obtain the confidence interval for these real data.

4.4.2 Estimation of a structural change

After selecting the sample period, we estimate the true change point using the SSR/CBB method. By repeating this method, we obtain the confidence intervals, as described in Section 4.2. Figure 4.4 depicts the empirical distribution of the estimated change point using SSR/CBB method. The SSR method detected a structural change point on March 22, 2002. From the empirical distribution, we obtained the lower and upper bounds of the confidence interval as October 05, 2001 and August 28, 2002, respectively.

Figure 4.4: Empirical Distribution of the Estimated Change Point and Confidence Interval



Based on the estimated change point, we divide our sample into two subsamples and estimate the regression model (4.2) as well as the GARCH error process associated with the equation (4.2) in each sub-sample. The regression results of the equation (4.2) as well as the estimated GARCH(1,1) parameters are presented in the following. The estimated parameters before March 22, 2002 are:

$$\left(\frac{IDR}{SDR}\right)_t = 53640.53 - 32165.89\left(\frac{USD}{SDR}\right)_t, R^2 = 0.660$$

and

$$h_t^2 = 25172.8 + 0.2045h_{t-1}^2 + 0.7840\varepsilon_{t-1}^2.$$

While the estimated parameters after the estimated change point are:

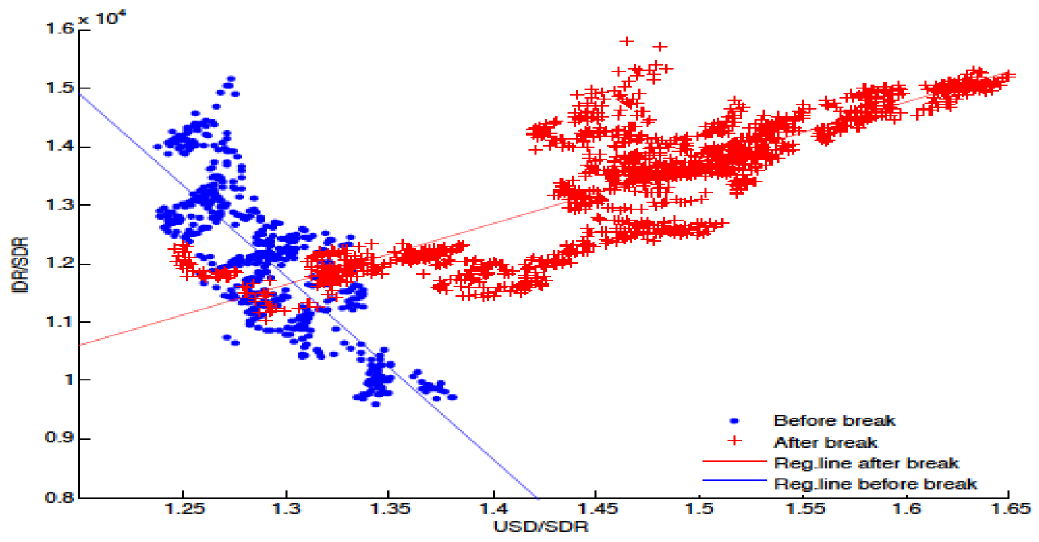
$$\left(\frac{IDR}{SDR}\right)_t = -1724.56 + 10263.91\left(\frac{USD}{SDR}\right)_t, R^2 = 0.670$$

and

$$h_t^2 = 2357.17 + 0.2110h_{t-1}^2 + 0.7778\varepsilon_{t-1}^2,$$

where all coefficients are statistically significant.

Figure 4.5: Scatterplot and Regression Line under Change Point March 22nd, 2002

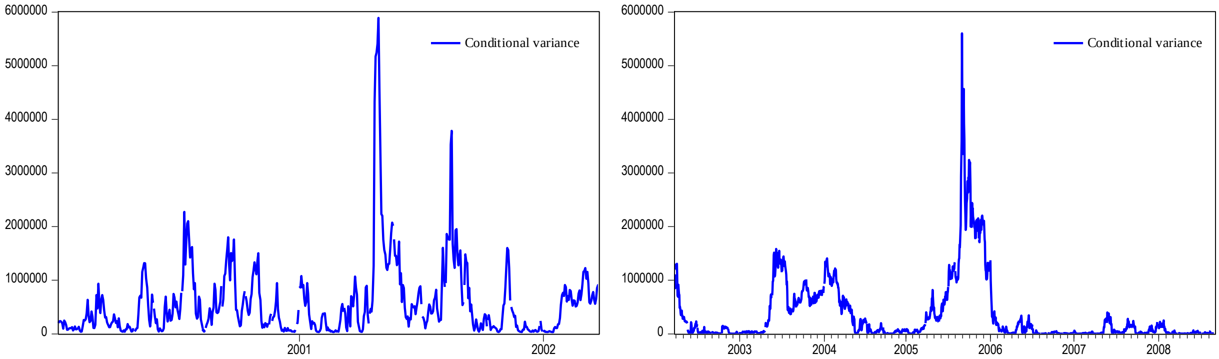


In Figure 4.5, we plot the two regression lines with the sample points plotted as dots (·) before the estimated change point and the plus sign (+) after the change. The two regression lines indicate that before the change point (March 22, 2002), the depreciation of the USD against the SDR corresponded to the appreciation of the IDR against the SDR. Meanwhile, after the change point, we find evidence of the opposite relationship between the two exchange rates.

Figure 4.6 clearly shows evidence of GARCH volatility in the sub-sample periods both before and after the change point. Figures 4.5 and 4.6 provide evidence that since March 2002, the IDR has moved with the USD. This indicates that exchange rate policy may change, even where there is no official announcement of a change in the exchange rate regime. In addition, although the conditional variance appears to be high in both sub-samples—that is, before and after the change point—the unconditional variance of the residual for the first sub-sample (before the change point) is higher than in the second sub-sample (after the change point).

This suggests that the IDR was relatively more volatile in the first sub-sample period, and we can interpret this as meaning that there was less official intervention for reducing the volatility of the IDR or it resulted from declining pressure on the IDR. After the change point, the IDR moved with the USD and became less volatile (we could say because it was highly managed or controlled). In addition, we also find that the IDR/SDR and USD/SDR are non-stationary I(1) variables and are co-integrated in both the first and second sub-samples. This provides some statistical evidences that the IDR/SDR maintains some relationship with the USD/SDR.

Figure 4.6: Conditional Variance (h_t^2) Before and After Change point



(a) Before the change point (b) After the change point

Overall, the regression analysis in each sub-sample provides good results, as we obtain relatively high R^2 and all the estimated parameters are significant. Even though this result does not provide clear evidence that the IDR was firmly pegged to the USD during the whole sample period, it potentially shows that the IDR moved with the USD after March 2002. We interpret this as reflecting the "fear of floating" highlighted in Calvo and Reinhart (2002), where a country's exchange rate is officially declared as following a free-floating regime but in fact is maintained more or less at a certain level by the central bank.

4.5. Conclusions

We estimated a single change point in a time series regression model with GARCH (1,1) error using SSR-based and LR-based CBB methods and compared these using Monte Carlo simulation under Models 1 and 2. In calculating the CBB in Models 1 and 2, we extended the procedure given by Hušková and Kirch (2013). In our Monte Carlo simulation, we observed that both the SSR/CBB and LR/CBB methods worked well in detecting a single change point and calculating confidence intervals. While the LR/CB is generally better than the SSR/CBB in many respects, the performance of the LR/CBB is more sensitive than the SSR/CBB to the location of the true change point, the block length specified in the CBB, and the number of parameters to be estimated.

As an application of the CBB method, we considered the change point in a real time-series regression model for the IDR/SDR (dependent variable) and USD/SDR (independent variable). Furthermore, we calculated the confidence interval for the structural change point in this regression model. From this empirical study, we detected a change point using the SSR method and drew a reasonable economic interpretation that even though the Indonesian government had officially announced a floating exchange rate regime, the IDR was not floating throughout the whole sample period but has moved with the USD since March 2002 and has also become less volatile. This indicates that there was some control over the rupiah’s movement and that the phenomenon of “fear of floating” may be present.

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Chapter 5

Estimation of Causal Order in SVAR(1) Model by Independent Component Analysis: A Monte Carlo Simulation and Real Data Analysis on Exchange Rates

Estimation of Causal Order in SVAR(1) Model by Independent Component Analysis: A Monte Carlo Simulation and Real Data Analysis on Exchange Rates*

5.1. Introduction

The economic phenomena can be described by explaining a relationship of several variables that shows cause and effect among the variables. To scrutiny the relationship among these variables, economics theories are needed as a basis to describe the relationship among observable variables as required in the theory. Unfortunately, not all economic variables are observable but some of them are unobservable, and consequently the data of the unobservable variables cannot be provided. To overcome this problem, a measurement of relationship among the variables is needed. There are two important issues arise here, i.e. theory and measurement.

Since 1940s, the economist had debated the relative roles of induction and deduction particularly on macroeconomics at Cowles Commission. The motto "Theory and Measurement," first adopted in 1952, succinctly captures the mission of the Cowles Foundation: development and application of rigorous logical, mathematical, and statistical methods of analysis in economics and related fields. In general, the Cowles Commission researchers attempt to link systematically empirical research and theory in rigorous manner. In addition the Cowles Commission also formulated specification and estimation methods based on theoretical models. Meanwhile, at the technical level the Cowles Commission developed econometric procedures of a simultaneous-equations model, which is regarded as general theoretical model. The simultaneous-equation model is firstly developed by Wright (1921) and later on Pearl (2000) tried to attach causal interpretation on its coefficients. This approach prevailed for almost two decades until skepticism of using this model appeared which is well known as Lucas critique.

* Part of this chapter has been presented in SMU – NTU – HUE – HU International Conference on Economics and Econometrics. Singapore, March 27th 2015

Lucas (1976) argues that predicting the effects of a change in economic policy entirely on the basis of relationships observed in historical data is inappropriate. More precisely, Lucas criticized that the Cowles Commission approach did not consider the economic agents' rational motivations and expectations. By using their rational motivation and expectation, the agent of economy will anticipate the change of the economic policy to obtain their best economic objectives. Meanwhile, Sims (1980) also criticized the simultaneous-equation model regarding on the technical point of view. According to Sims, there is no clear cut identification of endogenous and exogenous (predetermined) variable in the model and therefore Sims proposed vector autoregression (VAR) models which is commonly used in recent decades. This model is the most prevalent tool in empirical economics to analyze dynamic relationship among economic variables. Because statistical tests are frequently used in determining inter-dependencies and dynamic relationships between variables, this methodology was soon enriched by incorporating non-statistical a priori information. VAR models explain the endogenous variables solely by their own history, apart from deterministic regressors.

In some cases, modeling and testing relationship between or among economic variables are required. Suppose, for simple case there are 2 time series data, i.e. y and x, and the relationship between these variables are needed to be defined, therefore causality test is required. Granger (1969) proposed a causality test for determining whether one time series is useful in forecasting another. In this case, the Granger causality test finds only a predictive causality. Regarding on our simple case, the question that may be raised is how the changes in y cause changes in x? If y causes x, lags of y should be significant in the equation for x. If this is the case and not vice versa it would be said that y 'Granger causes' x. Meanwhile, if x causes y, lags of x should be significant in the equation for y1, and it can be said that x 'Granger causes' y. However, if both sets of lags were significant, it would be said that there was 'bi-directional causality'. The word 'causality' does not mean that the change of one variable causes another variable. The Granger-causality really means only a correlation between the current value of one variable and the past values of others.

However, this model is not sufficient for economic policy analysis because it does not provide the causal order among economic variables. One can conjecture the causal order from the impulse response function together with prior information such as economic theory, institutional knowledge, past experience, etc. This approach depends on expert experiences and hence not systematic and vague. To overcome this drawback, structural vector autoregressive (SVAR) model is introduced. This model can take into account that external information on structural and dynamic relationship so that one can recover the causal relationship among economic variables. The SVAR allow the explicit modeling of contemporaneous interdependence between the left-hand side variables. Hence, these types of models try to bypass the drawbacks of the VAR models.

Since the main idea of the VAR approach was to let the data speak and to avoid incredible a priori restriction (Sims (*ibid.*)), then the SVAR model which does not mainly based on data becoming quite contradictory. In addition, identification problem become another drawback of applying VAR model since all variables are endogenous. The traditional approach of simultaneous equation has been to include more variables, so that the equations can be separately expressed and identified. In general, for each additional equation to be identified in the system, having at least an additional exogenous variable was necessary.

The SVAR models are developed to provide the VAR with structural information; hence the causal relationships among the economic can be traced. The structural information must be derived from economic theory or from institutional knowledge that attributed to the data. Alternatively, more data-driven approach can be taken, where under certain general statistical assumptions it is possible to infer the SVAR model based on the statistical distribution of the estimated VAR residuals. Nevertheless, this alternative approach has drawbacks in which the information provided from statistical distribution is generally not sufficient to equip full identification of the SVAR model, therefore some additional knowledge are needed.

Shimizu *et al*. (2006) and Hyvärinen *et al*. (2008) found that full identification can be obtained for higher-order of the VAR residual if the data are non-Gaussian. Since many economic data are non-Gaussian, then under some reasonable assumptions, such as independence of shocks and causal acyclicity, the full identification of the SVAR model can be obtained by applying Independent Component Analysis (ICA). This method is developed in machine learning and blind signal separation with more data-driven approach. In addition the ICA does not use such prior information such as economic theory, institutional knowledge, past experience, etc.; instead it assumes non-Gaussian and independency of disturbance terms.

This chapter describes the SVAR models and the use of Independent Component Analysis in the economic field. The causal order of hard and soft currencies will be presented as an example of the application of ICA with real data analysis. Several hard currencies such as US dollar, Japanese Yen, Germany Mark as well as soft currencies such as Singapore dollar and Indonesian rupiah is selected to be analyzed in term of its causal order. Our conjecture is that the soft currencies will be highly affected by fluctuation of the hard currencies value. The rest of this chapter is structured as follows. Section 5.2 describe the SVAR model and discuss identification problems. In section 5.3, the Independent Component Analysis in SVAR model is shortly explained. Estimating the causal order by using Monte Carlo experiment is presented in section 5.4, while using real data of exchange rate in the application of ICA for a simple example is given in section 5.5. Finally, section 5.6 concludes.

5.2. SVAR Models and Problem of Identifications

For simplicity, it is considered a bivariate $Y_t = (y_{1t}, y_{2t})$ in first order structural vector autoregression, SVAR(1) as follows:

$$y_{1t} = \alpha_{10} - \alpha_{12} y_{2t} + \beta_{11} y_{1t-1} + \beta_{12} y_{2t-1} + \varepsilon_{1t} \quad (5.1)$$

$$y_{2t} = \alpha_{20} - \alpha_{21} y_{1t} + \beta_{21} y_{1t-1} + \beta_{22} y_{2t-1} + \varepsilon_{2t} \quad (5.2)$$

A set of variables (y_{1t}, y_{2t}) measured at regular time intervals at time t. The SVAR(1) model as expressed in equation (5.1) and (5.2) show that the value of each variable y_{it}, $i = 1,2$, has linear combination of all variables with 1 lag and the contemporaneous values of the other variables. The error terms or structural shocks ε_{1t} and $\varepsilon_{2t}$are white noise with zero means and variance σ_1^2

and σ_2^2 and a zero covariance. Note that the error term of ε_{1t} affecting y_{1t} directly and effecting y_{2t} indirectly. In this case, all variables are endogenous and there are 10 parameters to be estimated.

Since equation (5.1) and (5.2) are expressed in structural form, it must be converted into reduce form of standard VAR(1) in order to estimate the parameters. In reduced form, representation of y_{1t} and y_{2t} are only function of lagged $y_{1t}$and y_{2t}, therefore equation (5.1) and (5.2) can be rewritten as:

$$y_{1t} + \alpha_{12}y_{2t} = \alpha_{10} + \beta_{11}y_{1t-1} + \beta_{12}y_{2t-1} + \varepsilon_{1t} \qquad (5.3)$$

$$y_{2t} + \alpha_{21}y_{1t} = \alpha_{20} + \beta_{21}y_{1t-1} + \beta_{22}y_{2t-1} + \varepsilon_{2t} \qquad (5.4)$$

Transforming equation (5.3) and (5.4) into matrix:

$$\boldsymbol{Y}_t = \boldsymbol{\alpha} + \boldsymbol{\beta}\boldsymbol{Y}_{t-1} + \boldsymbol{\varepsilon}_t$$

$$\begin{bmatrix} 1 & \alpha_{12} \\ \alpha_{21} & 1 \end{bmatrix}\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix}\begin{bmatrix} y_{1t-1} \\ y_{2t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

$$\left(\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 0 & -\alpha_{12} \\ -\alpha_{21} & 0 \end{bmatrix}\right)\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix}\begin{bmatrix} y_{1t-1} \\ y_{2t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

$$(\boldsymbol{I} - \boldsymbol{B})\boldsymbol{Y_t} = \boldsymbol{\Gamma_1} + \boldsymbol{\Gamma_2}\boldsymbol{Y_{t-1}} + \boldsymbol{\varepsilon_t} \qquad (5.5.a)$$

$$\boldsymbol{\Gamma_0}\boldsymbol{Y_t} = \boldsymbol{\Gamma_1} + \boldsymbol{\Gamma_2}\boldsymbol{Y_{t-1}} + \boldsymbol{\varepsilon_t} \qquad (5.5.b)$$

where $\boldsymbol{B}$ is (2×2) matrices denoting the contemporaneous coefficients with zero diagonal; $\boldsymbol{\Gamma_1}$ is (2×1) vector of constant term and $\boldsymbol{\Gamma_2}$ is (2×2) matrices that denotes lagged coefficient; and $\boldsymbol{\varepsilon_t}$ is (2×1) vector of error terms. In equation (5.5.b) the notation of $\boldsymbol{\Gamma_0} = \boldsymbol{1} - \boldsymbol{B}$ expresses a standard SVAR model. Meanwhile pre-multiplication of equation (5.5.b) by $\boldsymbol{\Gamma_0}^{-1}$ obtain a standard VAR(1) in reduced form as follows.

$$\boldsymbol{Y_t} = \boldsymbol{\Gamma_0}^{-1}\boldsymbol{\Gamma_1} + \boldsymbol{\Gamma_0}^{-1}\boldsymbol{\Gamma_2}\boldsymbol{Y_{t-1}} + \boldsymbol{\Gamma_0}^{-1}\boldsymbol{\varepsilon_t} \qquad (5.6.a)$$

$$\boldsymbol{Y_t} = \boldsymbol{A_0} + \boldsymbol{A_1}\boldsymbol{Y_{t-1}} + \boldsymbol{u_t} \qquad (5.6.b)$$

where $\boldsymbol{u_t}$ is a vector of error terms with zero-mean white noise process and constant variance, i.e. $\boldsymbol{u_t} \sim \boldsymbol{N}(\boldsymbol{0}, \boldsymbol{\Omega})$. The equation (5.6.b) is the reduced form of VAR(1) and it allow us to estimate by using OLS equation by equation. According to this model, identification problem may arise because log-likelihood function depends only on matric $\boldsymbol{A_1}$ and Ω. A standard method to overcome the identification problem is to assume zero restrictions on the structural estimated parameter using economic theory or institutional knowledge.

In our case, we started with SVAR model and transform it into the reduced form or standard VAR(1) for estimation purposes. A interested question may be raised on whether is it possible to recover the parameters in the SVAR from the estimated parameters in the standard VAR? Since there are 10 parameters in the bivariate structural VAR(1) and only 9 estimated parameters in the standard VAR(1), therefore the standard VAR(1) in our case is underidentified. If one parameter in the structural VAR is restricted the standard VAR is exactly identified. Let $\alpha_{12} = 0$, implies:

$$\begin{bmatrix} 1 & 0 \\ \alpha_{21} & 1 \end{bmatrix} \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} y_{1t-1} \\ y_{2t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -\alpha_{12} & 1 \end{bmatrix} \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ -\alpha_{12} & 1 \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} y_{1t-1} \\ y_{2t-1} \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ -\alpha_{12} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \gamma_{10} \\ \gamma_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{1t-1} \\ y_{2t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}$$

Note that after assigning $\alpha_{12} = 0$, there are 9 parameters of the SVAR(1) that can be identified as follows:

$$\gamma_{10} = \alpha_{10}$$

$$\gamma_{11} = \beta_{11}$$

$$\gamma_{12} = \beta_{12}$$

$$\gamma_{20} = \alpha_{20}$$

$$\gamma_{21} = \beta_{21}$$

$$\gamma_{22} = \beta_{22}$$

$$var(e_1) = \sigma_{y1}^2$$

$$var(e_2) = \sigma_{y2}^2$$

$$cov(e_1, e_2) = -\alpha_{12}\sigma_{y2}^2$$

Our given restriction also implies that y_2 does not have a contemporaneous effect on y_1. In addition, the restriction shows that ε_{1t} and ε_{2t} affect y_1 contemporaneously but only ε_{2t} affect y_2.

5.3. Independent Component Analysis (ICA) for Econometrics

Hyvärinen *et al* (2001) defined Independent component analysis (ICA) as a method for finding underlying factors or components from multivariate (multidimensional) statistical data. What distinguishes ICA from other methods is that it looks for components that are both statistically independent and non-Gaussian. The basic idea of ICA is given as follows, suppose that given a set of number of variables m, number of observation T, and denote that x_{it}, where $i = 1, \cdots, m$ and $t = 1, \cdots, T$ in which the dimension of m and T can be very large. It is assumed that data are generated as a linear mixture of independent components which follows

$$y_{it} = \sum_j w_{ij} x_{jt}\, ; i = 1, \cdots, n; j = 1, \cdots m \tag{5.7}$$

where w_{ij} are some coefficients that define the representation. Using linear algebra, the equation (5.7) can be re-written as $\boldsymbol{y} = \boldsymbol{W}\boldsymbol{x}$, where $\boldsymbol{W}$ is some unknown matrix. Expressing this equation in a matrix form becomes

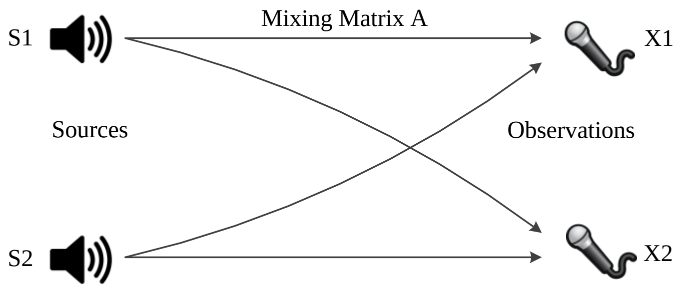
$$\begin{bmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ y_{nt} \end{bmatrix} = W \begin{bmatrix} x_{1t} \\ x_{2t} \\ \vdots \\ x_{mt} \end{bmatrix}$$

In this framework the matrix $\boldsymbol{W}$ can be determined by the statistical properties of the transformed components $\boldsymbol{y_{it}}$. The ICA consists of estimating both the matrix $\boldsymbol{W}$ and the $\boldsymbol{y_{it}}$ when only x_{it} is observed.

Figure 5.1 in the following shows a simple illustration about Independent Component Analysis. Suppose there are two sources of sound (S1 and S2) and there are also two microphones (X1 and

X2) where each of these devices is located adjacent each other. In this case, each microphones record all voices during period of time without distinguishing whether the sound is generated from S1 or S2. For simplicity, we assume that there is no delay or other disturbance factor in recording process.

Figure 5.1: "Cocktail Problem"



During given period of time, the source of sound, S1 and S2, emitted signal s_{1t} and s_{2t} where t is time index. At the same time, the microphones X1 and X2 recorded the sound which can be denoted as x_{1t} and x_{2t}. Since there are two different sounds, the process of recording can be expressed as linear function as follows:

$$x_{1t} = \alpha_{11}s_{1t} + \alpha_{12}s_{2t}$$
$$x_{2t} = \alpha_{21}s_{1t} + \alpha_{22}s_{2t}$$

where α_{11}, α_{12}, α_{21}, and α_{22} are some parameters that could represent the distances between the microphones and the speakers. As already mentioned, it would be very useful if the two original voice signal, s_{1t} and s_{2t}, can be estimated using only the recorded signals, x_{1t} and x_{2t}. Having all information of the parameters α_{ij} will make the estimation process easier. This is called the cocktail-party problem. Assuming that s_{1t} and s_{2t} are statistically independent is not enough for estimatingα_{11}, α_{12}, α_{21}, and α_{22} and since this is unrealistic in many cases. Hence, the recent development technique of ICA can be used to estimate the α_{ij} based on the information of the independence of s_{1t} and s_{2t}, which allows us to separate the two original source signals s_{1t} and s_{2t} from their mixtures x_{1t} and x_{2t}.

According to Hyvärinen *et al*, there are two principles of estimation in ICA, i.e. non-linear de-correlation and maximum non-Gaussianity. Referring to the equation (7), the non-linear de-correlation principle means that to find the matrix $\boldsymbol{W}$ so that for any $i \neq j$, the components y_i and $y_j$are uncorrelated, and the transformed components $g(y_i)$ and $h(y_j)$ are also uncorrelated, where *g* and *h* are some suitable nonlinear functions. Meanwhile, the maximum non-Gaussianity principle finds the local maxima of non-Gaussianity of a linear combination $\boldsymbol{y} = \boldsymbol{W}\boldsymbol{x}$ under the constraint that the variance of x is constant. By introducing non-Gaussianity, we can use higher order moments such as skewness and kurtosis to identify the true model. Overall, the main idea of ICA is to extract independent component from residual, u_t as in the equation (6.b).

Since the ICA has assumptions of non-Gaussianity and independency, it could overcome the identification problem and referring to the equation (1) and (2), there are several assumptions regarding on this matter, namely:

1. ε_{1t} and ε_{2t} follow a non-normal distribution
2. ε_{1t} and ε_{2t} are statistically independent
3. y_{1t} and y_{2t} have contemporaneous (acyclic) causal order or recursive order such that Γ_0 is lower triangular (hence it is assumed that causal order exist, but we do not know the order)

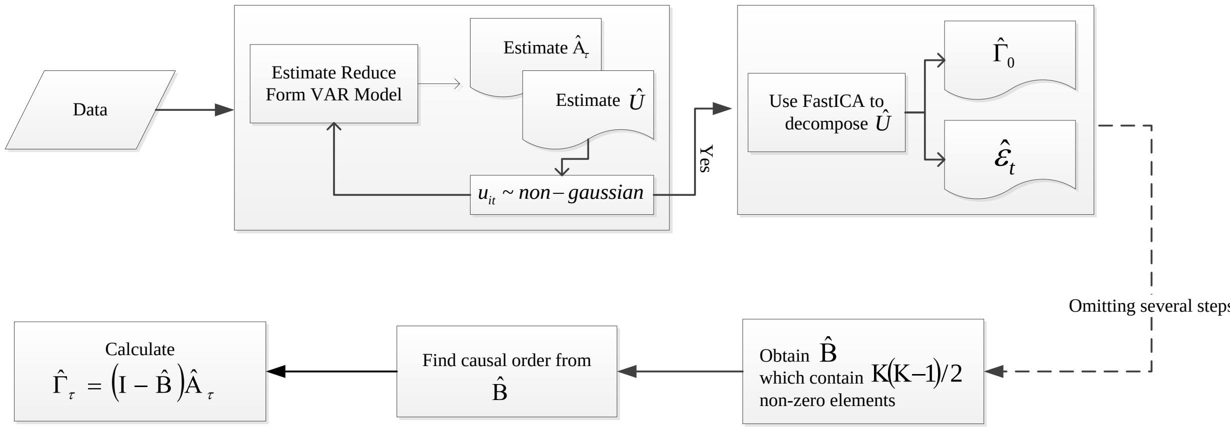
Moneta *et al* (2013) noted that in the original SVAR model, each ε_{it} affect y_{it}, but this connection is lost in the ICA estimation process. Thus, the common assumption of acyclic contemporaneous causal structure among the variables y_{it} which implies lower triangular of matrix Γ_0 and there is no contemporaneous cause. In addition, the contemporaneous structure is then equivalent to the matrix $\boldsymbol{B} = \boldsymbol{I} - \boldsymbol{\Gamma_0}$.

Due to its generality the ICA can be applied in many areas including economics. In econometrics, parallel time series data usually employed and ICA could decompose them into independent components that give an insight of the causal order behind the data set. Shimizu *et al* (2006) introduced LiNGAM[1], for Linear Non-Gaussian Acyclic Model, since acyclicity tie the component of ε_t to the component of $\boldsymbol{u_t}$ in a one-to-one relationship. Hyvärinen *et al* (2008) adopted the procedure to the identification of the SVAR model into VAR model and provided an

[1] Package for MATLAB can be downloaded from https://sites.google.com/site/sshimizu06/lingam

Algorithm of VAR-LiNGAM. Figure 5.2 provides Algorithm of VAR-LiNGAM as taken from Moneta *et al* (2013) in flow of diagram.

Figure 5.2: Algorithm of VAR-LiNGAM



5.4. Estimating Causal Order: Monte Carlo Experiment

In this section, we provide Monte Carlo experiment to estimate causal order of several variables. This experiment is based on four cases, namely case A, B, C, and D. In each case the coefficient of matrix B and Γ_1 are given differently in order to obtain different condition in our predetermined variables, i.e. contemporaneous and lagged variables. For simplicity, we consider SVAR(1) model with 4 endogenous variables, y_{1t}, y_{2t}, y_{3t}, and y_{4t} which is generated based on the following equation:

$$\boldsymbol{y_t} = \boldsymbol{B}\boldsymbol{y_t} + \boldsymbol{\Gamma_1}\boldsymbol{y_{t-1}} + \boldsymbol{\varepsilon_t} \tag{5.8}$$

where $\boldsymbol{y'_t} = (y_{1t}, y_{2t}, y_{3t}, y_{4t})$ and $\boldsymbol{\varepsilon'_t} = (\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}, \varepsilon_{4t})$. Matrix $\boldsymbol{B}$ is lower triangular which the coefficient represents contemporaneous condition, while matrix $\boldsymbol{\Gamma_1}$ contains the coefficient of lagged 1 of the underlying variables. In this case, we determined matrix $\boldsymbol{B}$ and $\boldsymbol{\Gamma_1}$ as follows:

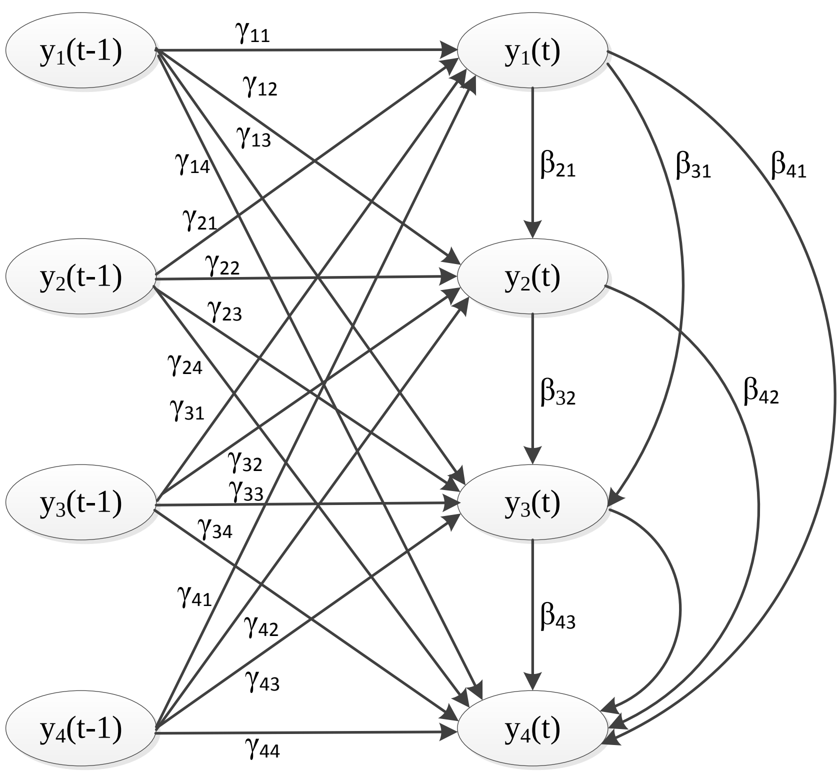
$$B = \begin{pmatrix} 0 & 0 & 0 & 0 \\ \beta_{21} & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & 0 \end{pmatrix} \text{ and } \Gamma_1 = \begin{pmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} \end{pmatrix}$$

Inserting matrices $\boldsymbol{B}$ and $\boldsymbol{\Gamma_1}$ into equation (5.8) to generate $\boldsymbol{y_t}$ and obtain:

$$y_{1t} = \gamma_{11}y_{1t-1} + \gamma_{12}y_{2t-1} + \gamma_{13}y_{3t-1} + \gamma_{14}y_{4t-1} + \varepsilon_{1t}$$
$$y_{2t} = \beta_{21}y_{1t} + \gamma_{21}y_{1t-1} + \gamma_{22}y_{2t-1} + \gamma_{23}y_{3t-1} + \gamma_{24}y_{4t-1} + \varepsilon_{2t}$$
$$y_{3t} = \beta_{31}y_{1t} + \beta_{32}y_{2t} + \gamma_{31}y_{1t-1} + \gamma_{32}y_{2t-1} + \gamma_{33}y_{3t-1} + \gamma_{34}y_{4t-1} + \varepsilon_{3t}$$
$$y_{4t} = \beta_{41}y_{1t} + \beta_{42}y_{2t} + \beta_{43}y_{3t} + \gamma_{41}y_{1t-1} + \gamma_{42}y_{2t-1} + \gamma_{43}y_{3t-1} + \gamma_{44}y_{4t-1} + \varepsilon_{4t}$$

In this case, given the matrix $\boldsymbol{B}$ and $\boldsymbol{\Gamma_1}$ we obtain causal order for our underlying variables. Figure 5.3 exhibits the relationship between the dependent and predetermined variables. Through this figure, we know that the causal contemporaneous order is $y_{1t} \rightarrow y_{2t} \rightarrow y_{3t} \rightarrow y_{4t}$.

Figure 5.3: Plot of Causal Order



To estimate SVAR parameters, transforming standard SVAR model into VAR model in reduced form is needed. To do that, equation (5.8) can be re-wrote as follows:

$$y_t - By_t = \Gamma_1 y_{t-1} + \varepsilon_t$$
$$(I - B)y_t = \Gamma_1 y_{t-1} + \varepsilon_t$$
$$y_t = \Gamma_0^{-1}\Gamma_1 y_{t-1} + \Gamma_0^{-1}\varepsilon_t$$
$$\boldsymbol{y_t} = \boldsymbol{A}\boldsymbol{y_{t-1}} + \boldsymbol{u_t} \tag{5.9}$$

where $A = \Gamma_0^{-1}\Gamma_1$ and $u_t = \Gamma_0^{-1}\varepsilon_t$. Equation (5.9) represents VAR(1) model and using ordinary least square (OLS), all the parameters in the model can be estimated.

5.4.1. Simulation scenario

As already explained, the Monte Carlo experiment is addressed to estimate causal order by using ICA. To conform to the ICA assumption on the non-Gaussianity, we generate the error term of ε_t that follow centered non-central t-distribution with degree of freedom 5 and 25. The smaller (higher) degree of freedom on this distribution produced narrower (wider) positive skewed distribution. The procedures regarding on this experiment is as follows:

Step 1	Specify coefficient matrix $\boldsymbol{B}$ and $\boldsymbol{\Gamma_1}$ and calculate $A = \Gamma_0^{-1}\Gamma_1$, where $\Gamma_0^{-1} = I - B$
Step 2	Generate univariate random variables of centered non-central t-dist. with df. 5 and 25 for $\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}, \varepsilon_{4t}$ separately (independently) and obtain $u_t = \Gamma_0^{-1}\varepsilon_t$
Step 3	Generate y_t based on the reduced form equation. This y_t is used as "observation" vector in what follows
Step 4	Estimate VAR(1) model from "observation" y_t and obtain residuals $\hat{u}_t$ of the estimated VAR(1) model
Step 5	Feed the residuals into LiNGAM to estimate coefficient matrix $\hat{B}$

In order to cover several cases, in this experiment we arrange 4 different cases and for each cases we assign different value in the coefficient of matrix $\boldsymbol{B}$ and $\boldsymbol{\Gamma_1}$. The 4 different cases are assigned as follows:

This case represent SVAR(1) model with contemporaneous and lagged causal order. Matrix B indicate a lower triangular which provide contemporaneous coefficient, while matrix Γ_1 indicate lower triangular with non-zero diagonal

Case A

$$B = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0.5 & 0 & 0 & 0 \\ 0.3 & 0.4 & 0 & 0 \\ 0.1 & 0.2 & 0.5 & 0 \end{pmatrix} \text{ and } \Gamma_1 = \begin{pmatrix} 0.6 & 0 & 0 & 0 \\ 0.4 & 0.5 & 0 & 0 \\ 0.3 & 0.4 & 0.5 & 0 \\ 0.3 & 0.3 & 0.4 & 0.5 \end{pmatrix}$$

Case B is similar to the case A but there is no lagged causal order which is indicated by coefficient of lagged variable as in matrix Γ_1

Case B

$$B = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0.5 & 0 & 0 & 0 \\ 0.3 & 0.4 & 0 & 0 \\ 0.1 & 0.2 & 0.5 & 0 \end{pmatrix} \text{ and } \Gamma_1 = \begin{pmatrix} 0.46 & 0.07 & -0.02 & 0.03 \\ 0.09 & 0.27 & -0.24 & -0.01 \\ 0.10 & -0.03 & 0.03 & -0.25 \\ -0.04 & -0.02 & 0.24 & 0.22 \end{pmatrix}$$

This case provides a scenario where there is no contemporaneous, since matrix B does not show lower triangular and slightly lagged causal order as indicated by zero value in some element in matrix Γ_1

Case C

$$B = \begin{pmatrix} 0 & 0.1 & 0 & 0.2 \\ 0.5 & 0 & 0.4 & 0.1 \\ 0.3 & 0 & 0 & 0 \\ 0.1 & 0.2 & 0.5 & 0 \end{pmatrix} \text{ and } \Gamma_1 = \begin{pmatrix} 0.6 & 0 & 0.1 & 0.1 \\ 0.4 & 0.5 & 0 & 0.1 \\ 0.3 & 0.4 & 0.5 & 0.1 \\ 0.3 & 0.3 & 0.4 & 0.5 \end{pmatrix}$$

Similar to the case C, case D also exhibit a situation where contemporaneous does not exist and there is no lagged causal order as there is no zero element in matrix Γ_1

Case D

$$B = \begin{pmatrix} 0 & 0.1 & 0 & 0.2 \\ 0.5 & 0 & 0.4 & 0.1 \\ 0.3 & 0 & 0 & 0 \\ 0.1 & 0.2 & 0.5 & 0 \end{pmatrix} \text{ and } \Gamma_1 = \begin{pmatrix} 0.6 & 0.4 & 0.3 & 0.3 \\ 0.4 & 0.5 & 0.4 & 0.3 \\ 0.3 & 0.4 & 0.5 & 0.4 \\ 0.3 & 0.3 & 0.4 & 0.5 \end{pmatrix}$$

Since this study dealing with the estimation of causal order, it means that we concern on the placement of our variable in the sequential order. Permutation gives us a guidance of how many possibilities of placing our variables in the order. In our case, we have 4 variables and using permutation rule we obtain 24 possible orders to place our variables. Table 5.1 shows a simple illustration on how our variables being placed in 24 possible orders.

Table 5.1: Possible Causal Order

	1st Position	2nd Position	3rd Position	4th Position
1.	y_1	y_2	y_3	y_4
2.	y_1	y_4	y_3	y_2
3.	y_1	y_4	y_2	y_3
⋮	⋮	⋮	⋮	⋮
24.	y_4	y_3	y_2	y_1

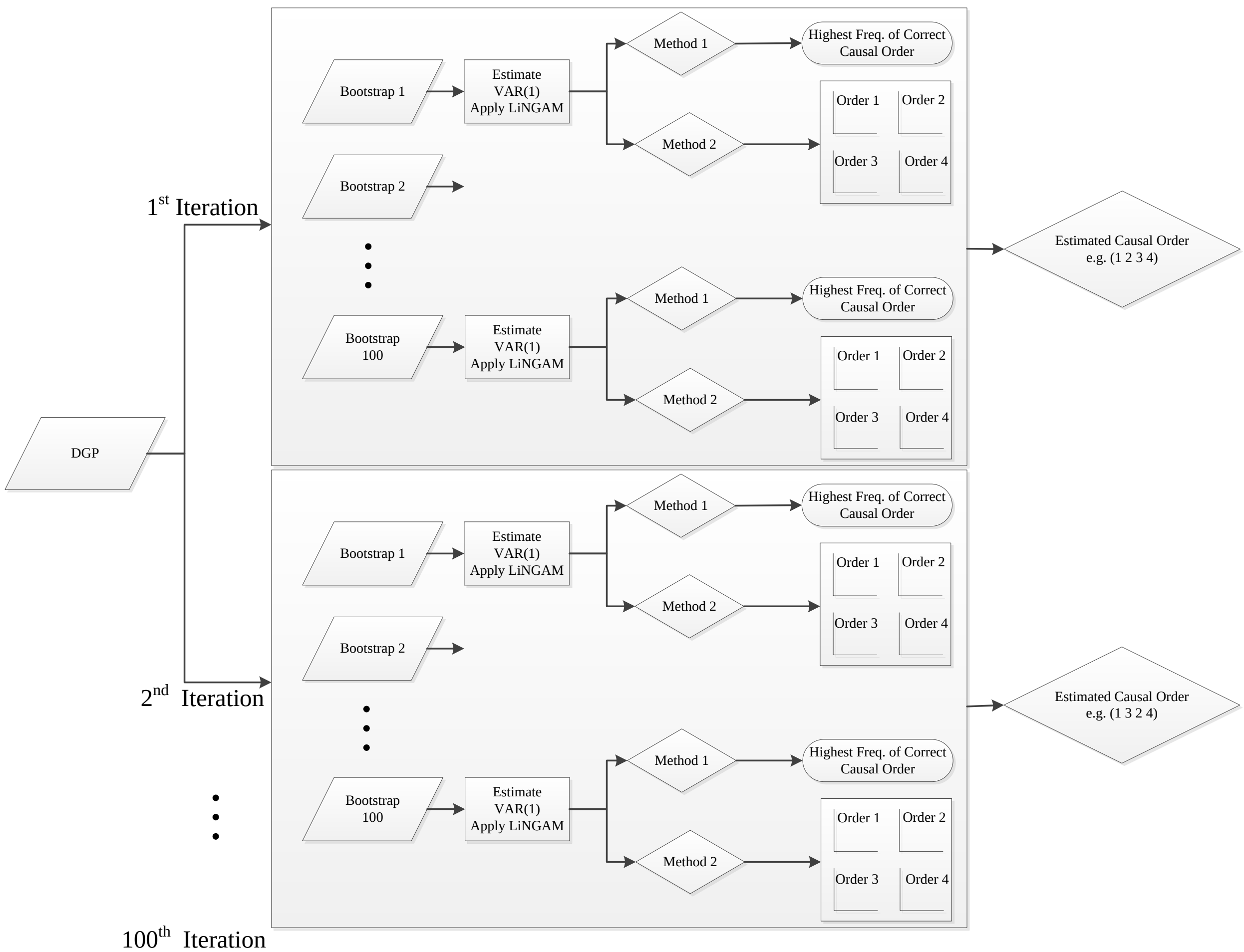
The following values are initial value to run the simulation:

1. Generate error term that follows centered non-central t-distribution. As already stated, we only use degree of freedom 5 and 25
2. Generate y-series for 300 observation using VAR(1) model as in the equation (9) $y_t = Ay_{t-1} + u_t$, with $y_{i1} = [0\ 0\ 0\ 0]$ or zero initial values for $t = 1$
3. By construction, the true causal order in this simulation is $y_1 \rightarrow y_2 \rightarrow y_3 \rightarrow y_4$ or may be written as [1 2 3 4] for simplicity
4. Based on generated y-series as in point 2, we apply bootstrap for 100 times. From this process, 100 ascending sorted set of observation are obtained
5. For each set of observation in point 4, we estimate parameters of VAR(1) and using the estimated parameter to estimate causal order using LiNGAM
6. Number of iteration is 100 for each data set and the highest frequency is selected as the estimated causal order

This simulation provides us the estimated causal order that can be distinguished in 2 different ways of presenting the result, namely Method 1 and Method 2. Method 1 provides the number of frequency of each estimated causal order which is based on the permutation possibilities order. Hence, using Method 1 we know how many times, for instance the order $y_1 \rightarrow y_2 \rightarrow y_3 \rightarrow y_4$ appears in the first iteration, and so on. The total number of frequency for each possible order must be equal to the number of iteration. Meanwhile, Method 2 presents the simulation result in different way, i.e. using histogram to show the frequency of each variable in each order. The estimated causal order is selected based on the highest frequency in each order or position.

To summarize the simulation procedures, we provide Figure 5.4. There are at least 3 parts on this simulation; (i) data generating process that mainly based on VAR(1) model with several initial values, (ii) applying bootstrap and LiNGAM to obtain the estimated causal order for each data set, and (iii) selecting the estimated causal order for each iteration. In this simulation, the Method 1 is superior to the Method 1 since it provides more comprehensive result.

Figure 5.4: The Simulation Procedures

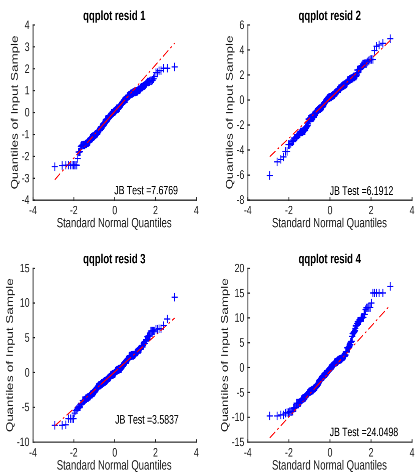


5.4.2. Simulation results

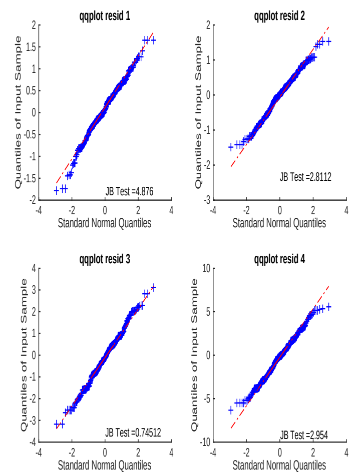
Our simulation successfully obtained the estimated causal order as expected only under Case A and B. The simulation cannot proceed the case C and D due to singularity problem on obtaining matrix $\boldsymbol{A}$. Therefore, we only focusing our experiment for case A and B. Before proceed our analysis on the experiment result, first we observe the distribution of our generated series which is designed to follow non-Gaussian. Hence, we apply normality test for each residual under the case A and B with degree of freedom 5 and 25. Figure 5.5 presents qq-plots of residual for each variable under different cases, i.e. A.1 (Case A with df. 5), A.2 (Case A with df. 25), B.1 (Case B with df. 5), and B.2 (Case B with df. 25). In almost all cases, the residual shows non-normality since the null hypothesis is always rejected due to high value of JB-test.

Figure 5.5: Normality of Residuals

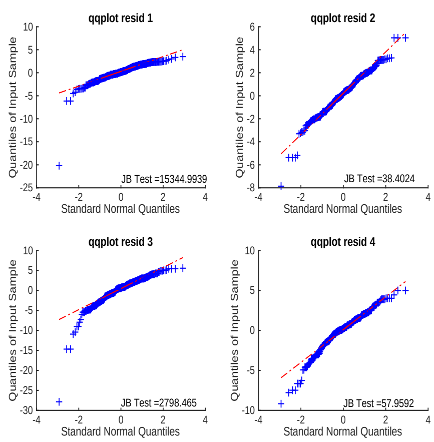
(i) Case A with Degree of Freedom 5 – A.1



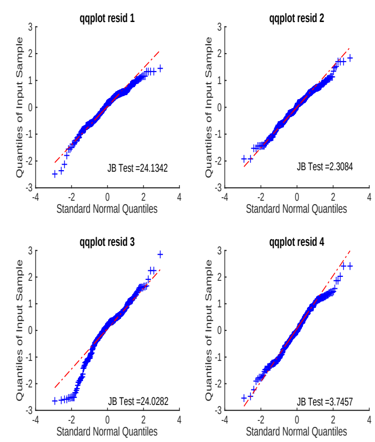
(ii) Case A with Degree of Freedom 25 – A.2



(iii) Case B with Degree of Freedom 5 – B.1



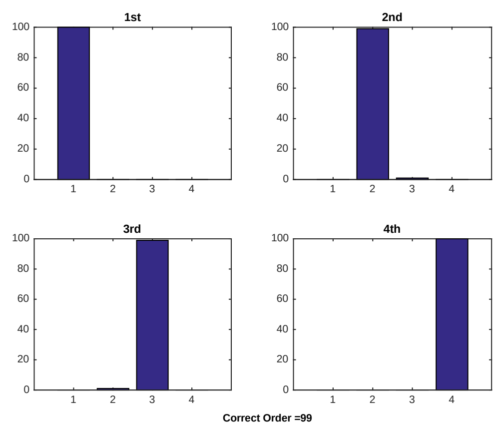
(iv) Case B with Degree of Freedom 25 – B.2



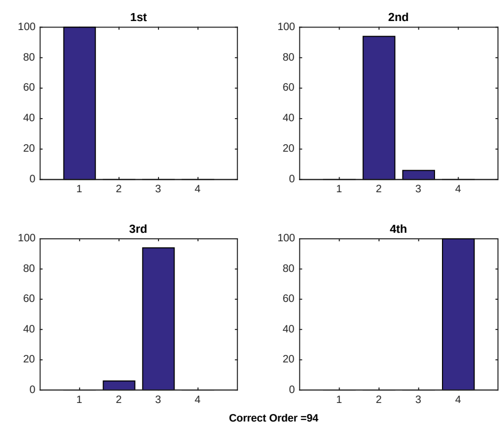
The simulation results are presented in Table 5.2. In that table, each column represents the simulation result for each case. First column shows that out of 100 iterations, the estimated causal order of $y_1 \rightarrow y_2 \rightarrow y_3 \rightarrow y_4$ appear 99 times and other causal order other than $y_1 \rightarrow y_2 \rightarrow y_3 \rightarrow y_4$ appear only once. When the degree of freedom is increased to 25, under the same case our simulation result as shown in second column, still obtain same estimated causal order of $y_1 \rightarrow y_2 \rightarrow y_3 \rightarrow y_4$ but with lower frequency, i.e. 94 times out of 100. The similar result is also obtained under Case B with degree of freedom 5, as shown in third column. But, the simulation result changed dramatically when changing the degree of freedom to 25 in case B. As shown in the fourth column, the frequency of $y_1 \rightarrow y_2 \rightarrow y_3 \rightarrow y_4$ decline to 13, while the estimated causal order of $y_2 \rightarrow y_1 \rightarrow y_3 \rightarrow y_4$ appears 63 times out of 100. To visualize the estimated causal order, Figure 6 is provided to exhibit the histogram of the estimated causal order. Figure 5.6.(i), for example, shows that the first order is taken by variable 1, the second order is filled by variable 2, while variable 3 and 4 sequentially occupy the third and fourth order. In total, 99 times out of 100 iterations, the simulation obtains correct causal order as indicated in beneath of the graph.

Figure 5.6: Histogram of the Estimated Causal Order

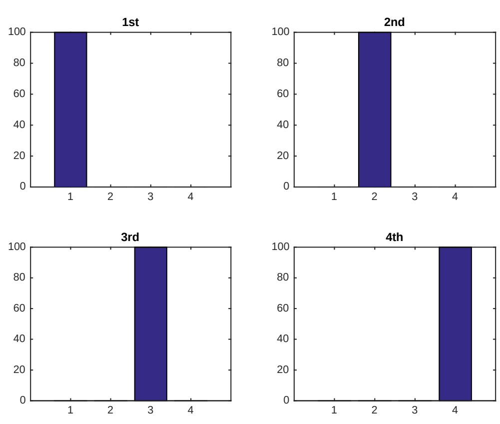
(i) Case A with Degree of Freedom 5 – A.1



(ii) Case A with Degree of Freedom 25 – A.2



(iii) Case B with Degree of Freedom 5 – B.1



(iv) Case B with Degree of Freedom 25 – B.2

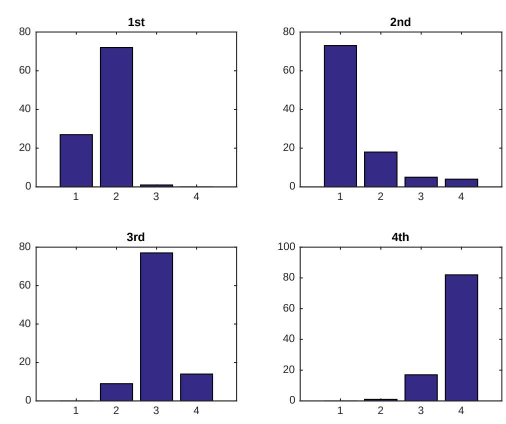


Table 5.2: Simulation Results – Method 1

(i) Case A df. 5 – A.1				(ii) Case A df. 25 – A.2				(iii) Case B df. 5 – B.1				(iv) Case B df. 25 – B.2			
No.	Permutation	SSR	Freq	No.	Permutation	SSR	Freq	No.	Permutation	SSR	Freq	No.	Permutation	SSR	Freq
1	4 2 3 1	18	0	1	4 3 2 1	20	0	1	4 3 2 1	20	0	1	4 1 2 3	12	0
2	4 2 1 3	14	0	2	4 3 1 2	18	0	2	4 3 1 2	18	0	2	4 1 3 2	14	0
3	4 3 2 1	20	0	3	4 2 3 1	18	0	3	4 2 3 1	18	0	3	4 2 1 3	14	0
4	4 3 1 2	18	0	4	4 2 1 3	14	0	4	4 2 1 3	14	0	4	4 2 3 1	18	0
5	4 1 3 2	14	0	5	4 1 2 3	12	0	5	4 1 2 3	12	0	5	4 3 2 1	20	0
6	4 1 2 3	12	0	6	4 1 3 2	14	0	6	4 1 3 2	14	0	6	4 3 1 2	18	0
7	2 4 3 1	14	0	7	3 4 2 1	18	0	7	3 4 2 1	18	0	7	1 4 2 3	6	3
8	2 4 1 3	10	0	8	3 4 1 2	16	0	8	3 4 1 2	16	0	8	1 4 3 2	8	1
9	2 3 4 1	12	0	9	3 2 4 1	14	0	9	3 2 4 1	14	0	9	1 2 4 3	2	5
10	2 3 1 4	6	0	10	3 2 1 4	8	0	10	3 2 1 4	8	0	**10**	**1 2 3 4**	**0**	**13**
11	2 1 3 4	2	0	11	3 1 2 4	6	0	11	3 1 2 4	6	0	11	1 3 2 4	2	5
12	2 1 4 3	4	0	12	3 1 4 2	10	0	12	3 1 4 2	10	0	12	1 3 4 2	6	0
13	3 2 4 1	14	0	13	2 3 4 1	12	0	13	2 3 4 1	12	0	13	2 1 4 3	4	9
14	3 2 1 4	8	0	14	2 3 1 4	6	0	14	2 3 1 4	6	0	14	2 1 3 4	2	63
15	3 4 2 1	18	0	15	2 4 3 1	14	0	15	2 4 3 1	14	0	15	2 4 1 3	10	0
16	3 4 1 2	16	0	16	2 4 1 3	10	0	16	2 4 1 3	10	0	16	2 4 3 1	14	0
17	3 1 4 2	10	0	17	2 1 4 3	4	0	17	2 1 4 3	4	0	17	2 3 4 1	12	0
18	3 1 2 4	6	0	18	2 1 3 4	2	0	18	2 1 3 4	2	0	18	2 3 1 4	6	0
19	**1 2 3 4**	**0**	**99**	19	1 3 2 4	2	6	19	1 3 2 4	2	0	19	3 1 2 4	6	1
20	1 2 4 3	2	0	20	1 3 4 2	6	0	20	1 3 4 2	6	0	20	3 1 4 2	10	0
21	1 3 2 4	2	1	**21**	**1 2 3 4**	**0**	**94**	**21**	**1 2 3 4**	**0**	**100**	21	3 2 1 4	8	0
22	1 3 4 2	6	0	22	1 2 4 3	2	0	22	1 2 4 3	2	0	22	3 2 4 1	14	0
23	1 4 3 2	8	0	23	1 4 2 3	6	0	23	1 4 2 3	6	0	23	3 4 2 1	18	0
24	1 4 2 3	6	0	24	1 4 3 2	8	0	24	1 4 3 2	8	0	24	3 4 1 2	16	0

Source: Author's estimation. SSR is Sum of Square of Residual. Given the true causal order is [1 2 3 4], then SSR = (true causal order – estimated causal order)^2.

Based on the simulation result, estimating causal order under non-Gaussian is heavily affected by the degree of coefficient of the lagged variables as well as the degree of freedom of the centered non-central t-distribution. When the coefficient of lagged variables is slightly low and the degree of freedom is quite high, then the ICA estimate the causal order less accurately since we still obtain the true causal order although in low frequency.

5.5. Application on the Exchange Rates

5.5.1. Background and data

As concluded in the chapter 2 on this study, the exchange rate of Indonesian rupiah is still pegged to several hard currencies, mainly the US dollar, although the central bank formally announced to adopt free floating regime when the Asian crisis hit in the middle of 1997. The study also found that there was a policy change regarding on the exchange rate management in Indonesia where the weight of hard currencies, particularly US dollar, have changed overtime.

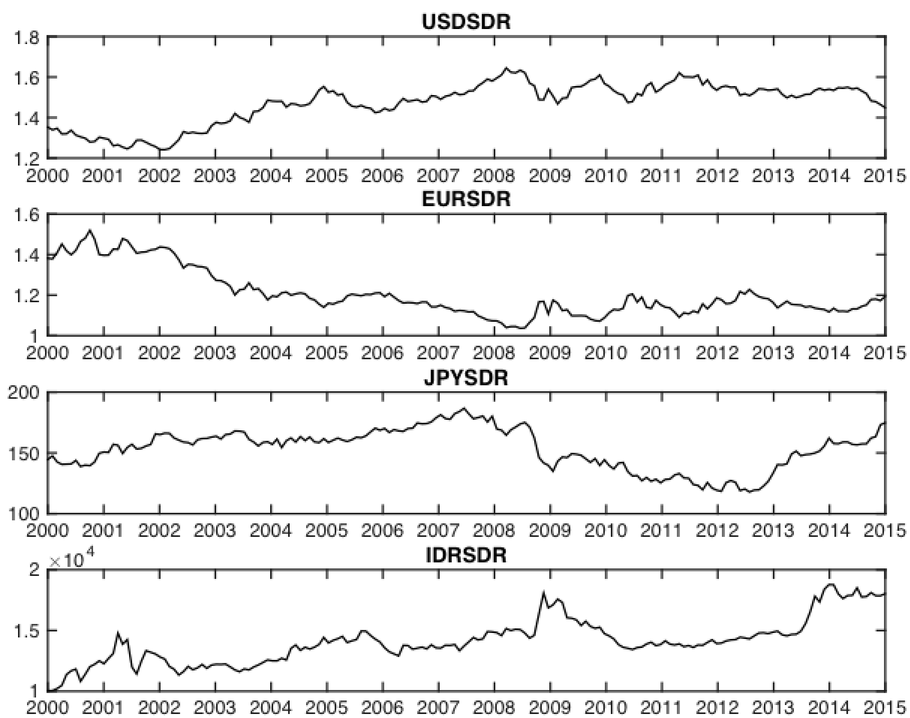
In the previous section, we have already explained the ICA framework (as well as applying the VAR-LiNGAM) that successfully estimated the causal order of several variables under SVAR model and non-Gaussian assumption. In this section, we apply the VAR-LiNGAM to analyze the relationship among the exchange rate of the several currencies. The SVAR can be applied to explain the dynamic interaction between soft currency and hard currencies. Unfortunately, the causal order modeling among the currencies remain unclear. But, according to Miskhin (2009), one choice that the emerging market countries have often made the decision to peg their currency to that of a large, low inflation country, typically United State is to achieve low inflation.

In this section, we take a simple example of estimating the causal order based on several nominal exchange rates of the US dollar, Euro, Japanese yen, and Indonesian rupiah against the Special Drawing Right[2] (SDR). The data is collected on the monthly basis from 2000 to 2014. In order to capture the effect of the Lehman shock, we divided our data into 2 periods, i.e. January 2000 –

[2] The SDR (Special Drawing Right) is an artificial "basket" currency that created and used by the IMF (International Monetary Fund) for internal accounting purposes. It is also used by some countries as a peg for their own currency, and is used as an international reserve asset.

August 2008 and September 2008 – December 2014 or simply noted as before and after Lehman shock respectively. The Augmented Dickey-Fuller tests do not reject the hypothesis of a unit root for each of the four series considered. We also select the optimal lag of 1 using Akaike's information criterion. Figure 5.7 exhibits the exchange rate movement for all surveyed currencies. The upward (downward) movement of the exchange rate represents the depreciation (appreciation) of the currency under consideration against the SDR. It can be seen clearly, that during the period before the Lehman shock, all currencies except the Euro had depreciation trends, but after the Lehman shock the trends of the exchange rate movement for each currency is somewhat unclear.

Figure 5.7: The Exchange Rate Movement

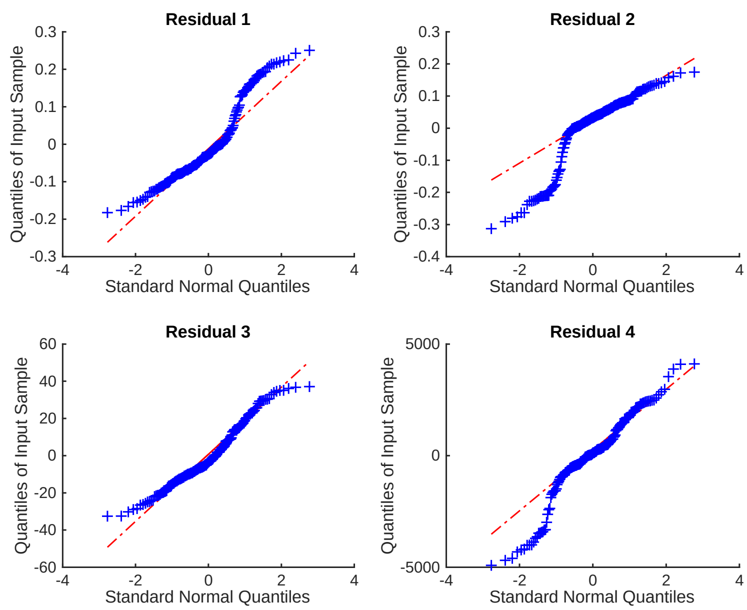


Source: International Financial Statistics - IMF

5.5.2. The results

We first observe normality of the four VAR residual as presented in Figure 5.8 by using q-q plots. The q-q plots show that all the residual did not follow normal distribution. This result is also in line with Jarque-Bera test which reject the hypothesis of normality. The main purpose to apply the VAR-LiNGAM in the exchange rate data is to estimate the causal order among the surveyed currencies. We applied the same procedures as in the simulation study, except the number of iteration which is now assigned to 1000 times.

Figure 5.8: Normality Test on the VAR(1) Residuals



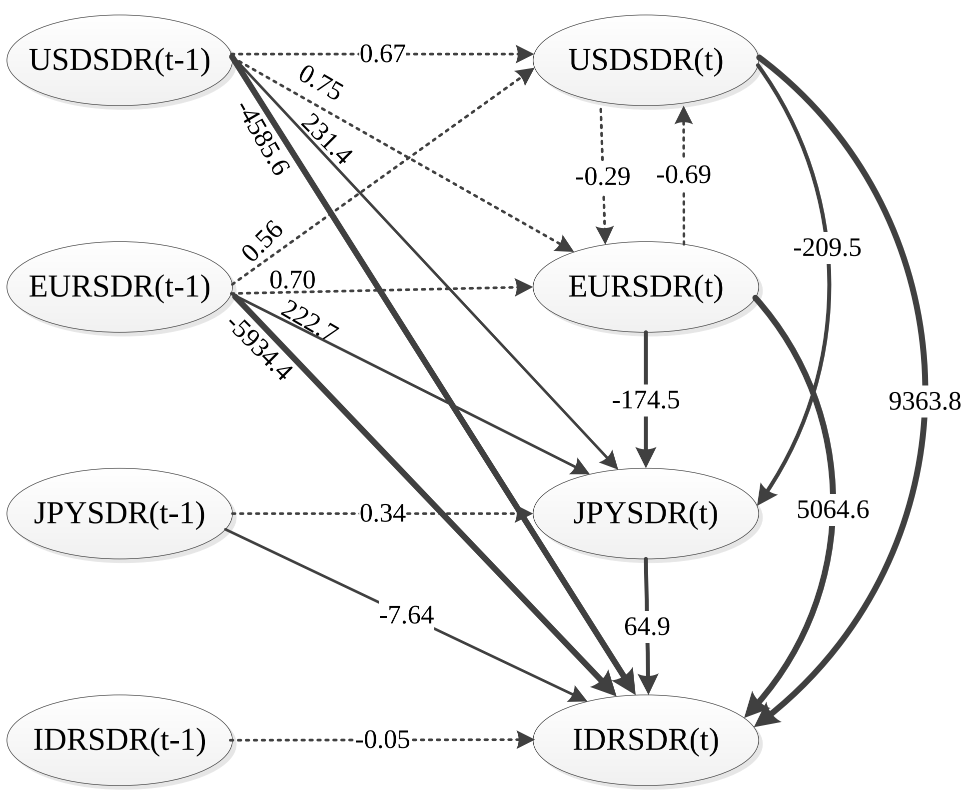
In this empirical study, as we obtain optimum lag 1, we develop SVAR(1) model in levels $\boldsymbol{y_t} = \boldsymbol{B}\boldsymbol{y_t} + \boldsymbol{\Gamma_1}\boldsymbol{y_{t-1}} + \boldsymbol{\varepsilon_t}$ to estimate the causal order. By applying LiNGAM, we estimate the matrices $\boldsymbol{B}$ and $\boldsymbol{\Gamma_1}$, and the estimated results are displayed in Table 5.3. The coefficient of $\hat{\beta}$ as shown in the first column represent contemporaneous, while the coefficient of $\hat{\Gamma}_1$ represent 1 lagged of the variables under consideration. These results provide useful information about the mechanism of the effect of one exchange rate currency to another, both in the contemporaneous and lag 1. The results suggest that Indonesian rupiah has been heavily effected by hard currency mainly the US dollar and the Euro in all period of observation. In addition, Figure 5.9 is provided to illustrate the relationship among the variables based on the estimated coefficient of contemporaneous and lagged variable.

Table 5.3: The Estimated $\boldsymbol{B}$ and $\boldsymbol{\Gamma_1}$

	Coefficient of $\hat{\beta}$				Coefficient of $\hat{\Gamma}_1$			
	January 2000 – December 2014							
	USDSDR	EURSDR	JPYSDR	IDRSDR	USDSDR	EURSDR	JPYSDR	IDRSDR
USDSDR	0.00	-0.29	0.00	0.00	0.67	0.56	0.00	0.00
EURSDR	-0.63	0.00	0.00	0.00	0.75	0.70	0.00	0.00
JPYSDR	-209.50	-174.50	0.00	0.00	231.45	222.78	0.34	0.00
IDRSDR	9363.88	5064.62	64.98	0.00	-4585.60	-5934.40	-7.64	-0.05
	January 2000 – August 2008							
	USDSDR	EURSDR	JPYSDR	IDRSDR	USDSDR	EURSDR	JPYSDR	IDRSDR
USDSDR	0.00	-0.22	0.00	0.00	0.53	0.52	0.00	0.00
EURSDR	-0.79	0.00	0.00	0.00	0.78	0.74	0.00	0.00
JPYSDR	-42.87	-74.71	0.00	0.00	98.63	101.62	0.32	0.00
IDRSDR	12395.70	2940.50	0.00	0.00	-2453.08	-2635.69	-13.35	0.01
	September 2008 – December 2014							
	USDSDR	EURSDR	JPYSDR	IDRSDR	USDSDR	EURSDR	JPYSDR	IDRSDR
USDSDR	0.00	-0.35	0.00	0.00	0.66	0.68	0.00	0.00
EURSDR	-0.30	0.00	0.00	0.00	0.56	0.55	0.00	0.00
JPYSDR	-125.89	-84.63	0.00	0.00	142.03	155.76	0.27	0.00
IDRSDR	13170.40	13192.71	118.57	0.00	-12489.47	-12409.49	-26.40	0.04

Source: Author's estimation

Figure 5.9: Plot of VAR-LiNGAM Result



Source: Author's estimation.

After observing the estimated coefficient of $\boldsymbol{B}$ and $\boldsymbol{\Gamma_1}$, we proceed our process to estimate the causal order. Table 5.4 provides the estimated causal order of the surveyed currencies in three different period of observation. When whole period of observation are included, as in the first column of Table 5.4, the causal order of [1 2 3 4] or $USDSDR \rightarrow EURSDR \rightarrow JPYSDR \rightarrow IDRSDR$ indicate the highest frequency. The same result is also obtained under the period before Lehman shock as presented in the second column, where the causal order of [1 2 3 4] has the highest frequency. However, the estimated causal order shows slightly different result after Lehman shock, where the US dollar come after the Euro while the next order remain equal in which the Indonesian rupiah placed in the last order.

Table 5.4: The Estimated Causal Order of the 4 Exchange Rates

No.	Jan. 2000 - Dec. 2014					Jan. 2000 - Aug. 2008					Sep. 2008 - Dec. 2014				
	1st	2nd	3rd	4th	Freq.	1st	2nd	3rd	4th	Freq.	1st	2nd	3rd	4th	Freq.
1	4	3	2	1	0	4	3	1	2	0	4	3	2	1	0
2	4	3	1	2	0	4	3	2	1	0	4	3	1	2	0
3	4	2	3	1	0	4	1	3	2	0	4	2	3	1	0
4	4	2	1	3	0	4	1	2	3	0	4	2	1	3	0
5	4	1	2	3	0	4	2	1	3	0	4	1	2	3	0
6	4	1	3	2	0	4	2	3	1	0	4	1	3	2	0
7	3	4	2	1	0	3	4	1	2	0	3	4	2	1	0
8	3	4	1	2	0	3	4	2	1	0	3	4	1	2	0
9	3	2	4	1	0	3	1	4	2	0	3	2	4	1	0
10	3	2	1	4	0	3	1	2	4	0	3	2	1	4	0
11	3	1	2	4	0	3	2	1	4	0	3	1	2	4	0
12	3	1	4	2	0	3	2	4	1	0	3	1	4	2	0
13	2	3	4	1	0	1	3	4	2	0	2	3	4	1	0
14	2	3	1	4	0	1	3	2	4	0	2	3	1	4	0
15	2	4	3	1	0	1	4	3	2	0	2	4	3	1	0
16	2	4	1	3	0	1	4	2	3	0	2	4	1	3	0
17	2	1	4	3	0	1	2	4	3	0	2	1	4	3	0
18	2	1	3	4	330	**1**	**2**	**3**	**4**	**743**	**2**	**1**	**3**	**4**	**551**
19	1	3	2	4	0	2	3	1	4	0	1	3	2	4	0
20	1	3	4	2	0	2	3	4	1	0	1	3	4	2	0
21	**1**	**2**	**3**	**4**	**670**	2	1	3	4	257	1	2	3	4	449
22	1	2	4	3	0	2	1	4	3	0	1	2	4	3	0
23	1	4	2	3	0	2	4	1	3	0	1	4	2	3	0
24	1	4	3	2	0	2	4	3	1	0	1	4	3	2	0

Source: Author's estimation.

5.6. Conclusions

The Independent Component Analysis which firstly developed in non-economic field basically tried to decompose a series of data into several part as we have explained using a simple example of the "Cocktail-party Problem". Using non-Gaussian assumption, this method estimates several parameters in SVAR model. Since the SVAR model consists of contemporaneous, the identification problem may arise and it became problematic on the estimation process. Converting a standard SVAR model into a reduced form of VAR model become a solution to overcome the estimation problem.

We have conducted several simulations based on 4 different cases, i.e. case A (contemporaneous with lagged variable) and case B (contemporaneous with slightly lagged variable). In addition, our simulation also distinguished the use of different degree of freedom in generating the error terms which is assumed non-normal. We generated error term based on the centered non-central t-distribution in order to fit with non-Gaussian assumption. In our simulation, the true causal order is set, but we assume that the true causal order is unknown. As a result, our simulation show that in almost all cases the ICA successfully estimated the true causal order except under case B with higher degree of freedom in the error term.

In our example, we apply this method to obtain the causal order among the exchange rate currencies. We provide 4 currencies that can be classified into 2 different groups, i.e. hard and soft currency. The hard currencies consist of the US dollar, Euro, and Japanese yen. Meanwhile the soft currency is only the Indonesian rupiah. The purpose of this empirical study is to estimate the causal order among those currencies before and after Lehman shock. As a result, the causal order before the Lehman shock was $USDSDR \rightarrow EURSDR \rightarrow JPYSDR \rightarrow IDRSDR$ and after the Lehman shock the causal order was $EURSDR \rightarrow USDSDR \rightarrow JPYSDR \rightarrow IDRSDR$. There was a slight different between the sequence order of the US dollar and Euro before and after Lehman shock.

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Chapter 6

Block Length Selection on Circular Block Bootstrap Method in Constructing Confidence Interval: A Monte Carlo Experiment

Block Length Selection on Circular Block Bootstrap Method in Constructing Confidence Interval: A Monte Carlo Experiment

6.1 Introduction

Since a theoretical distribution of the estimated single change point ($\hat{m}$) is generally difficult to be obtained, therefore a bootstrap is considered to obtain the sampling distribution of $\hat{m}$ and use this to construct confidence intervals. Block bootstrap (BB) as well as circular block bootstrap (CBB) are a modified bootstrap which is proposed to deal with dependent data by resampling from the collection of blocks of data. Typically, the economic time series has more or less dependency on past date, hence BB and CBB are recommended to detect a change point and construct confidence intervals for econometric time series models.

The bootstrapping method is nothing but a resampling method in time series. The procedures of bootstrapping are as follows: (i) simulate a distribution, (ii) repeat our estimate (or test or whatever) on the simulation, and then (iii) look at the distribution of this statistic over many simulations. Simple resampling will not work, because it destroys the dependence between successive values in the time series. To overcome this problem selecting blocks in the resampling process may become a solution. Within each block, we have preserved all of the dependence between observations.

In the chapter 4, the CBB method is applied to construct a confidence interval for the estimated single change point. The results of our experiment study as presented in the Table 4.1 and 4.2 show that using different block length causes different construction of the confidence interval. In some cases, shorter block length produce better construction of the confidence interval (e.g. under SSR/CBB method as in the Table 4.1) and in another case the longer block length also provide better confidence interval (e.g. under LR/CBB method as in the Table 4.1). When applying the CBB, the user is required to specify length of the block.

This chapter examines the block length selection in constructing confidence interval for a single estimated change point. Hušková and Kirch (2013) apply the bootstrap method to obtain confidence interval under linear regression model with exogenous explanatory variables and the error process follows time dependent data i.e. GARCH(1,1). Lazarová (2005) proposes an alternative approach of approximating the distribution of the test statistic by bootstrap procedures. She considered the statistical test for structural change in time series regression model where both explanatory variables and residual may exhibit long memory dependence. In our study, time dependent exist in the residual only. To find out more details about the impact of determination length of the block size, this chapter will examine the use of different length of the blocks to the time series data with the error process follows an AR (1) and ARFIMA (0, d, 0). We propose our hypothesis that when there is a strong time dependency longer block length is appropriate.

This chapter will be organized as follows; section 6.2 describes an introduction to long memory. Section 6.3 describes design of experiment i.e. the Monte Carlo simulation, including data generating process and estimation of a single change point using sum of square of residuals (SSR method). We observe the use of different length of block size in the process of constructing confidence interval in section 6.4. Finally, section 6.5 concludes.

6.2 Long Memory

In early 1950s, a British hydrologist Hurst introduced long memory model based on his study on the long-term behavior of the Aswan Dam on the Nile River in term of regularization of the river's flow. Mesa and Poveda (1993) wrote that Hurst (1951) consider the "adjusted range" to measure the reservoir capacity required under idealized condition and interested in the dependence of the adjusted range on the sample size. It is obvious that the adjusted range will be affected by the sample size but how fast? This study is then extended into more general application, including econometric.

Long memory processes consider slower rate of decay, such as hyperbolic decay. This condition is commonly found in financial time series data. The existence of long memory is usually observed by the persistence of autocorrelations. In stationary time series data, the volatility decay exponentially fast. For example, consider that the error process ε_t follows ARCH(1) model with $\alpha = 0.8$ and $k = 10$. Since the ε_t^2 have autocorrelations $\rho_k = \alpha^k$, then $\rho_{20} = 0.012$ which mean the autocorrelations decay very fast in lag 20. Meanwhile, in integrated ARCH(1) where the autocorrelation is $\rho_k = 1$ for all k there will be no decay or very slow decay. In stationary long memory model for volatility, the autocorrelation of ε_t^2 decay slowly to zero as a power law, $\rho_k \sim k^{2d-1}$ where d is $0 < d < \frac{1}{2}$.

The long memory model was independently developed by Granger and Joyeux (1980), Hosking (1981). Hoskings (1981) introduced a family of models by generalizing the $ARIMA(p,d,q)$ to meet the following requirements; (i) explicitly modeling long-term persistence, (ii) flexible to explain both short-term and long-term correlation structure of a series, (iii) enabling synthetic series to be easily generated from the model. The most popular long memory model is $ARFIMA(p,d,q)$ that similar to $ARIMA(p,d,q)$ except FI which stands for "Fractionally Integrated". In other words, ARFIMA models are ARIMA models in simple form which the d or the degree of integration is allowed to be a fraction of a whole number. In general, long memory process can be defined as

$$\sum_{k=-\infty}^{\infty} |\rho(k)| = \infty$$

A long memory process of y_t can be modeled by extending the integer integrated to fractional integrated process. Consider a simple model with fractional integration using lag operator as follows

$$(1 - L)^d (y_t - \mu) = \varepsilon_t$$

where L is lag operator, d is fractional integration, μ is mean of y_t, and ε_t is error term with zero mean and constant variance. When the volatility presence in, for instance, highly persistent of economic and financial time series, the integer difference of a time series is not sufficient. Hence the fractional difference of d is allowed to be used. The main interest on this matter is $(1-L)^d$, in which when the d is integer, e.g. $d = 2$, then $(1-L)^2 = 1 - 2L + L^2$. In general it can be defined as:

$$(1-L)^d = 1 + \sum_{k=0}^{\infty} \frac{d(d-1)(d-2)\cdots(d-k+1)}{k!}(-L)^k$$

The fractional difference filter can be equivalently treated as an infinite order autoregressive filter. With $|d| > \frac{1}{2}$ then y_t is non-stationary; when $0 < d < \frac{1}{2}$, y_t will be stationary and has long memory; and when $-\frac{1}{2} < d < 0$, the y_t is also stationary and has short memory (this condition sometimes referred to as anti-persistent).

6.3 Monte Carlo Experiment

In the chapter 4, we assumed that the error term followed GARCH(1,1) which means that our time series data was time dependent but not independent and identically distribution (*iid*) (i.e. u_t and u_s (t≠s) are independent). To examine the effect of using different length of block size in CBB for constructing confidence interval, our assumptions are as follows: (i) time series is time dependent, and (ii) the error process follows AR(1) and ARFIMA(0,d,0).

6.3.1 Data generating process

In this section, the data generating process (y_t) is based on two models, namely Model A and B. In these models, it is assumed that there is a single break and the true break point (m) is determined in three different locations, i.e. T/4, T/2, and 3T/4, where T is total observation of the generated series. Model A represents a case where time series data has small change on the structural change parameter, Besides, we also assumed that the error term of the generated series under Model A follows AR(1) and ARFIMA (0,d,0), later it is called as Model A.1 and Model

A.2 respectively. Model B represents time series data with large structural change and the error process is also assumed to follow AR(1) and ARFIMA(0,d,0), and it is called as Model B.1 and Model B.2 respectively.

To generate the series of y_t, we provide a simple equation with a constant term and error term. In Model A, the difference of the parameter structural change is 0.5. While in Model B, since the structural change is assigned to be larger than under Model A, the difference of the parameter structural change is 2. In the following, we provide four different cases to generate y_t series.

(i) Model A.1 – time series with small structural change and AR(1) error process

$y_t = 1 + u_t$, for $t = 1, \cdots, m$

$y_t = 1.5 + u_t$, for $t = m + 1, \cdots, T$

$u_t \sim AR(1)$

(ii) Model A.2 – time series with small structural change and ARFIMA(0,d,0) error process

$y_t = 1 + u_t$, for $t = 1, \cdots, m$

$y_t = 1.5 + u_t$, for$t = m + 1, \cdots, T$

$u_t \sim ARFIMA(0, d, 0)$

(iii) Model B.1 – time series with large structural change and AR(1) error process

$y_t = 1 + u_t$, for $t = 1, \cdots, m$

$y_t = 3 + u_t$, for $t = m + 1, \cdots, T$

$u_t \sim AR(1)$

(iv) Model B.2 – time series with large structural change and ARFIMA(0,d,0) error process

$y_t = 1 + u_t$, for $t = 1, \cdots, m$

$y_t = 3 + u_t$, for $t = m + 1, \cdots, T$

$u_t \sim ARFIMA(0, d, 0)$

We generate 1000 observations (i.e. $y_t, t = 1, \cdots, 1000$) for each model. In this chapter, our concern is not only to examine the effect of the block length selection, but we also to the change of the coefficient of AR(1) or α, as well as the coefficient of ARFIMA(0,d,0) or d in the error process. Therefore, the error process in this simulation is generated based on the following equation:

(a) AR(1) model

$$u_t = \alpha u_{t-1} + \varepsilon_t;\ \varepsilon_t \sim N(0,1)$$

(b) ARFIMA(0,d,0)

$$(1-L)^d(y_t - \mu) = u_t$$

Under Model A.1 and B.1, the error process will be generated by using different coefficient of AR(1) as 0.0, 0.3, 0.6 and 0.9. Meanwhile, under Model A.2 and B.2 the coefficient of ARFIMA(0,d,0) is set as 0.1, 0.3, 0.45 and 0.7. The higher coefficient of AR(1) as well as ARFIMA(0,d,0) represent the time dependency data.

6.3.2. The simulation procedures.

The experiment study is based on Monte Carlo simulation. The procedures of the simulation are as follows:

1. Generate 1000 observations of the y_t series under Model A.1, A.2, B.1, and B.2
2. For each model, estimate the true change point using sum of squares of residuals (SSR) method which is defined as

   $$SSR(k) = \sum_{t=1}^{k} e_{1,t}^2 + \sum_{t=k+1}^{T} e_{2,t}^2;\ \text{for T given}$$

   and estimate the true change point m by

   $$\hat{m} = argmin_k SSR(k).$$

3. Apply the CBB method to construct the confidence interval
4. Evaluate the confidence interval using four different (arbitrary) block length i.e. 5, 25, 50, and 100.

6.4 The Simulation Results

In the following, Table 6.1.A and 6.1.B presents the mean of estimated change point under Model A.1 and Model A.2 respectively.

Table 6.1.A: Mean of Estimated Change Point under Model A.1

True Change Point	Estimated Change Point			
	$\alpha = 0.0$	$\alpha = 0.3$	$\alpha = 0.6$	$\alpha = 0.9$
250	**252.15**	**253.45**	316.1	485.21
500	**499.35**	**500.55**	**503.67**	**514.17**
750	**749.16**	**743**	690.17	535.96

Table 6.1.B: Mean of Estimated Change Point under Model A.2

True Change Point	Estimated Change Point			
	$d = 0.1$	$d = 0.3$	$d = 0.45$	$d = 0.7$
250	**259.63**	394.52	494.56	533.02
500	**500.78**	**501.49**	**511.86**	**531.24**
750	**734.41**	620.19	560.70	535.09

In Table 6.1.A, the SSR method works well to detect all true change points accurately when the coefficient of AR(1) error process is zero and 0.3. In other word, we obtain evidence that SSR methods detect the true change points well when the time series data is less time dependence although under small parameter change. But the SSR method does not work well when the coefficient of AR(1) error process become higher, i.e., $\alpha = 0.6$ and $\alpha = 0.9$. In this case the estimated change points are far from the true change point except when the true change point is located in the middle.

Table 6.1.B shows that under Model A.2, the SSR works well only when the coefficient of ARFIMA is 0.1. Increasing the coefficient of ARFIMA causes the SSR method unable to detect the true change point accurately. When the coefficient of ARIMA is 0.1, the estimated change points are close to its true change point. As the ARFIMA coefficient increases (i.e. $d = 0.3, 0.45, 0.7$) the estimated change points are inaccurate and less accurate only when the true change point is in the middle.

By using the same estimation procedures, Table 6.2.A and 6.2.B in the following present the results of the estimated change points under Model B.1 and Model B.2. Since the structural change under Model B was larger, theoretically, the process of detecting true change point should be easier for the SSR method.

Table 6.2.A: Mean of Estimated Change Point under Model B.1

True Change Point	Estimated Change Point			
	$\alpha = 0.0$	$\alpha = 0.3$	$\alpha = 0.6$	$\alpha = 0.9$
250	**249.97**	**250.18**	**250.53**	302.86
500	**499.94**	**499.98**	**500.24**	**506.03**
750	**749.98**	**749.99**	**749.48**	694.15

Table 6.2.B: Mean of Estimated Change Point under Model B.2

True Change Point	Estimated Change Point			
	$d = 0.1$	$d = 0.3$	$d = 0.45$	$d = 0.7$
250	**249.98**	**251.62**	284.12	458.66
500	**500.03**	**499.15**	**500.08**	**530.62**
750	**749.98**	**749.80**	715.82	586.11

Under Model B.1 as presented in Table 6.2.A, the SSR methods works well to detect the true change points except when the coefficient of AR(1) is 0.9 or strong time dependency. Unlike in Model B.1, the estimated change point under Model B.2 is sensitive to the coefficient of ARFIMA. Assigning the ARFIMA coefficient exceed 0.3 causes the SSR method unable to estimate the true change point accurately.

6.4.1 Confidence interval with different block length

The Circular Block Bootstrap is applied to construct confidence interval for the estimated change point as in our previous study. In this case, we evaluate the effect on changing block length as well as coefficient of AR(1) and ARFIMA(0,d,0) under low and high structural change in the data generating process. The simulation results for Model A.1 and A.2 are presented in Table 6.3.A-6.3.B while Table 6.4.A-6.4.B exhibit simulation result under Model B.1, and B.2.

In these tables, several information regarding on the simulation result are provided, including mean (i.e. average of the 1000 estimated change point), RMSE (root mean of square error as an indicator to measure deviation from the mean), LB/UB (refer to lower and upper bound of the confidence interval), and range (distance of lower and upper bound). It is expected that the confidence interval has mean as close as the true change point and low RMSE. In addition, it is also important that the mean is located between the lower and upper bound of the confidence interval. We compare the simulation results under different cases in constructing the confidence interval in the Table 6.3.A – 6.4.B and well-constructed confidence interval will be indicated by shaded area of the table.

In the Appendix-C, all constructions of the confidence interval under different cases are presented in Figure A.1.1 to B.2.3. Figure A.1.1 represents the confidence interval under Model A.1 with true change point of 250. The first two notation indicate the model, while the third notation indicate the true change point, i.e. 1 for first true change point case (i.e. 250), 2 for second true change point (i.e. 500), and 3 for third true change point case (i.e. 750). In each figure, there are 4 rows which indicate different coefficient in each row and 4 columns that represent block length selection. For instance, Figure A.1.1.(a) shows the confidence interval under Model A.1 with true change point 250, AR(1) coefficient equal zero and 5 block length. The figures represent histogram of the estimated change point, therefore the peak of the histogram indicate the mean of the estimated change point. In addition, each figure also provide the true change point that is shown by solid (green) line and the lower and upper bound which is indicated by dash (red) line. As expected, the well-constructed confidence intervals have symmetric shape with the peak of the histogram close to the true change point and lies on the area inside lower and upper bound. Figure A.1.1.(a) can be taken as a good example of one of well-constructed confidence interval.

The simulation results under Model A.1 as exhibited in the Table 6.3.A shows when the coefficient of AR(1) is 0 or there is no time dependency case, the confidence interval is well constructed when the block length is 5 for all true change point. But when the coefficient of AR(1) is changed to 0.3, the confidence interval is well constructed under different block length, i.e. block length of 5 for the case under true change point of 250 and 750; while block length of 50 is suitable under true change point of 500. As the coefficient of AR(1) is greater than 0.5, the simulation results could not obtain good confidence interval, as it is indicated by large range in all cases. But, using block length of 5 under the true change point of 250, the simulation results still obtain better result even though the range is high.

Table 6.3.A: Low Structural Change with AR(1)

AR(1) Coefficients	Parameter	True Change Point: 250				True Change Point: 500				True Change Point: 750			
		5	25	50	100	5	25	50	100	5	25	50	100
$\alpha = 0.0$	Mean	246.05	251.85	245.25	347.82	510.7	501	492.9	466.1	730.31	750.37	732.48	679.94
	RMSE	93.6	110.05	122.68	273.49	61.9	84.9	113.6	152.7	151.48	92.28	106.2	158.19
	LB/UB	103/373	101/378	78/396	73/929	438/583	363/638	304/670	209/703	665/848	638/892	591/902	467/913
	Range	70	277	318	856	145	275	366	494	183	254	311	446
$\alpha = 0.3$	Mean	248.39	228.87	231.72	301.55	538.8	525.7	500	487.1	760.87	753.46	732.52	686.06
	RMSE	99.41	105.79	134.30	239.31	167.6	162.4	164.9	178.3	68.77	82.23	108.31	153.23
	LB/UB	164/340	98/339	63/367	33/735	329/849	304/824	253/786	202/775	686/840	638/880	584/902	481/928
	Range	176	241	304	702	520	520	533	573	154	242	318	447
$\alpha = 0.6$	Mean	252.12	380.71	487.80	534.50	433.9	457.8	498.5	456.8	619.27	595.67	557.78	493.49
	RMSE	244.95	328.71	338.13	337.09	187.2	212.6	213.7	229.6	292.2	298.31	282	271.17
	LB/UB	20/499	20/967	20/959	79/980	20/564	20/733	250/980	161/944	20/876	20/883	144/80	72/869
	Range	479	947	939	901	544	713	730	783	856	863	836	797
$\alpha = 0.9$	Mean	260.61	405.57	463.13	453.41	289.4	381.2	460.2	441.4	284.90	388.46	434.52	408.43
	RMSE	288.15	316.93	310.14	286.29	292.4	306.8	307.7	279.6	306.15	307.02	302.26	278.65
	LB/UB	20/811	20/831	20/858	20/846	20/823	20/837	20/880	20/826	20/867	20/851	20/858	29/825
	Range	791	811	838	826	803	817	860	806	847	831	838	796

Table 6.3.B: Low Structural Change with ARFIMA(0,d,0)

ARFIMA(0,d,0) Coefficients	Parameter	True Change Point: 250				True Change Point: 500				True Change Point: 750			
		5	25	50	100	5	25	50	100	5	25	50	100
$d = 0.1$	Mean	392.24	356.62	308.27	384.69	496.8	488.5	481.1	445.4	786.35	773.58	740	693.68
	RMSE	251.15	244.15	216.31	290.95	35.2	79.7	105.1	152.2	89.31	88.86	105.40	149.03
	LB/UB	168/926	97/878	48/745	73/917	440/555	372/625	298/641	199/686	678/906	644/920	573/904	470/915
	Range	758	781	697	844	115	253	343	487	228	276	331	445
$d = 0.3$	Mean	131.99	331.94	437	559.45	511.9	502.6	489.9	506.2	353.76	488.85	505.73	515.21
	RMSE	113.22	350.75	377.95	365.14	36.6	77.9	112.4	168.3	263.33	307.70	305.81	297.95
	LB/UB	71/165	64/972	59/969	85/973	450/570	384/638	300/650	248/814	20/721	95/972	100/963	94/924
	Range	94	908	910	888	120	254	350	566	701	877	863	830
$d = 0.45$	Mean	147.21	219.06	332.20	467.02	500	492.1	476.4	492.1	541.42	509.92	494.08	556.42
	RMSE	119.97	226.68	323.32	362.32	34.4	78.4	109.1	172.8	258.03	284.33	300.95	318.85
	LB/UB	59/246	20/614	32/936	39/936	450/560	375/625	300/650	195/783	77/780	50/818	20/885	54/935
	Range	187	594	904	897	110	250	350	588	703	768	865	881
$d = 0.7$	Mean	821.78	733.37	683.41	643.84	475.4	493.9	494	490.9	842.12	758.05	703.59	647.41
	RMSE	81.86	188.97	203.28	206.34	39.3	119.6	152.4	187.5	102.82	174.41	185.44	207.03
	LB/UB	783/951	442/958	364/960	328/965	411/530	314/661	254715	214/847	772/976	488/976	425/960	340/954
	Range	168	516	596	637	119	345	465	633	204	488	535	614

Table 6.4.A: High Structural Change with AR(1)

AR(1) Coefficients	Parameter	True Change Point: 250				True Change Point: 500				True Change Point: 750			
		5	25	50	100	5	25	50	100	5	25	50	100
$\alpha = 0.0$	Mean	247.55	240.99	234.38	285.02	498.2	487.2	466.8	454.5	747.26	735.06	727.98	693.40
	RMSE	29.38	65.29	113.26	217.38	35.6	81.7	111.8	149.5	30.13	67.96	97.78	143.66
	LB/UB	203/295	120/333	98/400	20/535	434/551	368/626	299/650	199/686	702/796	622/846	595/900	494/902
	Range	92	213	302	515	117	258	351	487	94	224	305	408
$\alpha = 0.3$	Mean	249.07	241.13	237.93	307.96	499.8	491.2	478.6	458.5	748.22	738.04	724.54	695.52
	RMSE	29.95	66.90	119.95	233.34	34.9	78.7	115.9	149.5	29.98	69.84	95.24	140.62
	LB/UB	198/296	123/344	50/351	40/811	442/555	373/626	282/656	208/706	700/796	625/850	548/850	497/903
	Range	98	221	301	771	113	253	370	498	96	225	302	406
$\alpha = 0.6$	Mean	267.88	255.30	298.29	387.25	490.9	478.4	467.4	456.4	743.15	733.57	716.06	685.48
	RMSE	36.28	67.82	191.24	285.03	34.3	77.2	108.6	153.7	32.11	70.45	96.99	146.31
	LB/UB	210/326	148/363	76/430	96/922	430/541	350/600	298/650	197/680	689/792	625/850	549/852	492/916
	Range	116	215	354	826	111	250	352	483	103	225	303	424
$\alpha = 0.9$	Mean	183.42	273.73	371.94	448.27	420	390.1	409.1	415.2	604.53	538.36	529.68	484.14
	RMSE	121.01	237.76	299.64	326.97	121.4	197	248.2	266.2	258.88	291.87	285.13	280.28
	LB/UB	70/382	20/646	20/908	20/894	310/635	33/637	20/779	20/839	109/951	20/899	85/955	59/901
	Range	312	626	888	874	325	604	759	819	842	879	870	842

Table 6.4.B: High Structural Change with ARFIMA(0,d,0)

ARFIMA(0,d,0) Coefficients	Parameter	True Change Point: 250				True Change Point: 500				True Change Point: 750			
		5	25	50	100	5	25	50	100	5	25	50	100
$d = 0.1$	Mean	247.90	234.87	235.17	313.77	498	488.8	479.4	456.7	749.36	739	727.56	692.31
	RMSE	30.36	66.44	116.27	251.68	35.5	74.5	106.9	149.1	30.77	70.83	97.57	145.16
	LB/UB	199/296	121/332	75/367	71/888	440/555	368/610	307/655	219/704	702/803	625/850	548/858	481/902
	Range	97	211	292	817	115	242	348	485	101	225	310	421
$d = 0.3$	Mean	232.98	235.31	317.81	483.51	512.7	501.7	492.4	504.7	747.40	734.40	716.45	674.46
	RMSE	38.95	103.65	254.93	326.12	35.5	75.6	109.6	174.4	31.48	67.46	100.25	166.73
	LB/UB	176/304	105/325	89/932	132/973	460/555	384/627	312/661	290/863	699/802	612/834	546/861	437/912
	Range	128	220	843	841	115	243	349	573	103	222	315	475
$d = 0.45$	Mean	248.65	240.21	268.05	384.98	499.2	493.1	486.1	472.9	738.80	718.91	698.45	661.10
	RMSE	29.64	73.09	184.72	295.14	35.1	79.9	110.6	171.2	38.72	79.18	106.84	175.77
	LB/UB	200/295	123/346	50/403	94/941	435/551	350/605	305/654	127/705	669/795	589/828	547/856	451/924
	Range	95	223	353	847	116	255	349	578	126	239	309	473
$d = 0.7$	Mean	250.53	317.02	367	395.03	474.5	493.5	490.1	489.9	728.54	691	649.72	627.90
	RMSE	53.19	190.31	223.05	231.03	38.8	116.6	144.8	175	97.62	149.96	180.08	196.08
	LB/UB	192/295	97/673	93/758	83/764	420/535	323/665	250/702	193/772	654/965	499/978	415/980	380/980
	Range	103	576	665	681	115	342	452	579	311	479	565	600

Under Model A.2, the simulation results as shown in Table 6.3.B indicate that under the case when the true change point is located in T/4, the CBB method unable to construct the confidence interval well. However, under the case when the true change point is assigned in T/2 the CBB method provide good confidence interval only when 5 block length is selected. The same thing happen under the case of true change point is 3T/4, selecting 5 block length resulted a good shape of the confidence interval. Unfortunately, increasing coefficient of ARFIMA ruined the confidence interval although 5 block length is selected.

As expected, assigning the case of large structural change ease the SSR method to estimate the true change point under AR(1) and ARFIMA(0,d,0) and as a result the confidence interval is well constructed. Table 6.4.A represent the simulation results under Model B.1 and as can be observe from the table as well as figure of histogram in the Appendix - C, selecting 5 block length provide well-constructed confidence interval except under the case when coefficient of AR(1) is 0.9. In this case, the CBB failed to construct good shape of confidence interval under all true change point cases. Meanwhile, the simulation result under Model B.2 as presented in Table 6.4.B indicate that using 5 block length for all cases, except under true change point of 3T/4 with $d = 0.7$, the CBB method successfully constructed a good shape of confidence interval.

Table 6.5.A: Low Structural Change with AR(1)

AR(1) Coefficients	Parameter	True Change Point: 250		True Change Point: 500		True Change Point: 750	
		Non-CBB	1	Non-CBB	1	Non-CBB	1
$\alpha = 0.0$	Mean	264.22	266.41	515.39	514.28	758.57	756.40
	RMSE	77.86	90.73	27.74	32.69	64.47	69.09
	LB/UB	172/355	171/351	471/551	469/548	703/821	707/823
	Range	183	180	80	79	118	116
$\alpha = 0.3$	Mean	237.94	240.15	543.27	532.22	761.89	762.18
	RMSE	47.98	64.15	137.78	139.49	29.22	28.89
	LB/UB	188/323	181/317	385/851	312/775	705/796	708/798
	Range	135	136	466	463	91	90
$\alpha = 0.6$	Mean	148.31	154.19	445.76	448.41	671.76	659.72
	RMSE	170.11	177.35	124.81	120.50	270.02	282.32
	LB/UB	20/409	20/409	400/554	402/538	20/851	20/850
	Range	389	389	154	136	831	830
$\alpha = 0.9$	Mean	131.99	137.62	134.54	148.54	174.92	195.11
	RMSE	152.99	165.89	150.33	177.69	250.78	274.92
	LB/UB	25/120	20/119	20/128	20/362	20/375	20/924
	Range	95	99	108	342	355	904

Table 6.5.B: Low Structural Change with ARFIMA(0,d,0)

ARFIMA(0,d,0) Coefficients	Parameter	True Change Point: 250		True Change Point: 500		True Change Point: 750	
		Non-CBB	1	Non-CBB	1	Non-CBB	1
$d = 0.1$	Mean	386.06	387.24	513.35	511.95	795.01	788.68
	RMSE	249.67	252.66	70.23	69.32	70.23	68.51
	LB/UB	205/921	199/921	432/543	453/534	716/917	709/914
	Range	716	722	111	81	201	205
$d = 0.3$	Mean	113.75	114.04	475.61	465.88	291.94	312.23
	RMSE	20.92	21.52	139.98	149.23	239.16	243.77
	LB/UB	85/138	90/139	114/560	108/554	24/568	20/587
	Range	53	49	446	446	544	567
$d = 0.45$	Mean	113.66	113.96	467.84	467.28	578.48	594.07
	RMSE	45.73	43.82	172.28	169.11	226.36	213.52
	LB/UB	88/124	86/124	96/579	99/579	98/716	99/715
	Range	36	38	483	480	618	616
$d = 0.7$	Mean	830.40	830.77	831.05	831.45	861.08	859.38
	RMSE	13.08	14.78	47.31	49.96	56.41	54.75
	LB/UB	812/849	808/848	808/852	807/851	815/967	815/966
	Range	37	40	44	44	152	151

Table 6.6.A: Large Structural Change with AR(1)

AR(1) Coefficients	Parameter	True Change Point: 250		True Change Point: 500		True Change Point: 750	
		Non-CBB	1	Non-CBB	1	Non-CBB	1
$\alpha = 0.0$	Mean	250.78	250.93	500.27	499.22	749.24	748.77
	RMSE	14.31	13.75	15.78	15.75	13.72	13.97
	LB/UB	226/272	226/271	474/524	472/523	723/768	724/769
	Range	46	45	50	51	45	45
$\alpha = 0.3$	Mean	250.81	250.64	502.35	501.19	750.93	751.16
	RMSE	14.76	14.28	15.32	15.89	13.93	13.67
	LB/UB	226/275	228/274	480/530	471/524	730/774	729/773
	Range	49	46	50	53	44	44
$\alpha = 0.6$	Mean	266.18	267.72	494.23	493.84	746.39	746.37
	RMSE	20.61	20.71	15.80	15.40	15.08	15.35
	LB/UB	229/297	232/299	466/517	466/516	723/772	720/771
	Range	68	67	51	50	49	51
$\alpha = 0.9$	Mean	150.83	151.47	413.75	413.39	677.61	674.71
	RMSE	99.37	100.13	65.76	66.41	154.25	152.62
	LB/UB	84/360	84/359	334/485	342/487	586/941	584/941
	Range	276	275	151	145	355	357

Table 6.6.B: Large Structural Change with ARFIMA(0,d,0)

ARFIMA(0,d,0) Coefficients	Parameter	True Change Point: 250		True Change Point: 500		True Change Point: 750	
		Non-CBB	1	Non-CBB	1	Non-CBB	1
$d = 0.1$	Mean	249.34	250.54	500.11	500.38	749.76	750.34
	RMSE	13.89	13.86	16.21	16.13	13.71	14.36
	LB/UB	228/274	229/274	473/525	473/525	728/772	729/774
	Range	46	45	52	52	44	45
$d = 0.3$	Mean	243.52	242.06	515.35	515.24	749.34	750.45
	RMSE	20.85	22.32	16.02	15.90	13.68	13.88
	LB/UB	218/268	215/269	487/539	487/539	725/769	728/773
	Range	50	54	52	52	44	45
$d = 0.45$	Mean	249.56	251.02	500.98	501.79	750.73	751.40
	RMSE	13.87	13.71	16.20	15.99	20.40	19.72
	LB/UB	224/269	230/274	476/528	471/524	723/785	724/780
	Range	45	44	52	53	62	56
$d = 0.7$	Mean	249.72	249.50	475.22	476.47	714.41	716.64
	RMSE	13.61	13.54	15.75	15.21	24.13	35.49
	LB/UB	227/270	226/269	444/497	453/502	690/737	689/739
	Range	43	43	53	49	47	50

In general, the simulation results indicate that selecting short block length (in this case 5 block length) provide a good result of constructing confidence interval for almost all cases. In order to obtain statistical evidence, we extend our simulation by assigning the block length of 0 and 1. The zero block length means that we did not extend our generated time series data with first several data as in the CBB method. In other word, the zero block length is nothing but usual resample method and for this reason we call the zero block length with non-CBB block length. While 1 block length is just the CBB method as in the previous case. We provide all the simulations result under non-CBB and 1 block length in Table 6.5.A to 6.6.B for Model A.1 to B.2 respectively.

Under Model A.1 and A.2, using non-CBB and 1 block length produce a good result except when the time dependency is high, i.e. $\alpha = 0.9$ and $d = 0.7$. In addition, as the true change point is assigned in T/2 the CBB method can produce better confidence interval although the time dependency is getting higher. The similar thing is also resulted under Model B.1 and B.2 where the confidence interval are well-constructed under all cases except when e. $\alpha = 0.9$ and $d = 0.7$. We also provide histogram of the estimated change point under non-CBB and 1 block length in Appendix-C, i.e. Figure C.1.1 to C.2.3. By examining non-CBB and 1 block length, we found that the constructions of the confidence intervals are almost similar in all cases.

6.5 Conclusions

Detecting and constructing single change point may be affected by selecting different block length when SSR together with CBB are applied. Therefore we study the effect of using different length of block length in several cases. First we generate series of data with small and large structural change. The data generating process is also followed by different error process which follows AR(1) and ARFIMA(0,d,0). The change of the parameter of small structural change is 0.5 while for large structural change the change of parameter is 2. The true change point is set in 3 different locations, i.e. T/4, T/2, and 3T/4 or in the 250th, 500th, and 750th. In addition, the study also concern to the change of the coefficient of AR(1) and ARFIMA(0,d,0) and in this case the coefficient of AR(1) is set as 0, 0.3, 0.6, and 0.9 while 0.1, 0.3, 0.45, and 0.7 for the coefficient of ARFIMA(0,d,0).

In Model A.1 and A.2, SSR method works well only when less time dependency on the error term. The estimated change point close to its true change point when the coefficient of AR(1) is less than 0.5. But only when the true change point is located in the middle of data (T/2), the SSR method detect the true change point regardless the coefficient of AR(1). This condition is quite similar for the case when the error process follows ARFIMA(0,d,0). The SSR method also works well when the coefficient of ARFIMA(0,d,0) is small enough, i.e. 0.1, because when the coefficient increased, the result of estimated change point become less accurate except for the case when the true change points are in the middle. Regarding to the construction of the confidence interval, our simulation results show that using short block length (i.e. 5) produce better result.

Under Model B where the change of structural parameter is large, the SSR method works well to estimate the true change point especially when the coefficient of AR(1) is 0.1, 0.3, and 0.6, while 0.1 and 0.3 for the coefficient of ARFIMA(0,d,0). The SSR method works well to detect the true change point under the case when the true change point is in the middle. To construct better confidence interval, the short block length is appropriate to be selected under Model B.1 and B.2.

In general, our simulation result suggests that the block length is very sensitive in constructing confidence interval, especially when CBB method is applied. In addition, time dependent in the error term must be considered when choosing the block length. In our simulation study, we obtain some evidences that the short block length should be chosen when the series is less time dependent as well as for strong time dependency data

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Appendix – A
Appendix – B
Appendix – C

Estimation Results

Appendix – A

Regression Results of Frankel-Wei's Model under *de jure* floating Regime as estimated in **Chapter 2**.

Table A: Regression Results (1997 – 2000) – Under *de jure* Floating Regime

Period	Constant	Coefficient				Adj. R^2
		USD	JPY	DEM/EUR[1)]	EMP	
1997.9 - 1998.12	-0.012 (0.022)	0.079 (0.974)	-0.206 (0.509)	0.196 (2.402)	0.981*** (0.085)	0.904
1999.1 - 2000.12	-0.008 (0.006)	0.334 (0.302)	-0.102 (0.215)	-0.518 (0.854)	0.772*** (0.047)	0.903

Source: IFS-IMF; Author's calculation; 1) DEM is used for 1997.9 – 1998.12 and EUR for 1999.1 – 2000.12; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Table B: Standard Deviation of Percentage Change of Rupiah and Foreign Reserve during Crisis Period

Year	σ_{USD}	σ_{JPY}	σ_{DEM}	σ_{FORES}	Index
1997	7.87	8.59	9.16	4.92	0.62
1998	31.25	30.31	30.40	6.60	0.83
1999	10.22	11.09	10.52	2.42	0.81

Source: IFS-IMF; Author's calculation.

Appendix – B

Regression Results of Frankel-Wei's Model for Asia-5 Countries Post-Asian Crisis as estimated in Chapter 3.

Table A.1: Regression Result of Exchange Rate Movement for Indonesia: Post Crisis

Period	Const.	Coefficient				Adj. R^2	DW Stat.
		USD	JPY	EUR	EMP		
2000.1-2001.12	-0.006 (0.006)	0.205 (0.233)	-0.035 (0.190)	-0.117 (0.615)	0.744*** (0.070)	0.851	2.268
2002.1-2003.12	-0.004 (0.004)	0.350** (0.160)	0.086 (0.198)	0.133 (0.383)	0.727*** (0.143)	0.771	2.167
2004.1-2005.12	-0.003 (0.003)	0.831*** (0.167)	0.014 (0.143)	0.083 (0.363)	0.390*** (0.064)	0.863	2.275
2006.1-2007.12	-0.007 (0.006)	0.759** (0.335)	0.013 (0.288)	1.042 (1.098)	0.244** (0.100)	0.613	2.585
2008.1-2009.12	-0.005 (0.003)	0.432*** (0.103)	0.044 (0.099)	-0.523*** (0.178)	0.693*** (0.062)	0.884	1.944
2010.1-2011.12	-0.003 (0.002)	0.812*** (0.092)	-0.080 (0.080)	-0.023 (0.070)	0.204*** (0.050)	0.928	2.295
2012.1-2013.12	-0.008 (0.005)	0.805*** (0.275)	-0.021 (0.161)	0.484 (0.540)	0.306** (0.108)	0.579	1.410
2000.1-2013.12	-0.005*** (0.002)	0.499*** (0.070)	0.041 (0.061)	-0.009 (0.105)	0.535*** (0.030)	0.744	1.922

Data Source: IFS-IMF. Author's calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Table A.2: Regression Result of Exchange Rate Movement for Malaysia: Post Crisis

Period	Const.	Coefficient				Adj. R^2	DW Stat.
		USD	JPY	EUR	EMP		
2000.1-2001.12	0.000 (0.000)	1.000*** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	1.000	2.159
2002.1-2003.12	0.000 (0.000)	1.000*** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	1.000	2.327
2004.1-2005.12	-0.001 (0.001)	0.986*** (0.036)	-0.018 (0.033)	0.019 (0.083)	0.035 (0.020)	0.987	2.589
2006.1-2007.12	-0.004 (0.002)	0.499*** (0.141)	0.064 (0.117)	0.981** (0.405)	0.275*** (0.071)	0.878	1.630
2008.1-2009.12	-0.002 (0.002)	0.524*** (0.088)	0.058 (0.076)	0.166 (0.132)	0.139** (0.056)	0.874	2.373
2010.1-2011.12	0.000 (0.004)	0.715*** (0.149)	-0.182 (0.130)	-0.015 (0.122)	0.189* (0.104)	0.740	1.330
2012.1-2013.12	0.000 (0.002)	0.113 (0.113)	0.060 (0.067)	-0.198 (0.236)	0.663*** (0.066)	0.856	3.109
2005.7-2013.12	-0.001 (0.001)	0.561*** (0.057)	-0.030 (0.046)	0.012 (0.072)	0.245*** (0.035)	0.779	1.700

Data Source: IFS-IMF. Author’s calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Appendix - B

Table A.3: Regression Result of Exchange Rate Movement for Philippines: Post Crisis

Period	Const.	Coefficient				Adj. R^2	DW Stat.
		USD	JPY	EUR	EMP		
2000.1-2001.12	-0.005	0.327	0.103	-0.007	0.371***	0.620	2.724
	(0.005)	(0.208)	(0.158)	(0.534)	(0.085)		
2002.1-2003.12	-0.005**	0.661***	-0.030	0.175	0.173**	0.887	1.748
	(0.002)	(0.105)	(0.115)	(0.209)	(0.062)		
2004.1-2005.12	0.000	0.984***	-0.100	-0.285	0.113	0.856	1.241
	(0.002)	(0.162)	(0.113)	(0.292)	(0.080)		
2006.1-2007.12	0.000	0.787***	-0.192	0.230	0.243**	0.638	2.144
	(0.006)	(0.273)	(0.232)	(0.796)	(0.107)		
2008.1-2009.12	-0.007**	0.465***	-0.152*	-0.106	0.608***	0.922	2.599
	(0.003)	(0.092)	(0.082)	(0.138)	(0.085)		
2010.1-2011.12	-0.002	0.619***	-0.015	0.114	0.170*	0.878	1.945
	(0.003)	(0.120)	(0.106)	(0.096)	(0.085)		
2012.1-2013.12	-0.004	0.493***	-0.093	-0.357	0.477***	0.784	1.734
	(0.002)	(0.138)	(0.087)	(0.287)	(0.083)		
2000.1-2013.12	-0.004***	0.563***	-0.042	0.085	0.335***	0.809	2.225
	(0.001)	(0.050)	(0.042)	(0.071)	(0.029)		

Data Source: IFS-IMF. Author’s calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Table A.4: Regression Result of Exchange Rate Movement for Thailand: Post Crisis

Period	Const.	Coefficient				Adj. R^2	DW Stat.
		USD	JPY	EUR	EMP		
2000.1-2001.12	-0.002	0.478***	-0.077	0.139	0.616***	0.840	1.255
	(0.003)	(0.111)	(0.114)	(0.314)	(0.120)		
2002.1-2003.12	0.000	0.567***	0.221**	0.067	0.187**	0.913	1.721
	(0.002)	(0.084)	(0.126)	(0.181)	(0.077)		
2004.1-2005.12	-0.006***	0.638***	0.005	-0.330	0.580***	0.913	2.030
	(0.002)	(0.076)	(0.071)	(0.197)	(0.081)		
2006.1-2007.12	-0.004	0.547**	-0.034	0.208	0.346**	0.650	2.083
	(0.004)	(0.204)	(0.179)	(0.659)	(0.132)		
2008.1-2009.12	-0.006**	0.623***	0.036	0.110	0.318***	0.937	1.868
	(0.002)	(0.069)	(0.069)	(0.105)	(0.064)		
2010.1-2011.12	-0.004**	0.693***	-0.061	-0.182***	0.481***	0.952	1.922
	(0.002)	(0.076)	(0.068)	(0.060)	(0.057)		
2012.1-2013.12	0.000	0.687***	-0.068	-0.260*	0.619***	0.948	1.750
	(0.001)	(0.071)	(0.043)	(0.149)	(0.039)		
2000.1-2013.12	-0.003***	0.618***	-0.026	-0.041	0.424***	0.884	1.827
	(0.001)	(0.033)	(0.031)	(0.050)	(0.028)		

Data Source: IFS-IMF. Author's calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Table A.5: Regression Result of Exchange Rate Movement for South Korea: Post Crisis

Period	Const.	Coefficient				Adj. R^2	DW Stat.
		USD	JPY	EUR	EMP		
2000.1-2001.12	-0.007**	0.479***	0.209**	0.290	0.549***	0.946	1.481
	(0.003)	(0.097)	(0.086)	(0.241)	(0.079)		
2002.1-2003.12	-0.011***	0.311**	0.046	0.207	0.717***	0.882	1.230
	(0.003)	(0.111)	(0.147)	(0.242)	(0.099)		
2004.1-2005.12	-0.002	0.441***	0.193***	-0.291*	0.480***	0.932	2.265
	(0.002)	(0.061)	(0.058)	(0.144)	(0.049)		
2006.1-2007.12	-0.006***	0.277***	0.070	0.356	0.671***	0.952	1.866
	(0.001)	(0.076)	(0.067)	(0.270)	(0.056)		
2008.1-2009.12	-0.005	0.292	0.094	-0.405	0.748***	0.769	1.916
	(0.005)	(0.175)	(0.162)	(0.265)	(0.086)		
2010.1-2011.12	-0.003	0.425***	-0.108	-0.035	0.671***	0.917	2.128
	(0.002)	(0.078)	(0.072)	(0.076)	(0.070)		
2012.1-2013.12	-0.003**	0.356***	-0.023	-0.269**	0.765***	0.933	1.878
	(0.001)	(0.057)	(0.035)	(0.123)	(0.052)		
2000.1-2013.12	-0.006***	0.336***	0.052	-0.169***	0.708***	0.859	1.836
	(0.001)	(0.042)	(0.036)	(0.064)	(0.026)		

Data Source: IFS-IMF. Author's calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Table B.1: Response of the Indonesian rupiah against the U.S dollar

Period	C	Coefficient		Adj. R^2
		USD+	USD-	
1991.1 - 1992.12	-0.003***	0.974***	-0.982***	0.999
	(0.000)	(0.010)	(0.014)	
1993.1 - 1994.12	-0.003***	1.012***	-1.003***	0.996
	(0.001)	(0.024)	(0.028)	
1995.1 - 1996.12	-0.004***	1.056***	-0.987***	0.989
	(0.001)	(0.044)	(0.038)	
1997.1 - 1999.12 (Crisis Period)	-0.077	2.222	1.875	-0.039
	(0.073)	(2.729)	(3.034)	
2000.1 - 2001.12	-0.048*	2.057*	0.551	0.085
	(0.024)	(1.046)	(0.830)	
2002.1 - 2003.12	0.004	0.737	-0.677***	0.404
	(0.007)	(0.468)	(0.224)	
2004.1 - 2005.12	-0.009	1.281***	-1.063***	0.639
	(0.007)	(0.345)	(0.317)	
2006.1 - 2007.12	0.002	1.069*	-1.030***	0.423
	(0.008)	(0.602)	(0.391)	
2008.1 - 2009.12	0.002	0.095	-0.393	0.002
	(0.014)	(0.421)	(0.332)	
2010.1 - 2011.12	0.005	0.629***	-0.915***	0.884
	(0.004)	(0.103)	(0.126)	
2012.1 - 2013.12	-0.008	0.740**	-1.290**	0.441
	(0.007)	(0.339)	(0.507)	
1991.1 - 1996.12 (Pre-Crisis)	-0.003***	0.994***	-0.993***	0.995
	(0.000)	(0.014)	(0.017)	
2000.1 - 2013.12 (Post-Crisis)	-0.007*	0.744***	-0.526***	0.240
	(0.004)	(0.166)	(0.144)	

Data Source: IFS-IMF. Author’s calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Table B.2: Response of the Malaysian ringgit against the U.S dollar

Period	C	Coefficient		Adj. R^2
		USD+	USD-	
1991.1 - 1992.12	0.001	0.939***	-0.915***	0.911
	(0.005)	(0.102)	(0.153)	
1993.1 - 1994.12	0.001	0.894***	-0.919***	0.675
	(0.006)	(0.237)	(0.278)	
1995.1 - 1996.12	0.002	0.894***	-1.002***	0.922
	(0.003)	(0.113)	(0.099)	
1997.1 - 1999.12	-0.016	1.106	-0.663	0.100
	(0.023)	(0.859)	(0.955)	
2000.1 - 2001.12	0.000	1.000***	-1.000***	1.000
	(0.000)	(0.000)	(0.000)	
2002.1 - 2003.12	0.000	1.000***	-1.000***	1.000
	(0.000)	(0.000)	(0.000)	
2004.1 - 2005.12	0.001	0.982***	-1.030***	0.986
	(0.001)	(0.049)	(0.045)	
2006.1 - 2007.12	0.004	1.053***	-0.880***	0.727
	(0.004)	(0.297)	(0.193)	
2008.1 - 2009.12	0.000	0.590***	-0.731***	0.817
	(0.005)	(0.140)	(0.110)	
2010.1 - 2011.12	0.010*	0.345**	-0.872***	0.737
	(0.005)	(0.131)	(0.160)	
2012.1 - 2013.12	-0.004	0.528*	-0.370	0.153
	(0.007)	(0.304)	(0.455)	
1991.1 - 1996.12	0.001	0.924***	-0.945***	0.870
	(0.003)	(0.073)	(0.090)	
2000.1 - 2013.12	0.003**	0.620***	-0.892***	0.791
	(0.001)	(0.061)	(0.052)	

Data Source: IFS-IMF. Author's calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Table B.3: Response of the Philippines peso against the U.S dollar

Period	C	Coefficient USD+	Coefficient USD-	Adj. R^2
1991.1 - 1992.12	0.001	1.028***	-0.805**	0.736
	(0.010)	(0.197)	(0.296)	
1993.1 - 1994.12	0.006	1.253***	-1.497***	0.733
	(0.008)	(0.312)	(0.366)	
1995.1 - 1996.12	0.000	0.948***	-1.182***	0.930
	(0.003)	(0.120)	(0.106)	
1997.1 - 1999.12	-0.020	1.352*	-0.761	0.248
	(0.018)	(0.680)	(0.756)	
2000.1 - 2001.12	-0.008	0.627	-0.760*	0.283
	(0.012)	(0.507)	(0.402)	
2002.1 - 2003.12	-0.004	0.647***	-0.862***	0.854
	(0.003)	(0.196)	(0.094)	
2004.1 - 2005.12	0.003	0.954***	-1.032***	0.840
	(0.004)	(0.174)	(0.160)	
2006.1 - 2007.12	0.014**	0.649	-1.158***	0.575
	(0.006)	(0.429)	(0.279)	
2008.1 - 2009.12	-0.009	0.958***	-0.713***	0.716
	(0.007)	(0.225)	(0.177)	
2010.1 - 2011.12	0.004	0.662***	-0.838***	0.844
	(0.005)	(0.119)	(0.145)	
2012.1 - 2013.12	-0.005	0.853***	-0.414	0.440
	(0.005)	(0.251)	(0.375)	
1991.1 - 1996.12	0.001	1.054***	-1.078***	0.772
	(0.004)	(0.116)	(0.144)	
2000.1 - 2013.12	0.000	0.732***	-0.852***	0.646
	(0.002)	(0.090)	(0.077)	

Data Source: IFS-IMF. Author’s calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Table B.4: Response of the Thailand bath against the U.S dollar

Period	C	Coefficient		Adj. R^2
		USD+	USD-	
1991.1 - 1992.12	0.000	0.887***	-0.888***	0.997
	(0.001)	(0.017)	(0.026)	
1993.1 - 1994.12	0.000	0.925***	-0.883***	0.987
	(0.001)	(0.040)	(0.047)	
1995.1 - 1996.12	-0.001	0.891***	-0.910***	0.988
	(0.001)	(0.040)	(0.035)	
1997.1 - 1999.12	0.000	0.397	-1.111	0.013
	(0.029)	(1.100)	(1.223)	
2000.1 - 2001.12	-0.006	0.734**	-0.764**	0.515
	(0.008)	(0.350)	(0.278)	
2002.1 - 2003.12	-0.002	1.139***	-0.663***	0.851
	(0.003)	(0.195)	(0.094)	
2004.1 - 2005.12	-0.002	0.776***	-0.633***	0.675
	(0.004)	(0.192)	(0.177)	
2006.1 - 2007.12	0.007	0.728*	-0.756***	0.528
	(0.005)	(0.355)	(0.231)	
2008.1 - 2009.12	-0.001	0.819***	-0.776***	0.834
	(0.005)	(0.156)	(0.123)	
2010.1 - 2011.12	0.003	0.690***	-0.781***	0.792
	(0.005)	(0.139)	(0.170)	
2012.1 - 2013.12	-0.007	0.870***	-0.293	0.347
	(0.006)	(0.288)	(0.430)	
1991.1 - 1996.12	0.000	0.894***	-0.895***	0.993
	(0.001)	(0.015)	(0.019)	
2000.1 - 2013.12	0.000	0.756***	-0.729***	0.700
	(0.002)	(0.074)	(0.064)	

Data Source: IFS-IMF. Author's calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Table B.5: Response of the South Korean won against the U.S dollar

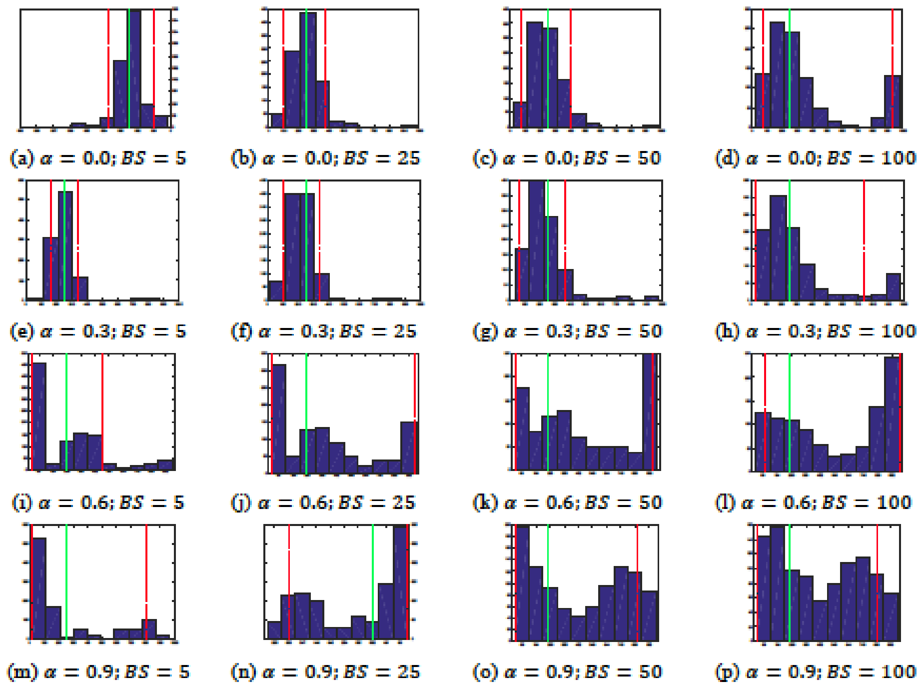
Period	C	Coefficient		Adj. R^2
		USD+	USD-	
1991.1 - 1992.12	-0.006***	1.065***	-0.970***	0.991
	(0.002)	(0.034)	(0.051)	
1993.1 - 1994.12	-0.001	1.007***	-0.954***	0.983
	(0.001)	(0.050)	(0.058)	
1995.1 - 1996.12	-0.004	0.901***	-0.823***	0.901
	(0.003)	(0.115)	(0.102)	
1997.1 - 1999.12	-0.025	1.847	-0.585	0.096
	(0.033)	(1.244)	(1.383)	
2000.1 - 2001.12	0.004	0.733*	-1.531***	0.689
	(0.009)	(0.398)	(0.316)	
2002.1 - 2003.12	-0.007	1.357***	-0.524***	0.577
	(0.006)	(0.380)	(0.182)	
2004.1 - 2005.12	0.005	0.687***	-0.357	0.430
	(0.005)	(0.230)	(0.211)	
2006.1 - 2007.12	-0.001	0.895**	-0.579**	0.434
	(0.005)	(0.395)	(0.256)	
2008.1 - 2009.12	-0.014	0.058	0.012	-0.095
	(0.017)	(0.529)	(0.417)	
2010.1 - 2011.12	0.013*	-0.039	-0.853***	0.418
	(0.007)	(0.181)	(0.222)	
2012.1 - 2013.12	0.003	0.353	-0.397	0.161
	(0.005)	(0.233)	(0.348)	
1991.1 - 1996.12	-0.004***	1.012***	-0.912***	0.964
	(0.001)	(0.038)	(0.047)	
2000.1 - 2013.12	0.002	0.284**	-0.595***	0.203
	(0.003)	(0.137)	(0.119)	

Data Source: IFS-IMF. Author’s calculation; ***, **, * indicate significant at α=1%, 5% and 10% respectively; (…) Standard Error

Appendix - C

The Histogram of the estimated single change point as simulated in **Chapter 6**.

Figure A.1.1: Model A.1 TCP 250



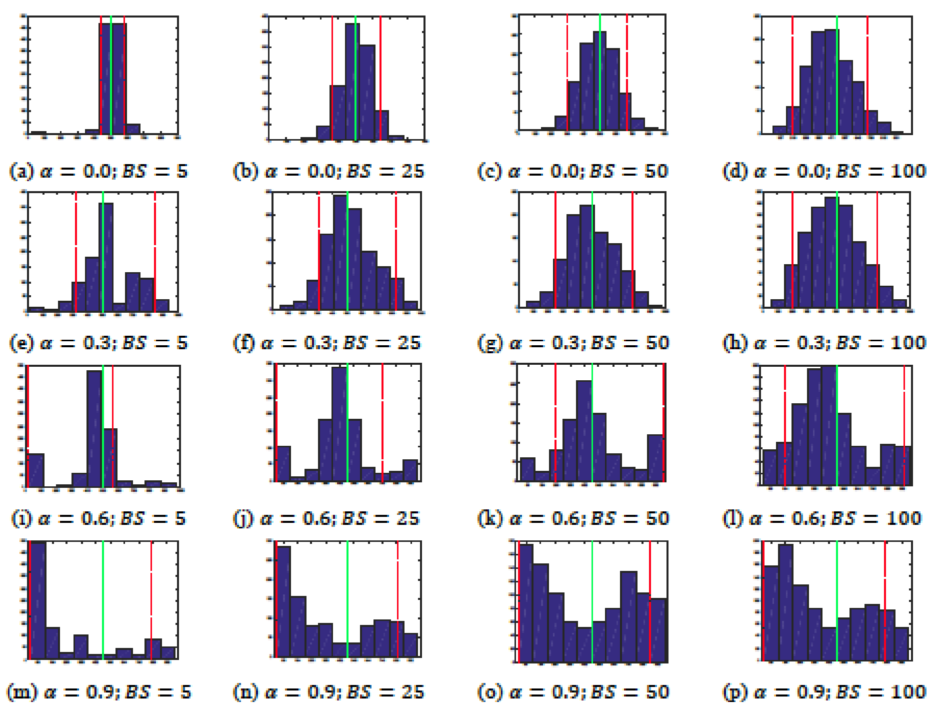
(a) $\alpha = 0.0; BS = 5$ (b) $\alpha = 0.0; BS = 25$ (c) $\alpha = 0.0; BS = 50$ (d) $\alpha = 0.0; BS = 100$

(e) $\alpha = 0.3; BS = 5$ (f) $\alpha = 0.3; BS = 25$ (g) $\alpha = 0.3; BS = 50$ (h) $\alpha = 0.3; BS = 100$

(i) $\alpha = 0.6; BS = 5$ (j) $\alpha = 0.6; BS = 25$ (k) $\alpha = 0.6; BS = 50$ (l) $\alpha = 0.6; BS = 100$

(m) $\alpha = 0.9; BS = 5$ (n) $\alpha = 0.9; BS = 25$ (o) $\alpha = 0.9; BS = 50$ (p) $\alpha = 0.9; BS = 100$

Figure A.1.2: Model A.1 TCP 500



(a) $\alpha = 0.0; BS = 5$ (b) $\alpha = 0.0; BS = 25$ (c) $\alpha = 0.0; BS = 50$ (d) $\alpha = 0.0; BS = 100$

(e) $\alpha = 0.3; BS = 5$ (f) $\alpha = 0.3; BS = 25$ (g) $\alpha = 0.3; BS = 50$ (h) $\alpha = 0.3; BS = 100$

(i) $\alpha = 0.6; BS = 5$ (j) $\alpha = 0.6; BS = 25$ (k) $\alpha = 0.6; BS = 50$ (l) $\alpha = 0.6; BS = 100$

(m) $\alpha = 0.9; BS = 5$ (n) $\alpha = 0.9; BS = 25$ (o) $\alpha = 0.9; BS = 50$ (p) $\alpha = 0.9; BS = 100$

Figure A.1.3: Model A.1 TCP 750

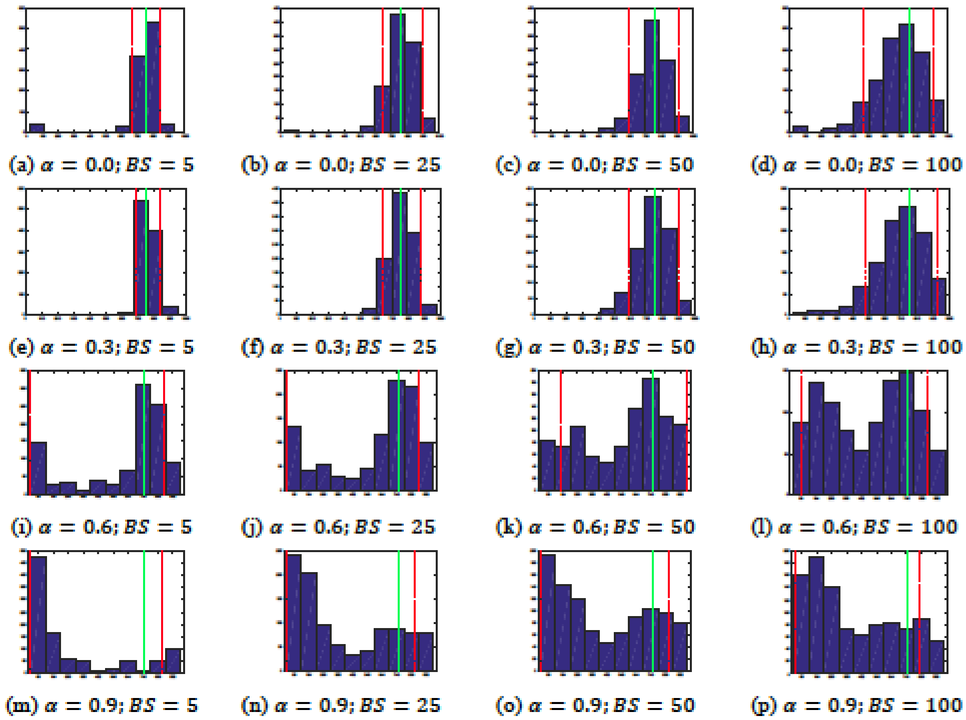


Figure A.2.1: Model A.2 TCP 250

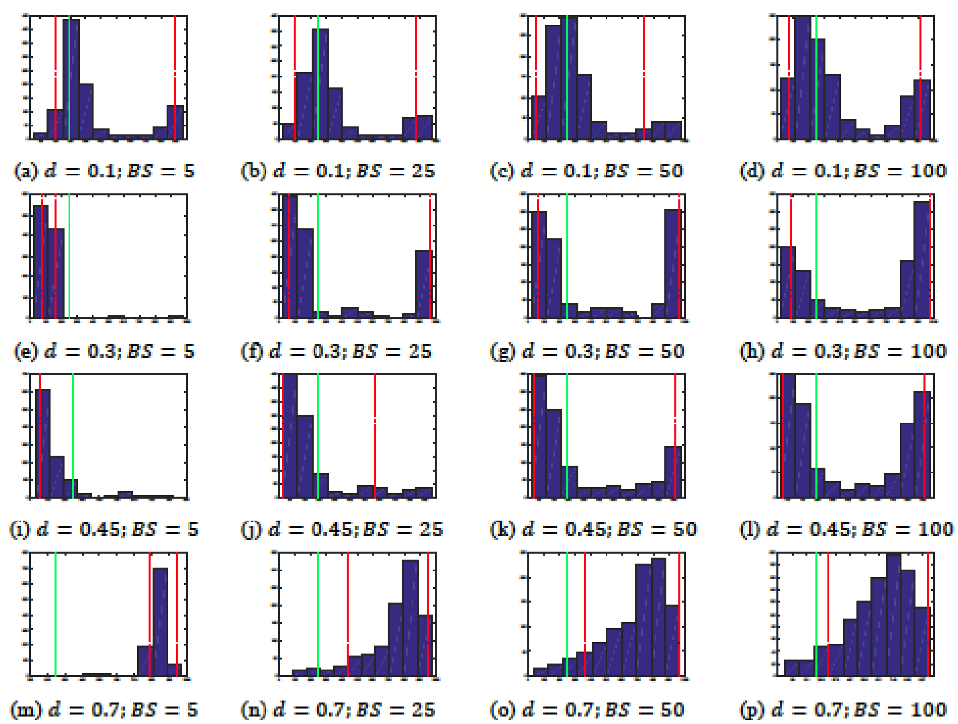
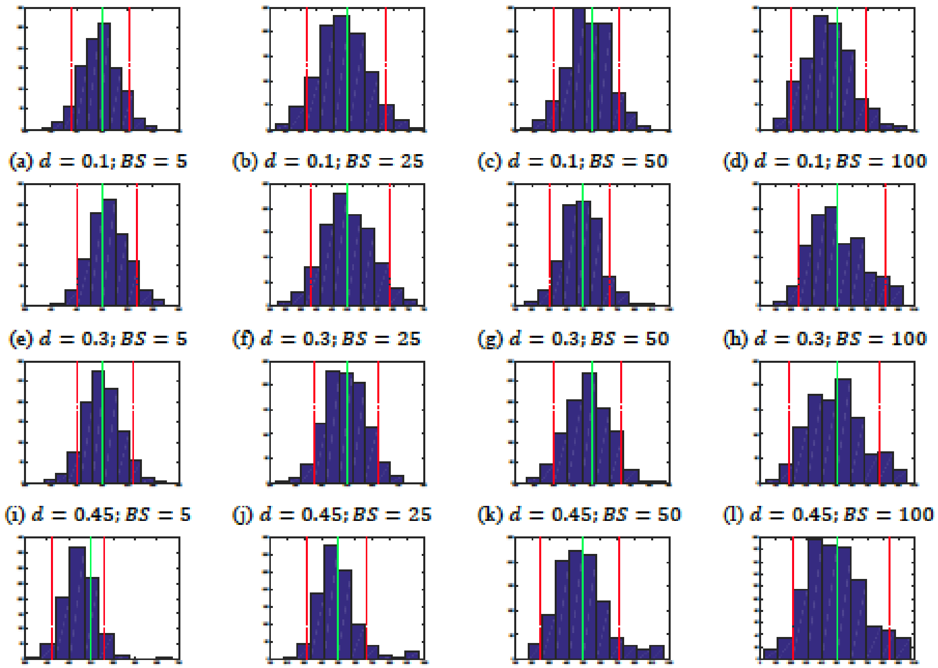


Figure A.2.2: Model A.2 TCP 500



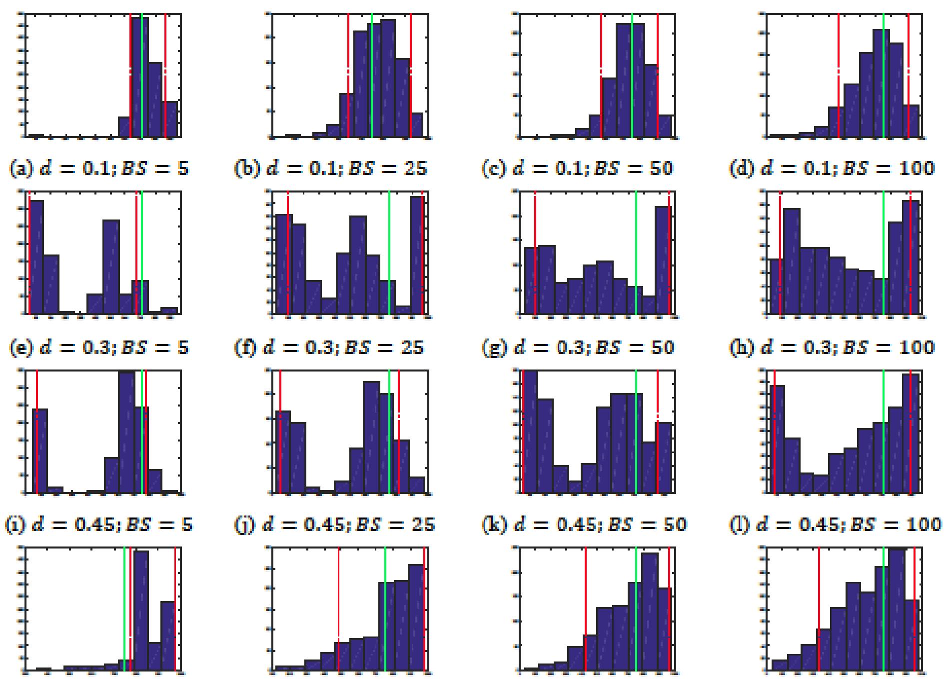
(a) $d = 0.1; BS = 5$ (b) $d = 0.1; BS = 25$ (c) $d = 0.1; BS = 50$ (d) $d = 0.1; BS = 100$

(e) $d = 0.3; BS = 5$ (f) $d = 0.3; BS = 25$ (g) $d = 0.3; BS = 50$ (h) $d = 0.3; BS = 100$

(i) $d = 0.45; BS = 5$ (j) $d = 0.45; BS = 25$ (k) $d = 0.45; BS = 50$ (l) $d = 0.45; BS = 100$

(m) $d = 0.7; BS = 5$ (n) $d = 0.7; BS = 25$ (o) $d = 0.7; BS = 50$ (p) $d = 0.7; BS = 100$

Figure A.2.3: Model A.2 TCP 750



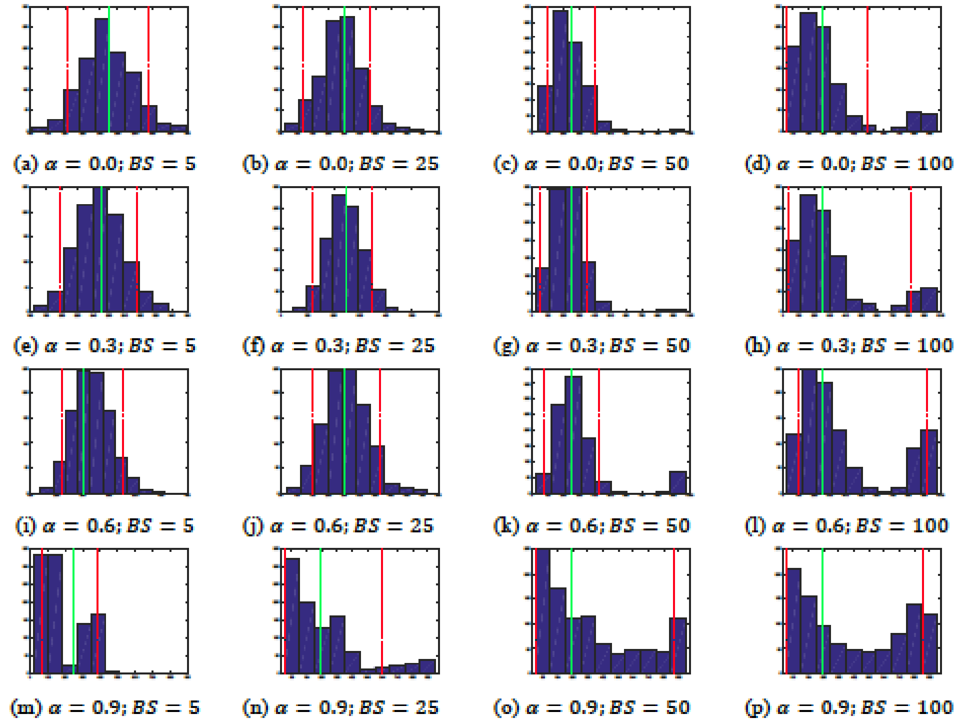
(a) $d = 0.1; BS = 5$ (b) $d = 0.1; BS = 25$ (c) $d = 0.1; BS = 50$ (d) $d = 0.1; BS = 100$

(e) $d = 0.3; BS = 5$ (f) $d = 0.3; BS = 25$ (g) $d = 0.3; BS = 50$ (h) $d = 0.3; BS = 100$

(i) $d = 0.45; BS = 5$ (j) $d = 0.45; BS = 25$ (k) $d = 0.45; BS = 50$ (l) $d = 0.45; BS = 100$

(m) $d = 0.7; BS = 5$ (n) $d = 0.7; BS = 25$ (o) $d = 0.7; BS = 50$ (p) $d = 0.7; BS = 100$

Figure B.1.1: Model B.1 TCP 250



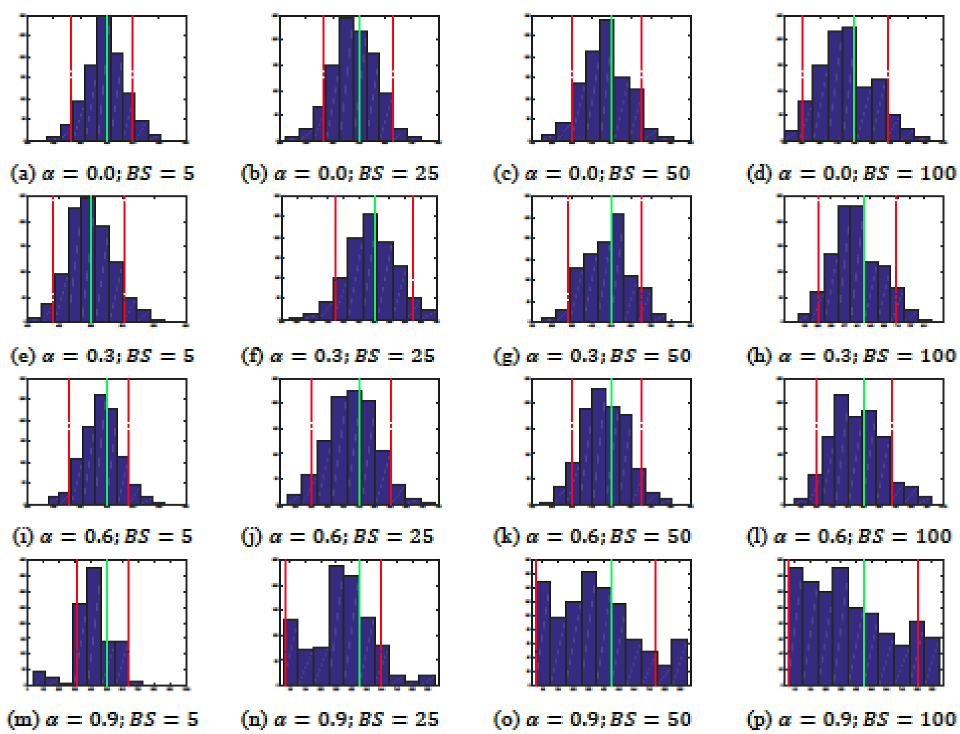
(a) $\alpha = 0.0; BS = 5$ (b) $\alpha = 0.0; BS = 25$ (c) $\alpha = 0.0; BS = 50$ (d) $\alpha = 0.0; BS = 100$

(e) $\alpha = 0.3; BS = 5$ (f) $\alpha = 0.3; BS = 25$ (g) $\alpha = 0.3; BS = 50$ (h) $\alpha = 0.3; BS = 100$

(i) $\alpha = 0.6; BS = 5$ (j) $\alpha = 0.6; BS = 25$ (k) $\alpha = 0.6; BS = 50$ (l) $\alpha = 0.6; BS = 100$

(m) $\alpha = 0.9; BS = 5$ (n) $\alpha = 0.9; BS = 25$ (o) $\alpha = 0.9; BS = 50$ (p) $\alpha = 0.9; BS = 100$

Figure B.1.2: Model B.1 TCP 500



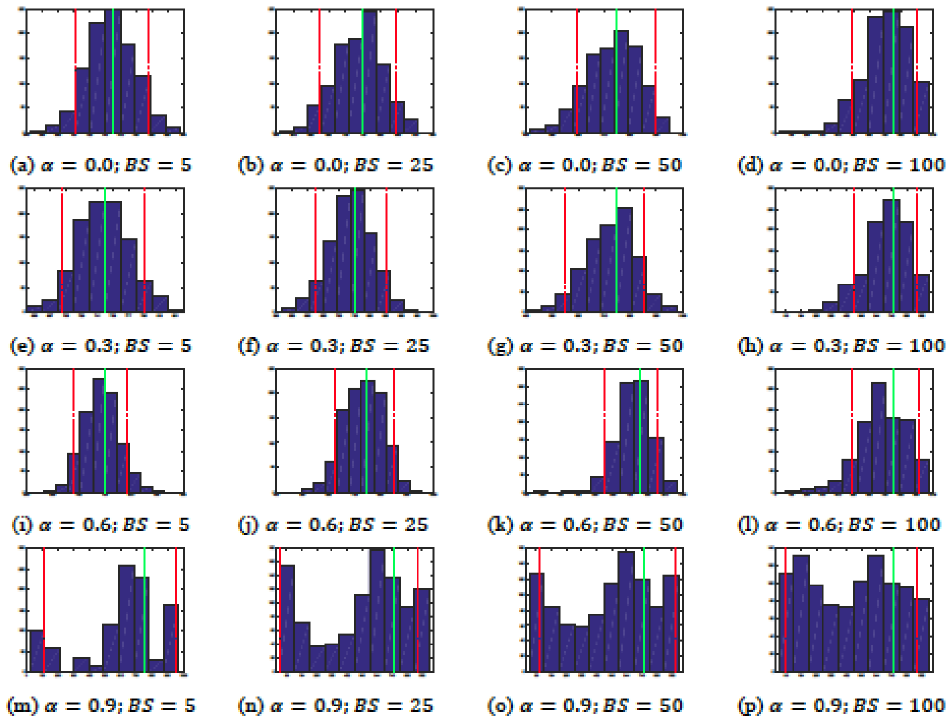
(a) $\alpha = 0.0; BS = 5$ (b) $\alpha = 0.0; BS = 25$ (c) $\alpha = 0.0; BS = 50$ (d) $\alpha = 0.0; BS = 100$

(e) $\alpha = 0.3; BS = 5$ (f) $\alpha = 0.3; BS = 25$ (g) $\alpha = 0.3; BS = 50$ (h) $\alpha = 0.3; BS = 100$

(i) $\alpha = 0.6; BS = 5$ (j) $\alpha = 0.6; BS = 25$ (k) $\alpha = 0.6; BS = 50$ (l) $\alpha = 0.6; BS = 100$

(m) $\alpha = 0.9; BS = 5$ (n) $\alpha = 0.9; BS = 25$ (o) $\alpha = 0.9; BS = 50$ (p) $\alpha = 0.9; BS = 100$

Figure B.1.3: Model B.1 TCP 750



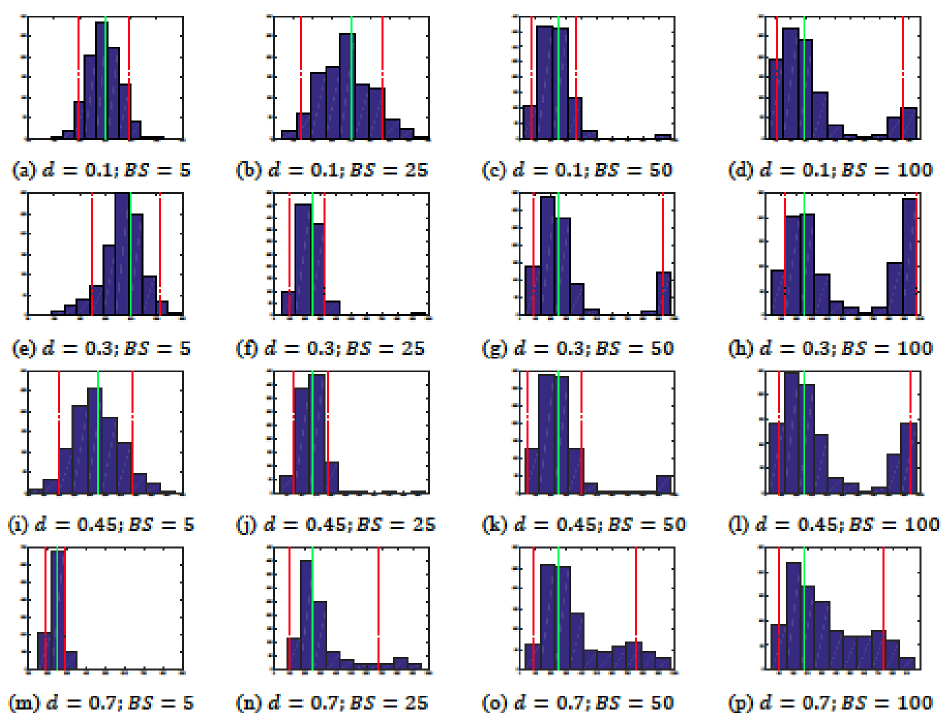
(a) $\alpha = 0.0; BS = 5$ (b) $\alpha = 0.0; BS = 25$ (c) $\alpha = 0.0; BS = 50$ (d) $\alpha = 0.0; BS = 100$

(e) $\alpha = 0.3; BS = 5$ (f) $\alpha = 0.3; BS = 25$ (g) $\alpha = 0.3; BS = 50$ (h) $\alpha = 0.3; BS = 100$

(i) $\alpha = 0.6; BS = 5$ (j) $\alpha = 0.6; BS = 25$ (k) $\alpha = 0.6; BS = 50$ (l) $\alpha = 0.6; BS = 100$

(m) $\alpha = 0.9; BS = 5$ (n) $\alpha = 0.9; BS = 25$ (o) $\alpha = 0.9; BS = 50$ (p) $\alpha = 0.9; BS = 100$

Figure B.2.1: Model B.2 TCP 250



(a) $d = 0.1; BS = 5$ (b) $d = 0.1; BS = 25$ (c) $d = 0.1; BS = 50$ (d) $d = 0.1; BS = 100$

(e) $d = 0.3; BS = 5$ (f) $d = 0.3; BS = 25$ (g) $d = 0.3; BS = 50$ (h) $d = 0.3; BS = 100$

(i) $d = 0.45; BS = 5$ (j) $d = 0.45; BS = 25$ (k) $d = 0.45; BS = 50$ (l) $d = 0.45; BS = 100$

(m) $d = 0.7; BS = 5$ (n) $d = 0.7; BS = 25$ (o) $d = 0.7; BS = 50$ (p) $d = 0.7; BS = 100$

Figure B.2.2: Model B.2 TCP 500

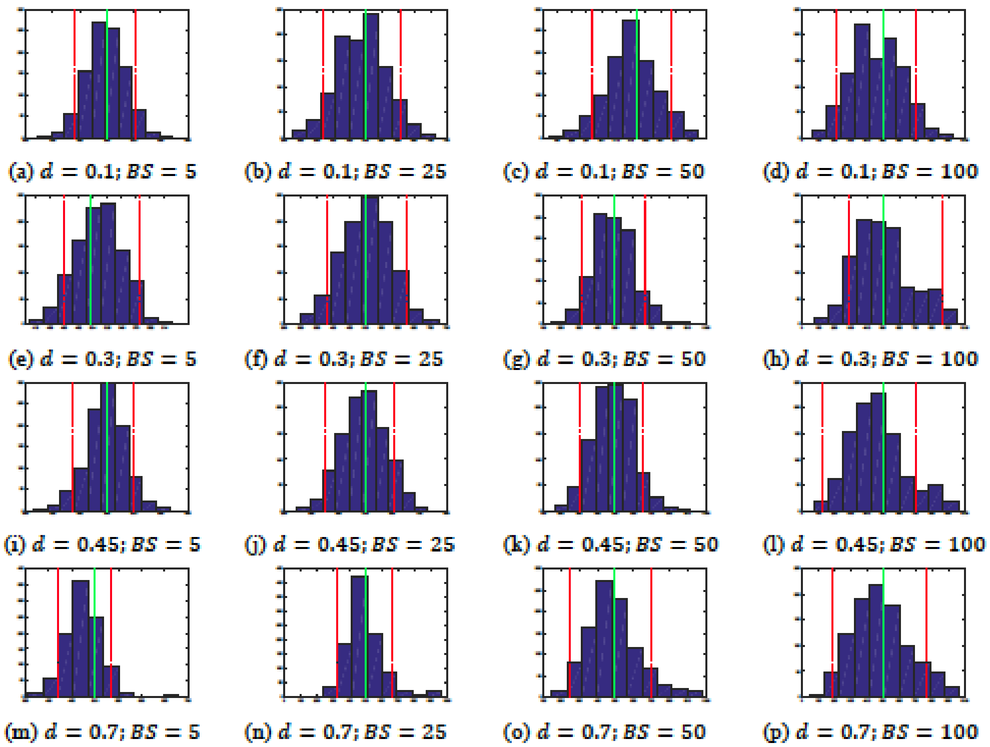


Figure B.2.3: Model B.2 TCP 750

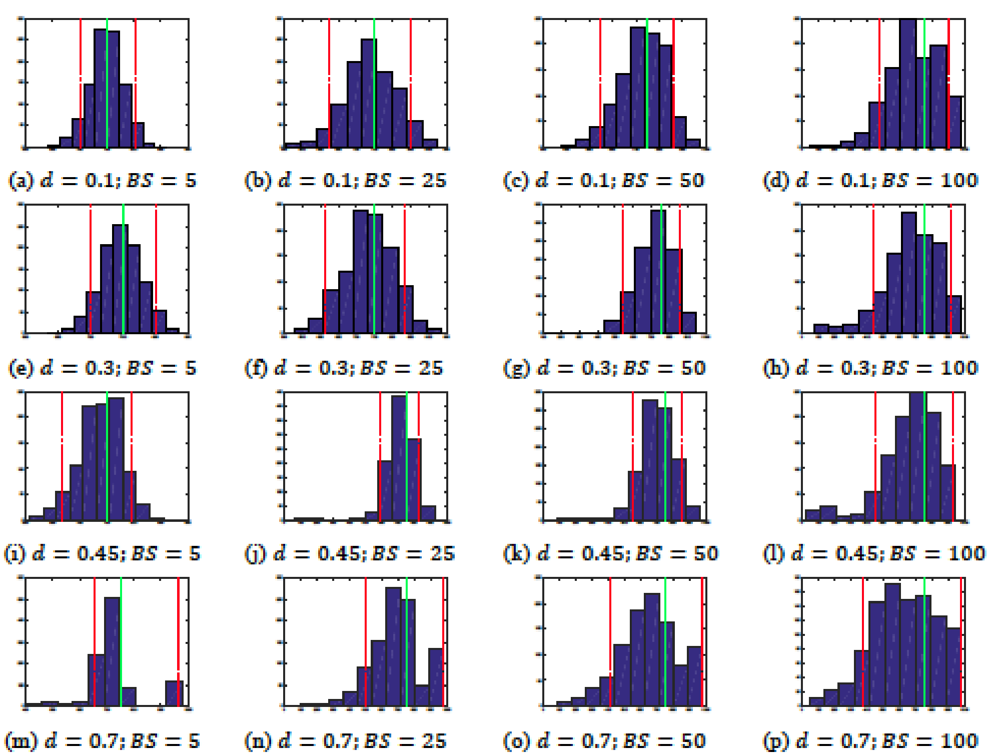


Figure C.1.1: Non-CBB and CBB-BS1 under Model A with TCP 250

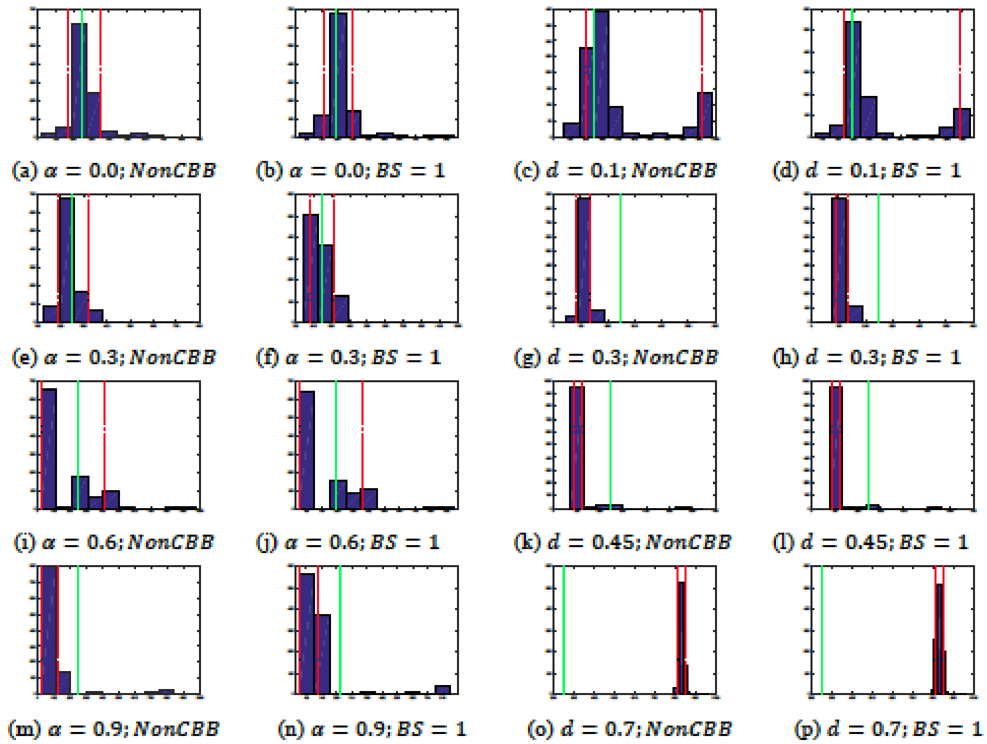


Figure C.1.2: Non-CBB and CBB-BS1 under Model A with TCP 500

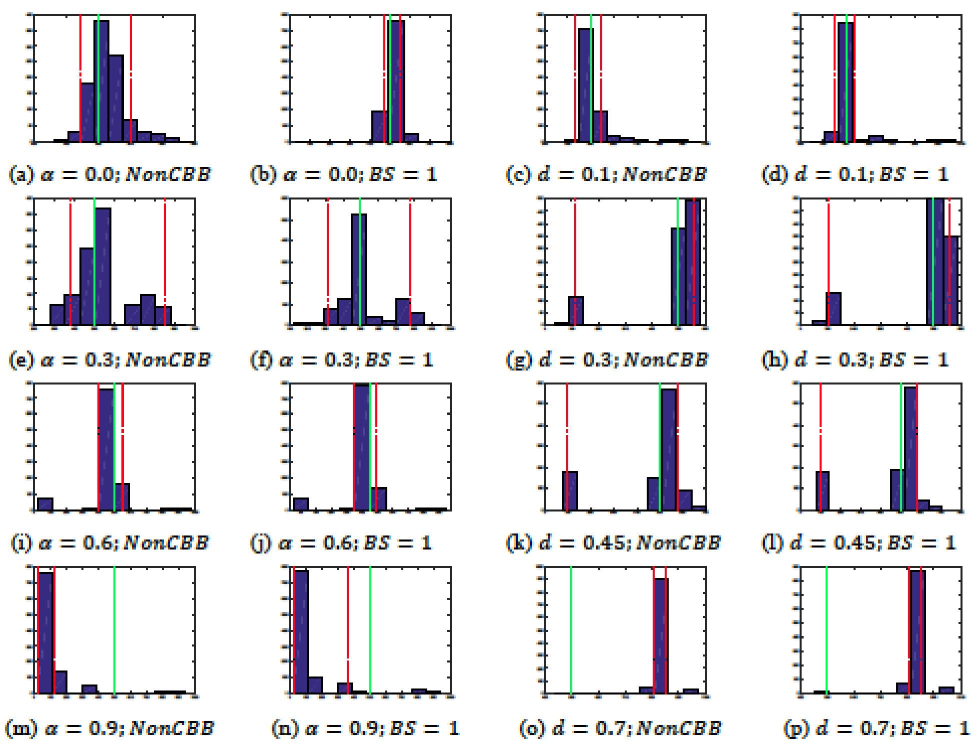


Figure C.1.3: Non-CBB and CBB-BS1 under Model A with TCP 750

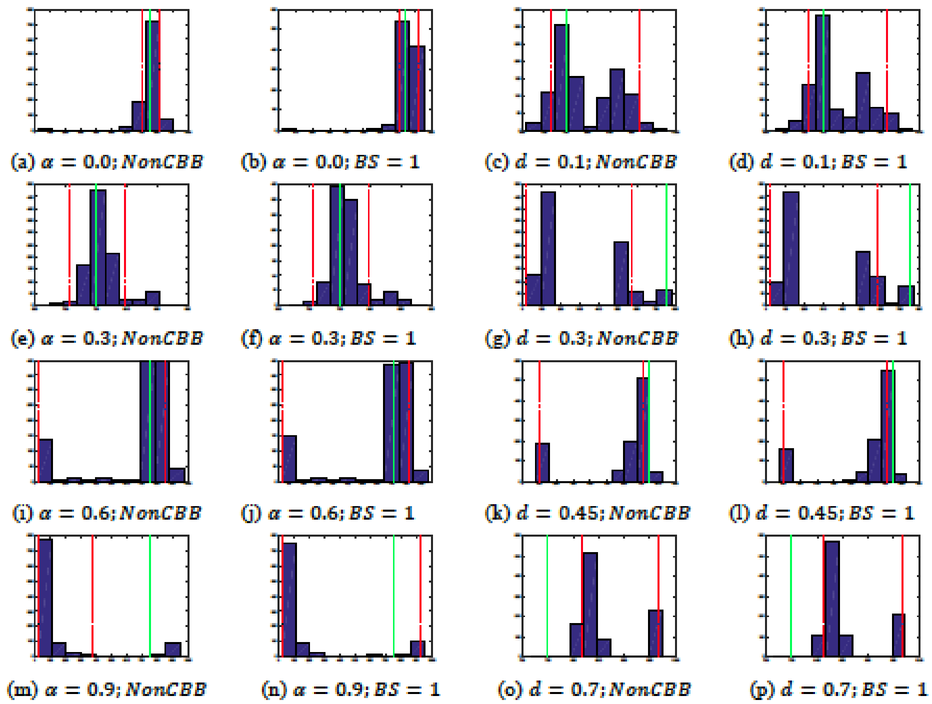


Figure C.2.1: Non-CBB and CBB-BS1 under Model B with TCP 250

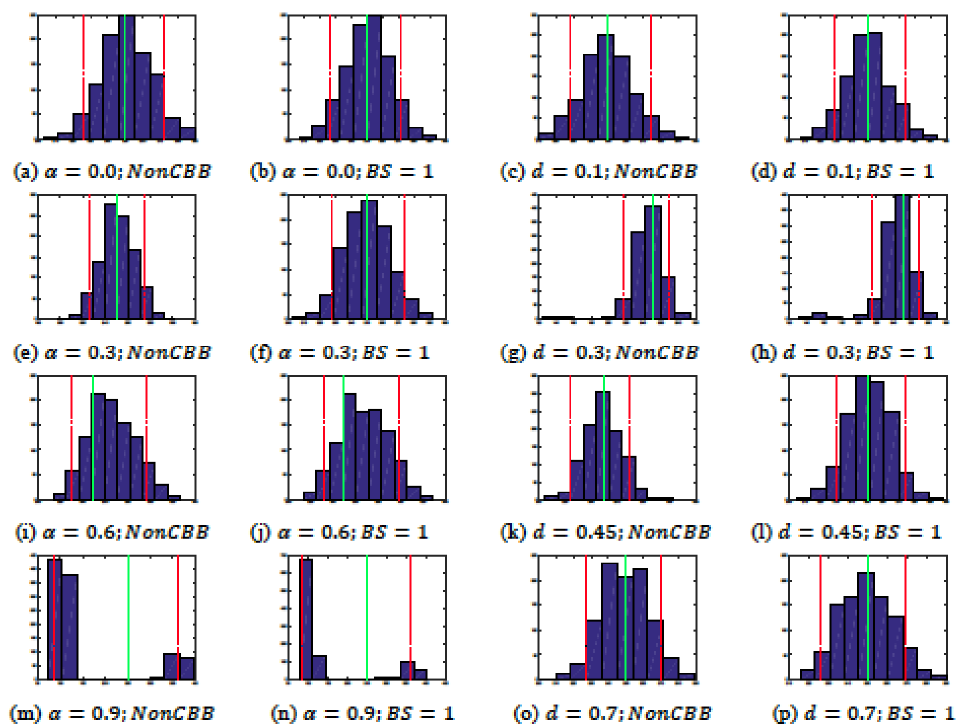


Figure C.2.2: Non-CBB and CBB-BS1 under Model B with TCP 500

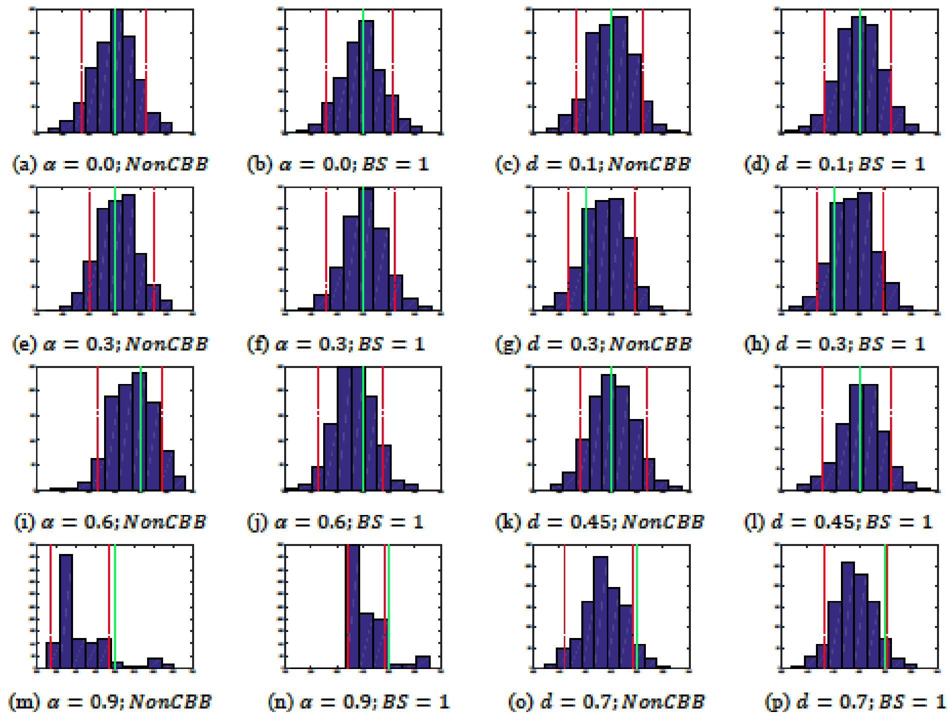
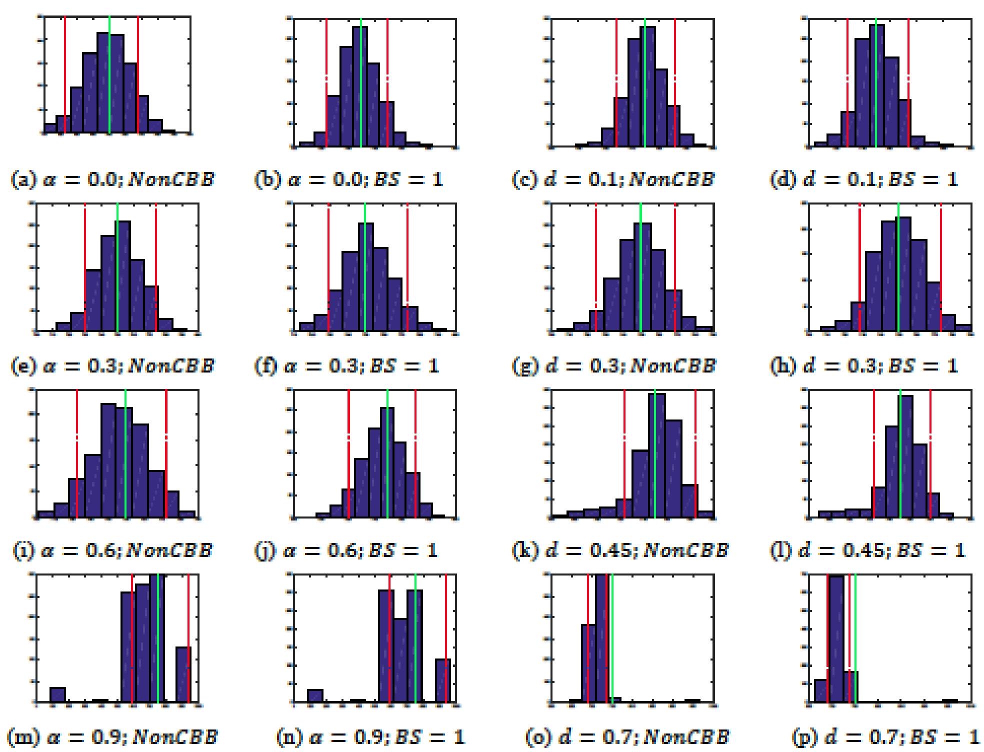


Figure C.2.3: Non-CBB and CBB-BS1 under Model B with TCP 750



Appendix – D

Matlab Codes

Appendix – D

The following script is codes for Matlab Program to estimate single change point using SSR and LR Test and Constructing Confidence Interval using CBB Methods in **Chapter 4**. This program is generated to Monte Carlo simulation.

1. DGP and estimating a single change point for Model 1 using SSR methods

```
% Estimating change point (m_hat) and Calculating E-tilde under Model 1 with SSR

clear all;
clc;

load x_series.mat

% Initial values
obs = 1000;
m = (3/4)*obs; %true change point is assign as T/4, T/2, and 3T/4
lb = 0.02*obs;
ub = obs-lb;

% Generate random values based on normal distribution
u = random('norm',0,1,obs,1);

% Providing matrix form
h = zeros(obs,1);
e = zeros(obs,1);
y1 = zeros(m,1);
y2 = zeros(obs-m,1);

% Error process
for t = 2:obs;    e(1) = 0;

        h(t) = 0.1+0.3*h(t-1)+0.4*e(t-1)^2;
        e(t) = sqrt(h(t))*u(t);

end;

% Independent variables dataset (constant term and one independent variable)
z1 = [ones(m,1) x(1:m)];
z2 = [ones(obs-m,1) x(m+1:obs)];
```

```
% Dependent variable
for t = 1:m;

        y1(t) = 0.1+0.1*x(t)+e(t);

end;

for t = m+1:obs;

        y2(t) = 0.2+0.2*x(t)+e(t);

end;


% Data set
y = [y1;y2(m+1:obs)];%dependent variable
z = [z1;z2];%independent variables

%----------------------------------------------------------------------
% Estimating change point of original x series with SSR Test

for k = lb:ub;

        betahat1 = (inv(z(1:k, 1:2).'*z(1:k, 1:2)))*(z(1:k, 1:2).'*y(1:k));
                yhat1 = (betahat1(1,1)+betahat1(2,1)*x(1:k));
                resid1 = y(1:k)-yhat1;
                ssr1(k) = sum(resid1.^2);

        betahat2 = (inv(z(k+1:obs, 1:2).'*z(k+1:obs, 1:2)))*(z(k+1:obs, 1:2).'*y(k+1:obs));
                yhat2 = (betahat2(1,1)+betahat2(2,1)*x(k+1:obs));
                resid2 = y(k+1:obs)-yhat2;
                ssr2(k) = sum(resid2.^2);

        ssr(k) = ssr1(k)+ssr2(k);
end;

min_ssr = min(ssr(lb:ub));
m_hat = find(ssr==min_ssr);

%----------------------------------------------------------------------

y1_mhat = y(1:m_hat);%first subsample with new estimated change point
y2_mhat = y(m_hat+1:obs);%second subsample with new estimated change point
        mju1_hat = mean(y1_mhat);
        mju2_hat = mean(y2_mhat);
e1_mhat = e(1:m_hat);
```

```
e2_mhat = e(m_hat+1:obs);
        e_mhat = [e1_mhat;e2_mhat];

h1_hat = zeros(m_hat,1);
h2_hat = zeros(obs-m_hat,1);

% Estimate arch parameter from each subseries
[omega1,alpha1,beta1] = ugarch(e1_mhat,1,1);
[omega2,alpha2,beta2] = ugarch(e2_mhat,1,1);

% Calculate the estimated sigma

h1_hat(1) = sum(y1_mhat.^2)*(1/m_hat);
   for t = 2:m_hat;
                h1_hat(t) = omega1+alpha1*h1_hat(t-1)+beta1*e_mhat(t-1)^2;
   end;

h2_hat(m_hat) = sum(y2_mhat.^2)*(1/(obs-m_hat));
   for t = m_hat+1:obs;
                h2_hat(t) = omega2+alpha2*h2_hat(t-1)+beta2*e_mhat(t-1)^2;
   end;

% Calculate mean of estimated sigma as initial values for generating new x series
init1 = mean(h1_hat);
init2 = mean(h2_hat);

% Calculate residual
e1_hat = y1_mhat./sqrt(h1_hat);
        m1 = mean(e1_hat);
        std1 = std(e1_hat);

e2_hat = y2_mhat./sqrt(h2_hat(m_hat+1:obs));
        m2 = mean(e2_hat);
        std2 = std(e2_hat);

e_all_hat = [e1_hat;e2_hat];
        ave_ehat = mean(e_all_hat);

e_tilde = e_all_hat-ave_ehat;
```

2. DGP and estimating a single change point for Model 2 using SSR methods

```
% Estimating change point (m_hat) and Calculating E-tilde under Model 2 with SSR

clear all;
clc;

load x_series.mat

% Initial values
obs = 1000;
m = (3/4)*obs;
lb = 0.02*obs;
ub = obs-lb;

% Generate error process that follows normal distribution
u = random('norm',0,1,obs,1);

% Generate matrix forms
h1 = zeros(m,1);
h2 = zeros(obs-m,1);
e1 = zeros(m,1);
e2 = zeros(obs-m,1);
y1 = zeros(m,1);
y2 = zeros(obs-m,1);

% Error process
for t = 2:m;     e1(1) = 0;      h1(1) = 0;

                 h1(t) = 0.1+0.3*h1(t-1)+0.4*e1(t-1)^2;
                 e1(t) = sqrt(h1(t))*u(t);

end;

for t = m+1:obs;        e2(m) = e1(m);          h2(m) = h1(m);

                 h2(t) = 0.2+0.4*h2(t-1)+0.5*e2(t-1)^2;
                 e2(t) = sqrt(h2(t))*u(t);

end;

% Independent variables dataset (constant term and one independent variable)
z1 = [ones(m,1) x(1:m)];
z2 = [ones(obs-m,1) x(m+1:obs)];
```

```
% Dependent variable
for t = 1:m;

        y1(t) = 0.1+0.1*x(t)+e1(t);

end;


for t = m+1:obs;

        y2(t) = 0.2+0.2*x(t)+e2(t);

end;

% Data set
y = [y1;y2(m+1:obs)];%dependent variable
z = [z1;z2];%independent variables
e = [e1;e2(m+1:obs)];

%-----------------------------------------------------------------------

% Estimating change point of original x series with SSR Test

for k = lb:ub;

        betahat1 = (inv(z(1:k, 1:2).'*z(1:k, 1:2)))*(z(1:k, 1:2).'*y(1:k));
                yhat1 = (betahat1(1,1)+betahat1(2,1)*x(1:k));
                resid1 = y(1:k)-yhat1;
                ssr1(k) = sum(resid1.^2);

        betahat2 = (inv(z(k+1:obs, 1:2).'*z(k+1:obs, 1:2)))*(z(k+1:obs, 1:2).'*y(k+1:obs));
                yhat2 = (betahat2(1,1)+betahat2(2,1)*x(k+1:obs));
                resid2 = y(k+1:obs)-yhat2;
                ssr2(k) = sum(resid2.^2);

        ssr(k) = ssr1(k)+ssr2(k);
end;

min_ssr = min(ssr(lb:ub));
m_hat = find(ssr==min_ssr);

%-----------------------------------------------------------------------

y1_mhat = y(1:m_hat);%first subsample with new estimated change point
y2_mhat = y(m_hat+1:obs);%second subsample with new estimated change point
```

```
   mju1_hat = mean(y1_mhat);
   mju2_hat = mean(y2_mhat);
e1_mhat = e(1:m_hat);
e2_mhat = e(m_hat+1:obs);
e_mhat = [e1_mhat;e2_mhat];

h1_hat = zeros(m_hat,1);
h2_hat = zeros(obs-m_hat,1);

% Estimate ARCH parameter from each subseries
[omega1,alpha1,beta1] = ugarch(e1_mhat,1,1);
[omega2,alpha2,beta2] = ugarch(e2_mhat,1,1);

% Estimated sigma
h1_hat(1) = sum(y1_mhat.^2)*(1/m_hat);
   for t = 2:m_hat;
         h1_hat(t) = omega1+alpha1*h1_hat(t-1)+beta1*e_mhat(t-1)^2;
   end;

h2_hat(m_hat) = sum(y2_mhat.^2)*(1/(obs-m_hat));

   for t = m_hat+1:obs;

         h2_hat(t) = omega2+alpha2*h2_hat(t-1)+beta2*e_mhat(t-1)^2;

   end;

% Calculate mean of estimated sigma as initial values for generating new x series
init1 = mean(h1_hat);
init2 = mean(h2_hat);

% Calculate residual
e1_hat = y1_mhat./sqrt(h1_hat);
   m1 = mean(e1_hat);
   std1 = std(e1_hat);

e2_hat = y2_mhat./sqrt(h2_hat(m_hat+1:obs));
   m2 = mean(e2_hat);
   std2 = std(e2_hat);

e_all_hat = [e1_hat;e2_hat];
   ave_ehat = mean(e_all_hat);

e_tilde=e_all_hat-ave_ehat;
```

3. CBB for constructing confidence interval using SSR methods

```
%Bootstrap CI for SSR test

clear all;
clc;

load garch_model2_ssr_q3_1000.mat % can be changed to Model 1 and Model 2

numboot = 1000;%number of iterations
blocksize = 5;%length of block

%performing CBB on e_tilde and estimating change point based on e_tilde
data = [e_tilde;e_tilde(1:blocksize-1)];
numblock = floor(obs/blocksize);
blockran = random('unid',obs,numblock,numboot);
obs_index = zeros(numblock*blocksize,numboot);
index=1;
transformer = repmat((0:blocksize-1)',1,numboot);

for i = 1:blocksize:obs;

        obs_index(i:(i+blocksize-1),:) = repmat(blockran(index,:),blocksize,1)+transformer;
                if index < numblock

                        index = index+1;

                end;

end;

obs_index = obs_index(1:numblock*blocksize,:);
obs_boot_data = data(obs_index);

% Converting e_tilde into y_star
for b = 1:numboot;

                temp=obs_index(:,b);
                        e_temp=sort(temp);
                                e_star=data(e_temp);
                        obs_star=numel(e_star);
                e1_star=e_star(1:m_hat);
                e2_star=e_star(m_hat+1:obs_star);
                        x1=x(1:m_hat);
                        x2=x(m_hat+1:obs_star);
                y1_star=betahat1(1,1)+betahat1(2,1)*x1+e1_star;
```

```
                    y2_star=betahat2(1,1)+betahat2(2,1)*x2+e2_star;
                    y_star=[y1_star;y2_star]; % new y series

%-----------------------------------------------------------------------%

% Estimating change point of original y series with SSR Test

                    for k = lb:ub;

                              betahat1_star = (inv(z(1:k, 1:2)'*z(1:k, 1:2)))*(z(1:k, 1:2)'*y_star(1:k));
                                        yhat1_star = (betahat1_star(1,1)+betahat1_star(2,1)*x(1:k));
                                        resid1_star = y_star(1:k)-yhat1_star;
                                        ssr1_star(k) = sum(resid1_star.^2);

                               betahat2_star = (inv(z(k+1:obs_star, 1:2)'*z(k+1:obs_star,
1:2)))*(z(k+1:obs_star, 1:2)'*y_star(k+1:obs_star));
                                        yhat2_star =
(betahat2_star(1,1)+betahat2_star(2,1)*x(k+1:obs_star));
                                        resid2_star = y_star(k+1:obs_star)-yhat2_star;
                                        ssr2_star(k) = sum(resid2_star.^2);

                              ssr_star(k) = ssr1_star(k)+ssr2_star(k);

                    end;

          min_ssr_star = min(ssr_star(lb:ub));
          m_hat_star = find(ssr_star==min_ssr_star);

%-----------------------------------------------------------------------%
          result(b,1) = m_hat_star;

end;

%-----------------------------------------------------------------------%

% Normal confidence interval
est_cp = sort(result);
m_all = mean(result);
sd_all = std(result);
ersq = (result-m).^2;
rmse = sqrt(sum(ersq)/numboot);

alpha = 0.1;
ci = 1-alpha;
bins = 15;
maxb = (1-(alpha/2))*(numboot);
```

```
minb = (numboot)-maxb;

bmin = est_cp(minb);
bmax = est_cp(maxb);
range = bmin:(bmax-bmin)/bins:bmax;

% Shortest confidence interval

for i = 1:numboot-(ci*numboot);

    d(i) = est_cp(numboot-(round(alpha*numboot))-1+i)-est_cp(i);

end

d_min = min(d);
d_num = find(d==d_min);
lowbound = est_cp(d_num);
upbound = est_cp(numboot-(round(alpha*numboot))-1+d_num);
      bmin2 = min(est_cp);
      bmax2 = max(est_cp);
      range2 = bmin2:(bmax2-bmin2)/bins:bmax2;
minlow = min(lowbound);
minup = min(upbound);

% Constructing confidence interval
figure;
hist(est_cp,bins);
    hold on;
    ylim = get(gca,'YLim');
                    plot(min(lowbound)*[1,1],ylim,'r--','LineWidth',1);
                    plot(min(upbound)*[1,1],ylim,'r--','LineWidth',1);
                    plot(m*[1,1],ylim,'g-','LineWidth',1);
                    title('Shortest C.I',...
                              'String',{['Num. Bootstrap=' num2str(numboot)],['Lenght of Block='
num2str(blocksize)]});
        annotation('textbox',...
                    [0.65 0.65 0.25 0.225],...
                    'String',{['Mean=' num2str(m_all)],['Standard Dev.=' num2str(sd_all)],...

['RMSE=' num2str(rmse)], ['Lower=' num2str(minlow)], ['Upper=' num2str(minup)],...
['True Break=' num2str(m)], ['Alpha=' num2str(alpha)]});
```

4. DGP and estimating a single change point for Model 1 using LR methods

```
% Estimating change point (m_hat) and Calculating E-tilde under Model 1 with LR

clear all;
clc;

obs = 1000;
m = (3/4)*obs;%true break
lb = 0.1*obs;
ub = obs-lb;

e1 = zeros(m,1);
e2 = zeros(obs,1);
h1 = zeros(m,1);
h2 = zeros(obs,1);
y1 = zeros(m,1);
y2 = zeros(obs,1);

% True value
omega1 = 0.1;
alpha1 = 0.3;
beta1 = 0.4;
        omega2 = 0.1;
        alpha2 = 0.3;
        beta2 = 0.4;
c1 = 0.1;
a1 = 0.1;
        c2 = 0.2;
        a2 = 0.2;

% Exogenous variable
x = random('unid',5,obs,1);
x1 = x(1:m);
x2 = x(m+1:obs);

u = random('norm',0,1,obs,1);

for t = 2:m;    e1(1) = 0;    h1(1) = 0;

   h1(t) = omega1+alpha1*h1(t-1)+beta1*e1(t-1)^2;
   e1(t) = sqrt(h1(t))*u(t);
   y1(t) = c1+a1*x(t)+e1(t);

end;
```

```
for t = m+1:obs;        e2(m) = e1(m);          h2(m) = h1(m);

    h2(t) = omega2+alpha2*h2(t-1)+beta2*e2(t-1)^2;
    e2(t) = sqrt(h2(t))*u(t);
    y2(t) = c2+a2*x(t)+e2(t);

end;

y=[y1;y2(m+1:obs)];

spec0=garchset('C',c1,'Regress',a1,'K',omega1,'GARCH',alpha1,'ARCH',beta1);
            spec0=garchset(spec0,'Display','Off');
spec1=garchset('C',c1,'Regress',a1,'K',omega1,'GARCH',alpha1,'ARCH',beta1);
            spec1=garchset(spec1,'Display','Off');
spec2=garchset('C',c2,'Regress',a2,'K',omega2,'GARCH',alpha2,'ARCH',beta2);
             spec2=garchset(spec2,'Display','Off');

% Estimate GARCH(1,1) parameters
for k = lb:ub;

            [est0,~,LLF0] = garchfit(spec0,y,x);
            [est1,~,LLF1] = garchfit(spec1,y(1:k),x(1:k));
            [est2,~,LLF2] = garchfit(spec2,y(k+1:obs),x(k+1:obs));
            LR(k) = (LLF1+LLF2)-LLF0;

end;

max_lr = max(LR(lb:ub));
m_hat = find(max_lr==LR);

%--------------------------------------------------------------------

% Generate e-tilde
y1_mhat = y(1:m_hat);%first subseries based on ori x series with ecp
y2_mhat = y(m_hat+1:obs);%second subseries of ori x series with ecp
    mju1_hat = mean(y1_mhat);
    mju2_hat = mean(y2_mhat);
        d_hat = mju2_hat-mju1_hat;
e1_hat = y1_mhat-mju1_hat;
e2_hat = y2_mhat-mju2_hat;
    e_hat = [e1_hat;e2_hat];
        ave_ehat = mean(e_hat);
e_tilde = e_hat-ave_ehat;
```

5. DGP and estimating a single change point for Model 2 using LR methods

```
% Estimating change point (m_hat) and Calculating E-tilde under Model 2 with LR

clear all;
clc;

obs = 1000;
m = (3/4)*obs;%true break
lb = 0.1*obs;
ub = obs-lb;

e1 = zeros(m,1);e2=zeros(obs,1);
h1 = zeros(m,1);h2=zeros(obs,1);
y1 = zeros(m,1);y2=zeros(obs,1);

%true value
omega1 = 0.1;
alpha1 = 0.3;
beta1 = 0.4;
        omega2 = 0.2;
        alpha2 = 0.4;
        beta2 = 0.5;
c1 = 0.1;
a1 = 0.1;
        c2 = 0.2;
        a2 = 0.2;

% Exogenous variable
x = random('unid',5,obs,1);
x1 = x(1:m);
x2 = x(m+1:obs);

u = random('norm',0,1,obs,1);

for t = 2:m;    e1(1) = 0;     h1(1) = 0;

        h1(t) = omega1+alpha1*h1(t-1)+beta1*e1(t-1)^2;
        e1(t) = sqrt(h1(t))*u(t);
        y1(t) = c1+a1*x(t)+e1(t);

end;
```

```
for t = m+1:obs;        e2(m) = e1(m);          h2(m) = h1(m);

            h2(t) = omega2+alpha2*h2(t-1)+beta2*e2(t-1)^2;
            e2(t) = sqrt(h2(t))*u(t);
            y2(t) = c2+a2*x(t)+e2(t);

end;

y = [y1;y2(m+1:obs)];

spec0 = garchset('C',0,'Regress',0.1,'K',0.1,'GARCH',0.1,'ARCH',0.1);
            spec0 = garchset(spec0,'Display','Off');
spec1 = garchset('C',0,'Regress',0.1,'K',0.1,'GARCH',0.1,'ARCH',0.1);
            spec1 = garchset(spec1,'Display','Off');
spec2 = garchset('C',0,'Regress',0.1,'K',0.1,'GARCH',0.1,'ARCH',0.1);
            spec2 = garchset(spec2,'Display','Off');

% Estimate parameters
for k = lb:ub;

            [est0,~,LLF0] = garchfit(spec0,y,x);
            [est1,~,LLF1] = garchfit(spec1,y(1:k),x(1:k));
            [est2,~,LLF2] = garchfit(spec2,y(k+1:obs),x(k+1:obs));
            LR(k) = (LLF1+LLF2)-LLF0;

end;

max_lr = max(LR(lb:ub));
m_hat = find(max_lr==LR);

%-----------------------------------------------------------------------

% Generate e-tilde
y1_mhat = y(1:m_hat);%first subseries based on ori x series with ecp
y2_mhat = y(m_hat+1:obs);%second subseries of ori x series with ecp
    mju1_hat = mean(y1_mhat);
    mju2_hat = mean(y2_mhat);
        d_hat = mju2_hat-mju1_hat;
e1_hat = y1_mhat-mju1_hat;
e2_hat = y2_mhat-mju2_hat;
    e_hat = [e1_hat;e2_hat];
        ave_ehat = mean(e_hat);
e_tilde = e_hat-ave_ehat;
```

6. CBB for constructing confidence interval using LR methods

```
%Bootstrap CI for LR test

clear all;
clc;

load garch_model1_lr_q2_1000.mat

numboot = 1000;
blocksize = 10;
result = zeros(numboot,1);
%coef0=zeros(numboot,4);
%coef1=zeros(numboot,4);
%coef2=zeros(numboot,4);

% Performing CBB on e_tilde and estimating change point based on e_tilde
data = [e_tilde;e_tilde(1:blocksize-1)];
numblock = floor(obs/blocksize);
blockran = random('unid',obs,numblock,numboot);
obs_index = zeros(numblock*blocksize,numboot);
index = 1;
transformer = repmat((0:blocksize-1)',1,numboot);

for i = 1:blocksize:obs;

        obs_index(i:(i+blocksize-1),:) = repmat(blockran(index,:),blocksize,1)+transformer;
                if index < numblock

                        index = index+1;

                end;
end;

obs_index = obs_index(1:numblock*blocksize,:);
obs_boot_data = data(obs_index);

% Converting e_tilde into y_star

for b = 1:numboot;
                temp = obs_index(:,b);
                        e_temp = sort(temp);
                        e_star = data(e_temp);
                obs_star = numel(e_star);
                        e1_star = e_star(1:m_hat);
                        e2_star = e_star(m_hat+1:obs_star);
```

```
        x1 = x(1:m_hat);
        x2 = x(m_hat+1:obs_star);
            y1_star = est1.C+est1.Regress.*x1+e1_star;
            y2_star = est2.C+est2.Regress.*x2+e2_star;
            y_star = [y1_star;y2_star];%new series of y

% Estimate parameters using LR methods

        for k = lb:ub;

            [est0s,~,LLF0s] = garchfit(spec0,y_star,x);
            [est1s,~,LLF1s] = garchfit(spec1,y_star(1:k),x(1:k));
            [est2s,~,LLF2s] = garchfit(spec2,y_star(k+1:obs_star),x(k+1:obs_star));
            LR_star(k) = (LLF1s+LLF2s)-LLF0s;

        end;

max_lr_star = max(LR_star(lb:ub));
m_hat_star = find(max_lr_star==LR_star);
result(b,1) = m_hat_star;
%   coef0(b,1)=est0s.K;
%   coef0(b,2)=est0s.GARCH;
%   coef0(b,3)=est0s.ARCH;
%   coef0(b,4)=LLF0s;
%       coef1(b,1)=est1s.K;
%       coef1(b,2)=est1s.GARCH;
%       coef1(b,3)=est1s.ARCH;
%       coef1(b,4)=LLF1s;
%   coef2(b,1)=est2s.K;
%   coef2(b,2)=est2s.GARCH;
%   coef2(b,3)=est2s.ARCH;
%   coef2(b,4)=LLF2s;
end;

%-----------------------------------------------------------------------

% Cormal confidence interval
est_cp = sort(result);
m_all = mean(result);
sd_all = std(result);
ersq = (result-m).^2;
rmse = sqrt(sum(ersq)/numboot);

alpha = 0.1;
ci = 1-alpha;
bins = 15;
```

```
maxb = (1-(alpha/2))*(numboot);
minb = (numboot)-maxb;

bmin = est_cp(minb);
bmax = est_cp(maxb);
range = bmin:(bmax-bmin)/bins:bmax;

% Shortest confidence interval
for i = 1:numboot-(ci*numboot);

        d(i) = est_cp(numboot-(round(alpha*numboot))-1+i)-est_cp(i);

end

d_min = min(d);
d_num = find(d==d_min);
lowbound = est_cp(d_num);
upbound = est_cp(numboot-(round(alpha*numboot))-1+d_num);
    bmin2 = min(est_cp);
    bmax2 = max(est_cp);
    range2 = bmin2:(bmax2-bmin2)/bins:bmax2;
minlow = min(lowbound);
minup = min(upbound);

% Constructing confidence interval;
figure;
hist(est_cp,bins);
   hold on;
   ylim=get(gca,'YLim');
     plot(min(lowbound)*[1,1],ylim,'r--','LineWidth',1);
     plot(min(upbound)*[1,1],ylim,'r--','LineWidth',1);
     plot(m*[1,1],ylim,'g-','LineWidth',1);
     title('Shortest C.I',...
    'String',{['Num. Bootstrap=' num2str(numboot)],['Lenght of Block=' num2str(blocksize)]});
     annotation('textbox',...
    [0.65 0.65 0.25 0.225],...
    'String',{['Mean=' num2str(m_all)],['Standard Dev.=' num2str(sd_all)],...
    ['RMSE=' num2str(rmse)], ['Lower=' num2str(minlow)], ['Upper=' num2str(minup)],...
    ['True Break=' num2str(m)], ['Alpha=' num2str(alpha)]});
```

7. Estimating a single change point for real data case (Indonesian exchange rate)

```
% Estimating change point (m_hat) and Calculating E-tilde under Model 1 with SSR

clear all;
clc;

load data_real_xdr.mat

obs =length(idrxdr);
lb = floor(0.02*obs);
ub = obs-lb;
y = idrxdr;
x = usdxdr;
z = [ones(obs,1),x];

%--------------------------------------------------------------------------

%estimating change point of original x series with SSR Test
for k = lb:ub;

    betahat1 = (inv(z(1:k, 1:2)'*z(1:k, 1:2)))*(z(1:k, 1:2)'*y(1:k));
        for j = 1:k;
            yhat1(j) = betahat1(1,1)+betahat1(2,1)*x(j);
            residsq1(j) = (y(j)-yhat1(j)).^2;
        end;
    ssr1(k) = sum(residsq1(1:k));

    betahat2 = (inv(z(k+1:obs, 1:2)'*z(k+1:obs, 1:2)))*(z(k+1:obs, 1:2)'*y(k+1:obs));
        for jj = k+1:obs;
            yhat2(jj) = betahat2(1,1)+betahat2(2,1)*x(jj);
            residsq2(jj) = (y(jj)-yhat2(jj)).^2;
        end;
   ssr2(k) = sum(residsq2(k+1:obs));

ssr(k) = ssr1(k)+ssr2(k);

end;

min_ssr = min(ssr(lb:ub));
m_hat = find(ssr==min_ssr);

%--------------------------------------------------------------------------
% First and second subsamples of x and y series
y1_mhat = y(1:m_hat);%first y subsample before new estimated change point
y2_mhat = y(m_hat+1:obs);%second y subsample after new estimated change point
```

```
x1_mhat = x(1:m_hat);%first x subsample before new estimated change point
x2_mhat = x(m_hat+1:obs);%second x subsample after new estimated change point

% Estimating mean equation parameters
bhat1 = (inv(z(1:m_hat, 1:2)'*z(1:m_hat, 1:2)))*(z(1:m_hat, 1:2)'*y1_mhat);
bhat2 = (inv(z(m_hat+1:obs, 1:2)'*z(m_hat+1:obs, 1:2)))*(z(m_hat+1:obs, 1:2)'*y2_mhat);

% Estimating y
yhat1 = bhat1(1,1)+bhat1(2,1)*x1_mhat;
yhat2 = bhat2(1,1)+bhat2(2,1)*x2_mhat;
yhat = [yhat1;yhat2];

% Estimating residuals
e1_mhat = y1_mhat-yhat1;
e2_mhat = y2_mhat-yhat2;
e_mhat = [e1_mhat;e2_mhat];
    mean_e_mhat = mean(e_mhat);
e_tilde = e_mhat-mean_e_mhat;%e_tilde
```

8. Constructing confidence interval for estimated single change point in the Indonesian exchange rate case

```
%Bootstrap for SSR

clear
clc

load etilde_ssr_level.mat

m = m_hat;
numit = 1000;%number of iterations
blocksize = 10;%length of block
result_star = zeros(numit,1);

temp_e_star = e_tilde;
        temp_e1_star = temp_e_star(1:m_hat);
        temp_e2_star = temp_e_star(m_hat+1:obs);
temp_x_star = x;
        temp_x1_star = temp_x_star(1:m_hat);
        temp_x2_star = temp_x_star(m_hat+1:obs);

% Calculating new y series as conversion from e_tilde
y1_star = bhat1(1,1)+bhat1(2,1)*temp_x1_star+temp_e1_star;
y2_star = bhat2(1,1)+bhat2(2,1)*temp_x2_star+temp_e2_star;
temp_y_star = [y1_star;y2_star];%new y series

% Performing CBB on e_tilde and estimating change point based on e_tilde
data_e_star = [temp_e_star;temp_e_star(1:blocksize-1)];
data_x_star = [temp_x_star;temp_x_star(1:blocksize-1)];
data_y_star = [temp_y_star;temp_y_star(1:blocksize-1)];
matrix_data = [data_e_star data_x_star data_y_star];
obs_new = numel(data_e_star);

numblock = floor(obs/blocksize);
blockran = random('unid',obs,numblock,numit);
obs_index = zeros(numblock*blocksize,numit);
index = 1;
transformer = repmat((0:blocksize-1)',1,numit);
for i = 1:blocksize:obs_new;
    obs_index(i:(i+blocksize-1),:) = repmat(blockran(index,:),blocksize,1)+transformer;
            if index < numblock
                        index = index+1;
            end;
end;
```

```
resample_index = obs_index(1:numblock*blocksize,:);

% Resampling
for b = 1:numit;
temp = resample_index(:,b);
   sort_temp = sort(temp);
   obs_star = numel(sort_temp);
e_star = matrix_data(:,1);
   e_star = e_star(sort_temp);
x_star = matrix_data(:,2);
   x_star = x_star(sort_temp);
y_star = matrix_data(:,3);
   y_star = y_star(sort_temp);
z_star = [ones(numel(x_star),1) x_star];
%----------------------------------------------------------------------
%estimating change point of original y series with SSR Test
lb_star = floor(0.02*obs_star);
ub_star = obs_star-lb_star;

for k = lb_star:ub_star;
      betahat1_star = (inv(z_star(1:k, 1:2)'*z_star(1:k, 1:2)))*(z_star(1:k, 1:2)'*y_star(1:k));
         for j = 1:k;
            yhat1_star(j) = betahat1_star(1,1)+betahat1_star(2,1)*x_star(j);
            residsq1_star(j) = (y_star(j)-yhat1_star(j)).^2;
         end;
      ssr1_star(k) = sum(residsq1_star(1:k));

      betahat2_star = (inv(z_star(k+1:obs_star, 1:2)'*z_star(k+1:obs_star,
1:2)))*(z_star(k+1:obs_star, 1:2)'*y_star(k+1:obs_star));
         for jj = k+1:obs_star;
            yhat2_star(jj) = betahat2_star(1,1)+betahat2_star(2,1)*x_star(jj);
            residsq2_star(jj) = (y_star(jj)-yhat2_star(jj)).^2;
         end;
      ssr2_star(k) = sum(residsq2_star(k+1:obs_star));
ssr_star(k)=ssr1_star(k)+ssr2_star(k);

end;

min_ssr_star=min(ssr_star(lb_star:ub_star));
m_hat_star_temp=find(ssr_star==min_ssr_star);
m_hat_star=sort_temp(m_hat_star_temp);

%----------------------------------------------------------------------
result_star(b,1)=m_hat_star_temp;
end;
%----------------------------------------------------------------------
```

```
% Normal confidence interval
est_cp = sort(result_star);
mean_est_cp = mean(result_star);
std_est_cp = std(result_star);
errsq = (result_star-mean_est_cp).^2;
rmse = sqrt(sum(errsq)/numit);

alpha = 0.1;
ci = 1-alpha;
bins = 15;

% %confidence interval
% maxb=(1-(alpha/2))*(numit);
% minb=(numit)-maxb;
% bmin=est_cp(minb);
% bmax=est_cp(maxb);
% range=bmax-bmin;
% %histogram CI
% figure;
% hist(est_cp,bins);
%     hold on;
%     ylim=get(gca,'YLim');
%         plot(bmin*[1,1],ylim,'r--','LineWidth',1);
%         plot(bmax*[1,1],ylim,'r--','LineWidth',1);
%         plot(m*[1,1],ylim,'g-','LineWidth',1);
%      annotation('textbox',...
%      [0.65 0.7 0.25 0.20],...
%      'String',{ ['True Break=' num2str(m)], ['Mean=' num2str(mean_est_cp)],['St.Dev.='
num2str(std_est_cp)],...
%      ['RMSE=' num2str(rmse)], ['Lower Bound=' num2str(bmin)], ['Upper Bound='
num2str(bmax)],...
%      ['Range=' num2str(range)], ['Block Size=' num2str(blocksize)]});

% Shortest confidence interval
for i = 1:numit-(ci*numit);

                d(i) = est_cp(numit-(round(alpha*numit))-1+i)-est_cp(i);

end

d_min = min(d);
d_num = find(d==d_min);
d_num = min(d_num);
lowerb = est_cp(d_num);
upperb = est_cp(numit-(round(alpha*numit))-1+d_num);
```

```
range = upperb-lowerb;

% Converting date
datebreak = datestr(x2mdate(date1(m_hat)));
datelow = datestr(x2mdate(date1(lowerb)));
dateup = datestr(x2mdate(date1(upperb)));


% Histogram of shortest CI
figure;
hist(est_cp,bins);
    hold on;
    ylim = get(gca,'YLim');
       plot(max(lowerb)*[1,1],ylim,'r--','LineWidth',1);
       plot(min(upperb)*[1,1],ylim,'r--','LineWidth',1);
       plot(m*[1,1],ylim,'g-','LineWidth',1);
     annotation('textbox',...
     [0.65 0.7 0.25 0.20],...
     'Linestyle','none',...
     'String',{ ['Est.Break =' datestr(datebreak)],...
     ['Lower =' datestr(datelow)], ['Upper =' datestr(dateup)],...
     ['Block Size=' num2str(blocksize)]});
```

Appendix – E

This script is to run Monte Carlo simulation to estimate causal order through Independent Component Analysis (ICA) as conducted in **Chapter 5**

1. Monte Carlo simulation for SVAR(1) model under case A-D

```
% Estimating causal order using 4 variables by LiNGAM

clear all
clc

%-------------------------------------------------------
T = 300; % number of observations
N = 4; % number of variables
Y = zeros(N,T+1); % matrix of DGP

% Given matrix C
C=[1    0.4  0.3   0.2
     0.4  1    0.2   0.1
     0.3  0.2  1     0.05
     0.2  0.1  0.05  1];

% Generating t-skewed distribution
df = 5; % degree of freedom is assigned to be equal to 5 and 25
U = mvtrnd(C,df,T+1);

% Under case A
```

$$B = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0.5 & 0 & 0 & 0 \\ 0.3 & 0.4 & 0 & 0 \\ 0.1 & 0.2 & 0.5 & 0 \end{pmatrix} \text{ and } \Gamma_1 = \begin{pmatrix} 0.6 & 0 & 0 & 0 \\ 0.4 & 0.5 & 0 & 0 \\ 0.3 & 0.4 & 0.5 & 0 \\ 0.3 & 0.3 & 0.4 & 0.5 \end{pmatrix}$$

```
% Under case B
```

$$B = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0.5 & 0 & 0 & 0 \\ 0.3 & 0.4 & 0 & 0 \\ 0.1 & 0.2 & 0.5 & 0 \end{pmatrix} \text{ and } \Gamma_1 = \begin{pmatrix} 0.46 & 0.07 & -0.02 & 0.03 \\ 0.09 & 0.27 & -0.24 & -0.01 \\ 0.10 & -0.03 & 0.03 & -0.25 \\ -0.04 & -0.02 & 0.24 & 0.22 \end{pmatrix}$$

% Under case C

$$B = \begin{pmatrix} 0 & 0.1 & 0 & 0.2 \\ 0.5 & 0 & 0.4 & 0.1 \\ 0.3 & 0 & 0 & 0 \\ 0.1 & 0.2 & 0.5 & 0 \end{pmatrix} \text{ and } \Gamma_1 = \begin{pmatrix} 0.6 & 0 & 0.1 & 0.1 \\ 0.4 & 0.5 & 0 & 0.1 \\ 0.3 & 0.4 & 0.5 & 0.1 \\ 0.3 & 0.3 & 0.4 & 0.5 \end{pmatrix}$$

% Under case D

$$B = \begin{pmatrix} 0 & 0.1 & 0 & 0.2 \\ 0.5 & 0 & 0.4 & 0.1 \\ 0.3 & 0 & 0 & 0 \\ 0.1 & 0.2 & 0.5 & 0 \end{pmatrix} \text{ and } \Gamma_1 = \begin{pmatrix} 0.6 & 0.4 & 0.3 & 0.3 \\ 0.4 & 0.5 & 0.4 & 0.3 \\ 0.3 & 0.4 & 0.5 & 0.4 \\ 0.3 & 0.3 & 0.4 & 0.5 \end{pmatrix}$$

```
%-------------------------------------------------------

% Generating Y

for t = 2:T+1;
        Y(:,t) = B*Y(:,t)+A*Y(:,t-1)+U(t,:)';
end;

Y=Y(:,2:end)';

% Maximum lag for VAR
maxlag = 1;

S = size(Y);
T = S(1,1); % Sample size
N = S(1,2); % Number of variables
% Y(:,1) = log(Y(:,1));
x = Y(:,2:N); % x variables in regression
y = Y(:,1); % y variable in regression

% ransam=random('unid',T,T,1);
itt=1000;
order = zeros(itt,N);
Gamma = zeros(itt,N,N,maxlag);
BB = zeros(itt,N,N);
JB = zeros(N,itt);
```

```
for i = 1:itt;
  [bootstat,bootsam] = bootstrp(1,@regress,y,x);
  W0 = [bootsam,y,x];
  W1 = sortrows(W0,1);
  W = W1(:,2:N+1);
  y_new_sort = W;

%--------------------- vgx -------------------------------------------
% Estimating the coefficient of VAR and obtaining the residual
Spec = vgxset('n',N,'nAR',maxlag,'constant',false);
[estSpec, EstStdErrors] = vgxvarx(Spec,y_new_sort(1:end,1:N));
vgxdisp(estSpec, EstStdErrors)

% ----------- VAR(5) by "for-end" loop with maxlag = 5 ------------------
Yest = 0;
     for lag = 1:maxlag;
      Yest = Yest+estSpec.AR{lag,1}*y_new_sort(maxlag-lag+1:end-lag,1:N)';
     end;
%---------------------------------------------------------------------

Yact = y_new_sort(maxlag+1:end,1:N);
Resid = Yest-Yact';
X = Resid

% Apply LiNGAM on residual obtained from step 4
[B stde ci kk] = estimate(X);

% The estimated beta for each itteration
BB(i,:,:) = B;

% The coefficient of gamma for each itteration
    for jj = 1:maxlag;
        Gamma(i,:,:,jj) = (eye(N)-B)*estSpec.AR{jj,1};
    end;
order(i,:) = kk;
end

%------------------- Estimation of Gamma -------------------------------
% G = zeros(N,N,maxlag);
% SD = zeros(N,N,maxlag);

% for i1 = 1:N;
%     for i2 = 1:N;
%         for i3 = 1:maxlag;
%             G(i1,i2,i3) = mean(Gamma(:,i1,i2,i3));
%             SD(i1,i2,i3) = std(Gamma(:,i1,i2,i3));
```

```
%         end;
%     end;
% end;

 G = zeros(itt,N,N,maxlag);

for i1 = 1:N;
    for i2 = 1:N;
        for i3 = 1:maxlag;
            G(:,i1,i2,i3) = (Gamma(:,i1,i2,i3));
            Gm(i1,i2,i3) = mean(Gamma(:,i1,i2,i3));
            Bm(i1,i2) = mean(BB(:,i1,i2));
            Std(i1,i2,i3) = std(Gamma(:,i1,i2,i3));
           % Std2(i1,i2) = std(BB(:,i1,i2));
            tstat(i1,i2,i3) = Gm(i1,i2,i3)/(Std(i1,i2,i3)/sqrt(itt));
           % tstat2 = Bm(i1,i2)/(Std2(i1,i2)/sqrt(itt));
            hist(G(:,i1,i2,i3))
        end;
    end;
end;

for i1 = 1:N;
    for i2 = 1:N;
        for i3 = 1:maxlag;
          if abs(tstat(i1,i2,i3)) < 2;
             Gm(i1,i2,i3) = 0
          else
          end
        end;
    end;
end;

for i1 = 1:N;
    for i2 = 1:N;
         Std2(i1,i2) = std(BB(:,i1,i2));
         tstat2(i1,i2) = Bm(i1,i2)/(Std2(i1,i2)/sqrt(itt));
         if abs(tstat2(i1,i2)) < 2;
             Bm(i1,i2) = 0
          else
          end
    end;
end;

%---------------------------------------------------------------------
ord = zeros(itt,N,N);
sum_ord = zeros(N,N);
```

```
for k = 1:N;
    for r = 1:itt;
        if order(r,k) == 1
            ord(r,1,k) = 1;
        else
            ord(r,1,k) = 0;
        end
        if order(r,k) == 2
            ord(r,2,k) = 1;
        else
            ord(r,2,k) = 0;
        end
        if order(r,k) == 3
            ord(r,3,k) = 1;
        else
            ord(r,3,k) = 0;
        end
        if order(r,k) == 4
            ord(r,4,k) = 1;
        else
            ord(r,4,k) = 0;
        end
end
  sum_ord(k,:) = [sum(ord(:,1,k)) sum(ord(:,2,k)) sum(ord(:,3,k)) ...
      sum(ord(:,4,k))];
end

V = perms(kk); sizeV = size(V); rowV = sizeV(1,1);
perm_order = zeros(itt,1);
num_order = zeros(rowV,1);
pct_order = zeros(rowV,1);

for v = 1:rowV
   for r = 1:itt;
      if order(r,1) == V(v,1) && order(r,2) == V(v,2) ...
        && order(r,3) == V(v,3) && order(r,4) == V(v,4)
            perm_order(r,1) = 1;
      else
            perm_order(r,1) = 0;
      end
    end
num_order(v) = sum(perm_order);
pct_order(v) = (sum(perm_order)/itt)*100;
end
```

```
no_perm = (1:rowV)';

% for bb = 1:length(no_perm);
%     SS(bb) = (true_order-V(bb,:))*(true_order-V(bb,:))';
% end

% correct = zeros(itt,1);
% for r = 1:itt;
% if order(r,1) == 1 && order(r,2) == 2 ...
%         && order(r,3) == 3 && order(r,4) == 4 && order(r,5) == 5
%     correct(r,1) = 1;
% else
%     correct(r,1) = 0;
% end
% end
% num_correct = sum(correct);

% table_order=table(no_perm,num2str(V),SS,num_order,pct_order)
% table_order=table(no_perm,num2str(V),num_order,pct_order)
% Table_order=table(no_perm,V(:,1),V(:,2),V(:,3),V(:,4),V(:,5),num_order)

p1 = num2str(V(:,1));
p2 = num2str(V(:,2));
p3 = num2str(V(:,3));
p4 = num2str(V(:,4));

freq = num_order;
table_order = table(no_perm,p1,p2,p3,p4,freq)

% Allocation of the order
figure(1);
subplot (2, 2, 1)
bar(sum_ord(1,:))
title ('1st Position')
    subplot (2, 2, 2)
    bar(sum_ord(2,:))
    title ('2nd Position')
subplot (2, 2, 3)
bar(sum_ord(3,:))
title ('3rd Position')
    subplot (2, 2, 4)
    bar(sum_ord(4,:))
    title ('4th Position')

% ax = axes('position',[0,0,1,1],'visible','off');
% tx = text(0.45,0.045,['Correct Order =',num2str(num_correct)]);
```

```
% set(tx,'fontweight','bold');

for q=1:N;
   JB(q,:) = jbtest((X(q,:)),0.05);
   %[h,p]=jbtest(abs(X(q,:)));
end;

figure(2);
subplot (2, 2, 1)
qqplot(X(1,:))
title ('Residual 1')
   subplot (2, 2, 2)
   qqplot(X(2,:))
   title ('Residual 2')
subplot (2, 2, 3)
qqplot(X(3,:))
title ('Residual 3')
   subplot (2, 2, 4)
   qqplot(X(4,:))
   title ('Residual 4')

figure(3);
subplot (2, 2, 1)
hist(X(1,:),20)
title ('Residual 1')
   subplot (2, 2, 2)
   hist(X(2,:),20)
   title ('Residual 2')
subplot (2, 2, 3)
hist(X(3,:),20)
title ('Residual 3')
   subplot (2, 2, 4)
   hist(X(4,:),20)
   title ('Residual 4')
```

2. Matlab script for estimating causal order using real data on Indonesia currency

```
% Causal order for exchange rate using LiNGAM

clear all
clc

% Real time series data
load er_asean5_monthly.mat;

Y = er5_00_14; % Data period Jan. 2000 -  Dec. 2014
% Y = er5_00_08_bls; % Data period Jan. 2000 -  Aug. 2008 (Before Lehman Shock)
% Y = er5_08_14_als; % Data period Sep. 2008 -  Dec. 2014 (After Lehman Shock)

% Maximum lag for VAR
maxlag = 1;

S = size(Y);
T = S(1,1); % Sample size
N = S(1,2); % Number of variables
% Y(:,1) = log(Y(:,1));
x = Y(:,2:N); % x variables in regression
y = Y(:,1); % y variable in regression

% ransam=random('unid',T,T,1);
itt=1000;
order = zeros(itt,N);
Gamma = zeros(itt,N,N,maxlag);
BB = zeros(itt,N,N);
JB = zeros(N,itt);

for i = 1:itt;
  [bootstat,bootsam] = bootstrp(1,@regress,y,x);
  W0 = [bootsam,y,x];
  W1 = sortrows(W0,1);
  W = W1(:,2:N+1);
  y_new_sort = W;

%--------------------- vgx ---------------------------------------------
% Estimating the coefficient of VAR and obtaining the residual
Spec = vgxset('n',N,'nAR',maxlag,'constant',false);
[estSpec, EstStdErrors] = vgxvarx(Spec,y_new_sort(1:end,1:N));
vgxdisp(estSpec, EstStdErrors)

% ----------- VAR(5) by "for-end" loop with maxlag = 5 ------------------
Yest = 0;
```

```
    for lag = 1:maxlag;
     Yest = Yest+estSpec.AR{lag,1}*y_new_sort(maxlag-lag+1:end-lag,1:N)';
    end;
%-----------------------------------------------------------------------

Yact = y_new_sort(maxlag+1:end,1:N);
Resid = Yest-Yact';
X = Resid

% Apply LiNGAM on residual obtained from step 4
[B stde ci kk] = estimate(X);

% The estimated beta for each itteration
BB(i,:,:) = B;

% The coefficient of gamma for each itteration
   for jj = 1:maxlag;
      Gamma(i,:,:,jj) = (eye(N)-B)*estSpec.AR{jj,1};
   end;
order(i,:) = kk;
end

%------------------- Estimation of Gamma ---------------------------------
% G = zeros(N,N,maxlag);
% SD = zeros(N,N,maxlag);

% for i1 = 1:N;
%    for i2 = 1:N;
%       for i3 = 1:maxlag;
%          G(i1,i2,i3) = mean(Gamma(:,i1,i2,i3));
%          SD(i1,i2,i3) = std(Gamma(:,i1,i2,i3));
%       end;
%    end;
% end;

 G = zeros(itt,N,N,maxlag);

for i1 = 1:N;
   for i2 = 1:N;
      for i3 = 1:maxlag;
         G(:,i1,i2,i3) = (Gamma(:,i1,i2,i3));
         Gm(i1,i2,i3) = mean(Gamma(:,i1,i2,i3));
         Bm(i1,i2) = mean(BB(:,i1,i2));
         Std(i1,i2,i3) = std(Gamma(:,i1,i2,i3));
        % Std2(i1,i2) = std(BB(:,i1,i2));
         tstat(i1,i2,i3) = Gm(i1,i2,i3)/(Std(i1,i2,i3)/sqrt(itt));
```

```
          % tstat2 = Bm(i1,i2)/(Std2(i1,i2)/sqrt(itt));
           hist(G(:,i1,i2,i3))
        end;
    end;
end;

for i1 = 1:N;
    for i2 = 1:N;
        for i3 = 1:maxlag;
          if abs(tstat(i1,i2,i3)) < 2;
             Gm(i1,i2,i3) = 0
          else
          end
        end;
    end;
end;

for i1 = 1:N;
    for i2 = 1:N;
         Std2(i1,i2) = std(BB(:,i1,i2));
         tstat2(i1,i2) = Bm(i1,i2)/(Std2(i1,i2)/sqrt(itt));
         if abs(tstat2(i1,i2)) < 2;
             Bm(i1,i2) = 0
          else
          end
    end;
end;

%---------------------------------------------------------------------
ord = zeros(itt,N,N);
sum_ord = zeros(N,N);

for k = 1:N;
    for r = 1:itt;
        if order(r,k) == 1
            ord(r,1,k) = 1;
        else
            ord(r,1,k) = 0;
        end
        if order(r,k) == 2
            ord(r,2,k) = 1;
        else
            ord(r,2,k) = 0;
        end
        if order(r,k) == 3
            ord(r,3,k) = 1;
```

```
        else
           ord(r,3,k) = 0;
        end
        if order(r,k) == 4
           ord(r,4,k) = 1;
        else
           ord(r,4,k) = 0;
        end
    end
     sum_ord(k,:) = [sum(ord(:,1,k)) sum(ord(:,2,k)) sum(ord(:,3,k)) ...
         sum(ord(:,4,k))];
    end

    V = perms(kk); sizeV = size(V); rowV = sizeV(1,1);
    perm_order = zeros(itt,1);
    num_order = zeros(rowV,1);
    pct_order = zeros(rowV,1);

    for v = 1:rowV
      for r = 1:itt;
        if order(r,1) == V(v,1) && order(r,2) == V(v,2) ...
          && order(r,3) == V(v,3) && order(r,4) == V(v,4)
            perm_order(r,1) = 1;
        else
            perm_order(r,1) = 0;
        end
       end
    num_order(v) = sum(perm_order);
    pct_order(v) = (sum(perm_order)/itt)*100;
    end

    no_perm = (1:rowV)';

    % for bb = 1:length(no_perm);
    %     SS(bb) = (true_order-V(bb,:))*(true_order-V(bb,:))';
    % end

    % correct = zeros(itt,1);
    % for r = 1:itt;
    % if order(r,1) == 1 && order(r,2) == 2 ...
    %         && order(r,3) == 3 && order(r,4) == 4 && order(r,5) == 5
    %     correct(r,1) = 1;
    % else
    %     correct(r,1) = 0;
    % end
    % end
```

```
% num_correct = sum(correct);

% table_order=table(no_perm,num2str(V),SS,num_order,pct_order)
% table_order=table(no_perm,num2str(V),num_order,pct_order)
% Table_order=table(no_perm,V(:,1),V(:,2),V(:,3),V(:,4),V(:,5),num_order)

p1 = num2str(V(:,1));
p2 = num2str(V(:,2));
p3 = num2str(V(:,3));
p4 = num2str(V(:,4));

freq = num_order;
table_order = table(no_perm,p1,p2,p3,p4,freq)

% Allocation of the order
figure(1);
subplot (2, 2, 1)
bar(sum_ord(1,:))
title ('1st Position')
   subplot (2, 2, 2)
   bar(sum_ord(2,:))
   title ('2nd Position')
subplot (2, 2, 3)
bar(sum_ord(3,:))
title ('3rd Position')
   subplot (2, 2, 4)
   bar(sum_ord(4,:))
   title ('4th Position')

for q=1:N;
   JB(q,:) = jbtest((X(q,:)),0.05);
   %[h,p]=jbtest(abs(X(q,:)));
end;

figure(2);
subplot (2, 2, 1)
qqplot(X(1,:))
title ('Residual 1')
   subplot (2, 2, 2)
   qqplot(X(2,:))
   title ('Residual 2')
subplot (2, 2, 3)
qqplot(X(3,:))
title ('Residual 3')
   subplot (2, 2, 4)
   qqplot(X(4,:))
```

```
   title ('Residual 4')

figure(3);
subplot (2, 2, 1)
histfit(X(1,:),20)
title ('Residual 1')
   subplot (2, 2, 2)
   histfit(X(2,:),20)
   title ('Residual 2')
subplot (2, 2, 3)
histfit(X(3,:),20)
title ('Residual 3')
   subplot (2, 2, 4)
   histfit(X(4,:),20)
   title ('Residual 4')
```

Appendix – F

Codes of Matlab Program for Estimating a Single Change Point using SSR and Constructing Confidence Interval using CBB and BB Methods in Chapter 6.

1. DGP and estimate a single change point under Model A.1 and A.2

```
% Estimating change point (m_hat) and Calculating E-tilde under Model A with SSR

clear all;
clc;

load ar1_0.6_new.mat %can be changed to series of data with the error process follows AR(1)
and ARFIMA(0,d,0)

obs=10000;
m=(1/4)*obs;
lb=0.02*obs;
ub=obs-lb;

u=random('norm',0,1,obs,1);
e=zeros(obs,1);
y1=zeros(m,1); y2=zeros(obs-m,1);

%error process
for t=2:obs; e(1)=0;
  e(t)=0.1*e(t-1)+u(t);
end;

%dependent variable
for t=1:m;
   y1(t)=1+e(t);
end;
for t=m+1:obs;
   y2(t)=1.5+e(t);
end;

%data set
y=[y1;y2(m+1:obs)];%dependent variable
z=ones(obs,1);%independent variables

%---------------------------------------------------------------------
%estimating change point of original x series with SSR Test
for k=lb:ub;
      betahat1=(inv(z(1:k)'*z(1:k)))*(z(1:k)'*y(1:k));
           for j=1:k;
```

```
            yhat1(j)=betahat1(1,1);
            residsq1(j)=(y(j)-yhat1(j)).^2;
        end;
    ssr1(k)=sum(residsq1(1:k));

    betahat2=(inv(z(k+1:obs)'*z(k+1:obs)))*(z(k+1:obs)'*y(k+1:obs));
        for jj=k+1:obs;
            yhat2(jj)=betahat2(1,1);
            residsq2(jj)=(y(jj)-yhat2(jj)).^2;
        end;
    ssr2(k)=sum(residsq2(k+1:obs));
ssr(k)=ssr1(k)+ssr2(k);
end;
min_ssr=min(ssr(lb:ub));
m_hat=find(ssr==min_ssr);
%--------------------------------------------------------------------
y1_mhat=y(1:m_hat);%first y subsample before new estimated change point
y2_mhat=y(m_hat+1:obs);%second y subsample after new estimated change point
  bhat1=(inv(z(1:m_hat)'*z(1:m_hat)))*(z(1:m_hat)'*y1_mhat);
  bhat2=(inv(z(m_hat+1:obs)'*z(m_hat+1:obs)))*(z(m_hat+1:obs)'*y2_mhat);
%estimated y
yhat1=bhat1(1,1);
yhat2=bhat2(1,1);
yhat=[yhat1;yhat2];
%estimated residuals
e1_mhat=y1_mhat-yhat1;
e2_mhat=y2_mhat-yhat2;
e_mhat=[e1_mhat;e2_mhat];
  mean_e_mhat=mean(e_mhat);
e_tilde=e_mhat-mean_e_mhat;%e_tilde
```

2. DGP and estimate a single change point under Model B.1 and B.2

```
% Estimating change point (m_hat) and Calculating E-tilde under Model B with SSR

clear all;
clc;

obs=1000;
m=(3/4)*obs;
lb=0.05*obs;
ub=obs-lb;

u=random('norm',0,1,obs,1);
e1=zeros(m,1); e2=zeros(obs-m,1);
y1=zeros(m,1); y2=zeros(obs-m,1);

%error process
for t=2:m; e1(1)=0;
   e1(t)=0.1*e1(t-1)+u(t);
end;
for t=m+1:obs; e2(m)=e1(m);
   e2(t)=0.2*e2(t-1)+u(t);
end;

%dependent variable
for t=1:m;
   y1(t)=1+e1(t);
end;
for t=m+1:obs;
   y2(t)=3+e2(t);
end;

%data set
y=[y1;y2(m+1:obs)];%dependent variable
z=ones(obs,1);%independent variables

%----------------------------------------------------------------------
%estimating change point of original x series with SSR Test
for k=lb:ub;
      betahat1=(inv(z(1:k)'*z(1:k)))*(z(1:k)'*y(1:k));
          for j=1:k;
             yhat1(j)=betahat1(1,1);
             residsq1(j)=(y(j)-yhat1(j)).^2;
          end;
      ssr1(k)=sum(residsq1(1:k));
```

```
       betahat2=(inv(z(k+1:obs)'*z(k+1:obs)))*(z(k+1:obs)'*y(k+1:obs));
            for jj=k+1:obs;
                yhat2(jj)=betahat2(1,1);
                residsq2(jj)=(y(jj)-yhat2(jj)).^2;
            end;
      ssr2(k)=sum(residsq2(k+1:obs));
ssr(k)=ssr1(k)+ssr2(k);
end;
min_ssr=min(ssr(lb:ub));
m_hat=find(ssr==min_ssr);
%--------------------------------------------------------------------
y1_mhat=y(1:m_hat);%first y subsample before new estimated change point
y2_mhat=y(m_hat+1:obs);%second y subsample after new estimated change point
    bhat1=(inv(z(1:m_hat)'*z(1:m_hat)))*(z(1:m_hat)'*y1_mhat);
    bhat2=(inv(z(m_hat+1:obs)'*z(m_hat+1:obs)))*(z(m_hat+1:obs)'*y2_mhat);
%estimated y
yhat1=bhat1(1,1);
yhat2=bhat2(1,1);
yhat=[yhat1;yhat2];
%estimated residuals
e1_mhat=y1_mhat-yhat1;
e2_mhat=y2_mhat-yhat2;
e_mhat=[e1_mhat;e2_mhat];
    mean_e_mhat=mean(e_mhat);
e_tilde=e_mhat-mean_e_mhat;%e_tilde
```

3. Constructing confidence interval using circular block bootstrap (CBB)

```
% Bootstrap CI for SSR test

clear
clc

load etilde_lo_ar1_0.6_ssr1_1_new.mat

numit=1000;%number of iterations
blocksize=50;%length of block
result_star=zeros(numit,1);

temp_e_star=e_tilde;
        temp_e1_star=temp_e_star(1:m_hat);
        temp_e2_star=temp_e_star(m_hat+1:obs);

%calculating new y series as conversion from e_tilde
y1_star=bhat1(1,1)+temp_e1_star;
y2_star=bhat2(1,1)+temp_e2_star;
temp_y_star=[y1_star;y2_star];%new y series

%performing CBB on e_tilde and estimating change point based on e_tilde
data_e_star=[temp_e_star;temp_e_star(1:blocksize-1)];
data_y_star=[temp_y_star;temp_y_star(1:blocksize-1)];
matrix_data=[data_e_star data_y_star];
obs_new=numel(data_e_star);

numblock=floor(obs/blocksize);
blockran=random('unid',obs,numblock,numit);
obs_index=zeros(numblock*blocksize,numit);
index=1;
transformer=repmat((0:blocksize-1)',1,numit);
for i=1:blocksize:obs_new;
    obs_index(i:(i+blocksize-1),:)=repmat(blockran(index,:),blocksize,1)+transformer;
        if index < numblock
            index=index+1;
        end;
end;
resample_index=obs_index(1:numblock*blocksize,:);

%converting e_tilde into y_star
for b=1:numit;
temp=resample_index(:,b);
    sort_temp=sort(temp);
    obs_star=numel(sort_temp);
```

```
e_star=matrix_data(:,1);
   e_star=e_star(sort_temp);
y_star=matrix_data(:,2);
   y_star=y_star(sort_temp);
z_star=ones(numel(e_star),1);
%-------------------------------------------------------------------
%estimating change point of original y series with SSR Test
lb_star=0.02*obs_star;
ub_star=obs_star-lb_star;

for k=lb_star:ub_star;
      betahat1_star=(inv(z_star(1:k)'*z_star(1:k)))*(z_star(1:k)'*y_star(1:k));
         for j=1:k;
            yhat1_star(j)=betahat1_star(1,1);
            residsq1_star(j)=(y_star(j)-yhat1_star(j)).^2;
         end;
      ssr1_star(k)=sum(residsq1_star(1:k));


betahat2_star=(inv(z_star(k+1:obs_star)'*z_star(k+1:obs_star)))*(z_star(k+1:obs_star)'*y_star(k
+1:obs_star));
         for jj=k+1:obs;
            yhat2_star(jj)=betahat2_star(1,1);
            residsq2_star(jj)=(y_star(jj)-yhat2_star(jj)).^2;
         end;
      ssr2_star(k)=sum(residsq2_star(k+1:obs));
ssr_star(k)=ssr1_star(k)+ssr2_star(k);
end;
min_ssr_star=min(ssr_star(lb_star:ub_star));
m_hat_star_temp=find(ssr_star==min_ssr_star);
m_hat_star=sort_temp(m_hat_star_temp);
%-------------------------------------------------------------------
result_star(b,1)=m_hat_star_temp;
end;
%-------------------------------------------------------------------
%normal confidence interval
est_cp=sort(result_star);
mean_est_cp=mean(result_star);
std_est_cp=std(result_star);
errsq=(result_star-mean_est_cp).^2;
rmse=sqrt(sum(errsq)/numit);

alpha=0.1;
ci=1-alpha;
bins=10;
```

```
% %confidence interval
% maxb=(1-(alpha/2))*(numit);
% minb=(numit)-maxb;
% bmin=est_cp(minb);
% bmax=est_cp(maxb);
% range=bmax-bmin;
% %histogram CI
% figure;
% hist(est_cp,bins);
%      hold on;
%      ylim=get(gca,'YLim');
%          plot(bmin*[1,1],ylim,'r--','LineWidth',1);
%          plot(bmax*[1,1],ylim,'r--','LineWidth',1);
%          plot(m*[1,1],ylim,'g-','LineWidth',1);
%       annotation('textbox',...
%       [0.65 0.7 0.25 0.20],...
%       'String',{ ['True Break=' num2str(m)], ['Mean=' num2str(mean_est_cp)],['St.Dev.='
num2str(std_est_cp)],...
%       ['RMSE=' num2str(rmse)], ['Lower Bound=' num2str(bmin)], ['Upper Bound='
num2str(bmax)],...
%       ['Range=' num2str(range)], ['Block Size=' num2str(blocksize)]});

%shortest confidence interval
for i=1:numit-(ci*numit);
      d(i)=est_cp(numit-(round(alpha*numit))-1+i)-est_cp(i);
end
d_min=min(d);
d_num=find(d==d_min);
d_num=min(d_num);
lowerb=est_cp(d_num);
upperb=est_cp(numit-(round(alpha*numit))-1+d_num);
range=upperb-lowerb;
%histogram of shortest CI
figure;
hist(est_cp,bins);
     hold on;
     ylim=get(gca,'YLim');
         plot(max(lowerb)*[1,1],ylim,'r--','LineWidth',1);
         plot(min(upperb)*[1,1],ylim,'r--','LineWidth',1);
         plot(m*[1,1],ylim,'g-','LineWidth',1);
      annotation('textbox',...
      [0.65 0.7 0.25 0.20],...
      'String',{ ['True Break=' num2str(m)], ['Mean=' num2str(mean_est_cp)],['St.Dev.='
num2str(std_est_cp)],...
      ['RMSE=' num2str(rmse)], ['Lower Bound=' num2str(lowerb)], ['Upper Bound='
num2str(upperb)],...
```

```
    ['Range=' num2str(range)], ['Block Size=' num2str(blocksize)]});
```

4. Constructing confidence interval using block bootstrap (BB)

```
% Bootstrap CI for SSR test

clear
clc

load etilde_lo_ar1_0.6_ssr1_1.mat

numit=10000;%number of iterations
blocksize=100;%length of block
result_star=zeros(numit,1);

temp_e_star=e_tilde;
        temp_e1_star=temp_e_star(1:m_hat);
        temp_e2_star=temp_e_star(m_hat+1:obs);

%calculating new y series as conversion from e_tilde
y1_star=bhat1(1,1)+temp_e1_star;
y2_star=bhat2(1,1)+temp_e2_star;
temp_y_star=[y1_star;y2_star];%new y series

%performing CBB on e_tilde and estimating change point based on e_tilde
data_e_star=temp_e_star;
data_y_star=temp_y_star;
matrix_data=[data_e_star data_y_star];
obs_new=numel(data_e_star);

numblock=floor(obs/blocksize);
blockran=random('unid',obs-(blocksize-1),numblock,numit);
obs_index=zeros(numblock*blocksize,numit);
index=1;
transformer=repmat((0:blocksize-1)',1,numit);
for i=1:blocksize:obs;
    obs_index(i:(i+blocksize-1),:)=repmat(blockran(index,:),blocksize,1)+transformer;
        if index < numblock
            index=index+1;
        end;
end;
resample_index=obs_index(1:numblock*blocksize,:);

%converting e_tilde into y_star
```

```
for b=1:numit;
temp=resample_index(:,b);
   sort_temp=sort(temp);
   obs_star=numel(sort_temp);
e_star=matrix_data(:,1);
   e_star=e_star(sort_temp);
y_star=matrix_data(:,2);
   y_star=y_star(sort_temp);
z_star=ones(numel(e_star),1);
%-----------------------------------------------------------------------
%estimating change point of original y series with SSR Test
lb_star=0.02*obs_star;
ub_star=obs_star-lb_star;

for k=lb_star:ub_star;
      betahat1_star=(inv(z_star(1:k)'*z_star(1:k)))*(z_star(1:k)'*y_star(1:k));
         for j=1:k;
            yhat1_star(j)=betahat1_star(1,1);
            residsq1_star(j)=(y_star(j)-yhat1_star(j)).^2;
         end;
      ssr1_star(k)=sum(residsq1_star(1:k));


betahat2_star=(inv(z_star(k+1:obs_star)'*z_star(k+1:obs_star)))*(z_star(k+1:obs_star)'*y_star(k
+1:obs_star));
         for jj=k+1:obs;
            yhat2_star(jj)=betahat2_star(1,1);
            residsq2_star(jj)=(y_star(jj)-yhat2_star(jj)).^2;
         end;
      ssr2_star(k)=sum(residsq2_star(k+1:obs));
ssr_star(k)=ssr1_star(k)+ssr2_star(k);
end;
min_ssr_star=min(ssr_star(lb_star:ub_star));
m_hat_star_temp=find(ssr_star==min_ssr_star);
m_hat_star=sort_temp(m_hat_star_temp);
%-----------------------------------------------------------------------
result_star(b,1)=m_hat_star_temp;
end;
%-----------------------------------------------------------------------
%normal confidence interval
est_cp=sort(result_star);
mean_est_cp=mean(result_star);
std_est_cp=std(result_star);
errsq=(result_star-mean_est_cp).^2;
rmse=sqrt(sum(errsq)/numit);
```

```
alpha=0.1;
ci=1-alpha;
bins=10;

% %confidence interval
% maxb=(1-(alpha/2))*(numit);
% minb=(numit)-maxb;
% bmin=est_cp(minb);
% bmax=est_cp(maxb);
% range=bmax-bmin;
% %histogram CI
% figure;
% hist(est_cp,bins);
%     hold on;
%     ylim=get(gca,'YLim');
%         plot(bmin*[1,1],ylim,'r--','LineWidth',1);
%         plot(bmax*[1,1],ylim,'r--','LineWidth',1);
%         plot(m*[1,1],ylim,'g-','LineWidth',1);
%      annotation('textbox',...
%      [0.65 0.7 0.25 0.20],...
%      'String',{ ['True Break=' num2str(m)], ['Mean=' num2str(mean_est_cp)],['St.Dev.='
num2str(std_est_cp)],...
%      ['RMSE=' num2str(rmse)], ['Lower Bound=' num2str(bmin)], ['Upper Bound='
num2str(bmax)],...
%      ['Range=' num2str(range)], ['Block Size=' num2str(blocksize)]});

%shortest confidence interval
for i=1:numit-(ci*numit);
    d(i)=est_cp(numit-(round(alpha*numit))-1+i)-est_cp(i);
end
d_min=min(d);
d_num=find(d==d_min);
d_num=min(d_num);
lowerb=est_cp(d_num);
upperb=est_cp(numit-(round(alpha*numit))-1+d_num);
range=upperb-lowerb;
%histogram of shortest CI
figure;
hist(est_cp,bins);
    hold on;
    ylim=get(gca,'YLim');
        plot(max(lowerb)*[1,1],ylim,'r--','LineWidth',1);
        plot(min(upperb)*[1,1],ylim,'r--','LineWidth',1);
        plot(m*[1,1],ylim,'g-','LineWidth',1);
     annotation('textbox',...
     [0.65 0.7 0.25 0.20],...
```

```
    'String',{ ['True Break=' num2str(m)], ['Mean=' num2str(mean_est_cp)],['St.Dev.='
num2str(std_est_cp)],...
    ['RMSE=' num2str(rmse)], ['Lower Bound=' num2str(lowerb)], ['Upper Bound='
num2str(upperb)],...
    ['Range=' num2str(range)], ['Block Size=' num2str(blocksize)]});
```

Appendix – E

Data

Appendix – E

Raw Data for **Chapter 2**.

Month	IDR/USD	Res.Indo	CHF/USD	DEM/USD	JPY/USD	EUR/USD
1970M01	326		4.31	3.6885	357.68	
1970M02	326		4.3	3.6895	357.56	
1970M03	326		4.31	3.6631	357.53	
1970M04	378		4.3	3.6353	358.45	
1970M05	378		4.32	3.633	358.9	
1970M06	378		4.32	3.6308	358.7	
1970M07	378		4.3	3.6309	358.7	
1970M08	378		4.3	3.631	358.21	
1970M09	378		4.33	3.632	357.9	
1970M10	378		4.33	3.6313	357.61	
1970M11	378		4.31	3.6317	357.59	
1970M12	378		4.32	3.648	357.65	
1971M01	378		4.3	3.6314	357.55	
1971M02	378	-0.04829	4.31	3.634	357.4	
1971M03	378	0.18144	4.3	3.63	357.39	
1971M04	378	-0.18601	4.3	3.6321	357.39	
1971M05	378	-0.21156	4.1	3.5499	357.37	
1971M06	378	-0.20868	4.1	3.4971	357.37	
1971M07	378	0.548766	4.09	3.4601	357.37	
1971M08	415	-0.17614	3.98	3.396	339	
1971M09	415	-0.01524	3.95	3.3175	334.21	
1971M10	415	0.087697	3.99	3.3364	329.3	
1971M11	415	0.01805	3.95	3.3092	327.65	
1971M12	415	-0.2708	3.92	3.2685	314.8	
1972M01	415	0.320708	3.87	3.209	310.45	
1972M02	415	-0.1066	3.87	3.1873	304.2	
1972M03	415	0.226602	3.84	3.1685	304.2	
1972M04	415	0.148223	3.86	3.1786	304.8	
1972M05	415	-0.02876	3.84	3.1767	304.55	
1972M06	415	0.2189	3.77	3.1555	301.1	
1972M07	415	0.083017	3.77	3.1749	301.1	
1972M08	415	-0.05416	3.78	3.1897	301.1	
1972M09	415	0.273447	3.8	3.2021	301.1	
1972M10	415	0.112333	3.8	3.2041	301.1	
1972M11	415	0.045881	3.78	3.1956	301.1	
1972M12	415	0.042772	3.77	3.2015	302	
1973M01	415	0.020795	3.62	3.1575	301.15	
1973M02	415	-0.15257	3.13	2.843	270	

1973M03	415	0.158477	3.24	2.8385	265.83
1973M04	415	-0.05312	3.24	2.8372	265.5
1973M05	415	-0.06011	3.1	2.73	264.95
1973M06	415	0.154803	2.96	2.425	265.3
1973M07	415	0.07705	2.87	2.352	263.45
1973M08	415	0.007393	3.03	2.4633	265.3
1973M09	415	0.116201	3.02	2.4155	265.7
1973M10	415	-0.02319	3.1	2.4445	266.83
1973M11	415	-0.0715	3.2	2.6185	280
1973M12	415	0.018762	3.24	2.703	280
1974M01	415	0.088274	3.29	2.7822	299
1974M02	415	-0.07469	3.12	2.6673	287.6
1974M03	415	0.033345	3	2.523	276
1974M04	415	0.314225	2.92	2.447	279.75
1974M05	415	0.006209	2.98	2.529	281.9
1974M06	415	0.103412	3	2.555	284.1
1974M07	415	0.283713	2.98	2.587	297.8
1974M08	415	-0.07641	3.01	2.664	302.7
1974M09	415	-0.08568	2.95	2.6527	298.5
1974M10	415	0.229502	2.87	2.5798	299.85
1974M11	415	-0.22049	2.72	2.477	300.1
1974M12	415	-0.23505	2.54	2.4095	300.95
1975M01	415	0.044857	2.5	2.341	297.85
1975M02	415	-0.21704	2.4	2.2845	286.6
1975M03	415	-0.40471	2.53	2.345	293.8
1975M04	415	-0.0276	2.55	2.378	293.3
1975M05	415	-0.67055	2.5	2.3465	291.35
1975M06	415	0.207401	2.51	2.3548	296.35
1975M07	415	0.235615	2.71	2.5765	297.35
1975M08	415	-0.34376	2.68	2.5847	297.9
1975M09	415	0.07881	2.75	2.6615	302.7
1975M10	415	0.543844	2.62	2.5552	301.8
1975M11	415	-0.31625	2.68	2.6276	303
1975M12	415	0.02367	2.62	2.6223	305.15
1976M01	415	0.571302	2.6	2.5943	303.7
1976M02	415	-0.1985	2.56	2.5645	302.25
1976M03	415	-0.14316	2.53	2.5383	299.7
1976M04	415	0.443809	2.51	2.536	299.4
1976M05	415	-0.10182	2.44	2.5945	299.95
1976M06	415	-0.13437	2.47	2.5742	297.4
1976M07	415	0.404208	2.48	2.543	293.4
1976M08	415	-0.08853	2.48	2.5269	288.75
1976M09	415	-0.08991	2.45	2.4365	287.45

1976M10	415	0.355811	2.44	2.4052	293.7
1976M11	415	-0.00326	2.44	2.4048	295.75
1976M12	415	-0.1328	2.45	2.3625	292.8
1977M01	415	0.203453	2.52	2.4214	289.3
1977M02	415	0.008958	2.55	2.3947	282.7
1977M03	415	-0.00239	2.54	2.3887	277.5
1977M04	415	0.233652	2.52	2.3589	277.7
1977M05	415	-0.04431	2.5	2.3564	277.3
1977M06	415	-0.11432	2.46	2.338	267.7
1977M07	415	0.154836	2.4	2.2878	266
1977M08	415	-0.00583	2.4	2.3219	267.3
1977M09	415	-0.08929	2.23	2.3074	265.45
1977M10	415	0.17642	2.23	2.2528	250.6
1977M11	415	-0.04752	2.16	2.2278	245.7
1977M12	415	-0.20099	2	2.105	240
1978M01	415	0.058041	1.98	2.1118	241.4
1978M02	415	-0.14611	1.87	2.036	238.7
1978M03	415	-0.07129	1.87	2.023	222.4
1978M04	415	0.123532	1.93	2.0678	222.9
1978M05	415	-0.12137	1.91	2.1008	223.4
1978M06	415	-0.0776	1.86	2.0753	204.7
1978M07	415	0.138426	1.74	2.0413	190.7
1978M08	415	-0.12115	1.65	1.9865	190.2
1978M09	415	-0.12001	1.54	1.9386	189.15
1978M10	415	0.149622	1.47	1.7367	176
1978M11	625	-0.31102	1.72	1.9234	197.5
1978M12	625	-0.09597	1.62	1.828	194.6
1979M01	625	0.157652	1.69	1.8616	201.3
1979M02	622.25	-0.03134	1.67	1.8515	202.2
1979M03	623.5	0.012884	1.69	1.8676	209.3
1979M04	625.25	0.094723	1.72	1.9019	218.5
1979M05	626.25	0.030535	1.72	1.9091	219.8
1979M06	625.75	-0.05949	1.66	1.8482	217
1979M07	625.5	0.083036	1.66	1.8377	217.2
1979M08	625.75	-0.03525	1.66	1.8278	220
1979M09	625.5	-0.08518	1.56	1.7425	223.3
1979M10	627.25	0.214616	1.66	1.8066	237.7
1979M11	627.25	0.022385	1.61	1.73	248.8
1979M12	627	0.00012	1.58	1.7315	239.7
1980M01	627.25	0.170342	1.63	1.7394	238.8
1980M02	628.5	0.000106	1.69	1.7723	249.8
1980M03	629	-0.01196	1.83	1.9419	249.7
1980M04	628.5	0.058202	1.67	1.8015	239

1980M05	626.25	0.040863	1.66	1.786	224.3
1980M06	625.25	0.05245	1.62	1.7582	217.6
1980M07	626.5	0.135374	1.66	1.7851	227
1980M08	625.75	-0.03508	1.65	1.7923	219
1980M09	625.75	-0.03995	1.65	1.8113	212.2
1980M10	626.5	0.126121	1.72	1.9092	211.5
1980M11	627.5	-0.08002	1.74	1.9257	216.7
1980M12	626.75	-0.02799	1.76	1.959	203
1981M01	628.25	0.18879	1.93	2.1167	204.7
1981M02	628.5	-0.06827	1.96	2.1295	208.8
1981M03	628	0.085298	1.91	2.1018	211
1981M04	629	0.129228	2.02	2.2145	215
1981M05	630	-0.04975	2.07	2.3274	224.1
1981M06	631.25	-0.08421	2.03	2.3909	225.8
1981M07	633.5	0.153231	2.14	2.4645	239.45
1981M08	633	-0.09574	2.12	2.429	228
1981M09	633.75	-0.14371	1.97	2.3225	232.7
1981M10	634.75	0.055817	1.85	2.2542	233.8
1981M11	634.5	-0.1284	1.77	2.2035	214.3
1981M12	644	-0.15276	1.8	2.2548	219.9
1982M01	646.75	0.110412	1.84	2.3085	230.5
1982M02	649.75	0.005143	1.89	2.386	237
1982M03	651.75	-0.00716	1.93	2.4142	246.5
1982M04	651.75	-0.09765	1.96	2.3327	235.1
1982M05	654	-0.05389	2	2.3452	243.5
1982M06	657.25	-0.16785	2.1	2.4598	254
1982M07	659.75	0.033048	2.09	2.4545	257.5
1982M08	665	-0.1596	2.12	2.4972	261.7
1982M09	671.25	-0.00971	2.17	2.5276	269.5
1982M10	681	0.013426	2.22	2.5668	277.3
1982M11	684	-0.09957	2.14	2.4872	253.1
1982M12	692.5	-0.09188	1.99	2.3765	235
1983M01	696.25	-0.01754	2	2.4475	237.9
1983M02	700.5	-0.09502	2.04	2.4212	235.45
1983M03	702.5	-0.49808	2.08	2.4265	239.4
1983M04	968	0.087215	2.06	2.4581	237
1983M05	969	0.184935	2.09	2.519	238.3
1983M06	974	0.070927	2.1	2.5419	239.7
1983M07	981	0.170493	2.13	2.6435	241.7
1983M08	984	0.115381	2.19	2.7068	246.6
1983M09	982	-0.00491	2.13	2.6391	236.1
1983M10	984	0.032172	2.14	2.6264	233.65
1983M11	991	0.01623	2.16	2.697	234

1983M12	994	0.00438	2.18	2.7238	232.2
1984M01	995	0.033172	2.24	2.8139	234.75
1984M02	993	0.033023	2.17	2.6058	233.5
1984M03	1000	0.007565	2.15	2.59	224.7
1984M04	1005	0.049848	2.24	2.7174	225.95
1984M05	1009	0.015497	2.26	2.7333	231.5
1984M06	1014	0.057446	2.33	2.7842	237.5
1984M07	1027	0.097047	2.46	2.8964	245.5
1984M08	1048	-0.03687	2.41	2.887	241.3
1984M09	1059	0.067435	2.5	3.0253	245.5
1984M10	1061	-0.00472	2.49	3.0296	245.25
1984M11	1067	0.010298	2.55	3.0963	246.3
1984M12	1074	0.019795	2.59	3.148	251.1
1985M01	1082	0.026566	2.68	3.1677	254.65
1985M02	1092	0.036101	2.83	3.3225	259.5
1985M03	1102	-0.02112	2.62	3.093	252.5
1985M04	1109	-0.01307	2.59	3.0902	252.25
1985M05	1117	0.006784	2.61	3.0892	251.85
1985M06	1118	-0.05374	2.56	3.0607	248.95
1985M07	1116	-0.09157	2.28	2.7884	236.65
1985M08	1119	-0.00277	2.28	2.7818	237.25
1985M09	1121	-0.04402	2.18	2.6699	217
1985M10	1123	0.003972	2.15	2.6168	211.5
1985M11	1122	-0.00771	2.08	2.512	202
1985M12	1125	-0.07616	2.08	2.4613	200.5
1986M01	1127	-0.00718	2.03	2.3892	191.8
1986M02	1128	-0.04228	1.87	2.2185	179.7
1986M03	1125	-0.04235	1.94	2.3175	179.6
1986M04	1124	-0.02176	1.83	2.1865	168.3
1986M05	1130	0.011709	1.92	2.3127	171.8
1986M06	1131	-0.07279	1.8	2.1986	165
1986M07	1131	-0.03816	1.68	2.094	154.3
1986M08	1132	-0.01587	1.66	2.052	156.1
1986M09	1633	-0.45254	1.64	2.0207	153.6
1986M10	1640	0.018012	1.72	2.0676	161.5
1986M11	1650	-0.03261	1.65	1.9773	162.4
1986M12	1641	-0.13849	1.62	1.9408	159.1
1987M01	1633	-0.19329	1.52	1.8085	152.5
1987M02	1644	0.094963	1.54	1.8268	153.05
1987M03	1644	0.009077	1.51	1.8051	145.8
1987M04	1641	0.090911	1.46	1.7864	139.5
1987M05	1649	-0.06077	1.51	1.8215	144
1987M06	1648	0.014597	1.52	1.8299	147

1987M07	1640	0.292831	1.54	1.8554	149.3
1987M08	1640	-0.10426	1.5	1.8152	142.4
1987M09	1650	0.006145	1.53	1.8383	146.35
1987M10	1648	-0.0425	1.44	1.7393	138.6
1987M11	1650	0.000362	1.34	1.6354	132.55
1987M12	1650	-0.01698	1.28	1.5815	123.5
1988M01	1662	-0.04149	1.36	1.6759	127.2
1988M02	1660	0.037894	1.39	1.6884	128
1988M03	1660	0.032656	1.37	1.6593	125.4
1988M04	1669	-0.02381	1.39	1.6683	124.85
1988M05	1673	0.036164	1.44	1.7267	125.25
1988M06	1688	0.049753	1.51	1.8211	132.4
1988M07	1693	-0.05745	1.56	1.881	132.55
1988M08	1699	0.029631	1.58	1.8748	135
1988M09	1706	0.000302	1.59	1.8798	134.55
1988M10	1715	-0.122	1.49	1.7684	125.75
1988M11	1721	0.043264	1.45	1.7354	121.75
1988M12	1731	0.027294	1.5	1.7803	125.85
1989M01	1740	-0.02627	1.59	1.8646	129.15
1989M02	1745	-0.03723	1.56	1.8296	127
1989M03	1756	0.108175	1.66	1.8927	132.05
1989M04	1759	0.078317	1.67	1.8783	132.45
1989M05	1771	-0.0426	1.71	1.9858	142.7
1989M06	1773	-0.14175	1.67	1.9525	144.1
1989M07	1774	0.028747	1.61	1.866	138.35
1989M08	1785	-0.02669	1.69	1.9604	144.3
1989M09	1783	-0.04102	1.62	1.8683	139.3
1989M10	1791	0.038069	1.61	1.8375	142.3
1989M11	1791	-0.02784	1.6	1.7895	142.95
1989M12	1797	0.159999	1.55	1.6978	143.45
1990M01	1805	-0.10127	1.49	1.6826	144.15
1990M02	1812	-0.04523	1.49	1.6918	148.4
1990M03	1823	0.058432	1.5	1.6944	157.2
1990M04	1829	-0.15804	1.46	1.6803	159.35
1990M05	1836	-0.17405	1.42	1.691	151.7
1990M06	1844	0.153502	1.42	1.6715	152.9
1990M07	1849	0.088542	1.35	1.596	147.35
1990M08	1858	0.005302	1.29	1.5622	144.25
1990M09	1864	-0.04543	1.3	1.5641	137.8
1990M10	1872	0.039683	1.29	1.5191	129.35
1990M11	1884	0.050958	1.28	1.505	133.35
1990M12	1901	0.210844	1.3	1.494	134.4
1991M01	1912	-0.04913	1.27	1.49	131.2

1991M02	1920	0.187416	1.32	1.5202	132
1991M03	1932	0.045671	1.46	1.717	141
1991M04	1939	-0.00022	1.46	1.7325	137.4
1991M05	1947	0.041508	1.47	1.7247	137.9
1991M06	1954	0.086922	1.56	1.812	137.9
1991M07	1959	-0.04373	1.52	1.7458	137.8
1991M08	1965	-0.01091	1.52	1.7408	137.15
1991M09	1968	-0.04957	1.45	1.6631	132.85
1991M10	1977	0.019431	1.47	1.6731	130.9
1991M11	1985	0.055837	1.44	1.6318	130.05
1991M12	1992	-0.06594	1.36	1.516	125.2
1992M01	2004	0.075805	1.43	1.6137	125.75
1992M02	2010	0.008145	1.49	1.6378	129.28
1992M03	2017	0.043279	1.5	1.6427	133.2
1992M04	2022	0.062142	1.52	1.6598	133.5
1992M05	2027	0.009975	1.46	1.6128	128.25
1992M06	2033	-0.05583	1.38	1.527	125.5
1992M07	2035	-0.01666	1.32	1.479	127.2
1992M08	2034	-0.02808	1.26	1.4097	122.9
1992M09	2038	-0.07059	1.23	1.4093	119.2
1992M10	2050	0.073763	1.37	1.537	123.2
1992M11	2059	0.064886	1.45	1.6015	124.7
1992M12	2062	-0.02313	1.46	1.614	124.75
1993M01	2066	0.048074	1.47	1.5935	124.6
1993M02	2067	0.041471	1.52	1.643	117.7
1993M03	2071	-0.01083	1.5	1.6143	116.35
1993M04	2074	-0.03458	1.43	1.5802	111.15
1993M05	2078	-0.01831	1.43	1.594	106.497
1993M06	2088	0.055608	1.51	1.6882	106.75
1993M07	2096	-0.00369	1.52	1.7397	105.9
1993M08	2102	-0.02845	1.47	1.6683	104.2
1993M09	2108	-0.02421	1.42	1.6199	105.15
1993M10	2106	0.038601	1.48	1.6753	108.2
1993M11	2106	0.010776	1.49	1.711	108.95
1993M12	2110	-0.0052	1.48	1.7263	111.85
1994M01	2122	-0.00749	1.46	1.7414	109.9
1994M02	2137	-0.00242	1.43	1.7136	104.15
1994M03	2143	-0.01999	1.41	1.672	103.15
1994M04	2149	-0.08147	1.41	1.664	102.5
1994M05	2155	-0.02872	1.4	1.6412	104.47
1994M06	2160	-0.01362	1.34	1.5954	99.05
1994M07	2169	-0.02322	1.35	1.5958	99.75
1994M08	2175	0.045306	1.33	1.583	99.55

1994M09	2181	-0.03598	1.29	1.5483	98.45
1994M10	2186	-0.01479	1.26	1.512	97.38
1994M11	2193	0.129499	1.33	1.5708	98.92
1994M12	2200	-0.03641	1.31	1.5488	99.74
1995M01	2207	-0.04643	1.28	1.5088	98.55
1995M02	2212	-0.03185	1.24	1.4611	97.05
1995M03	2219	-0.05942	1.14	1.3837	89.35
1995M04	2227	-0.00088	1.14	1.3812	83.75
1995M05	2236	0.010089	1.15	1.3887	83.2
1995M06	2246	0.031655	1.15	1.3837	84.6
1995M07	2256	0.024846	1.15	1.3805	88.43
1995M08	2266	0.037098	1.2	1.4665	99.1
1995M09	2275	-0.05257	1.14	1.4188	98.3
1995M10	2285	-0.00504	1.14	1.4134	101.7
1995M11	2296	0.040361	1.17	1.4367	101.55
1995M12	2308	-0.00836	1.15	1.4335	102.83
1996M01	2311	0.057751	1.22	1.4918	107.25
1996M02	2322	0.065043	1.2	1.4667	104.7
1996M03	2337	-0.01344	1.19	1.4757	106.28
1996M04	2342	0.037759	1.24	1.5294	104.8
1996M05	2354	0.011738	1.26	1.5341	108.2
1996M06	2342	0.040238	1.25	1.5219	109.42
1996M07	2353	-0.06052	1.19	1.4704	107.92
1996M08	2363	0.002274	1.2	1.4809	108.44
1996M09	2340	0.057581	1.26	1.5268	110.97
1996M10	2352	0.004921	1.26	1.5126	113.8
1996M11	2368	0.106191	1.3	1.5344	113.77
1996M12	2383	0.10788	1.35	1.5548	116
1997M01	2396	0.086514	1.42	1.6336	122
1997M02	2406	0.037273	1.48	1.6912	120.78
1997M03	2419	-0.02047	1.45	1.6778	124.05
1997M04	2433	0.033619	1.47	1.7274	126.85
1997M05	2440	-0.0106	1.41	1.7	116.45
1997M06	2450	0.038225	1.46	1.7441	114.4
1997M07	2599	-0.02619	1.51	1.8325	118.25
1997M08	3035	-0.22587	1.48	1.794	119.35
1997M09	3275	-0.04556	1.45	1.7655	121
1997M10	3670	-0.25419	1.4	1.723	119.95
1997M11	3648	0.004836	1.43	1.7637	127.55
1997M12	4650	-0.3106	1.46	1.7921	129.95
1998M01	10375	-0.69852	1.47	1.8265	126.9
1998M02	8750	0.005663	1.47	1.8112	127.25
1998M03	8325	0.10488	1.52	1.8468	132.05

1998M04	7500	0.159408	1.5	1.7948	132.3	
1998M05	10525	-0.27272	1.48	1.7823	139.05	
1998M06	14900	-0.33217	1.52	1.8087	140.85	
1998M07	13000	0.15383	1.49	1.7795	143.7	
1998M08	11075	0.158505	1.46	1.7723	141.46	
1998M09	10700	0.020675	1.39	1.6759	135.25	
1998M10	7550	0.376535	1.35	1.6508	116.4	
1998M11	7300	0.12741	1.41	1.702	123.65	
1998M12	8025	-0.07379	1.38	1.673	115.6	
1999M01	8950	-0.03436	1.42		116.2	0.878426
1999M02	8730	0.039997	1.44		119.4	0.907606
1999M03	8685	0.100203	1.49		120.4	0.930925
1999M04	8260	0.063164	1.52		119.33	0.943663
1999M05	8105	0.040487	1.52		121.42	0.956389
1999M06	6726	0.240928	1.55		121.1	0.968242
1999M07	6875	-0.07392	1.5		115.2	0.935104
1999M08	7565	-0.07142	1.52		110.82	0.945805
1999M09	8386	-0.1224	1.5		106.85	0.937647
1999M10	6900	0.227394	1.53		104.85	0.956938
1999M11	7425	-0.03583	1.59		102.5	0.990393
1999M12	7085	0.058901	1.6		102.2	0.995421
2000M01	7425	-0.00246	1.64		106.85	1.021346
2000M02	7505	0.017805	1.65		110.18	1.029442
2000M03	7590	0.03224	1.67		105.85	1.046792
2000M04	7945	-0.02599	1.73		106.55	1.100715
2000M05	8620	-0.11456	1.69		106.65	1.074922
2000M06	8735	-0.02253	1.63		105.4	1.046463
2000M07	9003	-0.01357	1.67		109.5	1.0819
2000M08	8290	0.216388	1.73		106.4	1.122839
2000M09	8780	-0.13804	1.74		107.85	1.140901
2000M10	9395	-0.05324	1.81		109.05	1.188072
2000M11	9530	-0.05384	1.74		111.17	1.151543
2000M12	9595	-0.04796	1.64		114.9	1.074691
2001M01	9450	0.028885	1.64		116.15	1.076079
2001M02	9835	-0.0335	1.67		116.4	1.081315
2001M03	10400	-0.03298	1.73		124.6	1.132246
2001M04	11675	-0.11792	1.73		123.45	1.126634
2001M05	11058	0.087856	1.79		119.2	1.179245
2001M06	11440	-0.03396	1.8		124.05	1.179245
2001M07	9525	0.15119	1.72		124.8	1.142204
2001M08	8865	0.012528	1.65		118.95	1.091941
2001M09	9675	-0.09703	1.61		119.3	1.09517
2001M10	10435	-0.08376	1.62		121.82	1.10595

Appendix - E

2001M11	10430	0.002003	1.65	123.95	1.123848
2001M12	10400	0.016171	1.68	131.8	1.134687
2002M01	10320	0.010637	1.7	132.9	1.157809
2002M02	10189	0.021096	1.71	133.9	1.155936
2002M03	9655	0.042919	1.68	133.2	1.146263
2002M04	9316	0.003073	1.62	128	1.110124
2002M05	8785	0.038552	1.56	124.4	1.065303
2002M06	8730	-0.03048	1.48	119.45	1.002506
2002M07	9108	0.000569	1.49	119.85	1.022181
2002M08	8867	0.022892	1.49	117.95	1.016984
2002M09	9015	-0.02627	1.48	121.55	1.014199
2002M10	9233	-0.02585	1.48	122.45	1.013788
2002M11	8976	0.031961	1.49	122.3	1.007354
2002M12	8940	0.000428	1.39	119.9	0.953562
2003M01	8876	-0.01187	1.36	118.95	0.924556
2003M02	8905	-0.00145	1.36	117.75	0.927472
2003M03	8908	0.011964	1.35	120.15	0.917852
2003M04	8675	0.062549	1.36	119.6	0.898392
2003M05	8279	0.009756	1.29	118.35	0.845881
2003M06	8285	0.04612	1.36	119.85	0.87512
2003M07	8505	-0.03082	1.37	120.1	0.883548
2003M08	8535	0.01981	1.41	117.05	0.915164
2003M09	8389	-0.03647	1.32	111.2	0.858222
2003M10	8495	0.022023	1.33	108.76	0.860437
2003M11	8537	-0.02837	1.29	109.5	0.83375
2003M12	8465	-0.0011	1.24	107.1	0.791766
2004M01	8441	0.012833	1.26	105.97	0.807494
2004M02	8447	0.011849	1.27	109	0.805283
2004M03	8587	0.023449	1.28	104.3	0.818063
2004M04	8661	-0.00036	1.3	110.2	0.83703
2004M05	9210	-0.11496	1.25	110.5	0.816593
2004M06	9415	-0.06546	1.25	108.38	0.822707
2004M07	9168	0.043514	1.28	112.08	0.830634
2004M08	9328	-0.0206	1.27	109.65	0.825696
2004M09	9170	0.005026	1.26	111	0.805867
2004M10	9090	-0.02689	1.2	106.13	0.785114
2004M11	9018	-0.02958	1.14	103.18	0.752162
2004M12	9290	-0.02133	1.13	104.12	0.73416
2005M01	9165	0.045184	1.17	104	0.760861
2005M02	9260	-0.00863	1.16	104.73	0.754318
2005M03	9480	-0.00902	1.2	107.35	0.771367
2005M04	9570	-0.00821	1.19	105.89	0.771784
2005M05	9495	0.008598	1.25	108.08	0.810964

2005M06	9713	-0.01571	1.28	110.4	0.826993
2005M07	9819	-0.0604	1.29	112.22	0.826925
2005M08	10240	-0.09235	1.27	111.3	0.819807
2005M09	10310	-0.02516	1.29	113.15	0.830427
2005M10	10090	0.092472	1.28	115.7	0.831739
2005M11	10035	0.048895	1.32	119.63	0.84969
2005M12	9830	0.064317	1.31	117.97	0.847673
2006M01	9395	0.025429	1.28	117.71	0.825219
2006M02	9230	0.061109	1.32	116.25	0.842105
2006M03	9075	0.133165	1.31	117.4	0.826173
2006M04	8775	0.053014	1.25	114.3	0.797639
2006M05	9220	-0.04699	1.21	112.24	0.777122
2006M06	9300	-0.08418	1.23	114.95	0.786596
2006M07	9070	0.046165	1.23	114.8	0.783269
2006M08	9100	0.018757	1.23	117.32	0.77815
2006M09	9235	0.01807	1.25	117.8	0.789889
2006M10	9110	-0.05217	1.25	117.65	0.78765
2006M11	9165	0.003424	1.21	116.4	0.757576
2006M12	9020	0.052045	1.22	118.95	0.759301
2007M01	9090	0.034914	1.25	121.68	0.771962
2007M02	9160	0.022533	1.22	118.48	0.756945
2007M03	9118	0.038435	1.22	117.65	0.750863
2007M04	9083	0.036066	1.21	119.6	0.735024
2007M05	8815	0.064304	1.23	121.62	0.743329
2007M06	9054	-0.00985	1.23	123.23	0.740466
2007M07	9186	-0.01313	1.21	118.95	0.729554
2007M08	9410	-0.03326	1.21	116.2	0.729661
2007M09	9137	0.024976	1.17	115.05	0.705268
2007M10	9103	0.01742	1.16	114.75	0.692185
2007M11	9376	-0.05028	1.12	110.3	0.677461
2007M12	9419	0.035979	1.13	114	0.679302
2008M01	9291	-0.04893	1.08	106.36	0.672495
2008M02	9051	0.013898	1.05	104.73	0.659326
2008M03	9217	-0.03509	0.99	100.1	0.632431
2008M04	9234	0.040023	1.04	104.08	0.643501
2008M05	9318	-0.02278	1.05	105.66	0.644828
2008M06	9225	0.013847	1.02	106.4	0.634357
2008M07	9118	0.060929	1.05	107.99	0.640574
2008M08	9153	0.006684	1.1	109.1	0.678656
2008M09	9378	-0.04521	1.1	104.3	0.699154
2008M10	10995	-0.23353	1.15	98.3	0.783883
2008M11	12151	-0.06319	1.21	95.25	0.785731
2008M12	10950	0.002445	1.06	90.75	0.718546

2009M01	11355	0.035236	1.16	89.6	0.780275
2009M02	11980	-0.05046	1.18	97.55	0.790889
2009M03	11575	0.088031	1.14	98.1	0.751428
2009M04	10713	0.108498	1.14	97.6	0.753296
2009M05	10340	0.001408	1.07	96.5	0.70932
2009M06	10225	0.012106	1.08	95.95	0.707514
2009M07	9920	0.030964	1.08	95.33	0.707314
2009M08	10060	-0.02556	1.06	92.7	0.700673
2009M09	9681	0.03332	1.03	89.77	0.68292
2009M10	9545	0.044464	1.02	91.38	0.675676
2009M11	9480	0.003176	1	86.75	0.665646
2009M12	9400	0.044852	1.03	92.06	0.694155
2010M01	9365	0.077942	1.05	89.85	0.716025
2010M02	9335	0.031889	1.08	89.25	0.73692
2010M03	9115	0.040115	1.06	93.25	0.741895
2010M04	9012	0.122972	1.08	94.06	0.751033
2010M05	9180	-0.0108	1.15	91.3	0.812546
2010M06	9083	-0.02645	1.08	88.6	0.81493
2010M07	8952	0.010619	1.04	86.5	0.767578
2010M08	9041	0.004415	1.02	84.25	0.788644
2010M09	8924	0.028531	0.97	83.4	0.732708
2010M10	8928	0.078108	0.99	80.58	0.721657
2010M11	9013	0.010538	1	84.15	0.769349
2010M12	8991	-0.02009	0.94	81.45	0.748391
2011M01	9057	-0.01161	0.94	82.05	0.730353
2011M02	8823	0.055073	0.93	81.7	0.722857
2011M03	8709	0.060831	0.91	83.13	0.703878
2011M04	8574	0.036574	0.87	82.06	0.672948
2011M05	8537	0.011993	0.85	80.85	0.695169
2011M06	8597	0.001814	0.83	80.72	0.691898
2011M07	8508	-0.00628	0.8	77.55	0.701262
2011M08	8578	0.016365	0.81	76.59	0.692042
2011M09	8823	-0.00757	0.9	76.63	0.740576
2011M10	8835	-0.0443	0.87	79.2	0.714235
2011M11	9170	-0.00383	0.92	78.05	0.745268
2011M12	9068	0.024973	0.94	77.72	0.772857
2012M01	9000	-0.00878	0.91	76.36	0.758956
2012M02	9085	-0.02718	0.9	80.65	0.743882
2012M03	9180	-0.01688	0.9	82.15	0.748727
2012M04	9190	0.060973	0.91	81.15	0.756773
2012M05	9565	-0.01846	0.97	78.8	0.806257
2012M06	9480	-0.05465	0.96	79.3	0.794281
2012M07	9485	0.022183	0.98	78.15	0.814067

2012M08	9560	-0.00999	0.95		78.45	0.792959
2012M09	9588	-0.0137	0.94		77.57	0.773395
2012M10	9615	-0.00777	0.93		79.64	0.769645
2012M11	9605	0.006402	0.93		82.45	0.77006
2012M12	9670	-0.00067	0.92		86.55	0.75792
2013M01	9698	-0.04836	0.91		87.65	0.738007
2013M02	9667	-0.00962	0.93		92.48	0.761673
2013M03	9719	0.013743	0.95		94.05	0.780945
2013M04	9722	0.013542	0.94		97.91	0.764994
2013M05	9802	-0.01322	0.95		101.03	0.768876
2013M06	9929	-0.09535	0.94		98.87	0.764526
2013M07	10278	-0.11019	0.93		98.06	0.753296
2013M08	10936	-0.06043	0.93		98.33	0.755572
2013M09	11613	-0.05531	0.91		97.75	0.740466
2013M10	11475	0.025123	0.9044		98.48	0.733
2013M11	11813	-0.02579	0.9048		101.37	0.7355
2013M12	12270	-0.02541	0.8915		105.3	0.7255

Appendix - E

Data (ready) for **Chapter 2**.

Month	Δidr	Δusd	Δjpy	Δdem	Δeur	Δemp
1970M01						
1970M02	-0.00023	-0.00023	0.000103	-0.0005		
1970M03	0.001161	0.001161	0.001245	0.008342		
1970M04	-0.14962	-0.00163	-0.0042	0.005992		
1970M05	0.00487	0.00487	0.003615	0.005502		
1970M06	-0.00139	-0.00139	-0.00083	-0.00078		
1970M07	-0.00302	-0.00302	-0.00302	-0.00304		
1970M08	-0.00046	-0.00046	0.000902	-0.00049		
1970M09	0.005794	0.005794	0.00666	0.005519		
1970M10	0.001616	0.001616	0.002427	0.001809		
1970M11	-0.00509	-0.00509	-0.00503	-0.0052		
1970M12	0.000927	0.000927	0.000759	-0.00355		
1971M01	-0.00441	-0.00441	-0.00413	0.000149		
1971M02	0.002092	0.002092	0.002512	0.001377		-0.04829
1971M03	-0.00256	-0.00256	-0.00253	-0.00146		0.18144
1971M04	0	0	0	-0.00058		-0.18601
1971M05	-0.04671	-0.04671	-0.04665	-0.02382		-0.21156
1971M06	-0.00049	-0.00049	-0.00049	0.014497		-0.20868
1971M07	-0.00244	-0.00244	-0.00244	0.008193		0.548766
1971M08	-0.11941	-0.02603	0.026745	-0.00733		-0.17614
1971M09	-0.00807	-0.00807	0.006162	0.015318		-0.01524
1971M10	0.009825	0.009825	0.024625	0.004144		0.087697
1971M11	-0.00932	-0.00932	-0.0043	-0.00113		0.01805
1971M12	-0.00941	-0.00941	0.030602	0.002969		-0.2708
1972M01	-0.01104	-0.01104	0.00287	0.007328		0.320708
1972M02	-0.00052	-0.00052	0.019821	0.006269		-0.1066
1972M03	-0.00778	-0.00778	-0.00778	-0.00187		0.226602
1972M04	0.005713	0.005713	0.003742	0.00253		0.148223
1972M05	-0.00467	-0.00467	-0.00385	-0.00407		-0.02876
1972M06	-0.01838	-0.01838	-0.00699	-0.01168		0.2189
1972M07	-0.00027	-0.00027	-0.00027	-0.00639		0.083017
1972M08	0.001589	0.001589	0.001589	-0.00306		-0.05416
1972M09	0.005805	0.005805	0.005805	0.001925		0.273447
1972M10	-0.00105	-0.00105	-0.00105	-0.00168		0.112333
1972M11	-0.00555	-0.00555	-0.00555	-0.00289		0.045881
1972M12	-0.00053	-0.00053	-0.00351	-0.00237		0.042772
1973M01	-0.04083	-0.04083	-0.03801	-0.02699		0.020795
1973M02	-0.14691	-0.14691	-0.03772	-0.04199		-0.15257
1973M03	0.034253	0.034253	0.049818	0.035837		0.158477
1973M04	0.000926	0.000926	0.002169	0.001384		-0.05312

1973M05	-0.04546	-0.04546	-0.04339	-0.00695	-0.06011
1973M06	-0.04492	-0.04492	-0.04624	0.073548	0.154803
1973M07	-0.03227	-0.03227	-0.02527	-0.00171	0.07705
1973M08	0.055315	0.055315	0.048318	0.009079	0.007393
1973M09	-0.00231	-0.00231	-0.00382	0.017282	0.116201
1973M10	0.024515	0.024515	0.020271	0.012581	-0.02319
1973M11	0.033342	0.033342	-0.01484	-0.03542	-0.0715
1973M12	0.013032	0.013032	0.013032	-0.01873	0.018762
1974M01	0.013776	0.013776	-0.05188	-0.0151	0.088274
1974M02	-0.05211	-0.05211	-0.01324	-0.00993	-0.07469
1974M03	-0.03986	-0.03986	0.001308	0.015757	0.033345
1974M04	-0.02874	-0.02874	-0.04224	0.001843	0.314225
1974M05	0.02071	0.02071	0.013054	-0.01225	0.006209
1974M06	0.007365	0.007365	-0.00041	-0.00286	0.103412
1974M07	-0.0077	-0.0077	-0.0548	-0.02015	0.283713
1974M08	0.011031	0.011031	-0.00529	-0.0183	-0.07641
1974M09	-0.02083	-0.02083	-0.00685	-0.01658	-0.08568
1974M10	-0.02631	-0.02631	-0.03082	0.001556	0.229502
1974M11	-0.05498	-0.05498	-0.05581	-0.01431	-0.22049
1974M12	-0.067	-0.067	-0.06982	-0.03937	-0.23505
1975M01	-0.01587	-0.01587	-0.00552	0.012968	0.044857
1975M02	-0.04082	-0.04082	-0.00232	-0.01639	-0.21704
1975M03	0.05196	0.05196	0.027148	0.025822	-0.40471
1975M04	0.009645	0.009645	0.011348	-0.00433	-0.0276
1975M05	-0.02038	-0.02038	-0.01371	-0.00705	-0.67055
1975M06	0.001798	0.001798	-0.01522	-0.00173	0.207401
1975M07	0.079751	0.079751	0.076382	-0.01023	0.235615
1975M08	-0.0116	-0.0116	-0.01345	-0.01478	-0.34376
1975M09	0.024054	0.024054	0.00807	-0.00523	0.07881
1975M10	-0.04599	-0.04599	-0.04301	-0.00523	0.543844
1975M11	0.020557	0.020557	0.016589	-0.00738	-0.31625
1975M12	-0.02208	-0.02208	-0.02915	-0.02006	0.02367
1976M01	-0.00766	-0.00766	-0.0029	0.003072	0.571302
1976M02	-0.01472	-0.01472	-0.00994	-0.00317	-0.1985
1976M03	-0.01091	-0.01091	-0.00244	-0.00064	-0.14316
1976M04	-0.0086	-0.0086	-0.0076	-0.00769	0.443809
1976M05	-0.02887	-0.02887	-0.03071	-0.05168	-0.10182
1976M06	0.013024	0.013024	0.021562	0.020879	-0.13437
1976M07	0.002625	0.002625	0.016166	0.014819	0.404208
1976M08	-0.00101	-0.00101	0.014967	0.005342	-0.08853
1976M09	-0.00925	-0.00925	-0.00473	0.027183	-0.08991
1976M10	-0.00744	-0.00744	-0.02895	0.005486	0.355811
1976M11	0.002869	0.002869	-0.00409	0.003036	-0.00326

1976M12	0.002657	0.002657	0.012682	0.020403	-0.1328
1977M01	0.027104	0.027104	0.03913	0.002479	0.203453
1977M02	0.014085	0.014085	0.037163	0.025173	0.008958
1977M03	-0.0042	-0.0042	0.014365	-0.00169	-0.00239
1977M04	-0.00711	-0.00711	-0.00783	0.005447	0.233652
1977M05	-0.00776	-0.00776	-0.00632	-0.0067	-0.04431
1977M06	-0.01732	-0.01732	0.017913	-0.00948	-0.11432
1977M07	-0.02522	-0.02522	-0.01885	-0.00352	0.154836
1977M08	0.000625	0.000625	-0.00425	-0.01417	-0.00583
1977M09	-0.0732	-0.0732	-0.06625	-0.06693	-0.08929
1977M10	0	0	0.057568	0.023947	0.17642
1977M11	-0.03279	-0.03279	-0.01304	-0.02163	-0.04752
1977M12	-0.07696	-0.07696	-0.05349	-0.02026	-0.20099
1978M01	-0.00955	-0.00955	-0.01536	-0.01277	0.058041
1978M02	-0.05606	-0.05606	-0.04481	-0.01951	-0.14611
1978M03	-0.00241	-0.00241	0.068325	0.004	-0.07129
1978M04	0.033937	0.033937	0.031692	0.012034	0.123532
1978M05	-0.0138	-0.0138	-0.01604	-0.02964	-0.12137
1978M06	-0.02561	-0.02561	0.061811	-0.01339	-0.0776
1978M07	-0.06463	-0.06463	0.006216	-0.04811	0.138426
1978M08	-0.05669	-0.05669	-0.05406	-0.02947	-0.12115
1978M09	-0.06462	-0.06462	-0.05908	-0.04021	-0.12001
1978M10	-0.04609	-0.04609	0.025968	0.063891	0.149622
1978M11	-0.25479	0.154684	0.039429	0.052576	-0.31102
1978M12	-0.0599	-0.0599	-0.04511	-0.00903	-0.09597
1979M01	0.042894	0.042894	0.009044	0.02468	0.157652
1979M02	-0.01018	-0.01459	-0.01906	-0.00915	-0.03134
1979M03	0.012588	0.014594	-0.01992	0.005936	0.012884
1979M04	0.015944	0.018747	-0.02427	0.000548	0.094723
1979M05	-0.00189	-0.00029	-0.00622	-0.00407	0.030535
1979M06	-0.03544	-0.03624	-0.02342	-0.00382	-0.05949
1979M07	0.001903	0.001504	0.000583	0.007201	0.083036
1979M08	-0.00504	-0.00464	-0.01745	0.000763	-0.03525
1979M09	-0.06124	-0.06164	-0.07653	-0.01385	-0.08518
1979M10	0.061564	0.064358	0.001865	0.028232	0.214616
1979M11	-0.0284	-0.0284	-0.07404	0.014922	0.022385
1979M12	-0.02089	-0.02129	0.01597	-0.02216	0.00012
1980M01	0.027992	0.028391	0.032152	0.023838	0.170342
1980M02	0.035442	0.037433	-0.0076	0.018695	0.000106
1980M03	0.081365	0.08216	0.082561	-0.00923	-0.01196
1980M04	-0.09239	-0.09318	-0.04939	-0.01814	0.058202
1980M05	0.000586	-0.003	0.060479	0.005641	0.040863
1980M06	-0.02613	-0.02772	0.002601	-0.01204	0.05245

1980M07	0.020908	0.022905	-0.01939	0.007721	0.135374
1980M08	-0.00183	-0.00302	0.032854	-0.00705	-0.03508
1980M09	0.000303	0.000303	0.031845	-0.01024	-0.03995
1980M10	0.039268	0.040466	0.04377	-0.01217	0.126121
1980M11	0.009853	0.011448	-0.01284	0.002843	-0.08002
1980M12	0.014899	0.013703	0.079011	-0.00344	-0.02799
1981M01	0.086533	0.088923	0.080584	0.011499	0.18879
1981M02	0.018362	0.018759	-0.00107	0.01273	-0.06827
1981M03	-0.02457	-0.02537	-0.03585	-0.01228	0.085298
1981M04	0.052388	0.053979	0.035199	0.001747	0.129228
1981M05	0.023575	0.025163	-0.01629	-0.02456	-0.04975
1981M06	-0.02221	-0.02023	-0.02778	-0.04715	-0.08421
1981M07	0.047878	0.051436	-0.00726	0.021117	0.153231
1981M08	-0.00719	-0.00798	0.041017	0.006527	-0.09574
1981M09	-0.07437	-0.07319	-0.09359	-0.02835	-0.14371
1981M10	-0.06654	-0.06496	-0.06968	-0.03511	0.055817
1981M11	-0.04518	-0.04557	0.04152	-0.02282	-0.1284
1981M12	0.003828	0.018689	-0.00711	-0.00433	-0.15276
1982M01	0.020994	0.025255	-0.02182	0.001719	0.110412
1982M02	0.021168	0.025796	-0.00201	-0.00722	0.005143
1982M03	0.018616	0.021689	-0.01761	0.00994	-0.00716
1982M04	0.010952	0.010952	0.058303	0.045294	-0.09765
1982M05	0.017303	0.02075	-0.01436	0.015405	-0.05389
1982M06	0.04725	0.052207	0.00999	0.004498	-0.16785
1982M07	-0.00942	-0.00563	-0.01931	-0.00347	0.033048
1982M08	0.005041	0.012967	-0.00321	-0.00428	-0.1596
1982M09	0.013368	0.022722	-0.00665	0.010622	-0.00971
1982M10	0.007255	0.021676	-0.00686	0.006286	0.013426
1982M11	-0.0401	-0.03571	0.05561	-0.0042	-0.09957
1982M12	-0.08159	-0.06924	0.004956	-0.02371	-0.09188
1983M01	-0.00305	0.002354	-0.00991	-0.02708	-0.01754
1983M02	0.016174	0.022259	0.032611	0.033063	-0.09502
1983M03	0.015327	0.018178	0.001541	0.015992	-0.49808
1983M04	-0.32961	-0.00902	0.001052	-0.02196	0.087215
1983M05	0.012449	0.013481	0.008011	-0.01099	0.184935
1983M06	0.001289	0.006435	0.000578	-0.00261	0.070927
1983M07	0.004507	0.011668	0.003359	-0.02752	0.170493
1983M08	0.026471	0.029524	0.009454	0.005861	0.115381
1983M09	-0.02725	-0.02929	0.014223	-0.00396	-0.00491
1983M10	0.001247	0.003281	0.013713	0.008105	0.032172
1983M11	0.004682	0.011771	0.010274	-0.01475	0.01623
1983M12	0.005039	0.008062	0.015784	-0.00183	0.00438
1984M01	0.027936	0.028942	0.01802	-0.0036	0.033172

1984M02	-0.0336	-0.03562	-0.03028	0.041215	0.033023
1984M03	-0.01249	-0.00547	0.032951	0.000617	0.007565
1984M04	0.035782	0.04077	0.035222	-0.00725	0.049848
1984M05	0.002871	0.006843	-0.01742	0.001009	0.015497
1984M06	0.026443	0.031386	0.005798	0.012935	0.057446
1984M07	0.042971	0.05571	0.022581	0.016202	0.097047
1984M08	-0.04402	-0.02378	-0.00653	-0.02053	-0.03687
1984M09	0.027166	0.037608	0.020352	-0.00918	0.067435
1984M10	-0.00429	-0.0024	-0.00139	-0.00383	-0.00472
1984M11	0.015681	0.02132	0.017048	-0.00046	0.010298
1984M12	0.008781	0.01532	-0.00398	-0.00124	0.019795
1985M01	0.027737	0.035158	0.021119	0.02892	0.026566
1985M02	0.046547	0.055746	0.03688	0.008035	0.036101
1985M03	-0.08753	-0.07841	-0.05106	-0.00683	-0.02112
1985M04	-0.01863	-0.0123	-0.01131	-0.0114	-0.01307
1985M05	0.001093	0.008281	0.009868	0.008605	0.006784
1985M06	-0.0185	-0.01761	-0.00603	-0.00834	-0.05374
1985M07	-0.11463	-0.11642	-0.06575	-0.02324	-0.09157
1985M08	-0.00172	0.000964	-0.00157	0.003334	-0.00277
1985M09	-0.04714	-0.04536	0.043861	-0.0043	-0.04402
1985M10	-0.01726	-0.01548	0.010193	0.00461	0.003972
1985M11	-0.03056	-0.03146	0.014501	0.009417	-0.00771
1985M12	-0.00483	-0.00216	0.005289	0.018225	-0.07616
1986M01	-0.02516	-0.02339	0.020974	0.006344	-0.00718
1986M02	-0.08118	-0.08029	-0.01512	-0.00616	-0.04228
1986M03	0.038189	0.035526	0.036083	-0.00813	-0.04235
1986M04	-0.05831	-0.0592	0.005783	-0.00101	-0.02176
1986M05	0.041845	0.047169	0.026586	-0.00894	0.011709
1986M06	-0.06593	-0.06505	-0.02466	-0.01446	-0.07279
1986M07	-0.06565	-0.06565	0.001401	-0.0169	-0.03816
1986M08	-0.01628	-0.0154	-0.027	0.004861	-0.01587
1986M09	-0.37724	-0.01081	0.005338	0.004564	-0.45254
1986M10	0.04212	0.046398	-0.00376	0.023453	0.018012
1986M11	-0.04742	-0.04134	-0.0469	0.003312	-0.03261
1986M12	-0.0086	-0.01407	0.006462	0.004565	-0.13849
1987M01	-0.05967	-0.06456	-0.02219	0.006043	-0.19329
1987M02	0.003744	0.010458	0.006858	0.00039	0.094963
1987M03	-0.02103	-0.02103	0.027503	-0.00908	0.009077
1987M04	-0.0268	-0.02863	0.015545	-0.01821	0.090911
1987M05	0.02807	0.032933	0.001184	0.013475	-0.06077
1987M06	0.005553	0.004946	-0.01567	0.000345	0.014597
1987M07	0.015988	0.011122	-0.0044	-0.00272	0.292831
1987M08	-0.02637	-0.02637	0.020948	-0.00446	-0.10426

1987M09	0.015072	0.021151	-0.00621	0.008505	0.006145
1987M10	-0.05911	-0.06032	-0.00591	-0.00496	-0.0425
1987M11	-0.07209	-0.07088	-0.02625	-0.00928	0.000362
1987M12	-0.04812	-0.04812	0.0226	-0.01461	-0.01698
1988M01	0.057879	0.065125	0.035606	0.007149	-0.04149
1988M02	0.020086	0.018882	0.012613	0.011451	0.037894
1988M03	-0.01559	-0.01559	0.004933	0.001797	0.032656
1988M04	0.00766	0.013067	0.017463	0.007658	-0.02381
1988M05	0.035814	0.038208	0.035009	0.003801	0.036164
1988M06	0.037862	0.046788	-0.00873	-0.00644	0.049753
1988M07	0.03251	0.035468	0.034336	0.003105	-0.05745
1988M08	0.008221	0.011759	-0.00656	0.015061	0.029631
1988M09	0.000302	0.004414	0.007753	0.00175	0.000302
1988M10	-0.07058	-0.06531	0.002325	-0.00422	-0.122
1988M11	-0.02783	-0.02434	0.007989	-0.0055	0.043264
1988M12	0.028566	0.03436	0.001239	0.008816	0.027294
1989M01	0.047586	0.052772	0.026888	0.006507	-0.02627
1989M02	-0.01876	-0.01589	0.000894	0.003056	-0.03723
1989M03	0.055527	0.061811	0.022818	0.027904	0.108175
1989M04	0.003101	0.004808	0.001783	0.012445	0.078317
1989M05	0.020406	0.027205	-0.04733	-0.02845	-0.0426
1989M06	-0.02534	-0.02421	-0.03397	-0.0073	-0.14175
1989M07	-0.03988	-0.03932	0.001404	0.005997	0.028747
1989M08	0.043245	0.049426	0.007319	7.5E-05	-0.02669
1989M09	-0.04242	-0.04354	-0.00827	0.004582	-0.04102
1989M10	-0.0085	-0.00403	-0.02533	0.012598	0.038069
1989M11	-0.00998	-0.00998	-0.01454	0.016491	-0.02784
1989M12	-0.03454	-0.03119	-0.03468	0.02141	0.159999
1990M01	-0.04032	-0.03588	-0.04074	-0.02688	-0.10127
1990M02	-0.00689	-0.00302	-0.03208	-0.00847	-0.04523
1990M03	-2E-05	0.006032	-0.05158	0.004497	0.058432
1990M04	-0.02969	-0.02641	-0.03999	-0.01805	-0.15804
1990M05	-0.02813	-0.02431	0.024891	-0.03065	-0.17405
1990M06	-0.00787	-0.00352	-0.0114	0.008078	0.153502
1990M07	-0.04817	-0.04546	-0.00849	0.000759	0.088542
1990M08	-0.05171	-0.04685	-0.02559	-0.02545	0.005302
1990M09	0.001792	0.005016	0.050761	0.003801	-0.04543
1990M10	-0.01318	-0.00889	0.054389	0.0203	0.039683
1990M11	-0.00989	-0.0035	-0.03396	0.005824	0.050958
1990M12	0.000713	0.009696	0.001852	0.017031	0.210844
1991M01	-0.0292	-0.02343	0.000668	-0.02075	-0.04913
1991M02	0.035714	0.039889	0.03381	0.019823	0.187416
1991M03	0.096849	0.10308	0.037122	-0.01866	0.045671

1991M04	-0.00122	0.002394	0.028258	-0.00659	-0.00022
1991M05	0.000314	0.004432	0.000799	0.008944	0.041508
1991M06	0.055835	0.059423	0.059423	0.010045	0.086922
1991M07	-0.0261	-0.02354	-0.02282	0.013674	-0.04373
1991M08	-0.00385	-0.00079	0.00394	0.00208	-0.01091
1991M09	-0.05066	-0.04914	-0.01728	-0.00347	-0.04957
1991M10	0.010161	0.014724	0.029511	0.008729	0.019431
1991M11	-0.02673	-0.02269	-0.01617	0.002305	0.055837
1991M12	-0.0626	-0.05908	-0.02108	0.014526	-0.06594
1992M01	0.05064	0.056646	0.052263	-0.00581	0.075805
1992M02	0.033627	0.036617	0.008932	0.021792	0.008145
1992M03	0.003555	0.007032	-0.02284	0.004044	0.043279
1992M04	0.014726	0.017202	0.014952	0.006846	0.062142
1992M05	-0.04331	-0.04084	-0.00072	-0.01211	0.009975
1992M06	-0.06352	-0.06056	-0.03888	-0.00589	-0.05583
1992M07	-0.04514	-0.04415	-0.05761	-0.01222	-0.01666
1992M08	-0.04531	-0.0458	-0.01141	0.002192	-0.02808
1992M09	-0.02567	-0.02371	0.006858	-0.02343	-0.07059
1992M10	0.103427	0.109297	0.076291	0.022558	0.073763
1992M11	0.048515	0.052896	0.040794	0.011788	0.064886
1992M12	0.005436	0.006892	0.006491	-0.00088	-0.02313
1993M01	0.007291	0.009229	0.010432	0.022012	0.048074
1993M02	0.035539	0.036022	0.092992	0.005431	0.041471
1993M03	-0.02075	-0.01882	-0.00728	-0.0012	-0.01083
1993M04	-0.04786	-0.04641	-0.00069	-0.02506	-0.03458
1993M05	-0.00242	-0.00049	0.042273	-0.00919	-0.01831
1993M06	0.051754	0.056555	0.054182	-0.00086	0.055608
1993M07	0.006064	0.009888	0.017882	-0.02016	-0.00369
1993M08	-0.04131	-0.03845	-0.02226	0.003461	-0.02845
1993M09	-0.03718	-0.03432	-0.0434	-0.00488	-0.02421
1993M10	0.043759	0.042809	0.014216	0.009182	0.038601
1993M11	0.008413	0.008413	0.001506	-0.01267	0.010776
1993M12	-0.01031	-0.00841	-0.03468	-0.01732	-0.0052
1994M01	-0.01654	-0.01087	0.006714	-0.01958	-0.00749
1994M02	-0.03055	-0.02351	0.030233	-0.00741	-0.00242
1994M03	-0.01654	-0.01374	-0.00409	0.010841	-0.01999
1994M04	0.000178	0.002974	0.009296	0.00777	-0.08147
1994M05	-0.01359	-0.01081	-0.02984	0.00299	-0.02872
1994M06	-0.04205	-0.03974	0.01354	-0.01143	-0.01362
1994M07	0.002514	0.006672	-0.00037	0.006421	-0.02322
1994M08	-0.01802	-0.01526	-0.01325	-0.00721	0.045306
1994M09	-0.03865	-0.0359	-0.02478	-0.01373	-0.03598
1994M10	-0.02168	-0.01939	-0.00847	0.004331	-0.01479

1994M11	0.049839	0.053036	0.037345	0.014884	0.129499
1994M12	-0.01719	-0.01401	-0.02226	9.72E-05	-0.03641
1995M01	-0.03125	-0.02807	-0.01607	-0.0019	-0.04643
1995M02	-0.0305	-0.02823	-0.0129	0.003891	-0.03185
1995M03	-0.08779	-0.08463	-0.00197	-0.0302	-0.05942
1995M04	-0.00281	0.00079	0.065515	0.002598	-0.00088
1995M05	0.000431	0.004464	0.011053	-0.00095	0.010089
1995M06	0.000677	0.005139	-0.01155	0.008746	0.031655
1995M07	-0.00871	-0.00427	-0.04854	-0.00195	0.024846
1995M08	0.044446	0.048869	-0.06505	-0.01156	0.037098
1995M09	-0.05484	-0.05088	-0.04277	-0.01781	-0.05257
1995M10	-0.00657	-0.00219	-0.03619	0.001625	-0.00504
1995M11	0.016437	0.02124	0.022716	0.004889	0.040361
1995M12	-0.01842	-0.01321	-0.02574	-0.01098	-0.00836
1996M01	0.055304	0.056603	0.014518	0.016739	0.057751
1996M02	-0.02231	-0.01757	0.006497	-0.0006	0.065043
1996M03	-0.01155	-0.00511	-0.02009	-0.01123	-0.01344
1996M04	0.037642	0.03978	0.053803	0.004037	0.037759
1996M05	0.011862	0.016973	-0.01495	0.013904	0.011738
1996M06	-0.00142	-0.00653	-0.01774	0.001454	0.040238
1996M07	-0.05466	-0.04997	-0.03617	-0.01554	-0.06052
1996M08	0.003457	0.007698	0.002891	0.000583	0.002274
1996M09	0.056358	0.046577	0.023514	0.016053	0.057581
1996M10	-0.00591	-0.0008	-0.02598	0.008548	0.004921
1996M11	0.026732	0.033511	0.033775	0.019202	0.106191
1996M12	0.029756	0.036071	0.016659	0.022863	0.10788
1997M01	0.046232	0.051672	0.001241	0.002233	0.086514
1997M02	0.036809	0.040974	0.051025	0.006322	0.037273
1997M03	-0.02308	-0.01769	-0.0444	-0.00973	-0.02047
1997M04	0.007101	0.012872	-0.00945	-0.01626	0.033619
1997M05	-0.04398	-0.04111	0.044438	-0.02512	-0.0106
1997M06	0.029367	0.033457	0.051218	0.007847	0.038225
1997M07	-0.02144	0.037603	0.004503	-0.01184	-0.02619
1997M08	-0.17637	-0.02129	-0.03054	-5.2E-05	-0.22587
1997M09	-0.0971	-0.02099	-0.03472	-0.00498	-0.04556
1997M10	-0.15084	-0.03697	-0.02825	-0.0126	-0.25419
1997M11	0.024984	0.018971	-0.04246	-0.00438	0.004836
1997M12	-0.22242	0.020269	0.001627	0.004294	-0.3106
1998M01	-0.79119	0.011342	0.035092	-0.00767	-0.69852
1998M02	0.167624	-0.00272	-0.00548	0.005691	0.005663
1998M03	0.085392	0.035601	-0.00143	0.016136	0.10488
1998M04	0.089458	-0.0149	-0.01679	0.013658	0.159408
1998M05	-0.35033	-0.01148	-0.06124	-0.00449	-0.27272

1998M06	-0.31978	0.027824	0.014962	0.01312		-0.33217
1998M07	0.116722	-0.01969	-0.03972	-0.00341		0.15383
1998M08	0.135724	-0.02454	-0.00882	-0.02048		0.158505
1998M09	-0.01485	-0.04929	-0.0044	0.006633		0.020675
1998M10	0.3184	-0.0303	0.119796	-0.01521		0.376535
1998M11	0.076932	0.043259	-0.01716	0.012715		0.12741
1998M12	-0.11547	-0.02078	0.046541	-0.00359		-0.07379
1999M01	-0.07981	0.02928	0.024103			-0.03436
1999M02	0.042996	0.018108	-0.00906		-0.01457	0.039997
1999M03	0.035131	0.029963	0.021623		0.004594	0.100203
1999M04	0.072646	0.022473	0.0314		0.008883	0.063164
1999M05	0.021045	0.002102	-0.01526		-0.01129	0.040487
1999M06	0.204897	0.018397	0.021036		0.00608	0.240928
1999M07	-0.05945	-0.03754	0.012407		-0.00272	-0.07392
1999M08	-0.08064	0.015001	0.053763		0.003622	-0.07142
1999M09	-0.11656	-0.01353	0.022951		-0.00487	-0.1224
1999M10	0.218472	0.02343	0.042325		0.003064	0.227394
1999M11	-0.03557	0.037764	0.060432		0.003401	-0.03583
1999M12	0.051635	0.004763	0.007694		-0.0003	0.058901
2000M01	-0.02132	0.025552	-0.01894		-0.00016	-0.00246
2000M02	-0.00597	0.004742	-0.02595		-0.00315	0.017805
2000M03	0.000795	0.012057	0.052149		-0.00466	0.03224
2000M04	-0.00814	0.037576	0.030985		-0.01265	-0.02599
2000M05	-0.10768	-0.02614	-0.02707		-0.00242	-0.11456
2000M06	-0.05049	-0.03724	-0.02545		-0.0104	-0.02253
2000M07	-0.00125	0.028968	-0.00919		-0.00433	-0.01357
2000M08	0.117663	0.035155	0.063874		-0.00199	0.216388
2000M09	-0.05633	0.001095	-0.01244		-0.01486	-0.13804
2000M10	-0.02706	0.04064	0.029575		0.000127	-0.05324
2000M11	-0.05514	-0.04087	-0.06012		-0.00964	-0.05384
2000M12	-0.06553	-0.05874	-0.09174		0.010334	-0.04796
2001M01	0.020347	0.00512	-0.0057		0.003829	0.028885
2001M02	-0.02611	0.013826	0.011676		0.008972	-0.0335
2001M03	-0.01826	0.037598	-0.03048		-0.00843	-0.03298
2001M04	-0.11507	0.000577	0.00985		0.005547	-0.11792
2001M05	0.088784	0.034488	0.069522		-0.01115	0.087856
2001M06	-0.0329	0.001059	-0.03882		0.001059	-0.03396
2001M07	0.142615	-0.04058	-0.04661		-0.00867	0.15119
2001M08	0.030358	-0.04145	0.006559		0.003552	0.012528
2001M09	-0.11334	-0.02591	-0.02885		-0.02886	-0.09703
2001M10	-0.06802	0.007603	-0.0133		-0.00219	-0.08376
2001M11	0.019086	0.018607	0.001273		0.002553	0.002003
2001M12	0.016567	0.013687	-0.04772		0.004088	0.016171

2002M01	0.020106	0.012384	0.004072	-0.00779	0.010637
2002M02	0.016947	0.004172	-0.00332	0.005792	0.021096
2002M03	0.04061	-0.01322	-0.00798	-0.00482	0.042919
2002M04	-0.00112	-0.03686	0.002963	-0.00482	0.003073
2002M05	0.019778	-0.03891	-0.01038	0.002303	0.038552
2002M06	-0.04968	-0.05596	-0.01535	0.0048	-0.03048
2002M07	-0.03442	0.007967	0.004624	-0.01147	0.000569
2002M08	0.029302	0.002485	0.018465	0.007583	0.022892
2002M09	-0.0216	-0.00504	-0.03511	-0.0023	-0.02627
2002M10	-0.02356	0.000337	-0.00704	0.000743	-0.02585
2002M11	0.029779	0.001549	0.002775	0.007916	0.031961
2002M12	-0.06507	-0.06909	-0.04927	-0.01421	0.000428
2003M01	-0.01432	-0.0215	-0.01355	0.009389	-0.01187
2003M02	-0.00459	-0.00133	0.008812	-0.00448	-0.00145
2003M03	-0.00167	-0.00133	-0.02151	0.009097	0.011964
2003M04	0.031221	0.004717	0.009305	0.026147	0.062549
2003M05	-0.00542	-0.05214	-0.04163	0.008087	0.009756
2003M06	0.049945	0.05067	0.038075	0.016686	0.04612
2003M07	-0.01821	0.007994	0.00591	-0.00159	-0.03082
2003M08	0.025279	0.0288	0.054523	-0.00636	0.01981
2003M09	-0.05141	-0.06866	-0.01739	-0.00442	-0.03647
2003M10	0.000209	0.012765	0.034952	0.010187	0.022023
2003M11	-0.03727	-0.03234	-0.03912	-0.00083	-0.02837
2003M12	-0.03356	-0.04203	-0.01987	0.009634	-0.0011
2004M01	0.022929	0.02009	0.030696	0.00042	0.012833
2004M02	0.008361	0.009071	-0.01912	0.011813	0.011849
2004M03	-0.01456	0.001883	0.045959	-0.01386	0.023449
2004M04	0.007667	0.016248	-0.03878	-0.00667	-0.00036
2004M05	-0.09918	-0.03772	-0.04044	-0.013	-0.11496
2004M06	-0.01802	0.003996	0.023368	-0.00346	-0.06546
2004M07	0.045859	0.019274	-0.0143	0.009685	0.043514
2004M08	-0.02138	-0.00408	0.017843	0.001886	-0.0206
2004M09	0.006422	-0.01066	-0.0229	0.013646	0.005026
2004M10	-0.03988	-0.04864	-0.00378	-0.02255	-0.02689
2004M11	-0.04617	-0.05412	-0.02593	-0.01124	-0.02958
2004M12	-0.03404	-0.00432	-0.01339	0.019904	-0.02133
2005M01	0.051012	0.037465	0.038619	0.001742	0.045184
2005M02	-0.02153	-0.01121	-0.01821	-0.00258	-0.00863
2005M03	0.004949	0.028429	0.00372	0.00608	-0.00902
2005M04	-0.01675	-0.00731	0.006388	-0.00785	-0.00821
2005M05	0.058402	0.050534	0.030064	0.001015	0.008598
2005M06	0.006439	0.029139	0.0079	0.009566	-0.01571
2005M07	-0.00651	0.004349	-0.012	0.004432	-0.0604

2005M08	-0.05784	-0.01586	-0.00762	-0.00721	-0.09235
2005M09	0.00881	0.015623	-0.00086	0.002751	-0.02516
2005M10	0.016752	-0.00482	-0.0271	-0.0064	0.092472
2005M11	0.02955	0.024085	-0.00932	0.002732	0.048895
2005M12	0.019879	-0.00076	0.013213	0.001616	0.064317
2006M01	0.022015	-0.02325	-0.02104	0.003601	0.025429
2006M02	0.044155	0.026437	0.038918	0.00618	0.061109
2006M03	0.00718	-0.00976	-0.0196	0.009345	0.133165
2006M04	-0.00822	-0.04184	-0.01508	-0.00669	0.053014
2006M05	-0.08334	-0.03387	-0.01568	-0.00781	-0.04699
2006M06	0.009696	0.018336	-0.00552	0.006217	-0.08418
2006M07	0.025367	0.000324	0.00163	0.004563	0.046165
2006M08	-0.00989	-0.00659	-0.0283	-3.1E-05	0.018757
2006M09	0.008269	0.022995	0.018912	0.008021	0.01807
2006M10	0.011632	-0.002	-0.00072	0.000843	-0.05217
2006M11	-0.04182	-0.0358	-0.02512	0.00313	0.003424
2006M12	0.026741	0.010793	-0.01088	0.008518	0.052045
2007M01	0.019112	0.026843	0.004151	0.010306	0.034914
2007M02	-0.03255	-0.02488	0.001772	-0.00523	0.022533
2007M03	0.003368	-0.00123	0.005803	0.006839	0.038435
2007M04	-0.00802	-0.01186	-0.0283	0.009459	0.036066
2007M05	0.046224	0.016274	-0.00047	0.005039	0.064304
2007M06	-0.02675	0	-0.01315	0.003858	-0.00985
2007M07	-0.03166	-0.01719	0.018163	-0.00234	-0.01313
2007M08	-0.02401	8.29E-05	0.023473	-6.3E-05	-0.03326
2007M09	-0.0007	-0.03014	-0.02019	0.003862	0.024976
2007M10	-0.00503	-0.00876	-0.00615	0.009969	0.01742
2007M11	-0.06393	-0.03438	0.005169	-0.01288	-0.05028
2007M12	-0.00021	0.004363	-0.02863	0.00165	0.035979
2008M01	-0.02795	-0.04164	0.027732	-0.03157	-0.04893
2008M02	-0.00516	-0.03133	-0.01589	-0.01155	0.013898
2008M03	-0.06955	-0.05138	-0.00616	-0.00973	-0.03509
2008M04	0.04215	0.043992	0.005002	0.026641	0.040023
2008M05	0.000717	0.009773	-0.00529	0.007712	-0.02278
2008M06	-0.02007	-0.0301	-0.03708	-0.01373	0.013847
2008M07	0.040719	0.029052	0.014219	0.019299	0.060929
2008M08	0.042697	0.046529	0.036302	-0.01122	0.006684
2008M09	-0.02056	0.003728	0.048722	-0.02603	-0.04521
2008M10	-0.1133	0.045773	0.10502	-0.06862	-0.23353
2008M11	-0.05214	0.047828	0.079347	0.045473	-0.06319
2008M12	-0.02463	-0.1287	-0.08031	-0.03932	0.002445
2009M01	0.051898	0.088217	0.10097	0.0058	0.035236
2009M02	-0.04211	0.011468	-0.07354	-0.00204	-0.05046

2009M03	0.002576	-0.03181	-0.03744		0.019368	0.088031
2009M04	0.074839	-0.00255	0.002559		-0.00503	0.108498
2009M05	-0.0209	-0.05634	-0.045		0.003815	0.001408
2009M06	0.017685	0.006501	0.012217		0.009051	0.012106
2009M07	0.033702	0.003419	0.009902		0.003702	0.030964
2009M08	-0.03405	-0.02003	0.007943		-0.0106	-0.02556
2009M09	0.006365	-0.03204	8.05E-05		-0.00637	0.03332
2009M10	0.008202	-0.00595	-0.02372		0.004719	0.044464
2009M11	-0.01321	-0.02005	0.031951		-0.00509	0.003176
2009M12	0.035922	0.027447	-0.03196		-0.01449	0.044852
2010M01	0.022286	0.018556	0.042854		-0.01246	0.077942
2010M02	0.029067	0.025858	0.032558		-0.00291	0.031889
2010M03	0.007849	-0.016	-0.05984		-0.02273	0.040115
2010M04	0.02755	0.016186	0.007537		0.003944	0.122972
2010M05	0.045952	0.064423	0.094205		-0.0143	-0.0108
2010M06	-0.05037	-0.06099	-0.03098		-0.06392	-0.02645
2010M07	-0.0249	-0.03943	-0.01544		0.020434	0.010619
2010M08	-0.02756	-0.01767	0.008691		-0.04474	0.004415
2010M09	-0.03532	-0.04835	-0.03821		0.025217	0.028531
2010M10	0.016064	0.016512	0.05091		0.03171	0.078108
2010M11	-0.00082	0.008656	-0.03469		-0.05534	0.010538
2010M12	-0.05765	-0.0601	-0.02749		-0.03248	-0.02009
2011M01	-0.0036	0.003718	-0.00362		0.028115	-0.01161
2011M02	0.010359	-0.01582	-0.01154		-0.0055	0.055073
2011M03	-0.00164	-0.01465	-0.032		0.011956	0.060831
2011M04	-0.03874	-0.05436	-0.0414		-0.00942	0.036574
2011M05	-0.0115	-0.01582	-0.00097		-0.04831	0.011993
2011M06	-0.02882	-0.02181	-0.0202		-0.0171	0.001814
2011M07	-0.03032	-0.04073	-0.00066		-0.05417	-0.00628
2011M08	0.002237	0.010431	0.022887		0.023667	0.016365
2011M09	0.079371	0.107532	0.10701		0.03975	-0.00757
2011M10	-0.03624	-0.03488	-0.06787		0.001336	-0.0443
2011M11	0.019936	0.057152	0.071779		0.01462	-0.00383
2011M12	0.031803	0.020617	0.024854		-0.01573	0.024973
2012M01	-0.02192	-0.02944	-0.01179		-0.01129	-0.00878
2012M02	-0.02807	-0.01867	-0.07333		0.00139	-0.02718
2012M03	-0.00329	0.007112	-0.01132		0.000619	-0.01688
2012M04	0.005643	0.006732	0.018979		-0.00396	0.060973
2012M05	0.023705	0.0637	0.093086		0.000361	-0.01846
2012M06	-0.00521	-0.01413	-0.02046		0.00083	-0.05465
2012M07	0.022955	0.023482	0.03809		-0.00112	0.022183
2012M08	-0.03282	-0.02495	-0.02878		0.001324	-0.00999
2012M09	-0.02251	-0.01958	-0.0083		0.005398	-0.0137

2012M10	-0.01022	-0.0074	-0.03374	-0.00254	-0.00777
2012M11	-0.00284	-0.00388	-0.03856	-0.00442	0.006402
2012M12	-0.01587	-0.00912	-0.05765	0.006768	-0.00067
2013M01	-0.00836	-0.00547	-0.0181	0.021154	-0.04836
2013M02	0.024045	0.020843	-0.0328	-0.01072	-0.00962
2013M03	0.017261	0.022626	0.005791	-0.00236	0.013743
2013M04	-0.01384	-0.01354	-0.05376	0.007102	0.013542
2013M05	0.006705	0.0149	-0.01647	0.009838	-0.01322
2013M06	-0.02575	-0.01288	0.008733	-0.00721	-0.09535
2013M07	-0.04662	-0.01208	-0.00385	0.002719	-0.11019
2013M08	-0.06173	0.000323	-0.00243	-0.00269	-0.06043
2013M09	-0.08731	-0.02724	-0.02133	-0.00705	-0.05531
2013M10	0.01107	-0.00088	-0.00832	0.00925	0.025123
2013M11	-0.02859	0.000442	-0.02848	-0.00296	-0.02579
2013M12	-0.05277	-0.01481	-0.05284	-0.00112	-0.02541

Raw Data for **Chapter 3**.

Month	idrusd	myrusd	phpusd	thbusd	krwusd	chfusd	jpyusd	demusd	eurusd	idn_fores	mal_fores	phi_fores	tha_fores	kor_fores
1970M1	326	3.07	3.94	20.93	305.35	4.31	357.68	3.69		n.a.	507	80	877	529.5
1970M2	326	3.07	5.78	20.93	306.15	4.30	357.56	3.69		n.a.	501	113	892	532
1970M3	326	3.07	6.12	20.93	306.85	4.31	357.53	3.66		n.a.	482	145	897	540.5
1970M4	378	3.07	6.24	20.93	308.65	4.30	358.45	3.64		n.a.	482	147	878	530.6
1970M5	378	3.09	6.17	20.93	309.35	4.32	358.90	3.63		n.a.	499	153	873	536.7
1970M6	378	3.08	6.20	20.93	310.75	4.32	358.70	3.63		n.a.	500	146	862	577.5
1970M7	378	3.09	6.25	20.93	312.35	4.30	358.70	3.63		n.a.	502	144	851	578.9
1970M8	378	3.09	6.30	20.93	312.95	4.30	358.21	3.63		n.a.	524	153	835	593.3
1970M9	378	3.08	6.43	20.93	313.85	4.33	357.90	3.63		n.a.	537	143	827	593.7
1970M10	378	3.08	6.43	20.93	314.95	4.33	357.61	3.63		n.a.	529	146	793	562.1
1970M11	378	3.08	6.43	20.93	315.75	4.31	357.59	3.63		n.a.	535	154	787	564.1
1970M12	378	3.08	6.43	20.93	316.65	4.32	357.65	3.65		n.a.	542	195	790	583.5
1971M1	378	3.05	6.43	20.93	318.55	4.30	357.55	3.63		156.7	524	184	805	562.4
1971M2	378	3.06	6.43	20.93	320.25	4.31	357.40	3.63		149	561	203	802	535
1971M3	378	3.05	6.43	20.93	322.25	4.30	357.39	3.63		179.1	559	220	811	536.6
1971M4	378	3.05	6.43	20.93	324.15	4.30	357.39	3.63		148.7	569	216	813	536.8
1971M5	378	3.05	6.43	20.93	326.35	4.10	357.37	3.55		126.1	603	223	810	540.3
1971M6	378	3.04	6.43	20.93	370.80	4.10	357.37	3.50		102.4	616	236	805	547.9
1971M7	378	3.05	6.43	20.93	370.80	4.09	357.37	3.46		177.7	641	257	800	545.4
1971M8	415	2.99	6.41	20.93	370.80	3.98	339.00	3.40		167.9	651	273	772	541.8
1971M9	415	2.97	6.43	20.93	370.80	3.95	334.21	3.32		166.7	644	272	748	538.5
1971M10	415	2.96	6.43	20.93	370.80	3.99	329.30	3.34		180.2	623	298	726	523
1971M11	415	2.96	6.43	20.93	370.80	3.95	327.65	3.31		185.2	605	305	728	538.2
1971M12	415	2.89	6.43	20.93	373.30	3.92	314.80	3.27		142.6	665	309	736	400.8
1972M1	415	2.85	6.43	20.93	376.40	3.87	310.45	3.21		198.7	637	300	756	389.7
1972M2	415	2.84	6.43	20.93	382.00	3.87	304.20	3.19		178.7	649	323	817	362.8
1972M3	415	2.82	6.43	20.93	387.10	3.84	304.20	3.17		225.9	634	309	838	333.7
1972M4	415	2.82	6.77	20.93	392.90	3.86	304.80	3.18		260.5	633	307	851	331
1972M5	415	2.81	6.77	20.93	396.10	3.84	304.55	3.18		254.3	734	355	889	338.8
1972M6	415	2.81	6.78	20.93	399.70	3.77	301.10	3.16		322.4	746	374	913	373.7
1972M7	415	2.78	6.78	20.93	399.30	3.77	301.10	3.17		350.4	717	379	910	415.7

1972M8	415	2.77	6.78	20.93	399.00	3.78	301.10	3.19	331.4	708	392	892	449.2
1972M9	415	2.77	6.78	20.93	398.70	3.80	301.10	3.20	433.1	712	378	874	480
1972M10	415	2.77	6.78	20.93	398.70	3.80	301.10	3.20	485.1	755	401	865	503.2
1972M11	415	2.77	6.78	20.93	398.80	3.78	301.10	3.20	510.7	791	405	865	506.2
1972M12	415	2.82	6.78	20.93	398.90	3.77	302.00	3.20	533.3	796	456	896	481.1
1973M1	415	2.79	6.78	20.93	398.90	3.62	301.15	3.16	567.2	799	494	934	527.2
1973M2	415	2.54	6.78	20.93	398.90	3.13	270.00	2.84	564	867	554	1036	525.9
1973M3	415	2.49	6.77	20.93	398.90	3.24	265.83	2.84	638.6	876	606	1118	467.7
1973M4	415	2.49	6.77	20.93	399.00	3.24	265.50	2.84	605	898	657	1105	488
1973M5	415	2.49	6.76	20.93	398.90	3.10	264.95	2.73	596.2	1007	739	1106	527.9
1973M6	415	2.36	6.76	20.93	398.90	2.96	265.30	2.42	728	1093	775	1126	555.8
1973M7	415	2.24	6.76	20.38	398.70	2.87	263.45	2.35	812.1	1142	779	1134	575.7
1973M8	415	2.31	6.74	20.38	398.30	3.03	265.30	2.46	774.1	1106	829	1104	656.1
1973M9	415	2.31	6.74	20.38	397.70	3.02	265.70	2.42	871.5	1193	796	1095	746
1973M10	415	2.30	6.74	20.38	397.20	3.10	266.83	2.44	830.9	1201	776	1073	773.3
1973M11	415	2.42	6.74	20.38	396.90	3.20	280.00	2.62	748.2	1156	833	1086	829.3
1973M12	415	2.45	6.73	20.38	397.50	3.24	280.00	2.70	752.5	1146	964	1132	829.2
1974M1	415	2.47	6.72	20.38	398.20	3.29	299.00	2.78	810.7	1160	999	1236	826.2
1974M2	415	2.47	6.72	20.38	398.50	3.12	287.60	2.67	792.6	1170	1070	1395	774.2
1974M3	415	2.38	6.73	20.38	398.90	3.00	276.00	2.52	852.8	1281	1116	1511	707.4
1974M4	415	2.36	6.72	20.38	399.00	2.92	279.75	2.45	1201.7	1296	1225	1545	630
1974M5	415	2.39	6.73	20.38	399.00	2.98	281.90	2.53	1184.4	1305	1351	1538	551.8
1974M6	415	2.41	6.71	20.38	399.00	3.00	284.10	2.55	1303.8	1309	1464	1656	513.4
1974M7	415	2.42	6.74	20.38	399.00	2.98	297.80	2.59	1744.9	1312	1444	1664	388.5
1974M8	415	2.40	6.75	20.38	399.00	3.01	302.70	2.66	1598.8	1301	1473	1628	363.6
1974M9	415	2.42	6.75	20.38	399.00	2.95	298.50	2.65	1498.4	1324	1456	1600	268.6
1974M10	415	2.40	6.85	20.38	399.00	2.87	299.85	2.58	1935.2	1294	1477	1620	199.2
1974M11	415	2.35	7.07	20.38	399.00	2.72	300.10	2.48	1640	1316	1487	1650	174.4
1974M12	415	2.31	7.06	20.38	484.00	2.54	300.95	2.41	1386.3	1411	1425	1681	275.5
1975M1	415	2.30	7.07	20.38	484.00	2.50	297.85	2.34	1473.1	1400	1527	1726	282.2
1975M2	415	2.23	7.02	20.38	484.00	2.40	286.60	2.28	1235.1	1358	1503	1854	317.7
1975M3	415	2.26	7.02	20.38	484.00	2.53	293.80	2.35	782.3	1277	1481	2041	298.3
1975M4	415	2.28	7.03	20.38	484.00	2.55	293.30	2.38	753.7	1219	1504	2019	439
1975M5	415	2.26	7.01	20.38	484.00	2.50	291.35	2.35	393.4	1197	1492	1954	431.1
1975M6	415	2.31	7.02	20.38	484.00	2.51	296.35	2.35	483.2	1235	1515	1946	490.1
1975M7	415	2.50	7.51	20.38	484.00	2.71	297.35	2.58	564.7	1351	1581	1834	545.7

1975M8	415	2.51	7.51	20.38	484.00	2.68	297.90	2.58	405.1	1255	1390	1780	640.7
1975M9	415	2.59	7.51	20.38	484.00	2.75	302.70	2.66	427.9	1160	1421	1723	716.6
1975M10	415	2.55	7.49	20.38	484.00	2.62	301.80	2.56	771.8	1272	1375	1714	817.6
1975M11	415	2.59	7.50	20.40	484.00	2.68	303.00	2.63	551.1	1249	1381	1647	831.5
1975M12	415	2.59	7.50	20.40	484.00	2.62	305.15	2.62	576.9	1321	1287	1605	777.4
1976M1	415	2.58	7.47	20.40	484.00	2.60	303.70	2.59	1029.3	1307	1383	1667	782.1
1976M2	415	2.56	7.47	20.40	484.00	2.56	302.25	2.56	856.5	1416	1388	1704	878.1
1976M3	415	2.55	7.45	20.40	484.00	2.53	299.70	2.54	750.4	1472	1469	1742	957.8
1976M4	415	2.56	7.43	20.40	484.00	2.51	299.40	2.54	1179.7	1540	1606	1757	1034.9
1976M5	415	2.56	7.43	20.40	484.00	2.44	299.95	2.59	1096.7	1602	1687	1737	1095.7
1976M6	415	2.54	7.43	20.40	484.00	2.47	297.40	2.57	946.4	1730	1619	1730	1174
1976M7	415	2.48	7.43	20.40	484.00	2.48	293.40	2.54	1414.1	1864	1475	1763	1320
1976M8	415	2.51	7.43	20.40	484.00	2.48	288.75	2.53	1295.6	2028	1491	1824	1424.3
1976M9	415	2.52	7.43	20.40	484.00	2.45	287.45	2.44	1195.2	2116	1562	1821	1539.6
1976M10	415	2.54	7.43	20.40	484.00	2.44	293.70	2.41	1718.7	2215	1564	1770	1738.7
1976M11	415	2.53	7.43	20.40	484.00	2.44	295.75	2.40	1708.2	2292	1546	1727	1737.7
1976M12	415	2.53	7.43	20.40	484.00	2.45	292.80	2.36	1491.8	2266	1581	1725	1962.1
1977M1	415	2.50	7.43	20.40	484.00	2.52	289.30	2.42	1779.5	2245	1475	1717	1965.7
1977M2	415	2.50	7.43	20.40	484.00	2.55	282.70	2.39	1770.4	2303	1304	1789	1939.1
1977M3	415	2.49	7.42	20.40	484.00	2.54	277.50	2.39	1773.6	2358	1332	1813	2079
1977M4	415	2.48	7.41	20.40	484.00	2.52	277.70	2.36	2256.4	2381	1406	1838	2130.5
1977M5	415	2.48	7.40	20.40	484.00	2.50	277.30	2.36	2175.4	2555	1375	1834	2317.1
1977M6	415	2.48	7.40	20.40	484.00	2.46	267.70	2.34	1974.3	2563	1480	1844	2376.3
1977M7	415	2.46	7.39	20.40	484.00	2.40	266.00	2.29	2363.8	2596	1484	1844	2623.8
1977M8	415	2.47	7.39	20.40	484.00	2.40	267.30	2.32	2348.6	2579	1467	1821	2716.9
1977M9	415	2.46	7.39	20.40	484.00	2.23	265.45	2.31	2311.1	2627	1448	1753	2900.8
1977M10	415	2.41	7.39	20.40	484.00	2.23	250.60	2.25	2757	2691	1470	1732	2947.1
1977M11	415	2.38	7.39	20.40	484.00	2.16	245.70	2.23	2716.7	2717	1461	1690	2876.9
1977M12	415	2.37	7.37	20.40	484.00	2.00	240.00	2.10	2399.8	2688	1456	1735	2954.9
1978M1	415	2.36	7.37	20.40	484.00	1.98	241.40	2.11	2567.6	2681	1560	1770	2966.4
1978M2	415	2.36	7.37	20.40	484.00	1.87	238.70	2.04	2346.5	2719	1583	1906	2872.1
1978M3	415	2.35	7.37	20.40	484.00	1.87	222.40	2.02	2190.3	2696	1759	1978	2632.1
1978M4	415	2.39	7.36	20.40	484.00	1.93	222.90	2.07	2395.6	2696	1766	1957	2306.5
1978M5	415	2.40	7.36	20.40	484.00	1.91	223.40	2.10	2151.3	2672	1831	1950	2307.5
1978M6	415	2.37	7.36	20.40	484.00	1.86	204.70	2.08	2042.3	2707	1842	1979	2408.2
1978M7	415	2.33	7.36	20.40	484.00	1.74	190.70	2.04	2502.1	2725	1786	2030	2513.7

1978M8	415	2.31	7.36	20.20	484.00	1.65	190.20	1.99	2345.9	2817	1770	2110	2555.8
1978M9	415	2.28	7.36	20.20	484.00	1.54	189.15	1.94	2219.5	2876	1795	2082	2577.8
1978M10	415	2.11	7.36	20.20	484.00	1.47	176.00	1.74	2699.3	3121	1701	2285	2471.7
1978M11	625	2.21	7.37	20.35	484.00	1.72	197.50	1.92	2551.7	2967	1664	1885	2420
1978M12	625	2.21	7.37	20.39	484.00	1.62	194.60	1.83	2461.3	3123	1746	1974	2735.5
1979M1	625	2.21	7.38	20.38	484.00	1.69	201.30	1.86	2760.6	3159	1700	2158	2689
1979M2	622.25	2.19	7.38	20.42	484.00	1.67	202.20	1.85	2702.8	3185	1698	2131	2630.4
1979M3	623.5	2.20	7.38	20.42	484.00	1.69	209.30	1.87	2703.6	3314	1780	2085	2675.1
1979M4	625.25	2.23	7.38	20.42	484.00	1.72	218.50	1.90	2925.2	3413	1841	2083	2610.9
1979M5	626.25	2.22	7.38	20.42	484.00	1.72	219.80	1.91	3021.6	3475	1967	2096	2640.6
1979M6	625.75	2.18	7.35	20.42	484.00	1.66	217.00	1.85	2949.8	3589	1969	2132	2459.1
1979M7	625.5	2.16	7.37	20.42	484.00	1.66	217.20	1.84	3199.1	3613	2046	2081	2532.6
1979M8	625.75	2.16	7.37	20.42	484.00	1.66	220.00	1.83	3103.9	3663	2042	2026	2582.6
1979M9	625.5	2.15	7.37	20.40	484.00	1.56	223.30	1.74	3030.5	3779	1979	2061	2741.6
1979M10	627.25	2.20	7.37	20.42	484.00	1.66	237.70	1.81	3531.7	3780	2055	1771	3020.9
1979M11	627.25	2.18	7.39	20.42	484.00	1.61	248.80	1.73	3715.7	3891	2069	1811	2901.7
1979M12	627	2.19	7.41	20.42	484.00	1.58	239.70	1.73	3794.6	3711	2216	1794	2909.5
1980M1	627.25	2.19	7.42	20.42	580.00	1.63	238.80	1.74	4375.1	3772	2212	1890	2724.2
1980M2	628.5	2.18	7.42	20.42	580.70	1.69	249.80	1.77	4223.2	3761	2244	1802	2669.8
1980M3	629	2.27	7.43	20.42	586.10	1.83	249.70	1.94	3846.9	3479	2293	1636	2656.7
1980M4	628.5	2.23	7.49	20.42	590.50	1.67	239.00	1.80	4472.1	4267	2505	1661	2473.6
1980M5	626.25	2.17	7.52	20.40	596.20	1.66	224.30	1.79	4655.9	3879	2435	2066	2514.4
1980M6	625.25	2.15	7.53	20.40	603.00	1.62	217.60	1.76	5036.5	3954	2467	2136	2488.4
1980M7	626.5	2.16	7.55	20.45	612.70	1.66	227.00	1.79	5647.3	3978	2663	2113	3110.9
1980M8	625.75	2.14	7.56	20.50	616.30	1.65	219.00	1.79	5462.6	4202	2367	1956	3297.4
1980M9	625.75	2.13	7.56	20.49	625.00	1.65	212.20	1.81	5247.1	4295	2440	2004	3687.8
1980M10	626.5	2.15	7.57	20.56	651.60	1.72	211.50	1.91	5723.2	4390	2506	1767	3423.7
1980M11	627.5	2.19	7.59	20.59	658.80	1.74	216.70	1.93	5231.3	4327	2619	1632	3248.8
1980M12	626.75	2.22	7.60	20.63	659.90	1.76	203.00	1.96	5011.7	4114	2846	1552	2912.3
1981M1	628.25	2.23	7.65	20.68	665.70	1.93	204.70	2.12	5551.3	4173	2533	1437	2668.3
1981M2	628.5	2.30	7.70	20.67	670.50	1.96	208.80	2.13	5090.6	3912	2495	1442	2743.7
1981M3	628	2.29	7.76	20.70	672.80	1.91	211.00	2.10	5681.8	3909	2508	1456	2836.2
1981M4	629	2.32	7.82	20.78	678.90	2.02	215.00	2.21	6135.6	3726	2526	1270	2926.1
1981M5	630	2.35	7.89	21.00	683.80	2.07	224.10	2.33	5701.8	3844	2449	1236	2684.9
1981M6	631.25	2.32	7.95	21.00	685.10	2.03	225.80	2.39	5359	3670	2267	1396	2395.8
1981M7	633.5	2.36	7.95	23.00	686.90	2.14	239.45	2.46	5954.4	3718	2223	1397	2315.6

1981M8	633	2.36	7.96	23.00	685.50	2.12	228.00	2.43	5449.8	3518	2271	1370	2437.6
1981M9	633.75	2.32	8.02	23.00	685.50	1.97	232.70	2.32	5084.7	3405	1999	1372	2579.8
1981M10	634.75	2.29	8.08	23.00	678.20	1.85	233.80	2.25	5746.5	3425	1984	1373	2640.9
1981M11	634.5	2.25	8.11	23.00	689.90	1.77	214.30	2.20	5287.6	3651	2242	1509	2663.4
1981M12	644	2.24	8.20	23.00	700.50	1.80	219.90	2.25	4521.2	3816	2197	1671	2618.7
1982M1	646.75	2.28	8.28	23.00	708.30	1.84	230.50	2.31	4944.1	3844	1529	1530	2779.9
1982M2	649.75	2.31	8.31	23.00	712.00	1.89	237.00	2.39	4865.5	3365	1523	1383	2794.7
1982M3	651.75	2.34	8.35	23.00	718.30	1.93	246.50	2.41	4741.7	3116	1599	1218	2806.5
1982M4	651.75	2.30	8.40	23.00	721.30	1.96	235.10	2.33	4253.7	3379	1411	1481	2996.9
1982M5	654	2.29	8.43	23.00	733.10	2.00	243.50	2.35	3961.4	3039	1479	1624	2823.7
1982M6	657.25	2.36	8.47	23.00	740.80	2.10	254.00	2.46	3194.7	3117	1541	1499	2489.5
1982M7	659.75	2.36	8.50	23.00	741.30	2.09	257.50	2.45	3333.3	2917	1457	1426	2150.7
1982M8	665	2.35	8.59	23.00	741.90	2.12	261.70	2.50	2827.3	2905	1336	1471	2331.5
1982M9	671.25	2.38	8.69	23.00	742.90	2.17	269.50	2.53	2762.8	3085	1401	1414	2557.3
1982M10	681	2.36	8.83	23.00	744.90	2.22	277.30	2.57	2779.9	3196	1214	1299	2667
1982M11	684	2.37	8.93	23.00	744.70	2.14	253.10	2.49	2619.4	3640	865	1358	2774.2
1982M12	692.5	2.32	9.17	23.00	748.80	1.99	235.00	2.38	2592.6	3509	885	1513	2743.6
1983M1	696.25	2.27	9.39	23.00	751.50	2.00	237.90	2.45	2555.3	3500	753	1536	2568.8
1983M2	700.5	2.27	9.52	23.00	753.10	2.04	235.45	2.42	2286.4	3616	602	1552	2365.3
1983M3	702.5	2.30	9.74	23.00	763.40	2.08	239.40	2.43	1368.3	3671	606	1574	2260.1
1983M4	968	2.31	9.93	23.00	767.90	2.06	237.00	2.46	2075.9	3852	539	1548	1862.8
1983M5	969	2.30	10.08	23.00	771.10	2.09	238.30	2.52	2466.7	3810	521	1617	2238.8
1983M6	974	2.33	11.00	23.00	776.70	2.10	239.70	2.54	2644.6	3820	520	1743	1965.4
1983M7	981	2.35	11.00	23.00	783.10	2.13	241.70	2.64	3122.1	3740	517	1827	2289
1983M8	984	2.36	11.00	23.00	790.10	2.19	246.60	2.71	3412.4	4010	547	1658	2181.4
1983M9	982	2.35	11.00	23.00	789.30	2.13	236.10	2.64	3489.5	4056	266	1703	2212.9
1983M10	984	2.35	14.00	23.00	792.90	2.14	233.65	2.63	3599.1	3795	234	1665	2068
1983M11	991	2.34	14.00	23.00	796.90	2.16	234.00	2.70	3640.9	3911	479	1509	2289.7
1983M12	994	2.34	14.00	23.00	795.50	2.18	232.20	2.72	3638.5	3509	746	1561	2229.5
1984M1	995	2.34	14.00	23.00	799.30	2.24	234.75	2.81	3657.6	3589	623	1725	1879.4
1984M2	993	2.33	14.00	23.00	793.30	2.17	233.50	2.61	3909.6	4093	782	1880	1899.6
1984M3	1000	2.29	14.00	23.00	791.80	2.15	224.70	2.59	3988.8	3654	712	1862	1927.8
1984M4	1005	2.29	14.00	23.00	797.60	2.24	225.95	2.72	4045.3	3572	555	1948	2017.3
1984M5	1009	2.31	14.00	23.00	798.30	2.26	231.50	2.73	4096.7	3694	591	1906	2025.7
1984M6	1014	2.32	18.00	23.00	803.40	2.33	237.50	2.78	4225.7	3508	427	1879	2021.3
1984M7	1027	2.34	18.00	23.00	811.40	2.46	245.50	2.90	4460.5	3657	327	1708	2109.9

Appendix - E

1984M8	1048	2.33	18.00	23.00	808.70	2.41	241.30	2.89	4492.5	3627	366	1653	2447.9
1984M9	1059	2.37	18.00	23.00	815.20	2.50	245.50	3.03	4677.1	3787	242	1579	2554.1
1984M10	1061	2.41	19.99	23.00	817.40	2.49	245.25	3.03	4675.1	3456	219	1582	2628.9
1984M11	1067	2.41	19.92	27.07	821.10	2.55	246.30	3.10	4650	3456	474	2094	2750.5
1984M12	1074	2.43	19.76	27.15	827.40	2.59	251.10	3.15	4701.5	3470	574	1890	2723.3
1985M1	1082	2.49	18.40	27.39	830.60	2.68	254.65	3.17	4696	3302	596	1737	2435.5
1985M2	1092	2.58	18.36	28.06	842.80	2.83	259.50	3.32	4647.2	2986	348	1613	2534.5
1985M3	1102	2.52	18.47	27.55	850.30	2.62	252.50	3.09	4966.3	3094	268	1679	2188.2
1985M4	1109	2.48	18.49	27.50	865.90	2.59	252.25	3.09	4994	3258	483	1769	2115.6
1985M5	1117	2.47	18.49	27.52	871.00	2.61	251.85	3.09	5022.5	3498	595	1803	1899.6
1985M6	1118	2.49	18.47	27.42	873.80	2.56	248.95	3.06	4848.6	3763	653	2030	1964.7
1985M7	1116	2.46	18.67	26.75	876.30	2.28	236.65	2.79	4961.7	3953	615	1931	2132.9
1985M8	1119	2.48	18.60	26.85	886.80	2.28	237.25	2.78	4956.5	4008	1121	1895	2339
1985M9	1121	2.44	18.64	26.30	891.70	2.18	217.00	2.67	4972	4380	1004	2153	2606.8
1985M10	1123	2.45	18.76	26.51	892.20	2.15	211.50	2.62	5078.7	4423	769	1944	3052.4
1985M11	1122	2.43	18.76	26.12	889.10	2.08	202.00	2.51	5196.1	4498	672	1832	3056.2
1985M12	1125	2.43	19.03	26.65	890.20	2.08	200.50	2.46	4838.4	4621	550	2157	2828.8
1986M1	1127	2.48	19.10	26.55	888.70	2.03	191.80	2.39	4926.2	4926	456	2169	2222.4
1986M2	1128	2.48	21.98	26.35	883.80	1.87	179.70	2.22	5121.6	5097	406	2212	2569.2
1986M3	1125	2.58	20.60	26.47	885.20	1.94	179.60	2.32	4725.3	4837	703	2325	2609.7
1986M4	1124	2.59	20.50	26.28	885.10	1.83	168.30	2.19	4901.2	4503	866	2351	2787
1986M5	1130	2.64	20.50	26.46	889.80	1.92	171.80	2.31	4755.7	4510	1028	2402	2661.8
1986M6	1131	2.63	20.58	26.30	886.60	1.80	165.00	2.20	4723.2	4846	1016	2312	2657
1986M7	1131	2.62	20.43	26.12	885.00	1.68	154.30	2.09	4854.8	4995	1065	2339	3544.9
1986M8	1132	2.61	20.47	26.14	880.20	1.66	156.10	2.05	4856.8	4898	1022	2428	3595.4
1986M9	1633	2.62	20.45	26.07	877.00	1.64	153.60	2.02	4504.5	4752	1049	2577	3815.4
1986M10	1640	2.62	20.44	26.25	873.20	1.72	161.50	2.07	4397.2	5269	1207	2636	3805.1
1986M11	1650	2.60	20.44	26.24	865.00	1.65	162.40	1.98	4462.8	5276	1173	2612	3675.5
1986M12	1641	2.60	20.53	26.13	861.40	1.62	159.10	1.94	3919.2	5697	1675	2736	3301.1
1987M1	1633	2.54	20.48	25.88	857.20	1.52	152.50	1.81	3429	5995	1762	2941	3781
1987M2	1644	2.52	20.53	25.91	854.80	1.54	153.05	1.83	3756.5	6111	1717	2815	4021.8
1987M3	1644	2.51	20.55	25.87	846.90	1.51	145.80	1.81	3871.3	6104	1605	3152	3499.7
1987M4	1641	2.48	20.48	25.57	834.10	1.46	139.50	1.79	4354.9	6614	1608	3318	3426.9
1987M5	1649	2.50	20.47	25.73	822.70	1.51	144.00	1.82	3984.7	6556	1418	3438	3318.8
1987M6	1648	2.52	20.46	25.84	808.90	1.52	147.00	1.83	4020.9	6743	1380	3596	3286
1987M7	1640	2.55	20.44	25.95	808.00	1.54	149.30	1.86	5303.4	6733	1391	3730	3272.4

1987M8	1640	2.52	20.45	25.74	807.70	1.50	142.40	1.82	4906	7503	1447	3770	3391.2
1987M9	1650	2.53	20.60	25.83	805.80	1.53	146.35	1.84	4862.4	7114	1048	3665	3491.7
1987M10	1648	2.51	20.73	25.62	801.40	1.44	138.60	1.74	4943.8	7235	876	3840	3582.8
1987M11	1650	2.49	20.88	25.36	796.40	1.34	132.55	1.64	5315.3	7383	725	3747	4473.5
1987M12	1650	2.49	20.80	25.07	792.30	1.28	123.50	1.58	5483.4	7055	913	3906	3566.3
1988M1	1662	2.55	20.87	25.23	781.60	1.36	127.20	1.68	4964.7	6813	716	4093	4639.3
1988M2	1660	2.59	21.01	25.27	760.80	1.39	128.00	1.69	5053.9	6537	630	4345	5622.4
1988M3	1660	2.57	21.02	25.15	746.20	1.37	125.40	1.66	5303.7	6635	683	4419	6942.5
1988M4	1669	2.58	21.02	25.13	740.00	1.39	124.85	1.67	5139.4	5846	666	4451	7622.1
1988M5	1673	2.59	20.91	25.16	732.90	1.44	125.25	1.73	5141.2	5657	617	4617	8218.7
1988M6	1688	2.61	21.06	25.47	728.30	1.51	132.40	1.82	5202.7	5857	563	4804	8970
1988M7	1693	2.64	21.04	25.47	723.80	1.56	132.55	1.88	4755.1	5735	427	4867	9546.7
1988M8	1699	2.67	21.08	25.55	722.00	1.58	135.00	1.87	4858	5349	428	5043	10678.1
1988M9	1706	2.68	21.34	25.55	719.00	1.59	134.55	1.88	4858	5239	381	5244	11720.5
1988M10	1715	2.67	21.39	25.22	701.40	1.49	125.75	1.77	4614.5	5899	426	5583	12644.4
1988M11	1721	2.67	21.38	25.06	687.50	1.45	121.75	1.74	4954.5	6144	586	5789	13736
1988M12	1731	2.72	21.34	25.24	684.10	1.50	125.85	1.78	4948.2	6134	951	5997	12340.1
1989M1	1740	2.73	21.35	25.39	680.60	1.59	129.15	1.86	4595.9	5695	814	6451	13367
1989M2	1745	2.73	21.35	25.36	673.10	1.56	127.00	1.83	4511.8	5638	728	6919	13458.7
1989M3	1756	2.75	21.33	25.54	671.90	1.66	132.05	1.89	4755.7	5619	624	7213	14086.9
1989M4	1759	2.70	21.56	25.53	666.30	1.67	132.45	1.88	5127.2	5793	433	7383	14878.7
1989M5	1771	2.71	21.61	25.90	666.70	1.71	142.70	1.99	4814.1	6076	506	7498	15694.7
1989M6	1773	2.71	21.81	25.95	667.20	1.67	144.10	1.95	4285.1	5850	461	7617	15638.7
1989M7	1774	2.66	21.88	25.74	667.40	1.61	138.35	1.87	4589.5	6204	377	7872	14544.4
1989M8	1785	2.70	21.88	25.97	669.20	1.69	144.30	1.96	4279.5	6068	507	8286	16491.8
1989M9	1783	2.69	21.95	25.79	670.00	1.62	139.30	1.87	4285.5	6444	551	8632	16912.8
1989M10	1791	2.70	22.10	25.84	671.60	1.61	142.30	1.84	4489.8	6652	823	8684	17261.2
1989M11	1791	2.70	22.23	25.80	672.70	1.60	142.95	1.79	4410.3	6689	766	8918	17135.9
1989M12	1797	2.70	22.44	25.69	679.60	1.55	143.45	1.70	5357.4	7393	1365	9461	14977.8
1990M1	1805	2.70	22.54	25.71	686.30	1.49	144.15	1.68	5040.6	7663	734	10222	13653.9
1990M2	1812	2.70	22.76	25.80	694.00	1.49	148.40	1.69	4851	7679	626	10864	13433.9
1990M3	1823	2.73	22.75	25.98	702.10	1.50	157.20	1.69	5143	7481	737	10942	13586.8
1990M4	1829	2.72	22.81	26.01	707.00	1.46	159.35	1.68	4523.5	7343	582	10908	14153.2
1990M5	1836	2.70	22.98	25.84	712.30	1.42	151.70	1.69	3909.3	7585	969	11367	14544.4
1990M6	1844	2.71	23.27	25.79	716.00	1.42	152.90	1.67	4593.9	7718	895	11823	14342.4
1990M7	1849	2.71	23.86	25.62	715.10	1.35	147.35	1.60	5266.9	7942	882	12397	15289.2

Appendix - E

1990M8	1858	2.69	25.00	25.48	714.00	1.29	144.25	1.56		5575.9	8330	1020	12868	15510.4
1990M9	1864	2.70	25.75	25.34	712.90	1.30	137.80	1.56		5318.7	8682	946	12589	15568
1990M10	1872	2.70	25.75	25.09	713.80	1.29	129.35	1.52		5607.4	10110	840	13165	15809.9
1990M11	1884	2.69	28.00	25.18	713.10	1.28	133.35	1.51		5959.2	9013	749	13160	15801.5
1990M12	1901	2.70	28.00	25.29	716.40	1.30	134.40	1.49		7352.7	9327	868	13247	14459.2
1991M1	1912	2.70	28.00	25.15	719.00	1.27	131.20	1.49		7207.6	9386	701	13903	14093.4
1991M2	1920	2.72	28.00	25.24	724.40	1.32	132.00	1.52		8388.3	9620	1272	14507	13715.7
1991M3	1932	2.77	28.00	25.65	724.70	1.46	141.00	1.72		7969.8	9186	1244	14147	12611.8
1991M4	1939	2.76	27.84	25.65	725.10	1.46	137.40	1.73		7977.8	9443	1788	14511	12837.7
1991M5	1947	2.76	27.81	25.63	723.00	1.47	137.90	1.72		8313.3	9481	2108	14925	13233.9
1991M6	1954	2.78	27.75	25.71	723.10	1.56	137.90	1.81		8575.8	9190	2362	15432	13019.7
1991M7	1959	2.79	27.75	25.73	726.10	1.52	137.80	1.75		8425.9	9337	2124	16212	13337.7
1991M8	1965	2.79	27.00	25.72	735.60	1.52	137.15	1.74		8366.6	9480	2208	16287	12974.1
1991M9	1968	2.74	27.00	25.54	741.50	1.45	132.85	1.66		8375.7	9299	2370	16836	13475.7
1991M10	1977	2.75	27.00	25.57	750.30	1.47	130.90	1.67		8453.7	9448	2569	16487	13179.3
1991M11	1985	2.75	26.70	25.48	754.50	1.44	130.05	1.63		9181.3	9766	2882	16666	13196.7
1991M12	1992	2.72	26.65	25.28	760.80	1.36	125.20	1.52		9150.7	10421	3186	17287	13306
1992M1	2004	2.69	26.53	25.40	762.00	1.43	125.75	1.61		9383.9	10631	3536	17836	13606.8
1992M2	2010	2.59	26.05	25.50	768.20	1.49	129.28	1.64		9147.8	10875	3891	18138	14105.2
1992M3	2017	2.59	25.38	25.60	775.10	1.50	133.20	1.64		9518.5	11469	4324	17778	14053.6
1992M4	2022	2.53	25.80	25.63	778.80	1.52	133.50	1.66		9980.7	12352	3708	18187	14656.3
1992M5	2027	2.53	26.25	25.48	783.50	1.46	128.25	1.61		10526.9	12574	3008	18727	14912.8
1992M6	2033	2.51	25.58	25.29	790.20	1.38	125.50	1.53		10608.1	12073	3115	19452	14130.8
1992M7	2035	2.50	24.91	25.31	788.10	1.32	127.20	1.48		10914.5	14211	3154	18963	14804.9
1992M8	2034	2.49	23.29	25.13	787.60	1.26	122.90	1.41		11104.1	15456	2983	19505	15568.4
1992M9	2038	2.50	25.12	25.09	786.60	1.23	119.20	1.41		10616.4	18174	3742	19908	14983.1
1992M10	2050	2.51	24.64	25.35	782.40	1.37	123.20	1.54		10306.1	18842	4108	20219	15281.4
1992M11	2059	2.53	25.49	25.51	785.10	1.45	124.70	1.60		10476.2	18991	4283	19765	16388.7
1992M12	2062	2.61	25.10	25.52	788.40	1.46	124.75	1.61		10181.2	16784	4283	20012	16639.9
1993M1	2066	2.62	25.35	25.49	794.00	1.47	124.60	1.59		10605	16896	4646	20774	17336.6
1993M2	2067	2.63	25.28	25.43	794.90	1.52	117.70	1.64		10668.1	16372	5018	20471	17558.9
1993M3	2071	2.59	25.51	25.36	794.00	1.50	116.35	1.61		10774.5	14907	5662	21079	18150.7
1993M4	2074	2.57	26.39	25.20	795.90	1.43	111.15	1.58		10918.5	15620	5731	21445	18667.8
1993M5	2078	2.56	27.09	25.12	801.10	1.43	106.50	1.59		10746.4	14993	4895.7	21943	18617.3
1993M6	2088	2.58	27.27	25.25	803.70	1.51	106.75	1.69		10787.9	15824	4766.6	22782	18363.5
1993M7	2096	2.57	27.70	25.29	806.60	1.52	105.90	1.74		10683.2	17500	4523.6	22722	18246.4

1993M8	2102	2.55	28.04	25.17	808.40	1.47	104.20	1.67	10821.4	20019	4138	23026	18394.2
1993M9	2108	2.55	29.81	25.20	808.80	1.42	105.15	1.62	10962.6	21988	4010.8	24008	19151
1993M10	2106	2.56	28.83	25.34	808.20	1.48	108.20	1.68	10906.2	20456	4251.6	24334	19455.1
1993M11	2106	2.56	27.96	25.42	807.60	1.49	108.95	1.71	10932	23287	4322	24007	20910.2
1993M12	2110	2.70	27.70	25.54	808.10	1.48	111.85	1.73	10988	26814	4546	24078	19704.2
1994M1	2122	2.76	27.68	25.48	808.10	1.46	109.90	1.74	11087.9	36760	4550.45	23996	19975.5
1994M2	2137	2.73	27.70	25.29	802.60	1.43	104.15	1.71	11404.2	33790	4680.78	24891	20179.1
1994M3	2143	2.67	27.57	25.23	806.50	1.41	103.15	1.67	11364.9	33193	5528.18	25308	20177.1
1994M4	2149	2.69	27.28	25.16	807.50	1.41	102.50	1.66	10473.8	31618	5906.2	25226	20399.9
1994M5	2155	2.58	26.87	25.20	806.10	1.40	104.47	1.64	10316.6	32074	5815.75	26116	20803.9
1994M6	2160	2.60	26.91	24.99	805.50	1.34	99.05	1.60	10614.1	32084	6411.54	26937	21120.3
1994M7	2169	2.59	26.23	25.03	802.60	1.35	99.75	1.60	10344.4	29689	6683.86	27186	20950.3
1994M8	2175	2.55	26.48	25.02	801.10	1.33	99.55	1.58	11020.7	30218	6536.7	27665	21428.3
1994M9	2181	2.57	26.00	24.97	798.90	1.29	98.45	1.55	11050.2	29824	6476.98	28545	21779.5
1994M10	2186	2.55	24.93	24.92	796.90	1.26	97.38	1.51	11126.6	28758	6032.11	28424	23088
1994M11	2193	2.56	23.88	25.05	794.30	1.33	98.92	1.57	12049.2	28844	5922.85	28321	23403.6
1994M12	2200	2.56	24.42	25.09	788.70	1.31	99.74	1.55	11819.9	24888	5886.54	28884	25032.1
1995M1	2207	2.56	24.57	25.02	786.70	1.28	98.55	1.51	11641.8	24610	5919.76	28491	25634.4
1995M2	2212	2.55	25.73	24.95	786.00	1.24	97.05	1.46	11626.1	24334	5575.02	28723	25752.4
1995M3	2219	2.54	25.99	24.74	771.50	1.14	89.35	1.38	11960.7	24385	5401.53	28597	25878.8
1995M4	2227	2.47	26.02	24.58	761.80	1.14	83.75	1.38	11983.8	24737	5601.61	30168	26552
1995M5	2236	2.47	25.80	24.63	760.10	1.15	83.20	1.39	12100.1	24738	5747.44	31708	26318.2
1995M6	2246	2.44	25.58	24.66	758.10	1.15	84.60	1.38	12480.8	25720	6035.87	33396	27613.6
1995M7	2256	2.46	25.59	24.75	756.50	1.15	88.43	1.38	12906.7	25794	6876.48	32848	30184.8
1995M8	2266	2.50	25.91	25.09	771.10	1.20	99.10	1.47	12812.2	24077	6816.44	33087	30409.4
1995M9	2275	2.51	26.07	25.07	768.40	1.14	98.30	1.42	12841.3	24255	6569.15	34319	30414.1
1995M10	2285	2.54	25.99	25.14	765.50	1.14	101.70	1.41	12861	23513	6121.02	34189	31379.1
1995M11	2296	2.54	26.18	25.16	769.20	1.17	101.55	1.44	13172.4	22929	6010.74	34655	32433.7
1995M12	2308	2.54	26.21	25.19	774.70	1.15	102.83	1.43	13305.6	22945	6258.87	35463	31928.2
1996M1	2311	2.56	26.19	25.35	784.30	1.22	107.25	1.49	13338.2	21531	6528.67	36146	32496.3
1996M2	2322	2.55	26.18	25.18	780.70	1.20	104.70	1.47	14555.8	22234	6846.44	37104	34298.7
1996M3	2337	2.54	26.20	25.23	782.70	1.19	106.28	1.48	14528.3	22661	6903.62	37398	32634.3
1996M4	2342	2.49	26.17	25.23	778.70	1.24	104.80	1.53	14530	23378	7438.48	37282	35115.6
1996M5	2354	2.50	26.22	25.34	787.90	1.26	108.20	1.53	14528.2	24583	7940.62	37473	35424.9
1996M6	2342	2.50	26.20	25.36	810.60	1.25	109.42	1.52	15146.2	24702	8342.46	38251	35747.7
1996M7	2353	2.50	26.23	25.27	813.30	1.19	107.92	1.47	15057.7	25270	8893.54	37772	34238.4

1996M8	2363	2.50	26.20	25.29	819.40	1.20	108.44	1.48		15039.9	25296	9870.94	37781	32721
1996M9	2340	2.51	26.26	25.42	821.20	1.26	110.97	1.53		15058.3	25214	9677.96	37956	32037.6
1996M10	2352	2.53	26.29	25.49	831.30	1.26	113.80	1.51		15222.3	25546	9524.04	38319	32228.8
1996M11	2368	2.53	26.29	25.51	828.70	1.30	113.77	1.53		16481.2	25917	9577.07	38029	32317.5
1996M12	2383	2.53	26.29	25.61	844.20	1.35	116.00	1.55		17820.4	26156	9930.57	37192	33236.7
1997M1	2396	2.49	26.34	25.87	861.30	1.42	122.00	1.63		18552.9	26096	9561.98	37733	30966.3
1997M2	2406	2.48	26.33	25.89	863.90	1.48	120.78	1.69		18561.5	26322	10209	36650	29756
1997M3	2419	2.48	26.37	25.97	897.10	1.45	124.05	1.68		18609.9	26913	10313.6	36573	29145.8
1997M4	2433	2.51	26.37	26.10	892.10	1.47	126.85	1.73		19110	26202	10073.2	35835	29930.8
1997M5	2440	2.51	26.37	25.80	891.80	1.41	116.45	1.70		19758.7	25466	9895.61	31809	31900.5
1997M6	2450	2.52	26.38	25.79	888.10	1.46	114.40	1.74		19934.5	25799	9687.57	30855	33316.2
1997M7	2599	2.63	28.97	32.07	892.00	1.51	118.25	1.83		19839.9	20933	8253.1	28939	32672.6
1997M8	3035	2.96	30.17	34.33	902.00	1.48	119.35	1.79		18881.8	21224	8792.05	24448	30370.3
1997M9	3275	3.19	33.87	36.52	914.80	1.45	121.00	1.77		19880.4	21380	9313.01	28121	29654
1997M10	3670	3.43	34.94	39.72	965.10	1.40	119.95	1.72		17928.4	21433	8469.85	29788	29728
1997M11	3648	3.51	34.66	40.14	1163.80	1.43	127.55	1.76		17570.8	20984	8342.98	24774	23628.1
1997M12	4650	3.89	39.98	47.25	1695.00	1.46	129.95	1.79		16087.7	20013	7178.22	25697	19710.4
1998M1	10375	4.57	42.41	54.92	1525.00	1.47	126.90	1.83		17649.8	18933	7009.74	25373	22778.1
1998M2	8750	3.67	40.36	42.92	1633.00	1.47	127.25	1.81		15010.7	19025	7687.23	24906	26670.5
1998M3	8325	3.65	37.08	38.80	1383.00	1.52	132.05	1.85		15306.1	19031	7737.9	26436	29676.6
1998M4	7500	3.73	39.98	38.71	1336.00	1.50	132.30	1.79		16415.1	18968	9167.55	28282	35471.7
1998M5	10525	3.89	38.90	40.22	1407.00	1.48	139.05	1.78		17739.7	18937	9228.11	26232	38292.2
1998M6	14900	4.17	42.09	42.31	1373.00	1.52	140.85	1.81		17521.3	18926	8940.14	25355	40764.1
1998M7	13000	4.14	42.02	40.83	1230.00	1.49	143.70	1.78		18183.7	18764	8732.69	25559.5	42885.5
1998M8	11075	4.21	43.87	41.96	1350.00	1.46	141.46	1.77		18602.7	18788	8364.39	26679	44684.3
1998M9	10700	3.80	43.81	39.31	1391.00	1.39	135.25	1.68		19275.4	19898	8916.77	26167	46904.2
1998M10	7550	3.80	40.83	36.77	1319.00	1.35	116.40	1.65		20429.2	21917	8832.4	27347	48760.5
1998M11	7300	3.80	39.46	36.11	1246.00	1.41	123.65	1.70		21486.9	22164	8816.18	27795.3	49931.4
1998M12	8025	3.80	39.06	36.69	1204.00	1.38	115.60	1.67		22401.4	24728	9149.59	28433.8	51963
1999M1	8950	3.80	38.72	36.86	1175.00	1.42	116.20		0.88	23443.1	26334	10027.8	27916	53242.1
1999M2	8730	3.80	39.10	37.44	1223.00	1.44	119.40		0.91	23372.9	26641	10577.9	27659.6	55092.2
1999M3	8685	3.80	38.77	37.64	1227.00	1.49	120.40		0.93	24944.4	26247	11301.3	28881.3	57088.5
1999M4	8260	3.80	38.02	37.24	1188.00	1.52	119.33		0.94	24709	27149	12117.3	29146	58902.3
1999M5	8105	3.80	38.10	37.06	1186.20	1.52	121.42		0.96	25194.1	28151	12105	29607.9	61051.3
1999M6	6726	3.80	38.02	36.84	1157.60	1.55	121.10		0.97	26118.4	29688	12221.8	30407	61630.2
1999M7	6875	3.80	38.25	37.09	1204.00	1.50	115.20		0.94	25743.2	30658	12310.2	30895.2	64581.5

1999M8	7565	3.80	39.67	38.30	1184.60	1.52	110.82	0.95	25981.6	31618	12566.3	31213.7	64417
1999M9	8386	3.80	41.11	40.98	1216.40	1.50	106.85	0.94	25830.4	30211	12657.2	31354	65110.7
1999M10	6900	3.80	40.16	38.70	1200.00	1.53	104.85	0.96	26061.9	29044	12738.1	31433.4	65844.3
1999M11	7425	3.80	40.79	39.02	1159.20	1.59	102.50	0.99	26055	28859	12852.7	31873.4	69323.6
1999M12	7085	3.80	40.31	37.47	1138.00	1.60	102.20	1.00	26245	29670	13143.2	33804.7	73700.3
2000M1	7425	3.80	40.39	37.49	1123.20	1.64	106.85	1.02	26744.7	31274	12797.4	31657.7	76370.6
2000M2	7505	3.80	40.85	37.95	1131.00	1.65	110.18	1.03	27388.3	32321	12608.7	30991.3	79379
2000M3	7590	3.80	41.06	37.81	1106.00	1.67	105.85	1.05	28263.2	32719	14125.4	31390.1	83299
2000M4	7945	3.80	41.28	38.02	1109.10	1.73	106.55	1.10	27763.1	31382.7	13889.8	31305.5	84196.4
2000M5	8620	3.80	42.83	39.11	1129.40	1.69	106.65	1.07	27572.6	31245.3	13498.3	31086.6	86471.3
2000M6	8735	3.80	43.15	39.12	1115.00	1.63	105.40	1.05	28354.4	31191.6	13328.6	31284.5	89828.3
2000M7	9003	3.80	44.94	41.45	1116.70	1.67	109.50	1.08	28007.2	30714.1	12814.9	31102	89928.6
2000M8	8290	3.80	45.08	40.88	1108.80	1.73	106.40	1.12	30913.3	30554.3	13481.8	31448.1	91088.5
2000M9	8780	3.80	46.28	42.21	1115.00	1.74	107.85	1.14	28487.9	29738.7	12894.4	31474.1	92189.6
2000M10	9395	3.80	51.43	43.95	1139.00	1.81	109.05	1.19	27751.7	28291.9	12427.3	31492.5	92278.8
2000M11	9530	3.80	49.39	43.88	1214.30	1.74	111.17	1.15	27787.7	27775	12485.5	31597.8	93004.7
2000M12	9595	3.80	50.00	43.27	1264.50	1.64	114.90	1.07	28280.4	27432.2	12974.8	31933.2	95855.1
2001M1	9450	3.80	49.41	42.55	1259.00	1.64	116.15	1.08	28522.9	27082.3	12324.5	32086.5	95077.2
2001M2	9835	3.80	48.26	42.86	1250.80	1.67	116.40	1.08	28312.8	26573.5	12114.6	32483.7	94992.1
2001M3	10400	3.80	49.38	44.77	1327.50	1.73	124.60	1.13	27899	24798.4	12686.1	31646.8	94108.7
2001M4	11675	3.80	51.22	45.54	1319.70	1.73	123.45	1.13	27819.5	24136.3	12413.3	31416	93093.7
2001M5	11058	3.80	50.58	45.29	1282.70	1.79	119.20	1.18	27793.7	23635.1	12387.5	31349.1	93292.5
2001M6	11440	3.80	52.37	45.21	1297.50	1.80	124.05	1.18	27764.4	23745.4	12503.7	30939.3	93911.1
2001M7	9525	3.80	53.56	45.69	1300.00	1.72	124.80	1.14	28003.5	24971.9	12248.6	31209.7	96712
2001M8	8865	3.80	51.21	44.10	1278.00	1.65	118.95	1.09	27508.6	25455.1	12071.8	31885.3	98686.6
2001M9	9675	3.80	51.36	44.38	1309.60	1.61	119.30	1.10	27961	27447.3	12217.9	31898.8	99743.7
2001M10	10435	3.80	51.94	44.62	1296.10	1.62	121.82	1.11	27524.4	27975.6	12067.3	32355.8	100136
2001M11	10430	3.80	52.02	43.99	1273.00	1.65	123.95	1.12	27058.2	28432.4	12527.4	32584.1	101317
2001M12	10400	3.80	51.40	44.22	1313.50	1.68	131.80	1.13	27047.5	28632.9	13352.7	32349.5	102487
2002M1	10320	3.80	51.20	43.92	1314.40	1.70	132.90	1.16	26792.6	28719.1	13963	33089.4	103971
2002M2	10189	3.80	51.35	43.68	1323.80	1.71	133.90	1.16	26904	29283.5	13774.6	33222.7	104761
2002M3	9655	3.80	51.15	43.48	1325.90	1.68	133.20	1.15	26966.2	30564.8	14850.8	32853.3	105759
2002M4	9316	3.80	50.74	43.20	1294.00	1.62	128.00	1.11	27079.4	30534.7	14510.3	33662	107292
2002M5	8785	3.80	49.97	42.37	1226.30	1.56	124.40	1.07	27592.6	30361.4	14375	34441.8	109261
2002M6	8730	3.80	50.42	41.53	1201.30	1.48	119.45	1.00	28127.3	31362.7	14207.8	35984.9	111934
2002M7	9108	3.80	51.29	41.95	1188.00	1.49	119.85	1.02	29128.9	31789.9	13480.1	37014	114991

2002M8	8867	3.80	51.81	42.17	1201.90	1.49	117.95	1.02	28942.8	32002.6	13426.2	37708.2	116018
2002M9	9015	3.80	52.45	43.34	1227.80	1.48	121.55	1.01	28807.8	31737.4	13216.9	36832.6	116105
2002M10	9233	3.80	53.02	43.27	1221.60	1.48	122.45	1.01	28741.7	31727.5	13126.9	36350.3	116409
2002M11	8976	3.80	53.59	43.35	1208.80	1.49	122.30	1.01	28804.5	32253.7	12940	36864.6	117742
2002M12	8940	3.80	53.10	43.15	1186.20	1.39	119.90	0.95	30754.3	32419.1	13200.5	38042.2	120811
2003M1	8876	3.80	53.80	42.72	1170.10	1.36	118.95	0.92	30829.6	32445.2	13403.5	38852	122294
2003M2	8905	3.80	54.35	42.62	1193.70	1.36	117.75	0.93	30926.4	32659.5	13244	37881.2	123377
2003M3	8908	3.80	53.53	42.85	1254.60	1.35	120.15	0.92	31350.8	32707	13074.6	36791.7	123217
2003M4	8675	3.80	52.82	42.80	1215.30	1.36	119.60	0.90	32348.5	33330.1	13247.8	37106.7	122970
2003M5	8279	3.80	52.28	41.66	1205.90	1.29	118.35	0.85	32843.1	34287.3	12909.3	37954.7	127673
2003M6	8285	3.80	53.71	41.98	1193.10	1.36	119.85	0.88	32717.7	34868.6	12881.3	38454	130886
2003M7	8505	3.80	54.69	41.96	1179.70	1.37	120.10	0.88	32307.9	36038.4	13044	36653	132132
2003M8	8535	3.80	55.11	41.14	1178.20	1.41	117.05	0.92	32131.7	36504.8	12951.5	37376	135430
2003M9	8389	3.80	54.94	39.95	1150.10	1.32	111.20	0.86	32615.3	38564.4	12980.2	39278.3	140752
2003M10	8495	3.80	55.25	39.87	1183.10	1.33	108.76	0.86	33334.6	41508.5	13625.6	39214.3	142524
2003M11	8537	3.80	55.77	39.87	1202.10	1.29	109.50	0.83	33632.6	41838.4	13468.7	40122	149541
2003M12	8465	3.80	55.57	39.59	1192.60	1.24	107.10	0.79	34742.4	42772.4	13523.3	40965.1	154509
2004M1	8441	3.80	56.09	39.23	1173.70	1.26	105.97	0.81	34393.4	45597.6	12906.7	41054.3	156601
2004M2	8447	3.80	56.28	39.28	1176.20	1.27	109.00	0.81	34513.6	47105.3	12699.6	41759.1	162160
2004M3	8587	3.80	56.36	39.41	1146.60	1.28	104.30	0.82	35850.5	49328.2	13085.6	41798.1	162713
2004M4	8661	3.80	55.86	39.95	1173.30	1.30	110.20	0.84	35564	51428	13419.9	41516.4	162809
2004M5	9210	3.80	55.84	40.47	1160.10	1.25	110.50	0.82	35007.1	51957.2	13478.1	41652.7	165700
2004M6	9415	3.80	56.18	40.89	1155.50	1.25	108.38	0.82	33385.2	51955	13077.9	42111.4	166188
2004M7	9168	3.80	56.01	41.32	1170.00	1.28	112.08	0.83	33307	52422.2	12800.7	42268.9	167170
2004M8	9328	3.80	56.22	41.60	1153.00	1.27	109.65	0.83	33333	52637	12759	42636.7	169652
2004M9	9170	3.80	56.34	41.45	1151.80	1.26	111.00	0.81	33286.5	55030.5	12609.6	43510.2	173602
2004M10	9090	3.80	56.35	41.00	1119.60	1.20	106.13	0.79	33721.8	57644.6	12715.4	44890.4	177529
2004M11	9018	3.80	56.23	39.51	1048.20	1.14	103.18	0.75	34285.6	61196.2	12696.6	46920.7	191720
2004M12	9290	3.80	56.27	39.06	1035.10	1.13	104.12	0.73	34724.1	64905.9	12979.5	48497.5	198175
2005M1	9165	3.80	55.11	38.50	1025.60	1.17	104.00	0.76	34522.3	67839.2	12737.8	47622.1	198822
2005M2	9260	3.80	54.72	38.28	1006.00	1.16	104.73	0.75	34970.2	70047	13511.3	48364.5	201264
2005M3	9480	3.80	54.79	39.11	1015.50	1.20	107.35	0.77	34485.1	70718.4	13691.9	47373	204626
2005M4	9570	3.80	54.35	39.57	997.10	1.19	105.89	0.77	34781	72040.2	13936.9	47906.5	205552
2005M5	9495	3.80	54.37	40.47	1007.70	1.25	108.08	0.81	33091.2	73256.2	14656	46902	205287
2005M6	9713	3.80	55.92	41.27	1025.40	1.28	110.40	0.83	32366.3	73616.9	15013.2	47007.6	204195
2005M7	9819	3.75	56.11	41.70	1026.80	1.29	112.22	0.83	30668.2	77162.7	14943.3	47086.9	204902

2005M8	10240	3.77	56.16	41.31	1038.50	1.27	111.30	0.82	29627.8	78674.5	15281.8	48042.5	205971
2005M9	10310	3.77	56.06	40.96	1041.10	1.29	113.15	0.83	28638.3	78964.6	15846.2	48349.7	205994
2005M10	10090	3.77	55.06	40.74	1040.20	1.28	115.70	0.83	30891	75697.4	15504.6	48349.1	206569
2005M11	10035	3.78	54.00	41.17	1033.50	1.32	119.63	0.85	31494.4	71726.5	15379.1	49232	207579
2005M12	9830	3.78	53.07	41.03	1011.60	1.31	117.97	0.85	32925.5	69376.9	15800.1	50502	209968
2006M1	9395	3.75	52.34	39.06	964.60	1.28	117.71	0.83	33038.1	70196.8	17611.5	51514.3	216506
2006M2	9230	3.71	52.09	39.27	970.90	1.32	116.25	0.84	33603	71105.8	17743.7	52726.4	215540
2006M3	9075	3.69	51.28	38.80	971.60	1.31	117.40	0.83	38114.7	72643.6	17721.6	53518.9	216936
2006M4	8775	3.63	51.83	37.47	943.40	1.25	114.30	0.80	40521.6	74669.8	17674.8	55347.8	222500
2006M5	9220	3.63	52.65	38.09	945.60	1.21	112.24	0.78	42021.6	77887	17968.9	55792	224291
2006M6	9300	3.68	53.59	38.19	960.30	1.23	114.95	0.79	38256.3	77974.9	18089.6	56238.4	225313
2006M7	9070	3.65	51.62	37.81	955.20	1.23	114.80	0.78	39060.3	78291.1	18198.2	56926	225313
2006M8	9100	3.68	50.94	37.54	961.50	1.23	117.32	0.78	40195.5	78515.1	18541.5	57508.8	226619
2006M9	9235	3.68	50.39	37.49	946.20	1.25	117.80	0.79	40591.4	78752.8	18717.1	59811.9	227819
2006M10	9110	3.65	49.81	36.74	942.30	1.25	117.65	0.79	38082.4	78876	19303.9	60517	228606
2006M11	9165	3.62	49.76	36.00	929.50	1.21	116.40	0.76	39844.9	79310	19523	62611	233688
2006M12	9020	3.53	49.13	36.05	929.80	1.22	118.95	0.76	40866	81723.6	19891.4	65147.1	238388
2007M1	9090	3.50	49.03	35.76	941.00	1.25	121.68	0.77	41516.9	82781.1	20583.5	64883.5	239709
2007M2	9160	3.51	48.29	35.39	941.80	1.22	118.48	0.76	43867.9	86164.8	21421.1	66286.9	242285
2007M3	9118	3.46	48.26	34.97	940.90	1.22	117.65	0.75	45433.5	87827.4	21542.1	68966.5	243386
2007M4	9083	3.42	47.51	34.74	930.80	1.21	119.60	0.74	47481.1	90848.6	21914.1	69130.7	246781
2007M5	8815	3.40	46.27	34.60	927.70	1.23	121.62	0.74	48347.4	97657.7	22473.8	69213.8	250264
2007M6	9054	3.45	46.33	34.50	926.80	1.23	123.23	0.74	49171.3	97680.3	23321.4	71144.4	250223
2007M7	9186	3.45	45.61	33.76	919.30	1.21	118.95	0.73	50090.7	97776.7	24859.4	72112.5	254394
2007M8	9410	3.50	46.70	34.29	938.30	1.21	116.20	0.73	49629.3	96089.6	27228.1	72524.4	254855
2007M9	9137	3.42	45.06	34.39	915.10	1.17	115.05	0.71	50920	97524.9	27731.1	78579.9	256848
2007M10	9103	3.34	43.95	33.96	900.70	1.16	114.75	0.69	52076	98931.9	28993.1	80198.4	259690
2007M11	9376	3.36	42.80	33.81	921.10	1.12	110.30	0.68	52791.7	100400	29248.5	82393.6	261472
2007M12	9419	3.31	41.40	33.72	936.10	1.13	114.00	0.68	54737.3	100635	30071.4	85110.1	261771
2008M1	9291	3.24	40.65	32.98	943.90	1.08	106.36	0.67	53600.9	108564	30811.2	90182.4	261421
2008M2	9051	3.19	40.36	31.85	939.00	1.05	104.73	0.66	54632.2	115570	32087.1	97822.9	261920
2008M3	9217	3.19	41.87	31.46	990.40	0.99	100.10	0.63	56547.8	119562	32645.5	107345	263778
2008M4	9234	3.16	42.19	31.70	1002.60	1.04	104.08	0.64	56427.7	123366	32615.1	107289	260020
2008M5	9318	3.24	43.88	32.40	1030.10	1.05	105.66	0.64	55117	124446	32282.9	106415	257672
2008M6	9225	3.27	44.76	33.48	1046.00	1.02	106.40	0.63	57018.5	125063	32593.4	103026	257584
2008M7	9118	3.26	44.14	33.48	1012.20	1.05	107.99	0.64	58182.6	124347	32842.2	102137	247011

Appendix - E

2008M8	9153	3.39	45.69	34.12	1089.00	1.10	109.10	0.68	56124.5	121861	33024.8	98868.5	242700
2008M9	9378	3.46	45.69	34.00	1207.00	1.10	104.30	0.70	54757.6	109052	33024.8	99906.4	239176
2008M10	10995	3.56	48.75	34.93	1291.00	1.15	98.30	0.78	48554.6	99523.2	32293.7	100962	211783
2008M11	12151	3.59	48.88	35.38	1469.00	1.21	95.25	0.79	48021	96847.9	32878.9	103760	199786
2008M12	10950	3.46	47.49	34.90	1259.50	1.06	90.75	0.72	49338.9	90605.1	33047.2	108317	200479
2009M1	11355	3.61	47.08	34.88	1379.50	1.16	89.60	0.78	48523.6	90422.6	34539.5	107908	201020
2009M2	11980	3.69	47.49	36.00	1534.00	1.18	97.55	0.79	48120.3	90199.7	33047.2	110414	200827
2009M3	11575	3.65	48.42	35.48	1383.50	1.14	98.10	0.75	52413.2	86854.5	34352.6	113409	205624
2009M4	10713	3.56	48.70	35.27	1282.00	1.14	97.60	0.75	54207.4	86762.9	34752.1	114055	211758
2009M5	10340	3.51	47.55	34.33	1255.00	1.07	96.50	0.71	55430.1	87348.2	34564.2	118464	225776
2009M6	10225	3.52	48.31	33.98	1273.90	1.08	95.95	0.71	55121.7	90525.9	34631.3	117886	230734
2009M7	9920	3.52	48.12	33.99	1228.50	1.08	95.33	0.71	54971	90107.2	35166.8	120472	236509
2009M8	10060	3.52	48.91	33.97	1248.90	1.06	92.70	0.70	55439.8	90556.1	35493.3	123016	240915
2009M9	9681	3.47	47.39	33.51	1178.10	1.03	89.77	0.68	56954.5	92216.6	36226.5	127165	249409
2009M10	9545	3.41	47.73	33.39	1182.50	1.02	91.38	0.68	59057.7	92301.3	36600.8	130540	259320
2009M11	9480	3.39	46.75	33.16	1162.80	1.00	86.75	0.67	60033.5	92395.6	37220.3	134721	265955
2009M12	9400	3.42	46.36	33.32	1164.50	1.03	92.06	0.69	60572	92865.1	37504.2	133599	265202
2010M1	9365	3.41	46.74	33.10	1161.80	1.05	89.85	0.72	64038.8	93111.7	38924.7	137626	268917
2010M2	9335	3.41	46.26	33.03	1160.00	1.08	89.25	0.74	64219.8	92996.7	38935.4	136965	265865
2010M3	9115	3.27	45.63	32.32	1131.30	1.06	93.25	0.74	66325.7	91517.5	38410.5	139259	267567
2010M4	9012	3.19	44.64	32.25	1108.40	1.08	94.06	0.75	72966.4	92209	39404.4	142573	274144
2010M5	9180	3.25	46.21	32.49	1202.50	1.15	91.30	0.81	68940.4	91696	39812.6	138447	265596
2010M6	9083	3.26	46.31	32.39	1210.30	1.08	88.60	0.81	70609.4	90878.8	40638.3	141611	269823
2010M7	8952	3.19	45.81	32.22	1182.70	1.04	86.50	0.77	73162.5	91127.3	41126.7	145879	281426
2010M8	9041	3.14	45.18	31.25	1189.10	1.02	84.25	0.79	75539.5	91354	41618.2	149337	280858
2010M9	8924	3.09	43.90	30.37	1140.20	0.97	83.40	0.73	80520.4	96619.5	45090.3	157129	285153
2010M10	8928	3.11	43.18	29.92	1125.30	0.99	80.58	0.72	85674.4	101214	48936.9	164774	288674
2010M11	9013	3.16	44.26	30.22	1159.70	1.00	84.15	0.77	86653	101692	52293.6	161660	285669
2010M12	8991	3.08	43.89	30.15	1134.80	0.94	81.45	0.75	89970.1	102325	53991.3	165656	286926
2011M1	9057	3.06	44.09	31.14	1121.50	0.94	82.05	0.73	89251.6	103801	55466.3	167722	291029
2011M2	8823	3.05	43.84	30.61	1128.70	0.93	81.70	0.72	93333	105462	55416.8	172915	292723
2011M3	8709	3.03	43.43	30.30	1096.70	0.91	83.13	0.70	99350	109407	57388	174410	293642
2011M4	8574	2.97	43.02	29.94	1071.50	0.87	82.06	0.67	107121	125556	59341.4	182191	302099
2011M5	8537	3.01	43.29	30.31	1079.20	0.85	80.85	0.70	109667	128295	59725.4	177906	299531
2011M6	8597	3.02	43.49	30.75	1067.70	0.83	80.72	0.69	113078	129760	59840.9	176638	298903
2011M7	8508	2.96	42.23	29.75	1054.50	0.80	77.55	0.70	115829	130817	62584.7	178789	303942

2011M8	8578	2.98	42.51	30.02	1066.80	0.81	76.59	0.69	117477	131658	66756.8	178061	305080
2011M9	8823	3.19	43.64	31.17	1178.10	0.90	76.63	0.74	107695	126267	66133	169974	296322
2011M10	8835	3.07	43.03	30.67	1110.00	0.87	79.20	0.71	106830	130073	66327.7	171323	303805
2011M11	9170	3.17	43.81	31.22	1143.00	0.92	78.05	0.75	104321	130072	66573.9	167466	300768
2011M12	9068	3.18	43.93	31.69	1151.80	0.94	77.72	0.77	103611	128964	65699.7	165200	298233
2012M1	9000	3.05	42.95	31.04	1123.30	0.91	76.36	0.76	104981	129426	66685.7	167740	303104
2012M2	9085	3.00	42.86	30.39	1118.70	0.90	80.65	0.74	105075	130075	66340.5	169759	307475
2012M3	9180	3.07	43.00	30.84	1133.00	0.90	82.15	0.75	103657	130899	63870	168775	307578
2012M4	9190	3.03	42.44	30.73	1130.00	0.91	81.15	0.76	109554	131126	64319.6	168496	308446
2012M5	9565	3.18	43.45	31.90	1180.30	0.97	78.80	0.81	105031	131168	64569.2	161837	302690
2012M6	9480	3.19	42.28	31.83	1145.40	0.96	79.30	0.79	99963.9	129579	64357.8	164601	304200
2012M7	9485	3.14	41.91	31.58	1130.60	0.98	78.15	0.81	99886.8	129810	67894.7	165220	305368
2012M8	9560	3.13	42.32	31.37	1134.70	0.95	78.45	0.79	102194	130306	68376.7	168677	307525
2012M9	9588	3.07	41.88	30.83	1111.40	0.94	77.57	0.77	103098	132520	69161.7	172650	312675
2012M10	9615	3.06	41.26	30.69	1090.70	0.93	79.64	0.77	103350	133376	69413	170704	314255
2012M11	9605	3.04	40.88	30.70	1082.90	0.93	82.45	0.77	104310	134130	71476.3	170931	316031
2012M12	9670	3.06	41.19	30.63	1070.60	0.92	86.55	0.76	105907	134940	71655.6	171106	316898
2013M1	9698	3.04	41.08	30.47	1089.00	0.91	87.65	0.74	101754	135365	73140	171258	318870
2013M2	9667	3.09	40.74	29.80	1083.00	0.93	92.48	0.76	98385.5	135515	72035.7	169266	316430
2013M3	9719	3.09	40.94	29.30	1111.10	0.95	94.05	0.78	98040	135000	72269.2	167728	316535
2013M4	9722	3.03	41.16	29.34	1101.20	0.94	97.91	0.76	100763	135640	72393.1	168887	317897
2013M5	9802	3.09	42.38	30.18	1129.70	0.95	101.03	0.77	98774	136761	71544.5	166237	317380
2013M6	9929	3.18	43.31	31.14	1142.00	0.94	98.87	0.76	92134	131867	71791	162543	315600.7
2013M7	10278	3.25	43.40	31.36	1109.40	0.93	98.06	0.75	86459	133608	73132	163497	318891
2013M8	10936	3.30	44.64	32.09	1110.00	0.93	98.33	0.76	86573	130545	72486	159652	320268.9
2013M9	11613	3.26	43.31	31.39	1075.60	0.91	97.75	0.74	89387	132043	73403	163482	326108.2
2013M10	11475	3.16	43.18	31.09	1061.40	0.90	98.48	0.73	90652	132582	73579	163295	332411.3
2013M11	11813	3.22	43.78	32.08	1060.30	0.90	101.37	0.74	90907	131800	73927	159016	334262.2
2013M12	12270	3.29	44.41	32.82	1055.60	0.89	105.30	0.73	93427	130492	73792	159022	335647.5

Appendix - E

Data (ready) for **Chapter 3**.

Month	idr	myr	php	thb	krw	usd	jpy	dem	eur	emp_idn	emp_mal	emp_phi	emp_tha	emp_kor
1970M01	-0.001	-0.001	-0.001	-0.001	-0.004	-0.001	0.000	0.000			-0.027	0.051	0.009	-0.040
1970M02	-0.002	0.000	-0.385	-0.002	-0.005	-0.002	-0.002	-0.002			-0.010	-0.038	0.017	0.002
1970M03	0.000	0.000	-0.057	0.000	-0.002	0.000	0.000	0.007			-0.039	0.193	0.006	0.014
1970M04	-0.148	0.000	-0.019	0.000	-0.006	0.000	-0.002	0.008			0.000	-0.006	-0.021	-0.024
1970M05	0.002	-0.005	0.013	0.002	0.000	0.002	0.001	0.002			0.027	0.051	-0.006	0.009
1970M06	0.003	0.006	-0.002	0.003	-0.002	0.003	0.003	0.003			0.005	-0.052	-0.013	0.069
1970M07	0.002	-0.001	-0.006	0.002	-0.003	0.002	0.002	0.002			0.002	-0.022	-0.013	-0.003
1970M08	0.003	0.002	-0.005	0.003	0.001	0.003	0.005	0.003			0.041	0.053	-0.019	0.023
1970M09	-0.002	0.002	-0.023	-0.002	-0.005	-0.002	-0.001	-0.002			0.029	-0.089	-0.010	-0.002
1970M10	-0.001	0.001	-0.001	-0.001	-0.005	-0.001	0.000	-0.001			-0.013	0.021	-0.042	-0.058
1970M11	0.001	-0.001	0.001	0.001	-0.002	0.001	0.001	0.001			0.010	0.053	-0.008	0.001
1970M12	-0.002	0.000	-0.002	-0.002	-0.005	-0.002	-0.002	-0.007			0.015	0.236	0.004	0.031
1971M01	-0.010	-0.003	-0.010	-0.010	-0.016	-0.010	-0.010	-0.005			-0.026	-0.058	0.019	-0.043
1971M02	0.001	0.000	0.001	0.001	-0.005	0.001	0.001	0.000		-0.050	0.067	0.098	-0.004	-0.055
1971M03	0.000	0.001	0.000	0.000	-0.007	0.000	0.000	0.001		0.184	-0.003	0.080	0.011	-0.003
1971M04	-0.001	-0.001	-0.001	-0.001	-0.007	-0.001	-0.001	-0.002		-0.186	0.018	-0.018	0.002	-0.006
1971M05	0.001	0.003	0.001	0.001	-0.006	0.001	0.001	0.023		-0.165	0.060	0.032	-0.004	0.000
1971M06	-0.001	0.000	-0.001	-0.001	-0.128	-0.001	-0.001	0.014		-0.208	0.022	0.057	-0.006	-0.114
1971M07	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.011		0.551	0.039	0.085	-0.006	-0.005
1971M08	-0.107	0.006	-0.011	-0.014	-0.014	-0.014	0.039	0.005		-0.150	0.036	0.064	-0.036	-0.007
1971M09	-0.013	-0.006	-0.016	-0.013	-0.013	-0.013	0.001	0.010		-0.007	-0.004	-0.006	-0.032	-0.006
1971M10	-0.002	0.000	-0.003	-0.002	-0.002	-0.002	0.012	-0.008		0.078	-0.031	0.091	-0.030	-0.029
1971M11	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.004	0.007		0.027	-0.029	0.023	0.003	0.029
1971M12	-0.023	0.002	-0.023	-0.023	-0.030	-0.023	0.017	-0.011		-0.344	0.037	-0.069	-0.071	-0.384
1972M01	-0.016	-0.004	-0.016	-0.016	-0.024	-0.016	-0.002	0.002		0.332	-0.031	-0.030	0.027	-0.036
1972M02	-0.005	0.001	-0.005	-0.005	-0.019	-0.005	0.016	0.002		-0.106	0.024	0.074	0.078	-0.086
1972M03	-0.004	0.002	-0.004	-0.004	-0.017	-0.004	-0.004	0.002		0.234	-0.017	-0.044	0.025	-0.097
1972M04	0.002	0.001	-0.049	0.002	-0.013	0.002	0.000	-0.001		0.143	-0.002	-0.058	0.015	-0.023
1972M05	-0.001	0.002	-0.001	-0.001	-0.009	-0.001	0.000	0.000		-0.024	0.151	0.145	0.044	0.015
1972M06	0.067	0.069	0.066	0.067	0.058	0.067	0.078	0.074		0.237	0.019	0.052	0.027	0.089
1972M07	-0.002	0.006	-0.003	-0.002	-0.001	-0.002	-0.002	-0.009		0.083	-0.031	0.013	-0.003	0.108
1972M08	0.001	0.005	0.000	0.001	0.001	0.001	0.001	-0.004		-0.056	-0.009	0.033	-0.020	0.078
1972M09	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.008		0.268	0.006	-0.036	-0.020	0.067

1972M10	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.032	0.113	0.059	0.059	-0.010	0.047
1972M11	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.002	0.051	0.047	0.010	0.000	0.006
1972M12	0.002	-0.015	0.002	0.002	0.002	0.002	-0.001	0.000	0.043	-0.011	0.119	0.035	-0.051
1973M01	-0.014	-0.005	-0.014	-0.014	-0.014	-0.014	-0.012	-0.001	0.062	0.013	0.080	0.042	0.092
1973M02	-0.044	0.050	-0.044	-0.044	-0.044	-0.044	0.065	0.061	-0.111	0.071	0.010	-0.002	-0.108
1973M03	0.005	0.026	0.006	0.005	0.005	0.005	0.021	0.007	0.124	0.031	0.091	0.076	-0.117
1973M04	-0.005	-0.005	-0.004	-0.005	-0.005	-0.005	-0.004	-0.004	-0.054	0.025	0.081	-0.012	0.042
1973M05	-0.031	-0.030	-0.030	-0.031	-0.030	-0.031	-0.029	0.008	-0.015	0.115	0.119	0.001	0.079
1973M06	-0.006	0.046	-0.006	-0.006	-0.006	-0.006	-0.007	0.113	0.200	0.134	0.048	0.018	0.052
1973M07	0.027	0.079	0.027	0.054	0.028	0.027	0.034	0.058	0.109	0.096	0.005	0.034	0.036
1973M08	0.022	-0.009	0.025	0.022	0.023	0.022	0.015	-0.024	-0.048	-0.063	0.065	-0.027	0.132
1973M09	0.018	0.019	0.019	0.018	0.020	0.018	0.017	0.038	0.119	0.076	-0.040	-0.008	0.130
1973M10	-0.011	-0.007	-0.011	-0.011	-0.009	-0.011	-0.015	-0.022	-0.048	0.010	-0.026	-0.020	0.037
1973M11	0.040	-0.010	0.040	0.040	0.041	0.040	-0.008	-0.029	-0.105	-0.088	0.071	0.012	0.071
1973M12	0.008	-0.004	0.010	0.008	0.007	0.008	0.008	-0.023	0.006	-0.021	0.147	0.041	-0.002
1974M01	0.020	0.012	0.021	0.020	0.018	0.020	-0.046	-0.009	0.074	0.004	0.036	0.088	-0.005
1974M02	-0.012	-0.012	-0.012	-0.012	-0.013	-0.012	0.026	0.030	-0.023	0.009	0.069	0.121	-0.066
1974M03	-0.038	0.000	-0.038	-0.038	-0.039	-0.038	0.004	0.018	0.073	0.128	0.042	0.080	-0.091
1974M04	-0.016	-0.009	-0.015	-0.016	-0.016	-0.016	-0.030	0.015	0.343	0.019	0.094	0.022	-0.116
1974M05	0.016	0.004	0.015	0.016	0.016	0.016	0.009	-0.016	-0.015	-0.006	0.097	-0.005	-0.133
1974M06	0.001	-0.005	0.003	0.001	0.001	0.001	-0.007	-0.009	0.096	-0.003	0.082	0.074	-0.072
1974M07	0.006	0.000	0.002	0.006	0.006	0.006	-0.041	-0.006	0.294	-0.001	-0.015	0.008	-0.276
1974M08	0.025	0.032	0.025	0.025	0.025	0.025	0.009	-0.004	-0.072	0.014	0.035	-0.006	-0.051
1974M09	-0.006	-0.014	-0.007	-0.006	-0.006	-0.006	0.008	-0.002	-0.067	0.007	-0.015	-0.019	-0.305
1974M10	-0.001	0.010	-0.015	-0.001	-0.001	-0.001	-0.005	0.027	0.249	-0.019	-0.007	0.006	-0.306
1974M11	0.004	0.026	-0.028	0.004	0.004	0.004	0.004	0.045	-0.175	0.029	-0.035	0.008	-0.143
1974M12	-0.011	0.004	-0.009	-0.011	-0.204	-0.011	-0.013	0.017	-0.182	0.070	-0.056	0.004	0.250
1975M01	-0.012	-0.008	-0.013	-0.012	-0.012	-0.012	-0.002	0.016	0.049	-0.015	0.056	0.015	0.012
1975M02	-0.020	0.011	-0.013	-0.020	-0.020	-0.020	0.018	0.004	-0.193	-0.016	-0.026	0.054	0.101
1975M03	0.007	-0.006	0.008	0.007	0.007	0.007	-0.017	-0.019	-0.446	-0.065	-0.004	0.106	-0.053
1975M04	0.023	0.016	0.022	0.023	0.023	0.023	0.025	0.010	-0.032	-0.049	0.019	-0.006	0.391
1975M05	0.018	0.025	0.020	0.018	0.018	0.018	0.025	0.031	-0.654	-0.016	-0.010	-0.037	-0.022
1975M06	0.050	0.029	0.050	0.050	0.050	0.050	0.033	0.047	0.214	0.019	0.024	0.004	0.137
1975M07	0.023	-0.056	-0.044	0.023	0.023	0.023	0.020	-0.067	0.193	0.048	0.012	-0.022	0.145
1975M08	0.017	0.012	0.017	0.017	0.017	0.017	0.015	0.014	-0.329	-0.076	-0.125	-0.027	0.164
1975M09	0.034	0.004	0.033	0.034	0.034	0.034	0.018	0.004	0.074	-0.089	0.041	-0.013	0.131

1975M10	-0.017	-0.001	-0.015	-0.017	-0.017	-0.017	-0.014	0.024	0.572	0.090	-0.049	-0.024	0.114
1975M11	0.029	0.013	0.028	0.028	0.029	0.029	0.025	0.001	-0.324	-0.021	0.016	-0.029	0.029
1975M12	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.010	-0.001	0.046	0.057	-0.070	-0.026	-0.067
1976M01	-0.003	0.002	0.001	-0.003	-0.003	-0.003	0.002	0.008	0.581	-0.004	0.077	0.040	0.008
1976M02	0.001	0.008	0.002	0.001	0.001	0.001	0.006	0.013	-0.184	0.087	0.004	0.022	0.116
1976M03	0.057	0.058	0.059	0.057	0.057	0.057	0.065	0.067	-0.122	0.051	0.070	0.033	0.098
1976M04	0.038	0.038	0.041	0.038	0.038	0.038	0.039	0.039	0.457	0.049	0.097	0.013	0.082
1976M05	0.044	0.041	0.044	0.044	0.044	0.044	0.043	0.022	-0.066	0.044	0.056	-0.004	0.064
1976M06	-0.010	-0.002	-0.010	-0.010	-0.010	-0.010	-0.001	-0.002	-0.151	0.082	-0.045	-0.007	0.066
1976M07	-0.002	0.022	-0.001	-0.002	-0.002	-0.002	0.012	0.011	0.401	0.097	-0.094	0.018	0.116
1976M08	0.005	-0.006	0.005	0.005	0.005	0.005	0.021	0.012	-0.091	0.070	0.007	0.031	0.073
1976M09	0.056	0.053	0.056	0.056	0.056	0.056	0.061	0.093	-0.086	0.034	0.041	-0.007	0.072
1976M10	0.044	0.037	0.044	0.044	0.044	0.044	0.022	0.056	0.365	0.041	0.003	-0.026	0.124
1976M11	-0.026	-0.024	-0.026	-0.026	-0.026	-0.026	-0.033	-0.026	-0.002	0.040	-0.007	-0.020	0.004
1976M12	-0.032	-0.033	-0.032	-0.032	-0.032	-0.032	-0.022	-0.014	-0.146	-0.023	0.012	-0.012	0.111
1977M01	-0.007	0.007	-0.007	-0.007	-0.007	-0.007	0.005	-0.032	0.185	0.012	-0.061	0.004	0.010
1977M02	0.003	0.005	0.003	0.003	0.003	0.003	0.026	0.014	-0.008	0.025	-0.127	0.038	-0.017
1977M03	-0.006	-0.002	-0.005	-0.006	-0.006	-0.006	0.012	-0.004	-0.001	0.025	0.020	0.011	0.067
1977M04	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.013	0.238	0.007	0.053	0.011	0.022
1977M05	0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.002	-0.036	0.072	-0.021	-0.002	0.084
1977M06	-0.002	-0.002	-0.001	-0.002	-0.002	-0.002	0.034	0.006	-0.101	-0.001	0.070	0.002	0.022
1977M07	-0.010	0.001	-0.010	-0.010	-0.010	-0.010	-0.004	0.012	0.175	0.019	-0.002	-0.005	0.094
1977M08	-0.003	-0.009	-0.003	-0.003	-0.003	-0.003	-0.008	-0.018	0.002	-0.004	-0.003	-0.004	0.043
1977M09	-0.002	0.002	-0.002	-0.002	-0.002	-0.002	0.005	0.004	-0.018	0.022	-0.014	-0.039	0.064
1977M10	-0.048	-0.028	-0.047	-0.048	-0.048	-0.048	0.010	-0.024	0.162	0.030	0.001	-0.026	0.002
1977M11	0.009	0.022	0.010	0.009	0.009	0.009	0.029	0.020	-0.018	0.020	-0.009	-0.027	-0.027
1977M12	-0.049	-0.042	-0.047	-0.049	-0.049	-0.049	-0.025	0.008	-0.150	-0.030	-0.027	0.000	0.001
1978M01	-0.023	-0.023	-0.023	-0.023	-0.023	-0.023	-0.029	-0.026	0.067	-0.002	0.068	0.020	0.004
1978M02	0.008	0.011	0.008	0.008	0.008	0.008	0.020	0.045	-0.100	0.008	0.005	0.065	-0.042
1978M03	0.041	0.042	0.041	0.041	0.041	0.041	0.112	0.048	-0.077	-0.016	0.097	0.029	-0.095
1978M04	0.014	-0.002	0.015	0.014	0.014	0.014	0.011	-0.008	0.098	-0.007	0.014	-0.002	-0.123
1978M05	0.005	0.002	0.005	0.005	0.005	0.005	0.003	-0.011	-0.102	-0.007	0.041	0.002	0.006
1978M06	-0.021	-0.008	-0.020	-0.021	-0.021	-0.021	0.067	-0.008	-0.068	0.010	-0.009	-0.001	0.027
1978M07	-0.038	-0.020	-0.038	-0.038	-0.038	-0.038	0.033	-0.021	0.187	0.008	-0.047	0.009	0.027
1978M08	-0.006	0.003	-0.006	0.004	-0.006	-0.006	-0.003	0.022	-0.073	0.034	-0.018	0.040	0.008
1978M09	-0.015	-0.005	-0.014	-0.015	-0.015	-0.015	-0.010	0.009	-0.063	0.023	0.007	-0.021	0.001

1978M10	-0.058	0.021	-0.059	-0.058	-0.058	-0.058	0.014	0.052	0.144	0.109	-0.106	0.042	-0.094
1978M11	-0.340	0.025	0.069	0.062	0.070	0.070	-0.046	-0.032	-0.407	-0.037	0.035	-0.142	0.037
1978M12	-0.043	-0.043	-0.044	-0.045	-0.043	-0.043	-0.028	0.008	-0.060	0.028	0.024	0.021	0.099
1979M01	0.019	0.018	0.019	0.020	0.019	0.019	-0.015	0.001	0.128	0.024	-0.014	0.103	-0.004
1979M02	-0.009	-0.005	-0.014	-0.016	-0.014	-0.014	-0.018	-0.008	-0.020	0.014	-0.004	-0.018	-0.025
1979M03	-0.024	-0.028	-0.023	-0.022	-0.022	-0.022	-0.057	-0.031	0.000	0.036	0.049	-0.020	0.019
1979M04	0.003	-0.009	0.005	0.005	0.005	0.005	-0.038	-0.013	0.087	0.026	0.045	0.010	-0.013
1979M05	-0.006	0.000	-0.004	-0.004	-0.004	-0.004	-0.010	-0.008	0.034	0.025	0.069	0.009	0.014
1979M06	-0.048	-0.028	-0.045	-0.048	-0.048	-0.048	-0.036	-0.016	-0.041	0.036	-0.013	0.000	-0.089
1979M07	-0.050	-0.044	-0.054	-0.051	-0.051	-0.051	-0.052	-0.045	0.074	0.006	0.028	-0.031	0.022
1979M08	0.013	0.014	0.014	0.014	0.014	0.014	0.001	0.019	-0.030	0.014	-0.002	-0.027	0.020
1979M09	0.024	0.032	0.024	0.025	0.024	0.024	0.009	0.072	-0.037	0.026	-0.045	0.005	0.046
1979M10	0.054	0.034	0.057	0.056	0.057	0.057	-0.006	0.021	0.175	0.002	0.062	-0.128	0.122
1979M11	-0.056	-0.050	-0.058	-0.056	-0.056	-0.056	-0.102	-0.013	0.034	0.017	-0.013	0.005	-0.057
1979M12	-0.012	-0.015	-0.016	-0.013	-0.013	-0.013	0.024	-0.014	0.014	-0.057	0.058	-0.017	-0.004
1980M01	-0.020	-0.018	-0.020	-0.020	-0.201	-0.020	-0.016	-0.024	0.143	0.019	-0.001	0.053	-0.246
1980M02	-0.007	-0.002	-0.005	-0.005	-0.006	-0.005	-0.050	-0.023	-0.028	0.008	0.023	-0.039	-0.012
1980M03	0.050	0.009	0.049	0.050	0.041	0.050	0.051	-0.041	-0.053	-0.078	0.062	-0.055	0.027
1980M04	-0.044	-0.027	-0.053	-0.045	-0.052	-0.045	-0.001	0.030	0.117	0.188	0.046	-0.019	-0.113
1980M05	-0.024	0.003	-0.032	-0.027	-0.037	-0.028	0.036	-0.019	0.031	-0.077	-0.045	0.206	-0.006
1980M06	-0.012	-0.004	-0.015	-0.014	-0.025	-0.014	0.017	0.002	0.070	0.019	0.002	0.023	-0.032
1980M07	0.008	0.002	0.007	0.008	-0.006	0.010	-0.032	-0.005	0.122	0.008	0.083	-0.004	0.217
1980M08	-0.022	-0.013	-0.024	-0.026	-0.029	-0.023	0.013	-0.027	-0.035	0.062	-0.122	-0.082	0.050
1980M09	0.002	0.006	0.002	0.002	-0.012	0.002	0.033	-0.009	-0.038	0.028	0.033	0.027	0.100
1980M10	-0.022	-0.029	-0.022	-0.024	-0.062	-0.021	-0.017	-0.073	0.103	0.030	0.042	-0.112	-0.099
1980M11	0.031	0.015	0.030	0.031	0.022	0.033	0.009	0.024	-0.081	-0.022	0.052	-0.071	-0.053
1980M12	-0.010	-0.025	-0.012	-0.012	-0.012	-0.011	0.055	-0.028	-0.041	-0.064	0.083	-0.051	-0.110
1981M01	-0.003	-0.002	-0.007	-0.003	-0.009	0.000	-0.009	-0.078	0.125	0.037	-0.098	-0.055	-0.071
1981M02	0.079	0.048	0.072	0.080	0.072	0.079	0.059	0.073	-0.070	-0.079	-0.005	0.021	0.038
1981M03	-0.017	-0.014	-0.026	-0.019	-0.021	-0.018	-0.028	-0.005	0.106	-0.001	-0.007	0.004	0.025
1981M04	0.046	0.035	0.040	0.043	0.038	0.047	0.029	-0.005	0.100	-0.036	0.025	-0.116	0.047
1981M05	0.032	0.018	0.025	0.023	0.026	0.034	-0.008	-0.016	-0.051	0.040	-0.016	-0.014	-0.069
1981M06	0.061	0.078	0.056	0.063	0.061	0.063	0.056	0.036	-0.047	-0.014	-0.068	0.139	-0.099
1981M07	0.042	0.025	0.046	-0.045	0.043	0.046	-0.013	0.015	0.122	0.013	0.001	-0.070	-0.016
1981M08	0.011	0.010	0.009	0.010	0.012	0.010	0.059	0.025	-0.093	-0.061	0.016	-0.024	0.049
1981M09	0.019	0.039	0.012	0.020	0.020	0.020	0.000	0.065	-0.081	-0.025	-0.146	-0.009	0.046

1981M10	-0.026	-0.010	-0.032	-0.024	-0.014	-0.024	-0.029	0.005	0.115	0.015	-0.021	-0.005	0.028
1981M11	-0.065	-0.048	-0.069	-0.066	-0.083	-0.066	0.022	-0.043	-0.108	0.056	0.093	0.069	-0.034
1981M12	0.017	0.034	0.021	0.032	0.017	0.032	0.006	0.009	-0.157	0.061	-0.017	0.116	-0.018
1982M01	0.009	-0.003	0.004	0.013	0.002	0.013	-0.034	-0.011	0.099	0.006	-0.358	-0.074	0.063
1982M02	0.032	0.023	0.032	0.037	0.031	0.037	0.009	0.004	-0.002	-0.128	0.010	-0.083	0.019
1982M03	0.016	0.007	0.014	0.019	0.010	0.019	-0.020	0.007	-0.017	-0.077	0.056	-0.115	0.008
1982M04	-0.004	0.011	-0.010	-0.004	-0.008	-0.004	0.044	0.031	-0.123	0.081	-0.146	0.181	0.047
1982M05	-0.005	0.003	-0.005	-0.001	-0.018	-0.001	-0.037	-0.007	-0.070	-0.096	0.048	0.097	-0.071
1982M06	0.025	0.001	0.025	0.030	0.019	0.030	-0.012	-0.018	-0.191	0.025	0.065	-0.051	-0.108
1982M07	-0.005	0.000	-0.005	-0.001	-0.002	-0.001	-0.015	0.001	0.039	-0.065	-0.059	-0.050	-0.147
1982M08	0.003	0.013	0.001	0.011	0.010	0.011	-0.005	-0.006	-0.164	0.006	-0.089	0.039	0.088
1982M09	0.007	0.005	0.004	0.016	0.015	0.016	-0.013	0.004	-0.022	0.059	0.046	-0.030	0.101
1982M10	-0.003	0.020	-0.005	0.011	0.009	0.011	-0.017	-0.004	0.001	0.054	-0.150	-0.075	0.049
1982M11	0.033	0.034	0.027	0.037	0.038	0.037	0.129	0.069	-0.080	0.110	-0.366	0.028	0.024
1982M12	-0.014	0.017	-0.028	-0.002	-0.007	-0.002	0.073	0.044	-0.044	-0.039	-0.026	0.086	-0.038
1983M01	0.048	0.074	0.029	0.053	0.050	0.053	0.041	0.024	-0.005	0.033	-0.170	0.030	-0.054
1983M02	0.000	0.008	-0.007	0.006	0.004	0.006	0.017	0.017	-0.120	0.031	-0.241	0.007	-0.088
1983M03	0.025	0.014	0.005	0.028	0.014	0.028	0.011	0.026	-0.506	0.012	-0.006	0.024	-0.049
1983M04	-0.375	-0.058	-0.073	-0.054	-0.060	-0.054	-0.044	-0.067	0.093	0.042	-0.139	-0.019	-0.202
1983M05	-0.031	-0.027	-0.045	-0.030	-0.034	-0.030	-0.035	-0.054	0.175	-0.004	-0.045	0.048	0.184
1983M06	0.045	0.038	-0.037	0.050	0.043	0.050	0.044	0.041	0.073	-0.001	-0.081	0.083	-0.129
1983M07	-0.001	0.000	0.006	0.006	-0.002	0.006	-0.002	-0.033	0.171	-0.016	0.006	0.059	0.156
1983M08	0.015	0.015	0.018	0.018	0.009	0.018	-0.002	-0.005	0.096	0.077	0.067	-0.087	-0.047
1983M09	0.000	0.002	-0.002	-0.002	-0.001	-0.002	0.042	0.024	0.013	0.003	-0.733	0.015	0.004
1983M10	-0.002	0.001	-0.241	0.000	-0.004	0.000	0.011	0.005	0.027	-0.068	-0.372	-0.025	-0.075
1983M11	0.014	0.022	0.021	0.021	0.016	0.021	0.019	-0.006	0.013	0.039	0.725	-0.090	0.105
1983M12	0.007	0.012	0.010	0.010	0.011	0.010	0.017	0.000	0.000	-0.103	0.446	0.037	-0.021
1984M01	0.032	0.032	0.033	0.033	0.028	0.033	0.022	0.000	0.017	0.034	-0.168	0.112	-0.163
1984M02	-0.057	-0.056	-0.059	-0.059	-0.052	-0.059	-0.054	0.018	0.044	0.110	0.202	0.061	-0.007
1984M03	0.025	0.049	0.032	0.032	0.034	0.032	0.070	0.038	0.009	-0.100	-0.098	-0.013	0.013
1984M04	0.027	0.034	0.032	0.032	0.025	0.032	0.027	-0.016	0.025	-0.005	-0.233	0.061	0.054
1984M05	0.004	-0.002	0.008	0.008	0.007	0.008	-0.016	0.002	0.014	0.029	0.068	-0.016	0.009
1984M06	0.019	0.021	-0.228	0.024	0.017	0.024	-0.002	0.005	0.036	-0.045	-0.566	-0.004	0.001
1984M07	0.022	0.024	0.035	0.035	0.025	0.035	0.002	-0.004	0.059	0.048	-0.249	-0.078	0.050
1984M08	-0.024	0.002	-0.004	-0.004	0.000	-0.004	0.014	0.000	-0.016	-0.006	0.109	-0.036	0.149
1984M09	0.039	0.032	0.049	0.049	0.041	0.049	0.032	0.002	0.047	0.044	-0.396	-0.028	0.052

1984M10	0.023	0.010	-0.080	0.025	0.022	0.025	0.026	0.023	0.000	-0.103	-0.202	0.005	0.029
1984M11	0.009	0.013	0.019	-0.148	0.010	0.015	0.011	-0.007	-0.004	0.005	0.783	0.124	0.048
1984M12	0.030	0.030	0.044	0.033	0.029	0.036	0.017	0.020	0.014	0.007	0.209	-0.096	-0.008
1985M01	0.018	-0.002	0.097	0.017	0.022	0.025	0.011	0.019	-0.003	-0.072	0.114	-0.088	-0.110
1985M02	0.025	-0.002	0.036	0.010	0.019	0.034	0.015	-0.014	-0.004	-0.120	-0.520	-0.082	0.041
1985M03	-0.140	-0.107	-0.137	-0.113	-0.140	-0.131	-0.104	-0.060	0.025	0.027	-0.300	0.026	-0.188
1985M04	-0.007	0.016	-0.002	0.001	-0.019	-0.001	0.000	0.000	-0.001	0.068	0.588	0.054	-0.052
1985M05	-0.030	-0.020	-0.023	-0.024	-0.029	-0.023	-0.022	-0.023	-0.003	0.072	0.207	0.017	-0.115
1985M06	-0.018	-0.024	-0.015	-0.013	-0.020	-0.017	-0.005	-0.008	-0.041	0.061	0.089	0.117	0.025
1985M07	-0.096	-0.086	-0.109	-0.073	-0.101	-0.098	-0.048	-0.005	-0.014	0.023	-0.109	-0.064	0.041
1985M08	0.018	0.012	0.024	0.017	0.008	0.020	0.018	0.023	-0.002	0.007	0.606	-0.021	0.082
1985M09	-0.003	0.015	-0.003	0.020	-0.006	-0.001	0.089	0.040	-0.022	0.082	-0.135	0.125	0.080
1985M10	-0.032	-0.032	-0.036	-0.038	-0.030	-0.030	-0.004	-0.010	0.008	-0.004	-0.284	-0.122	0.146
1985M11	-0.026	-0.018	-0.027	-0.012	-0.024	-0.027	0.019	0.014	0.004	0.006	-0.155	-0.064	-0.015
1985M12	0.024	0.026	0.012	0.006	0.025	0.026	0.034	0.047	-0.079	0.022	-0.220	0.138	-0.083
1986M01	0.021	0.002	0.019	0.026	0.024	0.022	0.067	0.052	0.005	0.032	-0.203	-0.002	-0.251
1986M02	-0.040	-0.042	-0.179	-0.031	-0.033	-0.039	0.026	0.035	-0.001	-0.008	-0.296	-0.012	0.111
1986M03	-0.009	-0.049	0.053	-0.016	-0.013	-0.011	-0.011	-0.055	-0.063	-0.075	0.629	0.061	0.029
1986M04	-0.039	-0.042	-0.035	-0.032	-0.039	-0.040	0.025	0.019	0.005	-0.106	0.181	-0.014	0.033
1986M05	0.037	0.022	0.042	0.035	0.037	0.042	0.021	-0.014	-0.007	0.010	0.200	0.043	-0.023
1986M06	-0.033	-0.030	-0.036	-0.026	-0.029	-0.032	0.008	0.018	-0.037	0.044	-0.045	-0.062	-0.028
1986M07	0.026	0.029	0.034	0.033	0.028	0.026	0.093	0.075	0.006	0.011	0.033	-0.003	0.268
1986M08	0.007	0.014	0.006	0.007	0.014	0.008	-0.003	0.028	-0.003	-0.017	-0.046	0.034	0.017
1986M09	-0.347	0.013	0.020	0.022	0.023	0.019	0.035	0.035	-0.447	-0.042	0.022	0.057	0.058
1986M10	0.031	0.035	0.036	0.028	0.040	0.035	-0.015	0.012	-0.006	0.126	0.163	0.038	0.024
1986M11	-0.032	-0.017	-0.026	-0.025	-0.016	-0.026	-0.031	0.019	-0.011	-0.010	-0.048	-0.029	-0.045
1986M12	-0.021	-0.027	-0.031	-0.022	-0.022	-0.026	-0.006	-0.008	-0.135	0.066	0.341	0.040	-0.114
1987M01	-0.032	-0.012	-0.034	-0.027	-0.032	-0.037	0.006	0.034	-0.164	0.040	0.018	0.046	0.105
1987M02	-0.016	-0.003	-0.012	-0.011	-0.007	-0.010	-0.013	-0.020	0.087	0.028	-0.026	-0.042	0.067
1987M03	-0.039	-0.033	-0.040	-0.037	-0.029	-0.039	0.010	-0.027	0.013	-0.012	-0.085	0.098	-0.147
1987M04	-0.035	-0.025	-0.034	-0.025	-0.022	-0.037	0.007	-0.026	0.104	0.076	-0.011	0.047	-0.022
1987M05	0.019	0.016	0.025	0.018	0.038	0.024	-0.008	0.004	-0.079	-0.001	-0.110	0.044	-0.003
1987M06	0.010	-0.001	0.010	0.006	0.027	0.010	-0.011	0.005	0.016	0.024	-0.020	0.047	0.014
1987M07	0.015	0.002	0.011	0.006	0.012	0.010	-0.005	-0.003	0.290	-0.002	0.017	0.041	0.005
1987M08	-0.020	-0.010	-0.021	-0.012	-0.020	-0.020	0.027	0.002	-0.098	0.098	0.019	-0.001	0.016
1987M09	-0.009	-0.008	-0.010	-0.006	0.000	-0.002	-0.030	-0.015	-0.005	-0.048	-0.319	-0.021	0.042

1987M10	-0.049	-0.042	-0.056	-0.042	-0.045	-0.050	0.004	0.005	-0.014	-0.007	-0.217	0.023	-0.001
1987M11	-0.068	-0.059	-0.074	-0.056	-0.060	-0.067	-0.022	-0.005	0.032	-0.011	-0.236	-0.053	0.189
1987M12	-0.022	-0.022	-0.018	-0.010	-0.016	-0.022	0.049	0.012	-0.001	-0.078	0.202	0.021	-0.254
1988M01	0.048	0.032	0.052	0.049	0.069	0.055	0.026	-0.002	-0.069	-0.021	-0.209	0.078	0.314
1988M02	0.001	-0.012	-0.006	-0.001	0.027	0.000	-0.006	-0.007	0.023	-0.050	-0.131	0.062	0.223
1988M03	-0.060	-0.053	-0.060	-0.055	-0.041	-0.060	-0.040	-0.043	0.029	0.003	0.061	0.003	0.211
1988M04	-0.008	-0.006	-0.003	-0.002	0.006	-0.002	0.002	-0.008	-0.035	-0.128	-0.023	0.010	0.104
1988M05	0.019	0.016	0.027	0.020	0.031	0.021	0.018	-0.013	0.012	-0.024	-0.057	0.049	0.099
1988M06	0.067	0.069	0.069	0.064	0.083	0.076	0.021	0.023	0.044	0.068	-0.059	0.068	0.134
1988M07	-0.002	-0.010	0.002	0.001	0.008	0.001	0.000	-0.031	-0.082	-0.022	-0.265	0.024	0.079
1988M08	0.012	0.004	0.013	0.012	0.018	0.015	-0.003	0.018	0.024	-0.075	0.007	0.039	0.121
1988M09	-0.006	-0.007	-0.014	-0.002	0.002	-0.002	0.001	-0.005	-0.006	-0.027	-0.130	0.037	0.096
1988M10	-0.060	-0.052	-0.057	-0.042	-0.030	-0.055	0.013	0.007	-0.099	0.079	0.067	0.034	0.059
1988M11	-0.040	-0.038	-0.036	-0.031	-0.017	-0.037	-0.005	-0.018	0.053	0.025	0.304	0.028	0.088
1988M12	0.015	0.005	0.023	0.013	0.026	0.021	-0.013	-0.005	0.008	-0.002	0.501	0.043	-0.087
1989M01	0.022	0.022	0.026	0.021	0.032	0.027	0.001	-0.019	-0.053	-0.053	-0.130	0.093	0.111
1989M02	0.009	0.011	0.012	0.013	0.023	0.012	0.029	0.031	-0.029	-0.020	-0.120	0.063	0.010
1989M03	0.023	0.022	0.031	0.023	0.032	0.030	-0.009	-0.004	0.068	0.011	-0.131	0.057	0.069
1989M04	-0.002	0.020	-0.012	0.000	0.008	-0.001	-0.004	0.007	0.071	0.048	-0.379	0.021	0.061
1989M05	0.065	0.066	0.070	0.057	0.071	0.072	-0.003	0.016	-0.029	0.083	0.195	0.042	0.094
1989M06	0.014	0.018	0.006	0.013	0.014	0.015	0.005	0.032	-0.120	-0.037	-0.105	0.012	-0.007
1989M07	-0.072	-0.055	-0.074	-0.063	-0.071	-0.071	-0.030	-0.026	0.036	0.042	-0.237	0.009	-0.105
1989M08	0.052	0.046	0.058	0.049	0.056	0.058	0.016	0.009	-0.044	-0.003	0.329	0.075	0.155
1989M09	-0.033	-0.032	-0.038	-0.028	-0.036	-0.035	0.001	0.014	-0.024	0.036	0.054	0.022	-0.002
1989M10	0.026	0.028	0.023	0.028	0.028	0.030	0.009	0.047	0.044	0.031	0.396	0.006	0.020
1989M11	0.006	0.005	0.000	0.008	0.004	0.006	0.001	0.032	-0.026	-0.003	-0.086	0.020	-0.017
1989M12	-0.027	-0.025	-0.033	-0.019	-0.034	-0.024	-0.027	0.029	0.171	0.078	0.548	0.043	-0.165
1990M01	-0.051	-0.046	-0.052	-0.048	-0.057	-0.047	-0.052	-0.038	-0.074	0.029	-0.634	0.068	-0.111
1990M02	-0.005	-0.002	-0.011	-0.005	-0.012	-0.001	-0.030	-0.007	-0.036	0.008	-0.162	0.064	-0.021
1990M03	0.019	0.016	0.026	0.018	0.014	0.025	-0.032	0.024	0.065	-0.023	0.176	0.012	0.012
1990M04	0.001	0.007	0.002	0.003	-0.003	0.004	-0.009	0.013	-0.133	-0.017	-0.240	-0.006	0.033
1990M05	-0.032	-0.022	-0.035	-0.021	-0.035	-0.028	0.021	-0.034	-0.157	0.031	0.495	0.040	0.013
1990M06	-0.039	-0.038	-0.048	-0.033	-0.040	-0.035	-0.043	-0.023	0.148	0.006	-0.101	0.032	-0.028
1990M07	-0.064	-0.060	-0.087	-0.055	-0.060	-0.062	-0.025	-0.016	0.103	0.000	-0.071	0.023	0.034
1990M08	-0.030	-0.019	-0.072	-0.020	-0.024	-0.025	-0.004	-0.004	0.037	0.039	0.084	0.028	0.001
1990M09	0.011	0.010	-0.015	0.020	0.016	0.014	0.060	0.013	-0.055	0.032	-0.110	-0.021	0.000

1990M10	-0.042	-0.038	-0.038	-0.028	-0.039	-0.038	0.026	-0.009	0.021	0.125	-0.146	0.028	-0.013
1990M11	-0.002	0.006	-0.079	0.001	0.005	0.004	-0.026	0.014	0.057	-0.110	-0.196	-0.001	0.003
1990M12	-0.004	0.002	0.005	0.000	0.000	0.005	-0.003	0.012	0.204	0.035	0.150	0.005	-0.091
1991M01	-0.023	-0.016	-0.017	-0.012	-0.021	-0.017	0.007	-0.015	-0.034	-0.001	-0.222	0.045	-0.038
1991M02	0.018	0.016	0.022	0.019	0.015	0.022	0.016	0.002	0.157	0.028	0.606	0.049	-0.025
1991M03	0.094	0.080	0.100	0.084	0.100	0.100	0.034	-0.021	-0.004	-0.013	0.031	0.012	-0.031
1991M04	0.012	0.020	0.021	0.015	0.015	0.015	0.041	0.006	0.001	0.036	0.373	0.030	0.021
1991M05	-0.005	-0.001	0.000	0.000	0.002	-0.001	-0.005	0.004	0.037	0.004	0.166	0.029	0.033
1991M06	0.050	0.046	0.055	0.050	0.053	0.053	0.053	0.004	0.047	-0.019	0.136	0.050	0.003
1991M07	-0.041	-0.041	-0.038	-0.039	-0.042	-0.038	-0.037	-0.001	-0.035	-0.002	-0.121	0.034	0.005
1991M08	-0.005	0.000	0.026	-0.001	-0.014	-0.001	0.003	0.001	-0.012	0.014	0.064	0.003	-0.043
1991M09	-0.040	-0.022	-0.038	-0.031	-0.046	-0.038	-0.006	0.008	-0.023	-0.026	0.048	0.017	0.007
1991M10	0.002	0.005	0.006	0.005	-0.006	0.006	0.021	0.000	0.006	0.016	0.082	-0.021	-0.033
1991M11	-0.015	-0.013	0.001	-0.007	-0.016	-0.011	-0.004	0.014	0.068	0.020	0.116	0.004	-0.015
1991M12	-0.065	-0.051	-0.059	-0.053	-0.069	-0.061	-0.023	0.013	-0.042	0.040	0.067	0.009	-0.035
1992M01	0.041	0.058	0.052	0.043	0.046	0.047	0.043	-0.015	0.043	0.054	0.132	0.050	0.044
1992M02	0.011	0.054	0.032	0.010	0.006	0.014	-0.014	-0.001	-0.017	0.075	0.126	0.025	0.040
1992M03	0.008	0.013	0.038	0.008	0.003	0.012	-0.018	0.009	0.043	0.061	0.138	-0.017	-0.006
1992M04	-0.018	0.007	-0.032	-0.017	-0.021	-0.016	-0.018	-0.026	0.046	0.098	-0.169	0.023	0.039
1992M05	-0.032	-0.031	-0.047	-0.024	-0.036	-0.030	0.010	-0.001	0.032	-0.003	-0.246	0.016	-0.008
1992M06	-0.045	-0.032	-0.016	-0.034	-0.050	-0.042	-0.020	0.013	-0.020	-0.056	0.036	0.021	-0.087
1992M07	-0.012	-0.010	0.016	-0.012	-0.008	-0.011	-0.025	0.021	0.018	0.156	0.030	-0.035	0.040
1992M08	-0.032	-0.029	0.035	-0.025	-0.032	-0.032	0.002	0.016	-0.009	0.061	-0.015	0.009	0.024
1992M09	0.104	0.104	0.031	0.108	0.108	0.106	0.137	0.107	-0.040	0.167	0.158	0.029	-0.030
1992M10	0.122	0.123	0.147	0.117	0.133	0.128	0.095	0.041	0.011	0.078	0.159	0.052	0.072
1992M11	0.037	0.032	0.008	0.035	0.038	0.042	0.030	0.001	0.031	0.017	0.027	-0.010	0.086
1992M12	-0.006	-0.035	0.011	-0.005	-0.009	-0.005	-0.005	-0.013	-0.027	-0.151	0.019	0.015	0.014
1993M01	0.005	0.002	-0.003	0.008	-0.001	0.007	0.008	0.019	0.034	-0.003	0.066	0.034	0.029
1993M02	0.051	0.048	0.055	0.054	0.051	0.052	0.109	0.021	0.010	-0.031	0.084	-0.008	0.016
1993M03	-0.055	-0.038	-0.062	-0.050	-0.052	-0.053	-0.041	-0.035	-0.008	-0.094	0.096	0.016	0.019
1993M04	-0.048	-0.037	-0.080	-0.040	-0.049	-0.046	0.000	-0.025	-0.006	0.038	-0.040	0.005	0.008
1993M05	0.008	0.015	-0.016	0.013	0.004	0.010	0.053	0.001	-0.021	-0.039	-0.188	0.023	-0.013
1993M06	0.028	0.024	0.026	0.027	0.029	0.033	0.030	-0.025	0.017	0.063	-0.016	0.050	0.001
1993M07	0.015	0.024	0.003	0.017	0.015	0.019	0.027	-0.011	-0.004	0.115	-0.058	0.005	-0.001
1993M08	-0.014	-0.005	-0.024	-0.006	-0.013	-0.011	0.005	0.031	-0.002	0.129	-0.114	0.006	-0.006
1993M09	-0.012	-0.009	-0.070	-0.010	-0.009	-0.009	-0.018	0.021	0.002	0.086	-0.100	0.033	0.032

1993M10	0.017	0.013	0.050	0.010	0.017	0.016	-0.013	-0.018	0.014	-0.057	0.110	0.026	0.035
1993M11	0.000	0.000	0.031	-0.003	0.001	0.000	-0.007	-0.021	0.009	0.136	0.054	-0.010	0.079
1993M12	0.002	-0.051	0.013	-0.001	0.003	0.004	-0.023	-0.005	0.011	0.094	0.067	0.006	-0.053
1994M01	-0.017	-0.033	-0.011	-0.009	-0.011	-0.011	0.006	-0.020	-0.002	0.288	-0.003	-0.006	0.009
1994M02	0.000	0.020	0.007	0.015	0.014	0.007	0.061	0.024	0.008	-0.085	0.014	0.031	0.004
1994M03	0.000	0.024	0.008	0.006	-0.002	0.003	0.013	0.028	-0.016	-0.007	0.162	0.010	-0.014
1994M04	-0.021	-0.024	-0.008	-0.015	-0.019	-0.018	-0.012	-0.013	-0.091	-0.060	0.070	-0.007	0.004
1994M05	-0.003	0.041	0.014	-0.002	0.001	0.000	-0.020	0.013	-0.015	0.059	0.002	0.036	0.024
1994M06	-0.022	-0.029	-0.021	-0.011	-0.019	-0.020	0.034	0.009	0.004	-0.031	0.075	0.018	-0.006
1994M07	0.005	0.013	0.035	0.007	0.013	0.009	0.002	0.009	-0.026	-0.070	0.071	0.011	-0.001
1994M08	-0.008	0.011	-0.015	-0.005	-0.003	-0.005	-0.003	0.003	0.058	0.030	-0.035	0.015	0.021
1994M09	-0.032	-0.034	-0.011	-0.027	-0.027	-0.029	-0.018	-0.007	-0.014	-0.031	-0.004	0.020	0.006
1994M10	-0.029	-0.022	0.016	-0.024	-0.024	-0.026	-0.015	-0.003	-0.007	-0.043	-0.041	-0.014	0.049
1994M11	0.034	0.036	0.080	0.032	0.041	0.037	0.022	-0.001	0.095	0.020	0.044	0.010	0.036
1994M12	-0.003	-0.001	-0.022	-0.002	0.007	0.000	-0.008	0.014	-0.025	-0.151	-0.031	0.016	0.072
1995M01	-0.023	-0.018	-0.026	-0.017	-0.017	-0.019	-0.007	0.007	-0.030	-0.021	-0.012	-0.022	0.015
1995M02	0.007	0.010	-0.037	0.012	0.010	0.009	0.024	0.041	-0.016	-0.022	-0.118	-0.001	-0.006
1995M03	-0.024	-0.014	-0.031	-0.013	-0.003	-0.021	0.061	0.033	-0.018	-0.034	-0.085	-0.039	-0.020
1995M04	-0.003	0.026	-0.001	0.007	0.013	0.000	0.065	0.002	-0.010	0.032	0.027	0.052	0.030
1995M05	0.001	0.008	0.014	0.003	0.008	0.005	0.012	0.000	0.004	0.001	0.033	0.046	-0.008
1995M06	0.002	0.017	0.015	0.005	0.009	0.006	-0.010	0.010	0.031	0.054	0.062	0.055	0.055
1995M07	-0.010	-0.013	-0.006	-0.009	-0.003	-0.005	-0.050	-0.003	0.035	0.001	0.136	-0.014	0.097
1995M08	0.027	0.015	0.019	0.018	0.013	0.032	-0.082	-0.029	0.032	-0.042	0.023	0.038	0.032
1995M09	-0.022	-0.021	-0.024	-0.017	-0.014	-0.018	-0.009	0.016	-0.011	-0.005	-0.052	0.028	-0.006
1995M10	-0.001	-0.011	0.006	0.001	0.007	0.003	-0.031	0.007	0.005	-0.038	-0.060	0.001	0.043
1995M11	0.021	0.027	0.018	0.025	0.021	0.026	0.027	0.009	0.025	-0.019	-0.020	0.018	0.034
1995M12	-0.015	-0.010	-0.011	-0.011	-0.017	-0.010	-0.023	-0.008	0.005	0.001	0.039	0.022	-0.023
1996M01	0.027	0.020	0.029	0.022	0.016	0.028	-0.014	-0.012	0.025	-0.048	0.067	0.036	0.029
1996M02	-0.022	-0.012	-0.017	-0.011	-0.013	-0.017	0.007	0.000	0.071	0.025	0.036	0.021	0.047
1996M03	-0.001	0.010	0.004	0.003	0.002	0.005	-0.010	-0.001	-0.003	0.030	0.013	0.011	-0.047
1996M04	0.009	0.029	0.012	0.011	0.017	0.011	0.025	-0.024	0.006	0.056	0.083	0.005	0.086
1996M05	-0.025	-0.023	-0.022	-0.024	-0.032	-0.020	-0.052	-0.023	0.000	0.053	0.069	0.006	0.002
1996M06	-0.001	-0.005	-0.006	-0.007	-0.035	-0.007	-0.018	0.001	0.046	0.006	0.049	0.019	-0.020
1996M07	-0.011	-0.006	-0.007	-0.003	-0.009	-0.006	0.008	0.028	-0.026	0.007	0.048	-0.024	-0.062
1996M08	-0.004	0.001	0.002	0.000	-0.007	0.001	-0.004	-0.007	0.000	0.007	0.111	0.005	-0.047
1996M09	0.007	-0.009	-0.005	-0.008	-0.005	-0.003	-0.026	-0.034	0.024	0.004	-0.009	0.012	-0.011

1996M10	-0.046	-0.051	-0.042	-0.044	-0.054	-0.041	-0.067	-0.032		0.001	-0.002	-0.022	0.002	-0.011
1996M11	-0.040	-0.030	-0.033	-0.034	-0.030	-0.033	-0.033	-0.047		0.074	0.018	0.007	-0.007	0.007
1996M12	-0.015	-0.010	-0.009	-0.013	-0.028	-0.009	-0.029	-0.022		0.076	0.013	0.041	-0.022	0.014
1997M01	0.053	0.075	0.056	0.048	0.038	0.058	0.008	0.009		0.065	0.045	-0.009	0.035	-0.060
1997M02	-0.021	-0.016	-0.017	-0.018	-0.020	-0.017	-0.007	-0.052		0.003	0.017	0.073	-0.023	-0.036
1997M03	-0.005	0.002	-0.001	-0.003	-0.037	0.000	-0.026	0.008		-0.004	0.022	0.007	-0.007	-0.060
1997M04	-0.006	-0.014	0.000	-0.005	0.006	0.000	-0.022	-0.029		0.036	-0.025	-0.008	-0.010	0.048
1997M05	-0.009	-0.006	-0.006	0.006	-0.006	-0.006	0.079	0.010		0.011	-0.047	-0.037	-0.127	0.045
1997M06	-0.019	-0.019	-0.015	-0.014	-0.010	-0.015	0.003	-0.040		0.007	0.011	-0.019	-0.027	0.050
1997M07	-0.043	-0.025	-0.077	-0.202	0.012	0.016	-0.017	-0.033		-0.042	-0.229	-0.232	-0.260	-0.002
1997M08	-0.147	-0.109	-0.032	-0.060	-0.003	0.008	-0.001	0.030		-0.208	-0.107	0.019	-0.241	-0.088
1997M09	-0.070	-0.071	-0.110	-0.056	-0.008	0.006	-0.008	0.022		-0.026	-0.070	-0.060	0.077	-0.039
1997M10	-0.150	-0.108	-0.068	-0.120	-0.090	-0.037	-0.028	-0.012		-0.231	-0.082	-0.139	-0.040	-0.064
1997M11	0.004	-0.024	0.006	-0.013	-0.189	-0.002	-0.064	-0.025		0.002	-0.027	0.009	-0.179	-0.401
1997M12	-0.229	-0.091	-0.129	-0.149	-0.362	0.014	-0.005	-0.002		-0.322	-0.143	-0.284	-0.117	-0.548
1998M01	-0.793	-0.151	-0.050	-0.141	0.115	0.009	0.033	-0.010		-0.707	-0.213	-0.080	-0.160	0.253
1998M02	0.167	0.214	0.046	0.243	-0.072	-0.004	-0.007	0.005		0.005	0.219	0.138	0.224	0.086
1998M03	0.028	-0.014	0.063	0.079	0.145	-0.021	-0.059	-0.041		0.080	0.018	0.102	0.171	0.284
1998M04	0.110	-0.017	-0.070	0.008	0.040	0.006	0.004	0.034		0.166	-0.034	0.086	0.062	0.205
1998M05	-0.314	-0.017	0.052	-0.014	-0.027	0.024	-0.025	0.031		-0.253	-0.035	0.042	-0.105	0.033
1998M06	-0.367	-0.089	-0.099	-0.071	0.005	-0.020	-0.033	-0.034		-0.357	-0.067	-0.108	-0.082	0.090
1998M07	0.151	0.023	0.017	0.051	0.125	0.015	-0.005	0.031		0.175	0.001	-0.020	0.045	0.162
1998M08	0.152	-0.026	-0.052	-0.036	-0.102	-0.009	0.007	-0.005		0.174	-0.026	-0.096	0.006	-0.062
1998M09	0.009	0.076	-0.024	0.039	-0.056	-0.026	0.019	0.030		0.049	0.138	0.044	0.024	-0.003
1998M10	0.359	0.010	0.081	0.078	0.064	0.011	0.161	0.026		0.380	0.070	0.034	0.084	0.065
1998M11	0.049	0.016	0.049	0.033	0.072	0.015	-0.045	-0.015		0.104	0.033	0.052	0.055	0.101
1998M12	-0.102	-0.008	0.003	-0.023	0.027	-0.007	0.060	0.010		-0.073	0.089	0.027	-0.013	0.054
1999M01	-0.099	0.010	0.019	0.005	0.034	0.010	0.005			-0.051	0.076	0.113	-0.010	0.062
1999M02	0.053	0.028	0.018	0.012	-0.012	0.028	0.001		-0.005	0.039	0.029	0.061	-0.007	0.012
1999M03	-0.001	-0.006	0.003	-0.011	-0.009	-0.006	-0.014		-0.031	0.076	-0.009	0.080	0.043	0.038
1999M04	0.050	-0.001	0.019	0.010	0.032	-0.001	0.008		-0.014	0.046	0.039	0.094	0.025	0.068
1999M05	0.024	0.005	0.003	0.010	0.007	0.005	-0.012		-0.008	0.045	0.043	0.004	0.028	0.044
1999M06	0.205	0.018	0.020	0.024	0.043	0.018	0.021		0.006	0.227	0.058	0.016	0.037	0.038
1999M07	-0.050	-0.028	-0.034	-0.034	-0.067	-0.028	0.022		0.007	-0.057	0.011	-0.020	-0.012	-0.014
1999M08	-0.086	0.009	-0.027	-0.023	0.026	0.009	0.048		-0.002	-0.091	0.027	-0.020	-0.026	0.010
1999M09	-0.129	-0.026	-0.062	-0.094	-0.053	-0.026	0.010		-0.018	-0.122	-0.058	-0.041	-0.076	-0.029

1999M10	0.203	0.008	0.031	0.065	0.021	0.008	0.027	-0.013	0.209	-0.034	0.035	0.065	0.030
1999M11	-0.049	0.024	0.009	0.016	0.059	0.024	0.047	-0.010	-0.066	0.002	0.001	0.014	0.094
1999M12	0.033	-0.014	-0.002	0.027	0.005	-0.014	-0.011	-0.019	0.052	0.026	0.032	0.097	0.078
2000M01	-0.051	-0.005	-0.006	-0.005	0.009	-0.005	-0.049	-0.030	-0.014	0.067	-0.014	-0.052	0.063
2000M02	0.009	0.019	0.008	0.007	0.012	0.019	-0.011	0.011	0.023	0.043	-0.016	-0.023	0.042
2000M03	-0.013	-0.002	-0.007	0.002	0.021	-0.002	0.039	-0.018	0.015	0.007	0.103	0.011	0.065
2000M04	-0.029	0.017	0.012	0.011	0.014	0.017	0.010	-0.033	-0.043	-0.021	-0.001	0.012	0.029
2000M05	-0.034	0.048	0.011	0.020	0.030	0.048	0.047	0.072	-0.089	-0.005	-0.066	-0.036	0.008
2000M06	-0.025	-0.012	-0.019	-0.012	0.001	-0.012	0.000	0.015	0.002	-0.015	-0.033	-0.007	0.038
2000M07	-0.021	0.009	-0.031	-0.048	0.008	0.009	-0.029	-0.024	-0.024	0.003	-0.062	-0.046	0.018
2000M08	0.112	0.029	0.026	0.043	0.036	0.029	0.058	-0.008	0.188	0.001	0.054	0.031	0.026
2000M09	-0.068	-0.010	-0.037	-0.042	-0.016	-0.010	-0.024	-0.026	-0.134	-0.022	-0.066	-0.026	0.012
2000M10	-0.053	0.015	-0.091	-0.026	-0.007	0.015	0.004	-0.026	-0.079	-0.035	-0.128	-0.025	-0.006
2000M11	0.005	0.019	0.060	0.021	-0.045	0.019	0.000	0.051	-0.015	-0.020	0.043	0.003	-0.058
2000M12	-0.056	-0.049	-0.061	-0.035	-0.089	-0.049	-0.082	0.020	-0.005	-0.029	0.010	0.008	-0.027
2001M01	0.035	0.019	0.031	0.036	0.024	0.019	0.009	0.018	0.028	-0.009	-0.036	0.025	0.000
2001M02	-0.029	0.011	0.034	0.003	0.017	0.011	0.008	0.006	-0.043	-0.015	0.010	0.009	0.010
2001M03	-0.040	0.016	-0.007	-0.028	-0.044	0.016	-0.052	-0.030	-0.046	-0.044	0.048	-0.045	-0.044
2001M04	-0.120	-0.004	-0.041	-0.021	0.001	-0.004	0.005	0.001	-0.123	-0.031	-0.062	-0.028	-0.009
2001M05	0.064	0.010	0.023	0.016	0.039	0.010	0.045	-0.035	0.063	-0.012	0.020	0.013	0.040
2001M06	-0.025	0.009	-0.025	0.011	-0.002	0.009	-0.031	0.009	-0.028	0.012	-0.018	-0.004	0.002
2001M07	0.168	-0.015	-0.038	-0.026	-0.017	-0.015	-0.021	0.017	0.181	0.040	-0.054	-0.012	0.017
2001M08	0.048	-0.024	0.021	0.012	-0.007	-0.024	0.024	0.021	0.031	-0.004	0.007	0.034	0.014
2001M09	-0.094	-0.007	-0.010	-0.013	-0.031	-0.007	-0.010	-0.010	-0.072	0.075	0.009	-0.007	-0.014
2001M10	-0.066	0.010	-0.001	0.005	0.020	0.010	-0.011	0.000	-0.083	0.028	-0.015	0.017	0.023
2001M11	0.021	0.021	0.019	0.035	0.039	0.021	0.004	0.005	-0.007	0.026	0.045	0.031	0.039
2001M12	-0.014	-0.017	-0.005	-0.023	-0.049	-0.017	-0.079	-0.027	0.010	0.014	0.083	-0.005	-0.012
2002M01	0.034	0.026	0.030	0.033	0.025	0.026	0.018	0.006	0.010	0.015	0.060	0.041	0.025
2002M02	0.010	-0.003	-0.006	0.003	-0.010	-0.003	-0.010	-0.001	0.017	0.020	-0.016	0.010	0.001
2002M03	0.049	-0.005	0.000	0.000	-0.006	-0.005	0.001	0.004	0.052	0.039	0.075	-0.011	0.004
2002M04	0.012	-0.023	-0.015	-0.017	0.001	-0.023	0.016	0.009	0.023	-0.018	-0.032	0.014	0.022
2002M05	0.052	-0.007	0.009	0.012	0.047	-0.007	0.022	0.034	0.060	-0.024	-0.012	0.024	0.054
2002M06	-0.041	-0.047	-0.056	-0.027	-0.026	-0.047	-0.006	0.014	-0.005	0.002	-0.051	0.034	0.014
2002M07	-0.061	-0.018	-0.035	-0.029	-0.007	-0.018	-0.022	-0.038	-0.001	0.020	-0.064	0.024	0.044
2002M08	0.035	0.008	-0.002	0.003	-0.003	0.008	0.024	0.013	0.017	0.003	-0.018	0.010	-0.007
2002M09	-0.024	-0.007	-0.019	-0.034	-0.028	-0.007	-0.037	-0.004	-0.018	-0.005	-0.024	-0.047	-0.017

2002M10	-0.022	0.002	-0.008	0.004	0.007	0.002	-0.005	0.003	-0.025	0.000	-0.017	-0.011	0.008
2002M11	0.033	0.005	-0.006	0.003	0.016	0.005	0.006	0.012	0.029	0.015	-0.027	0.010	0.020
2002M12	-0.034	-0.038	-0.029	-0.033	-0.019	-0.038	-0.018	0.017	0.043	-0.021	0.003	0.010	0.018
2003M01	-0.017	-0.024	-0.037	-0.014	-0.010	-0.024	-0.016	0.007	-0.003	-0.012	-0.010	0.019	0.013
2003M02	0.039	0.042	0.032	0.044	0.022	0.042	0.052	0.039	0.004	0.011	-0.018	-0.019	-0.007
2003M03	0.002	0.002	0.017	-0.004	-0.048	0.002	-0.018	0.012	0.011	-0.001	0.000	-0.037	-0.053
2003M04	0.016	-0.010	0.003	-0.009	0.021	-0.010	-0.006	0.011	0.050	0.012	0.019	0.002	0.022
2003M05	0.015	-0.032	-0.022	-0.005	-0.024	-0.032	-0.021	0.028	0.036	0.003	-0.041	0.024	0.020
2003M06	-0.002	-0.002	-0.028	-0.009	0.009	-0.002	-0.014	-0.035	0.009	0.030	-0.016	0.019	0.049
2003M07	-0.002	0.024	0.006	0.025	0.036	0.024	0.022	0.015	-0.032	0.039	0.001	-0.041	0.027
2003M08	0.016	0.019	0.011	0.039	0.020	0.019	0.045	-0.016	0.002	0.023	-0.004	0.050	0.037
2003M09	-0.040	-0.058	-0.054	-0.028	-0.033	-0.058	-0.006	0.007	-0.005	0.017	-0.032	0.042	0.025
2003M10	-0.023	-0.011	-0.016	-0.009	-0.039	-0.011	0.011	-0.013	0.008	0.072	0.042	-0.001	-0.017
2003M11	-0.022	-0.017	-0.026	-0.017	-0.033	-0.017	-0.024	0.015	-0.008	-0.004	-0.033	0.011	0.020
2003M12	-0.028	-0.037	-0.033	-0.030	-0.029	-0.037	-0.015	0.015	0.016	-0.003	-0.018	0.003	0.015
2004M01	-0.012	-0.015	-0.024	-0.005	0.001	-0.015	-0.004	-0.034	-0.004	0.067	-0.053	0.014	0.033
2004M02	-0.022	-0.021	-0.024	-0.022	-0.023	-0.021	-0.049	-0.018	0.004	0.033	-0.019	0.017	0.034
2004M03	-0.009	0.008	0.006	0.005	0.033	0.008	0.052	-0.008	0.021	0.046	0.028	-0.003	0.029
2004M04	0.025	0.034	0.043	0.020	0.011	0.034	-0.021	0.011	0.003	0.061	0.054	-0.001	-0.003
2004M05	-0.096	-0.034	-0.034	-0.047	-0.023	-0.034	-0.037	-0.009	-0.089	-0.001	-0.007	-0.021	0.017
2004M06	-0.009	0.013	0.006	0.002	0.017	0.013	0.032	0.005	-0.068	0.002	-0.035	0.003	0.009
2004M07	0.024	-0.002	0.001	-0.013	-0.015	-0.002	-0.036	-0.012	0.030	0.015	-0.013	-0.001	-0.001
2004M08	-0.005	0.013	0.009	0.006	0.027	0.013	0.035	0.019	-0.019	0.002	-0.009	0.000	0.027
2004M09	0.014	-0.003	-0.005	0.000	-0.002	-0.003	-0.016	0.021	0.010	0.039	-0.020	0.018	0.018
2004M10	-0.009	-0.018	-0.019	-0.007	0.010	-0.018	0.027	0.008	0.002	0.026	-0.012	0.022	0.031
2004M11	-0.032	-0.040	-0.038	-0.003	0.026	-0.040	-0.012	0.003	0.000	0.035	-0.024	0.057	0.118
2004M12	-0.042	-0.013	-0.013	-0.001	0.000	-0.013	-0.022	0.012	-0.028	0.048	0.010	0.033	0.035
2005M01	0.041	0.028	0.048	0.042	0.037	0.028	0.029	-0.008	0.026	0.063	0.020	0.014	0.031
2005M02	-0.033	-0.023	-0.016	-0.017	-0.003	-0.023	-0.030	-0.014	-0.002	0.027	0.061	0.017	0.027
2005M03	-0.003	0.021	0.019	-0.001	0.011	0.021	-0.004	-0.002	-0.024	0.023	0.026	-0.028	0.021
2005M04	-0.025	-0.015	-0.007	-0.027	0.003	-0.015	-0.002	-0.016	-0.005	0.015	0.022	-0.004	0.019
2005M05	0.058	0.050	0.050	0.028	0.040	0.050	0.030	0.001	-0.014	0.045	0.078	-0.016	0.016
2005M06	-0.009	0.014	-0.015	-0.006	-0.004	0.014	-0.008	-0.006	-0.032	0.017	0.008	-0.005	-0.010
2005M07	0.010	0.034	0.018	0.011	0.020	0.021	0.005	0.021	-0.061	0.063	-0.005	-0.005	0.005
2005M08	-0.057	-0.020	-0.016	-0.006	-0.027	-0.015	-0.007	-0.007	-0.082	0.009	0.016	0.024	-0.012
2005M09	0.003	0.010	0.011	0.018	0.007	0.009	-0.007	-0.004	-0.034	0.011	0.045	0.022	0.005

2005M10	0.015	-0.008	0.012	-0.001	-0.005	-0.006	-0.029	-0.008	0.100	-0.041	-0.001	0.008	0.006
2005M11	0.034	0.028	0.048	0.018	0.035	0.029	-0.005	0.007	0.040	-0.040	0.026	0.023	0.026
2005M12	0.024	0.002	0.020	0.006	0.024	0.003	0.017	0.005	0.061	-0.037	0.041	0.025	0.029
2006M01	0.017	-0.021	-0.014	0.021	0.019	-0.028	-0.026	-0.001	0.037	0.008	0.111	0.058	0.067
2006M02	0.032	0.024	0.019	0.009	0.008	0.014	0.027	-0.006	0.042	0.030	0.019	0.025	-0.004
2006M03	0.024	0.014	0.022	0.019	0.006	0.007	-0.003	0.026	0.139	0.025	0.010	0.023	0.002
2006M04	-0.008	-0.025	-0.052	-0.007	-0.012	-0.042	-0.015	-0.006	0.074	0.023	-0.034	0.048	0.034
2006M05	-0.088	-0.040	-0.055	-0.055	-0.041	-0.039	-0.021	-0.013	-0.029	0.026	-0.015	-0.024	-0.010
2006M06	0.016	0.012	0.007	0.022	0.009	0.025	0.001	0.012	-0.093	-0.002	-0.001	0.015	-0.001
2006M07	0.009	-0.010	0.021	-0.006	-0.011	-0.016	-0.015	-0.012	0.043	0.007	0.040	0.019	0.002
2006M08	-0.026	-0.029	-0.010	-0.016	-0.030	-0.023	-0.045	-0.016	0.022	-0.007	0.029	0.014	-0.004
2006M09	0.005	0.018	0.031	0.021	0.036	0.020	0.016	0.005	0.003	0.009	0.028	0.049	0.030
2006M10	-0.001	-0.005	-0.004	0.005	-0.011	-0.015	-0.014	-0.012	-0.053	0.009	0.040	0.030	0.005
2006M11	-0.036	-0.022	-0.029	-0.009	-0.016	-0.030	-0.019	0.009	0.021	-0.005	-0.006	0.036	0.017
2006M12	0.012	0.021	0.009	-0.005	-0.004	-0.003	-0.025	-0.006	0.043	0.056	0.034	0.041	0.022
2007M01	-0.002	0.014	0.007	0.013	-0.007	0.005	-0.017	-0.011	0.018	0.031	0.046	0.013	0.003
2007M02	-0.010	-0.003	0.013	0.008	-0.003	-0.002	0.025	0.018	0.038	0.029	0.045	0.022	0.000
2007M03	0.004	0.014	0.000	0.011	0.000	-0.001	0.006	0.007	0.036	0.030	0.003	0.048	0.002
2007M04	-0.015	-0.009	-0.003	-0.012	-0.008	-0.018	-0.035	0.003	0.039	0.034	0.024	0.000	0.015
2007M05	0.039	0.014	0.035	0.013	0.012	0.009	-0.008	-0.003	0.055	0.085	0.059	0.013	0.025
2007M06	-0.041	-0.028	-0.015	-0.011	-0.013	-0.014	-0.027	-0.010	-0.012	-0.016	0.034	0.029	-0.001
2007M07	-0.028	-0.013	0.003	0.009	-0.005	-0.013	0.022	0.002	-0.006	-0.009	0.069	0.025	0.014
2007M08	-0.018	-0.009	-0.018	-0.010	-0.015	0.006	0.029	0.005	-0.034	-0.033	0.067	-0.011	-0.020
2007M09	0.024	0.019	0.030	-0.008	0.019	-0.006	0.004	0.028	0.040	0.024	0.038	0.062	0.017
2007M10	-0.017	0.002	0.004	-0.008	-0.005	-0.021	-0.018	-0.002	0.016	0.027	0.060	0.023	0.017
2007M11	-0.026	-0.002	0.030	0.008	-0.019	0.003	0.043	0.025	-0.027	-0.002	0.024	0.020	-0.027
2007M12	0.026	0.047	0.064	0.034	0.015	0.031	-0.002	0.028	0.038	0.024	0.067	0.041	-0.009
2008M01	0.018	0.026	0.023	0.027	-0.004	0.005	0.074	0.015	-0.017	0.088	0.033	0.071	-0.019
2008M02	0.032	0.020	0.013	0.040	0.011	0.005	0.021	0.025	0.036	0.068	0.038	0.107	-0.002
2008M03	-0.021	-0.002	-0.039	0.010	-0.056	-0.003	0.043	0.039	-0.005	0.014	-0.040	0.084	-0.067
2008M04	0.009	0.020	0.003	0.003	-0.001	0.011	-0.028	-0.006	0.009	0.053	0.004	0.005	-0.014
2008M05	-0.012	-0.030	-0.043	-0.025	-0.030	-0.003	-0.018	-0.005	-0.031	-0.016	-0.048	-0.028	-0.034
2008M06	0.001	-0.016	-0.029	-0.042	-0.025	-0.009	-0.016	0.007	0.036	-0.010	-0.018	-0.073	-0.024
2008M07	0.017	0.007	0.019	0.006	0.038	0.006	-0.009	-0.004	0.040	0.003	0.029	-0.001	-0.001
2008M08	0.076	0.042	0.045	0.061	0.006	0.080	0.069	0.022	-0.008	-0.026	0.003	-0.019	-0.059
2008M09	-0.008	-0.004	0.016	0.019	-0.087	0.016	0.061	-0.014	-0.041	-0.123	0.008	0.022	-0.109

2008M10	-0.052	0.077	0.042	0.080	0.040	0.107	0.166	-0.008	-0.234	-0.076	-0.042	0.029	-0.144
2008M11	-0.047	0.046	0.050	0.040	-0.076	0.053	0.085	0.051	-0.111	-0.034	0.015	0.015	-0.187
2008M12	0.155	0.086	0.080	0.064	0.205	0.051	0.099	0.140	0.097	-0.066	0.000	0.022	0.123
2009M01	-0.017	-0.022	0.028	0.019	-0.072	0.019	0.032	-0.063	-0.030	-0.020	0.075	0.019	-0.066
2009M02	-0.046	-0.015	-0.001	-0.024	-0.099	0.008	-0.077	-0.006	-0.036	0.000	-0.027	0.017	-0.081
2009M03	0.024	0.002	-0.030	0.004	0.093	-0.010	-0.016	0.041	0.101	-0.044	0.001	0.023	0.108
2009M04	0.044	-0.009	-0.039	-0.027	0.043	-0.033	-0.028	-0.036	0.109	0.021	0.004	0.010	0.104
2009M05	-0.050	-0.071	-0.062	-0.059	-0.065	-0.086	-0.075	-0.026	0.025	-0.011	-0.014	0.032	0.052
2009M06	-0.014	-0.029	-0.041	-0.015	-0.040	-0.025	-0.019	-0.022	0.003	0.029	-0.017	0.003	0.004
2009M07	0.030	0.000	0.004	-0.001	0.036	0.000	0.006	0.000	0.027	-0.005	0.019	0.021	0.060
2009M08	0.001	0.014	-0.002	0.015	-0.002	0.015	0.043	0.024	-0.014	-0.004	-0.015	0.013	-0.006
2009M09	0.051	0.027	0.044	0.027	0.071	0.013	0.045	0.039	0.054	0.020	0.040	0.035	0.081
2009M10	-0.011	-0.005	-0.032	-0.021	-0.029	-0.025	-0.043	-0.014	0.047	0.017	0.000	0.026	0.032
2009M11	0.010	0.009	0.024	0.010	0.020	0.003	0.055	0.018	0.011	-0.006	0.025	0.026	0.029
2009M12	0.025	0.006	0.026	0.012	0.016	0.017	-0.042	-0.025	0.044	0.021	0.043	0.014	0.022
2010M01	0.007	0.007	-0.005	0.010	0.006	0.004	0.028	-0.027	0.068	0.015	0.038	0.045	0.025
2010M02	0.062	0.060	0.069	0.060	0.060	0.058	0.065	0.030	0.020	0.014	0.025	0.011	0.004
2010M03	0.029	0.046	0.018	0.027	0.030	0.005	-0.039	-0.002	0.066	0.034	0.009	0.048	0.041
2010M04	0.000	0.014	0.010	-0.009	0.009	-0.012	-0.020	-0.024	0.111	0.038	0.052	0.030	0.049
2010M05	0.032	0.031	0.016	0.043	-0.031	0.050	0.080	-0.029	-0.051	0.000	0.000	-0.012	-0.089
2010M06	-0.019	-0.031	-0.032	-0.027	-0.037	-0.030	0.000	-0.033	0.031	-0.013	0.015	0.022	0.006
2010M07	-0.021	-0.014	-0.025	-0.031	-0.013	-0.036	-0.012	0.024	0.024	-0.002	-0.004	0.009	0.039
2010M08	0.001	0.027	0.025	0.042	0.006	0.011	0.037	-0.016	0.028	0.025	0.032	0.060	-0.001
2010M09	-0.020	-0.017	-0.004	-0.004	0.009	-0.033	-0.022	0.041	0.046	0.041	0.078	0.049	0.026
2010M10	-0.001	-0.008	0.016	0.014	0.013	-0.001	0.034	0.015	0.052	0.029	0.088	0.052	0.015
2010M11	0.016	0.010	0.001	0.015	-0.005	0.025	-0.018	-0.039	0.032	0.019	0.072	0.001	-0.011
2010M12	-0.006	0.016	0.000	-0.006	0.014	-0.008	0.024	0.019	0.031	0.021	0.031	0.017	0.017
2011M01	-0.022	-0.007	-0.020	-0.047	-0.003	-0.015	-0.022	0.009	-0.029	0.008	0.008	-0.034	0.012
2011M02	0.005	-0.019	-0.016	-0.004	-0.028	-0.021	-0.017	-0.011	0.064	0.011	-0.002	0.041	-0.008
2011M03	0.022	0.017	0.018	0.019	0.038	0.009	-0.009	0.035	0.068	0.037	0.036	0.011	0.024
2011M04	-0.019	-0.017	-0.025	-0.023	-0.011	-0.034	-0.021	0.011	0.069	0.133	0.021	0.033	0.030
2011M05	0.013	-0.004	0.003	-0.003	0.002	0.009	0.024	-0.023	0.040	0.021	0.013	-0.023	-0.003
2011M06	0.023	0.027	0.026	0.016	0.041	0.030	0.032	0.035	0.024	0.009	-0.003	-0.021	0.009
2011M07	-0.006	0.005	0.013	0.016	-0.004	-0.016	0.024	-0.030	0.035	0.031	0.075	0.046	0.030
2011M08	-0.009	-0.009	-0.007	-0.010	-0.012	-0.001	0.012	0.012	-0.001	-0.008	0.051	-0.020	-0.014
2011M09	0.015	-0.025	0.017	0.006	-0.056	0.043	0.043	-0.024	-0.085	-0.080	-0.005	-0.054	-0.098

2011M10	-0.028	0.010	-0.013	-0.011	0.032	-0.027	-0.060	0.009	-0.025	0.052	0.002	0.009	0.069
2011M11	-0.011	-0.005	0.008	0.009	-0.003	0.026	0.041	-0.016	-0.039	-0.010	0.008	-0.019	-0.017
2011M12	0.021	0.008	0.007	-0.006	0.002	0.009	0.014	-0.027	0.015	0.001	-0.005	-0.018	-0.006
2012M01	-0.013	0.021	0.002	0.000	0.004	-0.021	-0.003	-0.003	0.010	0.036	0.027	0.026	0.031
2012M02	-0.019	0.005	-0.008	0.012	-0.006	-0.010	-0.064	0.010	-0.012	0.017	-0.006	0.030	0.015
2012M03	-0.015	-0.027	-0.007	-0.019	-0.017	-0.004	-0.023	-0.011	-0.020	-0.012	-0.037	-0.016	-0.008
2012M04	-0.017	-0.004	-0.002	-0.012	-0.013	-0.016	-0.003	-0.026	0.053	0.012	0.019	0.001	0.005
2012M05	0.008	0.000	0.024	0.010	0.004	0.048	0.077	-0.016	-0.056	-0.021	0.007	-0.051	-0.036
2012M06	0.003	-0.009	0.021	-0.004	0.024	-0.006	-0.013	0.009	-0.045	-0.019	0.019	0.014	0.030
2012M07	-0.006	0.009	0.004	0.003	0.008	-0.005	0.009	-0.030	0.005	0.022	0.069	0.018	0.023
2012M08	-0.018	-0.006	-0.019	-0.003	-0.013	-0.010	-0.014	0.017	0.006	-0.001	-0.012	0.018	-0.006
2012M09	-0.025	-0.001	-0.012	-0.004	-0.001	-0.022	-0.011	0.003	-0.007	0.025	0.009	0.028	0.024
2012M10	0.002	0.008	0.019	0.009	0.023	0.005	-0.022	0.010	0.001	0.011	0.020	-0.006	0.025
2012M11	0.005	0.008	0.013	0.004	0.011	0.004	-0.031	0.003	0.014	0.014	0.042	0.005	0.017
2012M12	0.011	0.013	0.010	0.020	0.029	0.017	-0.031	0.033	0.007	0.000	-0.006	0.002	0.013
2013M01	-0.003	-0.014	0.013	0.028	-0.017	0.000	-0.051	0.026	-0.046	-0.013	0.031	0.026	-0.014
2013M02	0.041	0.041	0.036	0.037	0.044	0.038	0.023	0.007	-0.013	0.021	0.000	0.005	0.015
2013M03	-0.001	0.006	0.000	0.021	-0.021	0.005	-0.013	-0.020	0.002	0.008	0.009	0.019	-0.014
2013M04	-0.026	-0.007	-0.032	-0.026	-0.017	-0.026	-0.074	-0.005	0.020	0.016	-0.011	-0.001	0.006
2013M05	0.012	0.003	-0.009	-0.008	-0.006	0.020	-0.002	0.015	-0.021	-0.002	-0.034	-0.037	-0.020
2013M06	-0.022	-0.039	-0.031	-0.041	-0.020	-0.009	0.020	-0.004	-0.087	-0.071	-0.023	-0.058	-0.021
2013M07	-0.032	-0.019	0.001	-0.004	0.032	0.003	0.003	0.018	-0.104	-0.015	0.010	-0.008	0.033
2013M08	-0.073	-0.027	-0.040	-0.035	-0.012	-0.012	-0.014	-0.015	-0.060	-0.039	-0.037	-0.047	0.003
2013M09	-0.103	-0.029	-0.012	-0.020	-0.009	-0.042	-0.036	-0.022	-0.042	0.012	0.030	0.033	0.038
2013M10	0.039	0.037	0.009	0.015	0.019	0.005	0.001	0.015	0.041	0.029	-0.001	0.002	0.026
2013M11	-0.080	-0.037	-0.028	-0.048	-0.013	-0.015	-0.047	-0.018	-0.056	-0.022	-0.003	-0.053	0.013
2013M12	-0.027	-0.027	-0.025	-0.032	-0.007	-0.010	-0.048	0.004	0.007	-0.030	-0.020	-0.025	0.004

Data for **Chapter 4** (Indonesian currency)

Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR
04/01/2000	9717.5	1.3807	24/05/2000	11134.1	1.31	20/10/2000	11333.7	1.279	19/03/2001	11946.9	1.2712
05/01/2000	9730.2	1.3803	25/05/2000	11035.3	1.3089	23/10/2000	11393.2	1.2799	20/03/2001	11977.6	1.2744
06/01/2000	9812.7	1.377	26/05/2000	11205.4	1.3198	24/10/2000	11421.8	1.2804	21/03/2001	11931.6	1.2698
07/01/2000	9838.1	1.3751	29/05/2000	11189.5	1.3192	25/10/2000	11419.2	1.2757	22/03/2001	11886.5	1.2647
10/01/2000	9704.7	1.373	30/05/2000	11409.4	1.3224	26/10/2000	11403.5	1.2746	23/03/2001	11928.3	1.2692
11/01/2000	9948.9	1.3749	31/05/2000	11360.6	1.3203	27/10/2000	11708.8	1.2806	26/03/2001	11942.9	1.2707
12/01/2000	9898	1.374	01/06/2000	11204.9	1.3163	30/10/2000	11675.2	1.2811	27/03/2001	13100.8	1.268
13/01/2000	9855.6	1.373	02/06/2000	10891.4	1.3239	31/10/2000	12065.7	1.2822	28/03/2001	13147.5	1.2678
14/01/2000	9820.5	1.3677	05/06/2000	11244.9	1.3274	01/11/2000	12021.5	1.2868	29/03/2001	13011	1.263
17/01/2000	9896.7	1.3676	06/06/2000	11425.8	1.3365	02/11/2000	11855.5	1.2867	30/03/2001	13077.4	1.2583
18/01/2000	9926.3	1.3683	07/06/2000	11478.3	1.3377	03/11/2000	11847.1	1.2905	02/04/2001	13099.1	1.2585
19/01/2000	9927.4	1.3686	08/06/2000	11284.5	1.3339	06/11/2000	11781.9	1.2878	03/04/2001	13195.1	1.2653
20/01/2000	9861.2	1.3703	09/06/2000	11257.5	1.3305	07/11/2000	11829.6	1.2879	04/04/2001	13401.1	1.2698
21/01/2000	9912.8	1.3702	12/06/2000	11416.2	1.3318	08/11/2000	11989.5	1.2856	05/04/2001	13461.6	1.2687
24/01/2000	9853.2	1.3659	13/06/2000	11410.8	1.3342	09/11/2000	11824.7	1.2866	06/04/2001	13729.3	1.2713
25/01/2000	9986.1	1.3655	14/06/2000	11217.7	1.3319	10/11/2000	11838.1	1.288	09/04/2001	13677	1.2716
26/01/2000	10145.6	1.3637	15/06/2000	11313.6	1.3314	14/11/2000	11722.1	1.2855	10/04/2001	13363.5	1.2656
27/01/2000	10074.7	1.3614	16/06/2000	11269.9	1.3369	15/11/2000	11751	1.2836	11/04/2001	13333.4	1.2638
28/01/2000	10006.9	1.3496	19/06/2000	11549	1.3372	16/11/2000	12005.5	1.2812	12/04/2001	13453.2	1.2689
31/01/2000	9999.6	1.3488	20/06/2000	11504.8	1.3352	20/11/2000	11985	1.2779	16/04/2001	13646.5	1.2644
01/02/2000	10004.3	1.3468	21/06/2000	11516.9	1.3302	21/11/2000	12069.1	1.2753	17/04/2001	13622.5	1.263
02/02/2000	10266.1	1.3454	22/06/2000	11584.8	1.3321	22/11/2000	12020	1.2735	18/04/2001	13727.1	1.2657
03/02/2000	10274.7	1.3506	23/06/2000	11525	1.3291	23/11/2000	11952.6	1.2713	19/04/2001	13967.8	1.2704
04/02/2000	10272.7	1.3455	26/06/2000	11527.8	1.3273	24/11/2000	11831.9	1.2683	20/04/2001	14892.6	1.2751
07/02/2000	10079.2	1.3436	27/06/2000	11354.3	1.3298	27/11/2000	12052.1	1.2756	23/04/2001	15028.2	1.2728
08/02/2000	9835.4	1.3464	28/06/2000	11540.3	1.331	28/11/2000	12045.8	1.2782	24/04/2001	15041	1.2715
09/02/2000	9783.5	1.3496	29/06/2000	11610.6	1.3353	29/11/2000	12110.7	1.2777	25/04/2001	15038.2	1.2729
10/02/2000	9800.3	1.348	30/06/2000	11652.8	1.3333	30/11/2000	12124.6	1.2825	26/04/2001	15154	1.273
11/02/2000	9759.3	1.3453	04/07/2000	11886.8	1.3319	01/12/2000	12183.2	1.2862	27/04/2001	14908.9	1.2683
14/02/2000	9610.5	1.3438	05/07/2000	12441.8	1.3312	04/12/2000	12309.9	1.2919	30/04/2001	14673.7	1.2659
15/02/2000	9878.6	1.346	06/07/2000	11903.8	1.3294	05/12/2000	12138.7	1.2881	01/05/2001	14141.1	1.2711
16/02/2000	9971.4	1.3458	07/07/2000	12317.2	1.3272	06/12/2000	12399.2	1.292	02/05/2001	14236.3	1.271
17/02/2000	9949.2	1.3444	10/07/2000	12332.5	1.3301	07/12/2000	12222.3	1.2919	03/05/2001	14067.9	1.2699

18/02/2000	9833.9	1.3418	11/07/2000	12332.4	1.3298	08/12/2000	12320.9	1.2894	04/05/2001	13934.7	1.2725
21/02/2000	9968.8	1.3421	12/07/2000	12407.6	1.3223	11/12/2000	11866.8	1.2893	07/05/2001	13929.7	1.2718
22/02/2000	10042	1.3508	13/07/2000	12352	1.3197	12/12/2000	12093.4	1.287	08/05/2001	13938.5	1.2676
23/02/2000	10018.5	1.348	14/07/2000	12405.6	1.3216	13/12/2000	12150.5	1.2846	09/05/2001	14012.9	1.2654
24/02/2000	10008.1	1.3447	17/07/2000	12510.8	1.3186	14/12/2000	11947.9	1.2898	10/05/2001	14180.2	1.2623
25/02/2000	9707.7	1.3377	18/07/2000	12237.8	1.3183	15/12/2000	12080.3	1.2949	11/05/2001	14201.5	1.2613
28/02/2000	9960.6	1.3392	19/07/2000	12191.7	1.3155	18/12/2000	12156.9	1.2931	14/05/2001	14393.8	1.2597
29/02/2000	9710.9	1.3345	20/07/2000	12191.5	1.3194	19/12/2000	12007.3	1.2906	15/05/2001	14446.1	1.2618
01/03/2000	9760.9	1.344	21/07/2000	11650.9	1.3197	20/12/2000	11967.3	1.2973	16/05/2001	14425.1	1.2643
02/03/2000	9994.8	1.3399	24/07/2000	11715.1	1.3187	21/12/2000	12062.7	1.2997	17/05/2001	14362.7	1.2649
03/03/2000	9758	1.339	25/07/2000	11699.8	1.3211	22/12/2000	12190.3	1.3034	18/05/2001	14350.7	1.2617
06/03/2000	9777	1.3377	26/07/2000	12023.4	1.3215	27/12/2000	12102.7	1.3043	22/05/2001	14356.4	1.2574
07/03/2000	9780.8	1.3403	27/07/2000	12020.3	1.3183	28/12/2000	12470.8	1.3017	23/05/2001	14374.6	1.2579
08/03/2000	9952.1	1.3401	28/07/2000	11779.4	1.3135	29/12/2000	12582.6	1.3075	24/05/2001	14347.9	1.2557
09/03/2000	9914.4	1.3446	31/07/2000	11762.5	1.3136	02/01/2001	12442.3	1.3095	25/05/2001	14392.6	1.2562
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31/03/2000	10298.1	1.351	29/08/2000	10887.7	1.3072	24/01/2001	12143.7	1.2929	18/06/2001	14027.7	1.2524
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05/04/2000	10516.9	1.3478	01/09/2000	10918	1.3091	29/01/2001	12139.4	1.2915	21/06/2001	14160.3	1.249
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13/04/2000	10183	1.3412	12/09/2000	10908.7	1.2862	06/02/2001	12438.5	1.2998	29/06/2001	14066.7	1.245
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26/04/2000	10647.4	1.3279	22/09/2000	11398.1	1.2967	16/02/2001	12119	1.292	12/07/2001	14178	1.248
27/04/2000	10465.5	1.323	25/09/2000	11348.1	1.2949	19/02/2001	12139.2	1.2918	13/07/2001	14105.4	1.2463
28/04/2000	10418.5	1.3173	26/09/2000	11371	1.2983	20/02/2001	12110.6	1.2883	16/07/2001	14133.6	1.2465
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04/05/2000	10424.2	1.3092	02/10/2000	11287.5	1.2954	26/02/2001	12327.6	1.2866	20/07/2001	14026.8	1.2599
05/05/2000	10409.5	1.3084	03/10/2000	11307.8	1.293	27/02/2001	12575.7	1.2884	23/07/2001	12664.3	1.2551
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09/05/2000	10578.6	1.3088	05/10/2000	11284.3	1.2891	01/03/2001	12701.3	1.2951	25/07/2001	12626.4	1.2623
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15/05/2000	11225.4	1.3104	12/10/2000	11480.9	1.2937	09/03/2001	12159.7	1.2938	31/07/2001	11832.2	1.2582
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23/05/2000	11024.7	1.3096	19/10/2000	11362.5	1.2803	16/03/2001	11921.6	1.2686	08/08/2001	11751.9	1.2606

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13/08/2001	10753	1.271	09/01/2002	13096	1.2553	03/06/2002	11019	1.2908	28/10/2002	12187	1.3198
14/08/2001	10656.1	1.2751	10/01/2002	13076	1.2577	04/06/2002	11164	1.2932	29/10/2002	12149	1.3213

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05/09/2001	11548.5	1.2732	31/01/2002	12809	1.2388	25/06/2002	11325	1.3099	20/11/2002	11905	1.3304
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27/11/2001	13141.2	1.2607	23/04/2002	11889	1.2604	17/09/2002	11905	1.3118	12/02/2003	12210	1.3658

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30/11/2001	13299.5	1.2692	26/04/2002	11786	1.2666	20/09/2002	11931	1.3198	17/02/2003	12156	1.3667
03/12/2001	13208.6	1.2655	29/04/2002	11831	1.2691	23/09/2002	11936	1.3183	18/02/2003	12105	1.3665
04/12/2001	13259.6	1.265	30/04/2002	11827	1.2674	24/09/2002	11946	1.3185	19/02/2003	12120	1.3687
05/12/2001	13225.6	1.2625	01/05/2002	11863	1.2717	25/09/2002	11852	1.3194	20/02/2003	12144	1.3724
06/12/2001	13127.1	1.2655	02/05/2002	11877	1.27	26/09/2002	11870	1.3172	21/02/2003	12198	1.3694
07/12/2001	13078.4	1.2643	03/05/2002	11879	1.2754	27/09/2002	11874	1.3171	24/02/2003	12192	1.3707
10/12/2001	12942.6	1.2628	06/05/2002	11849	1.2769	30/09/2002	11937	1.3248	25/02/2003	12176	1.3705
11/12/2001	12868.6	1.2642	07/05/2002	11849	1.2755	01/10/2002	11920	1.3227	26/02/2003	12195	1.3717
12/12/2001	12706.5	1.2663	08/05/2002	11787	1.2684	02/10/2002	11898	1.3208	27/02/2003	12190	1.3696
13/12/2001	12823.6	1.2679	09/05/2002	11800	1.2714	03/10/2002	11951	1.3227	28/02/2003	12188	1.3687
14/12/2001	12979.9	1.2703	10/05/2002	11805	1.2732	04/10/2002	11894	1.3205	03/03/2003	12194	1.3717
17/12/2001	12990.7	1.2703	13/05/2002	11809	1.2731	07/10/2002	11854	1.3179	04/03/2003	12159	1.3745
18/12/2001	12875.7	1.2687	14/05/2002	11755	1.267	08/10/2002	11848	1.3166	05/03/2003	12246	1.3807
19/12/2001	12784.7	1.2669	15/05/2002	11771	1.271	09/10/2002	11888	1.3208	06/03/2003	12252	1.3825
20/12/2001	12788.8	1.2647	16/05/2002	11772	1.2722	10/10/2002	11876	1.3208	07/03/2003	12301	1.3843
21/12/2001	12782.6	1.2584	17/05/2002	11609	1.2796	11/10/2002	11914	1.3198	10/03/2003	12311	1.386
24/12/2001	12809.4	1.254	21/05/2002	11598	1.2817	15/10/2002	12206	1.3165	11/03/2003	12274	1.384
27/12/2001	13099.9	1.2566	22/05/2002	11674	1.2845	16/10/2002	12133	1.3175	12/03/2003	12280	1.3845
28/12/2001	13177.8	1.2553	23/05/2002	11494	1.2817	17/10/2002	12141	1.3127	13/03/2003	12232	1.3756
31/12/2001	13113.8	1.2598	24/05/2002	11503	1.2817	18/10/2002	12044	1.3101	14/03/2003	12203	1.3667
02/01/2002	13192	1.2631	27/05/2002	11494	1.2809	21/10/2002	12094	1.3117	17/03/2003	12234	1.3608
03/01/2002	13081	1.2615	28/05/2002	11368	1.2853	22/10/2002	12116	1.3137	18/03/2003	12261	1.36
04/01/2002	13164	1.2608	29/05/2002	11405	1.2857	23/10/2002	12062	1.3149	19/03/2003	12324	1.357

Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR
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21/03/2003	12223	1.3529	15/08/2003	11900	1.3897	13/01/2004	12468	1.4986	07/06/2004	13769	1.4744
24/03/2003	12194	1.3594	18/08/2003	11808	1.3838	14/01/2004	12521	1.4983	08/06/2004	13577	1.4719
25/03/2003	12116	1.3613	19/08/2003	11744	1.3832	15/01/2004	12481	1.4906	09/06/2004	13575	1.4636
26/03/2003	12139	1.3616	20/08/2003	11627	1.3846	16/01/2004	12381	1.4787	10/06/2004	13717	1.4659
27/03/2003	12127	1.3629	21/08/2003	11546	1.3782	19/01/2004	12395	1.4754	11/06/2004	13727	1.4585
28/03/2003	12138	1.3645	22/08/2003	11599	1.3738	20/01/2004	12508	1.4879	14/06/2004	13672	1.4588
31/03/2003	12241	1.3747	25/08/2003	11577	1.3748	21/01/2004	12515	1.4911	15/06/2004	13838	1.4656
01/04/2003	12192	1.3744	26/08/2003	11607	1.3747	22/01/2004	12616	1.4983	16/06/2004	13762	1.4588

02/04/2003	12146	1.3659	27/08/2003	11613	1.375	23/01/2004	12540	1.4912	17/06/2004	13774	1.4622
03/04/2003	12128	1.3648	28/08/2003	11715	1.3753	26/01/2004	12616	1.4886	18/06/2004	13807	1.4673
04/04/2003	12075	1.3618	29/08/2003	11728	1.3802	27/01/2004	12582	1.4945	21/06/2004	13793	1.4663
07/04/2003	12059	1.3564	02/09/2003	11643	1.376	28/01/2004	12578	1.4941	22/06/2004	13818	1.4641
08/04/2003	12098	1.3599	03/09/2003	11650	1.3748	29/01/2004	12504	1.4811	23/06/2004	13846	1.4643
09/04/2003	12035	1.3611	04/09/2003	11667	1.3765	30/01/2004	12547	1.4852	24/06/2004	13813	1.4708
10/04/2003	12076	1.3675	05/09/2003	11718	1.3845	02/02/2004	12572	1.4842	25/06/2004	13850	1.4685
11/04/2003	12073	1.3639	08/09/2003	11740	1.3875	03/02/2004	12632	1.4924	28/06/2004	13818	1.471
14/04/2003	12096	1.3651	09/09/2003	11737	1.3908	04/02/2004	12577	1.4911	29/06/2004	13796	1.4657
15/04/2003	12093	1.3664	10/09/2003	11718	1.3897	05/02/2004	12594	1.494	30/06/2004	13744	1.4663
16/04/2003	12090	1.3699	11/09/2003	11761	1.3897	06/02/2004	12683	1.4982	02/07/2004	13480	1.4749
17/04/2003	11987	1.3727	12/09/2003	11816	1.3957	09/02/2004	12617	1.4984	05/07/2004	13464	1.4728
21/04/2003	11835	1.3671	15/09/2003	11836	1.3951	10/02/2004	12634	1.5022	06/07/2004	13211	1.4741
22/04/2003	11985	1.3748	16/09/2003	11743	1.3896	11/02/2004	12658	1.508	07/07/2004	13296	1.4811
23/04/2003	12006	1.3736	17/09/2003	11834	1.3946	12/02/2004	12670	1.5079	08/07/2004	13349	1.4806
24/04/2003	12046	1.3798	18/09/2003	11837	1.3971	13/02/2004	12682	1.5044	09/07/2004	13222	1.4814
25/04/2003	12068	1.3786	19/09/2003	11906	1.4052	16/02/2004	12612	1.5061	12/07/2004	13038	1.4831
28/04/2003	12026	1.3766	22/09/2003	11991	1.4153	17/02/2004	12685	1.5103	13/07/2004	13219	1.4755
29/04/2003	11996	1.3774	23/09/2003	11942	1.4174	18/02/2004	12655	1.5074	14/07/2004	13219	1.4798
30/04/2003	12053	1.3873	24/09/2003	11917	1.4167	19/02/2004	12685	1.5002	15/07/2004	13209	1.4771
01/05/2003	12037	1.3914	25/09/2003	11934	1.4173	20/02/2004	12586	1.489	16/07/2004	13211	1.4841
02/05/2003	12038	1.3881	26/09/2003	11925	1.4174	23/02/2004	12600	1.4904	19/07/2004	13302	1.4849
05/05/2003	12071	1.3923	29/09/2003	11976	1.4234	24/02/2004	12671	1.498	20/07/2004	13283	1.4806
06/05/2003	12001	1.3977	30/09/2003	11956	1.4254	25/02/2004	12577	1.4863	21/07/2004	13233	1.469
07/05/2003	11862	1.3971	01/10/2003	11969	1.4295	26/02/2004	12519	1.482	22/07/2004	13338	1.4729
08/05/2003	12007	1.4028	02/10/2003	11968	1.4309	27/02/2004	12570	1.482	23/07/2004	13349	1.4645
09/05/2003	11995	1.4039	03/10/2003	11943	1.4242	01/03/2004	12571	1.4832	26/07/2004	13373	1.4658
12/05/2003	11845	1.4073	06/10/2003	11986	1.43	02/03/2004	12485	1.4688	27/07/2004	13249	1.4591
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14/05/2003	11898	1.4067	08/10/2003	12036	1.435	04/03/2004	12532	1.4673	29/07/2004	13412	1.4578
15/05/2003	11872	1.4063	09/10/2003	11982	1.4307	05/03/2004	12712	1.475	30/07/2004	13266	1.4572
16/05/2003	11892	1.4096	10/10/2003	12015	1.4376	08/03/2004	12654	1.473	03/08/2004	13371	1.4597
20/05/2003	11900	1.4161	14/10/2003	12080	1.4332	09/03/2004	12645	1.4764	04/08/2004	13421	1.4589
21/05/2003	11800	1.4165	15/10/2003	12056	1.4294	10/03/2004	12538	1.4645	05/08/2004	13437	1.4581
22/05/2003	11809	1.4154	16/10/2003	12067	1.4312	11/03/2004	12675	1.4662	06/08/2004	13486	1.4723
23/05/2003	11713	1.4201	17/10/2003	12027	1.4287	12/03/2004	12703	1.4626	09/08/2004	13537	1.4704

26/05/2003	11646	1.4236	20/10/2003	12017	1.4296	15/03/2004	12681	1.4657	10/08/2004	13523	1.4718
27/05/2003	11641	1.4227	21/10/2003	12065	1.4307	16/03/2004	12651	1.4706	11/08/2004	13490	1.4673
28/05/2003	11680	1.4151	22/10/2003	12185	1.4393	17/03/2004	12549	1.4691	12/08/2004	13566	1.466
29/05/2003	11855	1.4206	23/10/2003	12218	1.4379	18/03/2004	12630	1.4823	13/08/2004	13601	1.4745
30/05/2003	11758	1.4153	24/10/2003	12224	1.4405	19/03/2004	12671	1.4756	16/08/2004	13661	1.4731
02/06/2003	11679	1.4156	27/10/2003	12320	1.4387	22/03/2004	12700	1.4828	17/08/2004	13662	1.473
03/06/2003	11632	1.4119	28/10/2003	12300	1.4357	23/03/2004	12636	1.4805	18/08/2004	13646	1.4718
04/06/2003	11490	1.4136	29/10/2003	12211	1.4358	24/03/2004	12663	1.4757	19/08/2004	13670	1.4764
05/06/2003	11785	1.4246	30/10/2003	12195	1.4367	25/03/2004	12710	1.4718	20/08/2004	13559	1.4733
06/06/2003	11545	1.4154	31/10/2003	12168	1.4292	26/03/2004	12671	1.4686	23/08/2004	13495	1.467
09/06/2003	11596	1.417	03/11/2003	12119	1.419	29/03/2004	12678	1.4721	24/08/2004	13518	1.4605
10/06/2003	11641	1.4159	04/11/2003	12079	1.4238	30/03/2004	12697	1.4756	25/08/2004	13494	1.459
11/06/2003	11720	1.4208	05/11/2003	12059	1.4221	31/03/2004	12705	1.4833	26/08/2004	13582	1.4598
12/06/2003	11759	1.421	06/11/2003	12069	1.4184	01/04/2004	12747	1.4887	27/08/2004	13544	1.4574
13/06/2003	11671	1.4238	07/11/2003	12080	1.4237	02/04/2004	12674	1.4739	30/08/2004	13620	1.4578
16/06/2003	11710	1.4253	10/11/2003	12065	1.4269	05/04/2004	12601	1.4665	31/08/2004	13789	1.4661
17/06/2003	11628	1.4235	12/11/2003	12168	1.4317	06/04/2004	12591	1.4713	01/09/2004	13664	1.4639
18/06/2003	11682	1.4184	13/11/2003	12277	1.4359	07/04/2004	12669	1.4763	02/09/2004	13583	1.4632
19/06/2003	11653	1.4161	14/11/2003	12242	1.4366	08/04/2004	12660	1.4703	03/09/2004	13520	1.4553
20/06/2003	11641	1.4131	17/11/2003	12173	1.4362	12/04/2004	12611	1.4709	07/09/2004	13510	1.4585
23/06/2003	11604	1.4118	18/11/2003	12223	1.4453	13/04/2004	12583	1.4599	08/09/2004	13583	1.4634
24/06/2003	11546	1.4082	19/11/2003	12222	1.4439	14/04/2004	12538	1.4554	09/09/2004	13654	1.4635
25/06/2003	11654	1.4148	20/11/2003	12371	1.4439	15/04/2004	12547	1.4529	23/09/2004	13406	1.4683
26/06/2003	11588	1.4036	21/11/2003	12315	1.4451	16/04/2004	12596	1.4615	24/09/2004	13363	1.4664
27/06/2003	11601	1.4019	24/11/2003	12245	1.4372	19/04/2004	12525	1.4603	27/09/2004	13453	1.4681
30/06/2003	11610	1.4049	25/11/2003	12259	1.4378	20/04/2004	12538	1.4544	28/09/2004	13565	1.4676
02/07/2003	11549	1.4087	26/11/2003	12322	1.4454	21/04/2004	12530	1.4476	29/09/2004	13436	1.4676
03/07/2003	11626	1.4093	27/11/2003	12274	1.4448	22/04/2004	12525	1.4475	30/09/2004	13508	1.4749
04/07/2003	11517	1.4086	28/11/2003	12288	1.4492	23/04/2004	12454	1.4457	01/10/2004	13475	1.4723
07/07/2003	11445	1.4005	01/12/2003	12318	1.4472	27/04/2004	12512	1.4532	04/10/2004	13309	1.4643
08/07/2003	11435	1.3948	02/12/2003	12344	1.4548	28/04/2004	12522	1.4469	05/10/2004	13313	1.4659
09/07/2003	11507	1.3976	03/12/2003	12368	1.456	29/04/2004	12744	1.4516	06/10/2004	13367	1.4648
10/07/2003	11528	1.4013	04/12/2003	12396	1.4548	30/04/2004	12759	1.4521	07/10/2004	13346	1.4646
11/07/2003	11447	1.3975	05/12/2003	12364	1.4596	03/05/2004	12774	1.4504	08/10/2004	13370	1.4745
14/07/2003	11492	1.3968	08/12/2003	12403	1.4639	04/05/2004	12725	1.4586	12/10/2004	13482	1.469
15/07/2003	11473	1.3921	09/12/2003	12458	1.4654	05/05/2004	12731	1.4653	13/10/2004	13434	1.4671

16/07/2003	11461	1.3891	10/12/2003	12424	1.4629	06/05/2004	12738	1.4605	14/10/2004	13374	1.4736
17/07/2003	11454	1.3855	11/12/2003	12421	1.461	07/05/2004	12601	1.446	15/10/2004	13416	1.4789
18/07/2003	11605	1.3895	12/12/2003	12447	1.4671	10/05/2004	12939	1.4396	18/10/2004	13457	1.4799
21/07/2003	11603	1.3955	15/12/2003	12434	1.4674	11/05/2004	12946	1.4379	19/10/2004	13467	1.4815
22/07/2003	11702	1.3927	16/12/2003	12500	1.4697	12/05/2004	12934	1.4445	20/10/2004	13502	1.4879
23/07/2003	12030	1.4015	17/12/2003	12515	1.4734	13/05/2004	12946	1.4366	21/10/2004	13617	1.4901
24/07/2003	11983	1.399	18/12/2003	12549	1.4728	14/05/2004	13020	1.4399	22/10/2004	13568	1.4907
25/07/2003	11967	1.4036	19/12/2003	12489	1.4729	17/05/2004	13012	1.4467	25/10/2004	13590	1.4998
28/07/2003	11966	1.4028	22/12/2003	12508	1.4748	18/05/2004	13141	1.4452	26/10/2004	13595	1.4981
29/07/2003	12052	1.4005	23/12/2003	12516	1.4747	19/05/2004	13137	1.4506	27/10/2004	13585	1.4963
30/07/2003	11903	1.3946	24/12/2003	12583	1.4784	20/05/2004	13027	1.4449	28/10/2004	13640	1.4985
31/07/2003	11840	1.3882	29/12/2003	12509	1.4796	21/05/2004	13117	1.452	29/10/2004	13653	1.4987
01/08/2003	11831	1.3895	30/12/2003	12540	1.4818	25/05/2004	13468	1.4584	01/11/2004	13565	1.4974
05/08/2003	12008	1.3938	31/12/2003	12546	1.4853	26/05/2004	13511	1.4591	02/11/2004	13600	1.4963
06/08/2003	11946	1.3937	02/01/2004	12529	1.486	27/05/2004	13579	1.4702	03/11/2004	13674	1.5009
07/08/2003	12025	1.3983	05/01/2004	12494	1.4931	28/05/2004	13640	1.4681	04/11/2004	13637	1.505
08/08/2003	11918	1.394	06/01/2004	12473	1.4985	31/05/2004	13618	1.4683	05/11/2004	13708	1.51
11/08/2003	11923	1.3961	07/01/2004	12492	1.4934	01/06/2004	13760	1.468	08/11/2004	13641	1.5099
12/08/2003	11917	1.3937	08/01/2004	12532	1.4993	02/06/2004	13902	1.4703	09/11/2004	13570	1.5092
13/08/2003	11905	1.3938	09/01/2004	12554	1.5034	03/06/2004	13860	1.4667	10/11/2004	13663	1.5054

Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR
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15/11/2004	13549	1.5091	11/04/2005	14328	1.5105	02/09/2005	15333	1.484	31/01/2006	13594	1.4498
16/11/2004	13564	1.5116	12/04/2005	14250	1.5047	06/09/2005	15701	1.4815	01/02/2006	13506	1.4452
17/11/2004	13600	1.5169	13/04/2005	14357	1.509	07/09/2005	15393	1.4792	02/02/2006	13543	1.4452
18/11/2004	13636	1.5134	14/04/2005	14351	1.5024	08/09/2005	15311	1.4762	03/02/2006	13419	1.4389
19/11/2004	13621	1.5203	15/04/2005	14416	1.509	09/09/2005	15122	1.4787	06/02/2006	13261	1.4353
22/11/2004	13631	1.5191	18/04/2005	14549	1.5154	12/09/2005	14901	1.4709	07/02/2006	13207	1.4367
23/11/2004	13678	1.5217	19/04/2005	14481	1.5169	13/09/2005	14808	1.468	08/02/2006	13337	1.4336
24/11/2004	13666	1.5269	20/04/2005	14598	1.5195	14/09/2005	14729	1.4701	09/02/2006	13253	1.4349
25/11/2004	13695	1.5315	21/04/2005	14707	1.5192	15/09/2005	14731	1.466	10/02/2006	13250	1.435
26/11/2004	13792	1.5345	22/04/2005	14661	1.5205	16/09/2005	14795	1.4633	13/02/2006	13250	1.4342
29/11/2004	13771	1.534	25/04/2005	14781	1.5169	19/09/2005	14855	1.4609	14/02/2006	13240	1.4332
30/11/2004	13825	1.533	26/04/2005	14635	1.5147	20/09/2005	14873	1.4615	15/02/2006	13227	1.4326
01/12/2004	13816	1.538	27/04/2005	14516	1.5138	21/09/2005	15014	1.4637	16/02/2006	13155	1.4317

02/12/2004	13841	1.5354	28/04/2005	14448	1.5131	22/09/2005	14938	1.459	17/02/2006	13206	1.4327
03/12/2004	14009	1.543	29/04/2005	14547	1.5162	23/09/2005	14801	1.4536	20/02/2006	13288	1.4353
06/12/2004	13955	1.5449	02/05/2005	14374	1.5112	26/09/2005	14916	1.4525	21/02/2006	13247	1.4328
07/12/2004	14042	1.5454	03/05/2005	14370	1.5118	27/09/2005	14833	1.4479	22/02/2006	13375	1.4328
08/12/2004	14115	1.5324	04/05/2005	14357	1.5154	28/09/2005	14967	1.4479	23/02/2006	13340	1.4368
09/12/2004	14001	1.5308	05/05/2005	14412	1.5166	29/09/2005	14892	1.4479	24/02/2006	13323	1.4343
10/12/2004	14085	1.5276	06/05/2005	14330	1.51	30/09/2005	14902	1.4502	27/02/2006	13212	1.4346
13/12/2004	14282	1.534	09/05/2005	14252	1.5083	03/10/2005	14870	1.4412	28/02/2006	13205	1.4388
14/12/2004	14235	1.5297	10/05/2005	14259	1.5098	04/10/2005	14690	1.4413	01/03/2006	13168	1.4362
15/12/2004	14394	1.5418	11/05/2005	14226	1.5053	05/10/2005	14452	1.4458	02/03/2006	13268	1.4415
16/12/2004	14257	1.5348	12/05/2005	14185	1.4987	06/10/2005	14684	1.4533	03/03/2006	13203	1.4422
17/12/2004	14264	1.5355	13/05/2005	14179	1.4938	07/10/2005	14567	1.4507	06/03/2006	13234	1.4392
20/12/2004	14351	1.5408	16/05/2005	14145	1.492	11/10/2005	14516	1.4448	07/03/2006	13251	1.4326
21/12/2004	14294	1.5376	17/05/2005	14107	1.4926	12/10/2005	14719	1.4459	08/03/2006	13379	1.4334
22/12/2004	14350	1.5375	18/05/2005	14062	1.4933	13/10/2005	14570	1.4402	09/03/2006	13299	1.4337
23/12/2004	14336	1.543	19/05/2005	14050	1.4915	14/10/2005	14687	1.4494	10/03/2006	13165	1.4294
24/12/2004	14287	1.5455	20/05/2005	14002	1.4854	17/10/2005	14576	1.4454	13/03/2006	13207	1.4324
29/12/2004	14454	1.5449	24/05/2005	14115	1.4886	18/10/2005	14513	1.4395	14/03/2006	13201	1.4402
30/12/2004	14494	1.5501	25/05/2005	14150	1.4889	19/10/2005	14523	1.4428	15/03/2006	13109	1.441
31/12/2004	14319	1.5466	26/05/2005	14042	1.4838	20/10/2005	14514	1.4431	16/03/2006	13246	1.4466
04/01/2005	14201	1.53	27/05/2005	14064	1.4864	21/10/2005	14474	1.4416	17/03/2006	13236	1.4506
05/01/2005	14305	1.5313	30/05/2005	14101	1.4822	24/10/2005	14553	1.4446	20/03/2006	13265	1.4488
06/01/2005	14171	1.5233	31/05/2005	13997	1.4769	25/10/2005	14476	1.4513	21/03/2006	13125	1.4424
07/01/2005	14079	1.5173	01/06/2005	14102	1.4701	26/10/2005	14482	1.4478	22/03/2006	13147	1.4441
10/01/2005	14164	1.5212	02/06/2005	14126	1.472	27/10/2005	14520	1.4524	23/03/2006	13088	1.4368
11/01/2005	14149	1.5256	03/06/2005	14127	1.4708	28/10/2005	14575	1.4487	24/03/2006	13132	1.4398
12/01/2005	14146	1.5341	06/06/2005	14128	1.4754	31/10/2005	14549	1.4425	27/03/2006	13053	1.4407
13/01/2005	14018	1.5299	07/06/2005	14063	1.4771	01/11/2005	14498	1.4415	28/03/2006	13083	1.4428
14/01/2005	13986	1.5239	08/06/2005	14153	1.479	02/11/2005	14582	1.4456	29/03/2006	13176	1.4385
17/01/2005	13927	1.5226	09/06/2005	14210	1.4719	03/11/2005	14424	1.4402	30/03/2006	13120	1.4443
18/01/2005	13984	1.5215	10/06/2005	14086	1.4657	04/11/2005	14443	1.4307	31/03/2006	13167	1.4441
19/01/2005	13930	1.5209	13/06/2005	14008	1.459	07/11/2005	14418	1.4295	03/04/2006	13006	1.4428
20/01/2005	13846	1.5163	14/06/2005	13987	1.4596	08/11/2005	14396	1.4292	04/04/2006	13015	1.4508
21/01/2005	13965	1.521	15/06/2005	14073	1.4641	09/11/2005	14227	1.4275	05/04/2006	13064	1.4505
24/01/2005	13923	1.5218	16/06/2005	14151	1.4636	10/11/2005	14241	1.4269	06/04/2006	13047	1.4479
25/01/2005	13886	1.5139	17/06/2005	14186	1.4709	14/11/2005	14167	1.4213	07/04/2006	12914	1.4415

26/01/2005	13890	1.5236	20/06/2005	14215	1.4654	15/11/2005	14274	1.4226	10/04/2006	12901	1.4402
27/01/2005	13933	1.5209	21/06/2005	14216	1.4669	16/11/2005	14215	1.4194	11/04/2006	13013	1.4424
28/01/2005	13886	1.5204	22/06/2005	14148	1.4657	17/11/2005	14295	1.4219	12/04/2006	12933	1.4422
31/01/2005	13947	1.5209	23/06/2005	14070	1.4629	18/11/2005	14344	1.4221	13/04/2006	12983	1.4425
01/02/2005	14046	1.5182	24/06/2005	14092	1.4634	21/11/2005	14245	1.4221	17/04/2006	13097	1.4524
02/02/2005	13959	1.5191	27/06/2005	14209	1.4661	22/11/2005	14303	1.4217	18/04/2006	13064	1.4529
03/02/2005	13945	1.5147	28/06/2005	14166	1.4613	23/11/2005	14403	1.4257	19/04/2006	12940	1.4575
04/02/2005	13929	1.5157	29/06/2005	14217	1.4607	24/11/2005	14391	1.4251	20/04/2006	12953	1.4559
07/02/2005	13904	1.5048	30/06/2005	14183	1.4581	25/11/2005	14320	1.4207	21/04/2006	12952	1.4577
08/02/2005	13998	1.503	04/07/2005	14227	1.4456	28/11/2005	14323	1.4253	24/04/2006	12894	1.4625
09/02/2005	13931	1.5033	05/07/2005	14262	1.4455	29/11/2005	14330	1.4241	25/04/2006	12946	1.4644
10/02/2005	13969	1.5085	06/07/2005	14178	1.4451	30/11/2005	14342	1.4251	26/04/2006	12920	1.4674
11/02/2005	14027	1.507	07/07/2005	14196	1.4442	01/12/2005	14304	1.4197	27/04/2006	12919	1.4719
14/02/2005	14071	1.516	08/07/2005	14096	1.4434	02/12/2005	14231	1.4198	28/04/2006	13043	1.4786
15/02/2005	14067	1.5167	11/07/2005	14182	1.4517	05/12/2005	14200	1.4241	01/05/2006	12971	1.4797
16/02/2005	14039	1.5142	12/07/2005	14309	1.4605	06/12/2005	14193	1.4239	02/05/2006	13019	1.482
17/02/2005	14162	1.5198	13/07/2005	14253	1.4522	07/12/2005	13944	1.4207	03/05/2006	13023	1.482
18/02/2005	14044	1.5187	14/07/2005	14254	1.4522	08/12/2005	14006	1.428	04/05/2006	13039	1.4843
21/02/2005	14096	1.5195	15/07/2005	14149	1.449	09/12/2005	14011	1.4277	05/05/2006	13085	1.489
22/02/2005	14044	1.5301	18/07/2005	14227	1.452	12/12/2005	14009	1.4366	08/05/2006	13042	1.4899
23/02/2005	14117	1.5277	19/07/2005	14205	1.445	13/12/2005	13997	1.4338	09/05/2006	13051	1.492
24/02/2005	14149	1.527	20/07/2005	14244	1.4455	14/12/2005	14113	1.4442	10/05/2006	13066	1.4957
25/02/2005	14140	1.5271	21/07/2005	14289	1.455	15/12/2005	14137	1.441	11/05/2006	13086	1.5003
28/02/2005	14189	1.5325	22/07/2005	14254	1.4513	16/12/2005	14276	1.4444	12/05/2006	13215	1.5021
01/03/2005	14181	1.5288	25/07/2005	14260	1.4504	19/12/2005	14223	1.4426	15/05/2006	13690	1.4992
02/03/2005	14112	1.5249	26/07/2005	14228	1.4464	20/12/2005	14138	1.4338	16/05/2006	13766	1.4991
03/03/2005	14169	1.5236	27/07/2005	14282	1.4464	21/12/2005	14059	1.4305	17/05/2006	13514	1.4941
04/03/2005	14301	1.5315	28/07/2005	14337	1.4522	22/12/2005	14065	1.4345	18/05/2006	13760	1.4971
07/03/2005	14234	1.5284	29/07/2005	14258	1.4538	23/12/2005	14147	1.433	19/05/2006	13742	1.4925
08/03/2005	14378	1.536	02/08/2005	14278	1.4601	28/12/2005	14114	1.4309	23/05/2006	13835	1.4979
09/03/2005	14390	1.5386	03/08/2005	14346	1.4667	29/12/2005	14108	1.4296	25/05/2006	14011	1.4931
10/03/2005	14375	1.5391	04/08/2005	14353	1.4685	30/12/2005	14115	1.4286	26/05/2006	13739	1.4889
11/03/2005	14397	1.5425	05/08/2005	14273	1.464	03/01/2006	13992	1.439	29/05/2006	13710	1.4889
14/03/2005	14370	1.5336	08/08/2005	14352	1.467	04/01/2006	13990	1.4458	30/05/2006	13723	1.4976
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16/03/2005	14367	1.5398	10/08/2005	14353	1.4691	06/01/2006	13865	1.4522	01/06/2006	13935	1.4938

17/03/2005	14432	1.5366	11/08/2005	14425	1.4754	09/01/2006	13650	1.4477	02/06/2006	13873	1.5002
18/03/2005	14408	1.5333	12/08/2005	14459	1.4766	10/01/2006	13685	1.4475	05/06/2006	13896	1.5016
21/03/2005	14317	1.5242	15/08/2005	14576	1.4735	11/01/2006	13781	1.4518	06/06/2006	13981	1.4919
22/03/2005	14335	1.5266	16/08/2005	14579	1.4725	12/01/2006	13562	1.4466	07/06/2006	13922	1.4904
23/03/2005	14239	1.5136	17/08/2005	14550	1.4699	13/01/2006	13584	1.4505	08/06/2006	13978	1.4809
24/03/2005	14231	1.5106	18/08/2005	14601	1.4622	16/01/2006	13758	1.4497	09/06/2006	13896	1.481
28/03/2005	14274	1.5048	19/08/2005	14537	1.461	17/01/2006	13690	1.4462	12/06/2006	13888	1.4786
29/03/2005	14400	1.5069	22/08/2005	14717	1.4667	18/01/2006	13796	1.4471	13/06/2006	13978	1.4761
30/03/2005	14343	1.5091	23/08/2005	14758	1.4654	19/01/2006	13623	1.4491	14/06/2006	14068	1.4799
31/03/2005	14282	1.5113	24/08/2005	15108	1.4656	20/01/2006	13692	1.4483	15/06/2006	13888	1.4786
01/04/2005	14295	1.5063	25/08/2005	15197	1.4696	23/01/2006	13764	1.4587	16/06/2006	13722	1.479
04/04/2005	14210	1.5021	26/08/2005	15292	1.4707	24/01/2006	13818	1.4597	19/06/2006	13812	1.4761
05/04/2005	14210	1.5024	29/08/2005	15803	1.4655	25/01/2006	13594	1.4561	20/06/2006	13846	1.476
06/04/2005	14238	1.5032	30/08/2005	15280	1.4608	26/01/2006	13597	1.454	21/06/2006	13860	1.4811
07/04/2005	14243	1.505	31/08/2005	15321	1.469	27/01/2006	13613	1.4475	22/06/2006	13843	1.4741

Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR
23/06/2006	13772	1.4702	21/11/2006	13660	1.4881	17/04/2007	13926	1.5289	11/09/2007	14704	1.5506
26/06/2006	13778	1.4711	22/11/2006	13660	1.4961	18/04/2007	13928	1.53	12/09/2007	14642	1.553
27/06/2006	13653	1.4733	23/11/2006	13682	1.4979	19/04/2007	13935	1.5311	13/09/2007	14550	1.55
28/06/2006	13774	1.4699	24/11/2006	13775	1.5054	20/04/2007	13969	1.5304	14/09/2007	14471	1.5465
29/06/2006	13783	1.4698	27/11/2006	13773	1.5074	23/04/2007	13849	1.5296	17/09/2007	14489	1.5462
30/06/2006	13813	1.4866	28/11/2006	13887	1.5101	24/04/2007	13869	1.5315	18/09/2007	14516	1.5458
04/07/2006	13483	1.4872	29/11/2006	13828	1.5094	25/04/2007	13886	1.5325	19/09/2007	14285	1.5486
05/07/2006	13496	1.4811	30/11/2006	13856	1.5173	26/04/2007	13799	1.5275	20/09/2007	14329	1.5593
06/07/2006	13518	1.4835	01/12/2006	13927	1.5211	27/04/2007	13870	1.5296	21/09/2007	14298	1.5571
07/07/2006	13483	1.4895	04/12/2006	13942	1.5215	30/04/2007	13892	1.5315	24/09/2007	14187	1.5587
10/07/2006	13474	1.4856	05/12/2006	13898	1.5216	01/05/2007	13892	1.5284	25/09/2007	14333	1.5607
11/07/2006	13475	1.4856	06/12/2006	13837	1.5201	02/05/2007	13877	1.527	26/09/2007	14237	1.5586
12/07/2006	13451	1.4807	07/12/2006	13840	1.5189	03/05/2007	13837	1.525	27/09/2007	14224	1.5598
13/07/2006	13508	1.4798	08/12/2006	13810	1.513	04/05/2007	13628	1.5267	28/09/2007	14314	1.566
14/07/2006	13535	1.4767	11/12/2006	13771	1.5121	07/05/2007	13587	1.5283	01/10/2007	14262	1.5653
17/07/2006	13634	1.4691	12/12/2006	13761	1.5134	08/05/2007	13582	1.5244	02/10/2007	14211	1.5625
18/07/2006	13530	1.4681	13/12/2006	13747	1.5123	09/05/2007	13399	1.5259	03/10/2007	14120	1.5593
19/07/2006	13588	1.4722	14/12/2006	13648	1.5101	10/05/2007	13377	1.5222	04/10/2007	14283	1.5595
20/07/2006	13509	1.477	15/12/2006	13718	1.5053	11/05/2007	13456	1.5227	05/10/2007	14180	1.5607

21/07/2006	13583	1.4807	18/12/2006	13699	1.5031	14/05/2007	13382	1.5233	09/10/2007	14193	1.5568
24/07/2006	13490	1.4771	19/12/2006	13857	1.5107	15/05/2007	13406	1.5266	10/10/2007	14178	1.5603
25/07/2006	13449	1.4728	20/12/2006	13759	1.5094	16/05/2007	13425	1.5215	11/10/2007	14088	1.5617
26/07/2006	13439	1.4765	21/12/2006	13712	1.5095	17/05/2007	13341	1.5193	12/10/2007	14193	1.5594
27/07/2006	13472	1.4844	22/12/2006	13721	1.5056	18/05/2007	13453	1.5203	15/10/2007	14117	1.5624
28/07/2006	13544	1.4865	27/12/2006	13551	1.5055	22/05/2007	13182	1.5179	16/10/2007	14129	1.5605
31/07/2006	13571	1.4881	28/12/2006	13658	1.5072	23/05/2007	13259	1.5198	17/10/2007	14223	1.5629
01/08/2006	13579	1.4881	29/12/2006	13520	1.5083	24/05/2007	13265	1.5173	18/10/2007	14270	1.5687
02/08/2006	13532	1.4903	02/01/2007	13566	1.514	25/05/2007	13322	1.5178	19/10/2007	14262	1.5685
03/08/2006	13525	1.489	03/01/2007	13548	1.5055	28/05/2007	13221	1.5179	22/10/2007	14330	1.5628
04/08/2006	13616	1.4981	04/01/2007	13493	1.5021	29/05/2007	13344	1.5187	23/10/2007	14317	1.5688
08/08/2006	13611	1.4942	05/01/2007	13543	1.4977	30/05/2007	13361	1.5158	24/10/2007	14379	1.5694
09/08/2006	13623	1.4962	08/01/2007	13586	1.4997	31/05/2007	13416	1.5173	25/10/2007	14345	1.5718
10/08/2006	13518	1.4883	09/01/2007	13572	1.4972	01/06/2007	13400	1.5164	26/10/2007	14438	1.576
11/08/2006	13550	1.4875	10/01/2007	13530	1.4941	04/06/2007	13292	1.5201	29/10/2007	14335	1.5765
14/08/2006	13467	1.4856	11/01/2007	13606	1.4922	05/06/2007	13343	1.5222	30/10/2007	14329	1.5779
15/08/2006	13585	1.4892	12/01/2007	13663	1.4945	06/06/2007	13531	1.5211	31/10/2007	14430	1.5799
16/08/2006	13551	1.4934	15/01/2007	13648	1.4955	07/06/2007	13426	1.5181	01/11/2007	14427	1.5795
17/08/2006	13551	1.4929	16/01/2007	13605	1.4942	08/06/2007	13728	1.5122	02/11/2007	14513	1.5817
18/08/2006	13490	1.4892	17/01/2007	13619	1.4968	11/06/2007	13719	1.5122	05/11/2007	14479	1.5814
21/08/2006	13594	1.495	18/01/2007	13622	1.4953	12/06/2007	13622	1.5114	06/11/2007	14514	1.5856
22/08/2006	13496	1.4882	19/01/2007	13601	1.4971	13/06/2007	13758	1.5091	07/11/2007	14474	1.5942
23/08/2006	13544	1.4885	22/01/2007	13639	1.4963	14/06/2007	13659	1.5086	08/11/2007	14569	1.5969
24/08/2006	13653	1.4868	23/01/2007	13633	1.4999	15/06/2007	13672	1.5107	09/11/2007	14559	1.5968
25/08/2006	13604	1.4856	24/01/2007	13612	1.4966	18/06/2007	13515	1.5127	13/11/2007	14632	1.5932
28/08/2006	13558	1.4875	25/01/2007	13572	1.4974	19/06/2007	13539	1.5143	14/11/2007	14715	1.593
29/08/2006	13531	1.4865	26/01/2007	13651	1.4926	20/06/2007	13554	1.5151	15/11/2007	14868	1.5917
30/08/2006	13556	1.49	29/01/2007	13577	1.4937	21/06/2007	13648	1.5136	16/11/2007	14812	1.5833
31/08/2006	13609	1.4881	30/01/2007	13580	1.4943	22/06/2007	13593	1.5152	19/11/2007	14851	1.5852
01/09/2006	13506	1.4903	31/01/2007	13581	1.4972	25/06/2007	13647	1.5159	20/11/2007	14933	1.5919
05/09/2006	13567	1.4898	01/02/2007	13663	1.4994	26/06/2007	13751	1.5175	21/11/2007	15033	1.5953
06/09/2006	13580	1.4867	02/02/2007	13623	1.4961	27/06/2007	13895	1.5171	22/11/2007	14969	1.5964
07/09/2006	13510	1.485	05/02/2007	13593	1.4953	28/06/2007	13791	1.5184	23/11/2007	14878	1.5956
08/09/2006	13575	1.4801	06/02/2007	13514	1.4977	29/06/2007	13702	1.5205	26/11/2007	14891	1.5981
11/09/2006	13497	1.4798	07/02/2007	13567	1.4995	03/07/2007	13712	1.527	27/11/2007	14997	1.5953
12/09/2006	13463	1.4804	08/02/2007	13557	1.4983	04/07/2007	13795	1.5269	28/11/2007	15005	1.5902

Appendix - E

14/09/2006	13575	1.4841	09/02/2007	13505	1.4956	05/07/2007	13771	1.5249	29/11/2007	14904	1.5911
15/09/2006	13461	1.479	12/02/2007	13492	1.4933	06/07/2007	13785	1.5258	30/11/2007	14831	1.5857
18/09/2006	13436	1.4794	13/02/2007	13555	1.4963	09/07/2007	13785	1.526	03/12/2007	14830	1.5861
19/09/2006	13525	1.4811	14/02/2007	13692	1.5031	10/07/2007	13779	1.5323	04/12/2007	14745	1.5906
20/09/2006	13591	1.483	15/02/2007	13576	1.5047	11/07/2007	13851	1.5349	05/12/2007	14708	1.5824
21/09/2006	13633	1.4857	16/02/2007	13572	1.5046	12/07/2007	13852	1.5349	06/12/2007	14684	1.581
22/09/2006	13752	1.4895	19/02/2007	13680	1.5044	13/07/2007	13879	1.5367	07/12/2007	14717	1.5811
25/09/2006	13721	1.4874	20/02/2007	13636	1.5037	16/07/2007	13939	1.5369	10/12/2007	14690	1.5848
26/09/2006	13680	1.4832	21/02/2007	13624	1.5017	17/07/2007	13948	1.537	11/12/2007	14684	1.5834
27/09/2006	13660	1.4823	22/02/2007	13632	1.5022	18/07/2007	13973	1.5396	12/12/2007	14684	1.5836
28/09/2006	13593	1.4806	23/02/2007	13616	1.5044	19/07/2007	13952	1.539	13/12/2007	14659	1.5783
29/09/2006	13638	1.4796	26/02/2007	13635	1.5046	20/07/2007	13997	1.5418	14/12/2007	14586	1.5684
02/10/2006	13681	1.484	27/02/2007	13745	1.5116	23/07/2007	14007	1.5413	17/12/2007	14740	1.5658
03/10/2006	13629	1.4831	28/02/2007	13812	1.511	24/07/2007	13917	1.543	18/12/2007	14657	1.5665
04/10/2006	13700	1.4809	01/03/2007	13813	1.5095	25/07/2007	14059	1.5374	19/12/2007	14682	1.5622
05/10/2006	13676	1.4806	02/03/2007	13862	1.5097	26/07/2007	14065	1.5397	20/12/2007	14709	1.5618
06/10/2006	13613	1.4745	05/03/2007	13888	1.5051	27/07/2007	14136	1.5351	21/12/2007	14786	1.5613
10/10/2006	13521	1.4693	06/03/2007	13829	1.5052	30/07/2007	14152	1.5363	24/12/2007	14685	1.562
11/10/2006	13573	1.4699	07/03/2007	13880	1.5075	31/07/2007	14127	1.5377	27/12/2007	14827	1.5718
12/10/2006	13567	1.4693	08/03/2007	13770	1.5052	01/08/2007	14372	1.5366	28/12/2007	14849	1.5782
13/10/2006	13561	1.4674	09/03/2007	13758	1.5036	02/08/2007	14313	1.5364	31/12/2007	14817	1.5745
16/10/2006	13491	1.4694	12/03/2007	13877	1.5073	03/08/2007	14245	1.5425	02/01/2008	14824	1.5829
17/10/2006	13523	1.4735	13/03/2007	13886	1.509	07/08/2007	14370	1.5387	03/01/2008	14925	1.5822
18/10/2006	13491	1.4702	14/03/2007	13985	1.5111	08/08/2007	14317	1.541	04/01/2008	14952	1.5864
19/10/2006	13467	1.4755	15/03/2007	13990	1.511	09/08/2007	14370	1.537	07/01/2008	14986	1.5804
20/10/2006	13504	1.4764	16/03/2007	14003	1.5148	10/08/2007	14330	1.537	08/01/2008	14902	1.5819
23/10/2006	13497	1.4715	19/03/2007	14007	1.5137	13/08/2007	14380	1.5326	09/01/2008	14873	1.578
24/10/2006	13497	1.4728	20/03/2007	13882	1.5148	14/08/2007	14275	1.5301	10/01/2008	14844	1.5812
25/10/2006	13482	1.4743	21/03/2007	13810	1.5148	15/08/2007	14388	1.5264	11/01/2008	14957	1.5838
26/10/2006	13536	1.4794	22/03/2007	13836	1.518	16/08/2007	14407	1.5271	14/01/2008	15022	1.5888
27/10/2006	13500	1.4842	23/03/2007	13838	1.515	17/08/2007	14540	1.5312	15/01/2008	14971	1.59
30/10/2006	13562	1.4848	26/03/2007	13780	1.517	20/08/2007	14320	1.5292	16/01/2008	14853	1.5812
31/10/2006	13588	1.4886	27/03/2007	13844	1.5177	21/08/2007	14480	1.5298	17/01/2008	14962	1.5845
01/11/2006	13581	1.4884	28/03/2007	13838	1.5176	22/08/2007	14401	1.5322	18/01/2008	14921	1.5798
02/11/2006	13530	1.4885	29/03/2007	13826	1.5165	23/08/2007	14338	1.5331	21/01/2008	14902	1.5734
03/11/2006	13504	1.4831	30/03/2007	13899	1.519	24/08/2007	14442	1.5368	22/01/2008	15000	1.58

06/11/2006	13502	1.4826	02/04/2007	13835	1.5198	27/08/2007	14435	1.5374	23/01/2008	14776	1.5802
07/11/2006	13544	1.4893	03/04/2007	13830	1.5176	28/08/2007	14447	1.5379	24/01/2008	14937	1.5868
08/11/2006	13524	1.4871	04/04/2007	13842	1.5175	29/08/2007	14434	1.5399	25/01/2008	14729	1.5838
09/11/2006	13564	1.4895	05/04/2007	13882	1.5198	30/08/2007	14511	1.538	28/01/2008	14927	1.5902
10/11/2006	13603	1.4918	09/04/2007	13748	1.5154	31/08/2007	14376	1.5378	29/01/2008	14812	1.5886
14/11/2006	13561	1.4876	10/04/2007	13848	1.5199	04/09/2007	14387	1.5351	30/01/2008	14758	1.5891
15/11/2006	13653	1.4863	11/04/2007	13813	1.52	05/09/2007	14454	1.5406	31/01/2008	14778	1.5925
16/11/2006	13561	1.4864	12/04/2007	13839	1.5224	06/09/2007	14499	1.5417	01/02/2008	14654	1.5917
17/11/2006	13641	1.488	13/04/2007	13875	1.524	07/09/2007	14578	1.5482	04/02/2008	14631	1.5911
20/11/2006	13648	1.487	16/04/2007	13912	1.5253	10/09/2007	14570	1.5493	05/02/2008	14571	1.5814

Date	IDR/SDR	USD/SDR	Date	IDR/SDR	USD/SDR
06/02/2008	14685	1.5818	30/06/2008	15100	1.6307
07/02/2008	14605	1.5739	02/07/2008	15068	1.6363
08/02/2008	14560	1.5739	03/07/2008	14963	1.6274
11/02/2008	14609	1.5751	04/07/2008	15026	1.6277
12/02/2008	14563	1.5787	07/07/2008	15005	1.6224
13/02/2008	14591	1.5766	08/07/2008	14924	1.6229
14/02/2008	14590	1.5805	09/07/2008	14961	1.6282
15/02/2008	14533	1.5816	10/07/2008	14961	1.6291
18/02/2008	14454	1.5788	11/07/2008	15017	1.6368
19/02/2008	14496	1.5837	14/07/2008	14979	1.6377
20/02/2008	14493	1.5788	15/07/2008	14953	1.6416
21/02/2008	14556	1.5874	16/07/2008	14917	1.6381
22/02/2008	14542	1.5893	17/07/2008	15043	1.637
25/02/2008	14539	1.5879	18/07/2008	14941	1.6349
26/02/2008	14529	1.5916	21/07/2008	15038	1.6357
27/02/2008	14533	1.6052	22/07/2008	14963	1.6321
28/02/2008	14603	1.6077	23/07/2008	14927	1.6277
29/02/2008	14612	1.6106	24/07/2008	14797	1.6239
03/03/2008	14730	1.6118	25/07/2008	14881	1.6252
04/03/2008	14743	1.6141	28/07/2008	14866	1.6288
05/03/2008	14670	1.6155	29/07/2008	14841	1.6199
06/03/2008	14648	1.6212	30/07/2008	14804	1.6188
07/03/2008	14750	1.6215	31/07/2008	14708	1.6203
10/03/2008	14872	1.625	01/08/2008	14695	1.6195

11/03/2008	14932	1.6202	05/08/2008	14619	1.6125
12/03/2008	14932	1.6294	06/08/2008	14638	1.6078
13/03/2008	15059	1.6372	07/08/2008	14540	1.6046
14/03/2008	15115	1.6386	08/08/2008	14630	1.5893
17/03/2008	15235	1.649	11/08/2008	14590	1.5853
18/03/2008	15174	1.6491	12/08/2008	14512	1.5821
19/03/2008	15067	1.6377	13/08/2008	14521	1.5806
20/03/2008	14938	1.6292	14/08/2008	14445	1.5778
24/03/2008	14935	1.6248	15/08/2008	14478	1.5694
25/03/2008	14998	1.6358	18/08/2008	14494	1.5717
26/03/2008	15082	1.6446	19/08/2008	14506	1.5728
27/03/2008	15041	1.6454	20/08/2008	14384	1.57
28/03/2008	15064	1.6423	21/08/2008	14501	1.581
31/03/2008	15083	1.6434	22/08/2008	14436	1.5737
01/04/2008	15095	1.6315	25/08/2008	14460	1.5754
02/04/2008	15084	1.6304	26/08/2008	14406	1.5666
03/04/2008	15120	1.6347	27/08/2008	14415	1.5671
04/04/2008	15027	1.638	28/08/2008	14343	1.567
07/04/2008	15025	1.6347	29/08/2008	14354	1.5669
08/04/2008	15069	1.6331			
09/04/2008	15049	1.6387			
10/04/2008	15009	1.6367			
11/04/2008	15088	1.6395			
14/04/2008	15102	1.6422			
15/04/2008	15031	1.6387			
16/04/2008	15147	1.6469			
17/04/2008	15120	1.6446			
18/04/2008	14976	1.6336			
21/04/2008	15008	1.64			
22/04/2008	15170	1.6481			
23/04/2008	15064	1.6401			
24/04/2008	15004	1.6289			
25/04/2008	15049	1.6286			
28/04/2008	15052	1.6297			
29/04/2008	14994	1.628			
30/04/2008	15054	1.6254			

01/05/2008	15014	1.621
02/05/2008	14976	1.6177
05/05/2008	14910	1.6199
06/05/2008	14946	1.6235
07/05/2008	14831	1.6132
08/05/2008	14922	1.6173
09/05/2008	14952	1.6199
12/05/2008	14950	1.6232
13/05/2008	15008	1.6201
14/05/2008	14998	1.6165
15/05/2008	14987	1.619
16/05/2008	15140	1.6251
20/05/2008	15124	1.6297
21/05/2008	15177	1.6343
22/05/2008	15176	1.6313
23/05/2008	15257	1.6364
26/05/2008	15271	1.6357
27/05/2008	15294	1.6322
28/05/2008	15079	1.6273
29/05/2008	15100	1.6214
30/05/2008	15081	1.623
02/06/2008	15050	1.6233
03/06/2008	15056	1.6178
04/06/2008	15052	1.6172
05/06/2008	15020	1.6201
06/06/2008	15230	1.6296
09/06/2008	15136	1.6283
10/06/2008	15034	1.6145
11/06/2008	15118	1.6197
12/06/2008	14979	1.6103
13/06/2008	15036	1.6086
16/06/2008	14980	1.6137
17/06/2008	14974	1.615
18/06/2008	14950	1.6145
19/06/2008	15023	1.6161
20/06/2008	15000	1.6221

23/06/2008	14919	1.6148
24/06/2008	15064	1.62
25/06/2008	14907	1.6179
26/06/2008	14980	1.6281
27/06/2008	15008	1.6308

Data for **Chapter 5** - (Indonesian currency against SDR).

Month	USD/SDR	EUR/SDR	JPY/SDR	IDR/SDR
Jan-00	1.35288	1.38176	144.555	10045.1
Feb-00	1.33928	1.37871	147.562	10051.3
Mar-00	1.34687	1.40989	142.566	10222.7
Apr-00	1.31921	1.45207	140.562	10481.1
May-00	1.32002	1.41892	140.78	11378.6
Jun-00	1.33728	1.39941	140.949	11681.1
Jul-00	1.31335	1.42091	143.812	11824.1
Aug-00	1.3048	1.46508	138.831	10816.8
Sep-00	1.29789	1.48076	139.977	11395.5
Oct-00	1.27934	1.51995	139.512	12019.4
Nov-00	1.28197	1.47624	142.517	12217.2
Dec-00	1.30291	1.40023	149.704	12501.4
Jan-01	1.29779	1.39652	150.738	12264.1
Feb-01	1.29248	1.39758	150.445	12711.5
Mar-01	1.26065	1.42737	157.077	13110.8
Apr-01	1.26579	1.42608	156.262	14778.1
May-01	1.25423	1.47904	149.504	13869.3
Jun-01	1.24565	1.46893	154.523	14250.2
Jul-01	1.25874	1.43774	157.091	11989.5
Aug-01	1.28823	1.40667	153.235	11420.2
Sep-01	1.28901	1.41169	153.779	12471.2
Oct-01	1.27808	1.41349	155.696	13336.8
Nov-01	1.26608	1.42288	156.931	13205.2
Dec-01	1.25673	1.426	165.637	13070
Jan-02	1.24204	1.43805	165.067	12817.9
Feb-02	1.24163	1.43524	166.254	12651
Mar-02	1.24691	1.42929	166.088	12038.9
Apr-02	1.26771	1.40732	162.267	11810
May-02	1.29066	1.37494	160.558	11338.4
Jun-02	1.33046	1.33379	158.923	11614.9
Jul-02	1.32248	1.35181	158.499	12045.1
Aug-02	1.32751	1.35006	156.58	11771
Sep-02	1.32269	1.34147	160.773	11924.1
Oct-02	1.32163	1.33985	161.834	12202.6
Nov-02	1.32408	1.33382	161.935	11884.9
Dec-02	1.35952	1.29639	163.006	12154.1
Jan-03	1.37654	1.27269	163.739	12218.2
Feb-03	1.37085	1.27142	161.418	12207.4

Mar-03	1.37379	1.26094	165.061	12237.7
Apr-03	1.38391	1.24329	165.516	12005.4
May-03	1.41995	1.20111	168.051	11755.8
Jun-03	1.40086	1.22592	167.893	11606.1
Jul-03	1.39195	1.22986	167.173	11838.5
Aug-03	1.37727	1.26043	161.209	11755
Sep-03	1.42979	1.22708	158.993	11994.5
Oct-03	1.43178	1.23196	155.72	12163
Nov-03	1.44878	1.20792	158.641	12368.2
Dec-03	1.48597	1.17654	159.147	12578.7
Jan-04	1.48131	1.19615	156.974	12503.7
Feb-04	1.48007	1.19187	161.328	12502.2
Mar-04	1.48051	1.21115	154.417	12713.1
Apr-04	1.45183	1.21523	159.992	12574.3
May-04	1.46882	1.19943	162.305	13527.8
Jun-04	1.46622	1.20627	158.909	13804.5
Jul-04	1.45776	1.21086	163.386	13364.7
Aug-04	1.46073	1.20612	160.169	13625.7
Sep-04	1.46899	1.18381	163.058	13470.6
Oct-04	1.49878	1.17671	159.066	13623.9
Nov-04	1.5359	1.15525	158.474	13850.7
Dec-04	1.55301	1.14016	161.699	14427.5
Jan-05	1.52484	1.16019	158.583	13975.2
Feb-05	1.53199	1.15561	160.445	14186.2
Mar-05	1.51083	1.1654	162.188	14322.7
Apr-05	1.51678	1.17063	160.612	14515.6
May-05	1.47495	1.19613	159.413	14004.7
Jun-05	1.45661	1.20461	160.81	14148.1
Jul-05	1.45186	1.20058	162.928	14255.8
Aug-05	1.45984	1.19679	162.48	14948.8
Sep-05	1.44946	1.20367	164.006	14943.9
Oct-05	1.4458	1.20253	167.279	14588.1
Nov-05	1.42414	1.21008	170.37	14291.2
Dec-05	1.42927	1.21155	168.611	14049.7
Jan-06	1.4454	1.19277	170.138	13579.5
Feb-06	1.43503	1.20845	166.822	13245.3
Mar-06	1.44085	1.19039	169.156	13075.7
Apr-06	1.47106	1.17337	168.142	12908.6
May-06	1.49418	1.16116	167.707	13776.3
Jun-06	1.47937	1.16367	170.054	13758.1
Jul-06	1.48386	1.16226	170.347	13458.6
Aug-06	1.48852	1.15829	174.633	13545.5
Sep-06	1.47637	1.16617	173.916	13634.3

Oct-06	1.48004	1.16575	174.127	13483.2
Nov-06	1.50773	1.14222	175.5	13818.3
Dec-06	1.5044	1.14229	178.948	13569.7
Jan-07	1.49015	1.15034	181.321	13545.5
Feb-07	1.50472	1.13899	178.279	13783.2
Mar-07	1.51019	1.13395	177.674	13769.9
Apr-07	1.52418	1.12031	182.292	13844.1
May-07	1.51286	1.12455	183.994	13335.9
Jun-07	1.51557	1.12223	186.764	13722
Jul-07	1.53122	1.11711	182.139	14065.8
Aug-07	1.53263	1.1183	178.092	14422
Sep-07	1.55665	1.09786	179.093	14223.1
Oct-07	1.57188	1.08803	180.373	14308.8
Nov-07	1.59018	1.07728	175.397	14909.5
Dec-07	1.58025	1.07347	180.148	14884.4
Jan-08	1.59527	1.07281	169.673	14821.7
Feb-08	1.61055	1.06188	168.673	14577.1
Mar-08	1.6445	1.04003	164.614	15157.4
Apr-08	1.62378	1.0449	169.003	14994
May-08	1.62069	1.04507	171.242	15101.6
Jun-08	1.63362	1.0363	173.817	15070.1
Jul-08	1.62088	1.03829	175.039	14779.2
Aug-08	1.56988	1.06541	171.274	14369.1
Sep-08	1.55722	1.08874	162.418	14603.6
Oct-08	1.4883	1.16665	146.3	16363.9
Nov-08	1.48797	1.16914	141.729	18080.3
Dec-08	1.54027	1.10675	139.78	16866
Jan-09	1.50596	1.17506	134.934	17100.2
Feb-09	1.46736	1.16052	143.141	17579
Mar-09	1.49507	1.12344	146.666	17305.4
Apr-09	1.49783	1.12831	146.188	16046.3
May-09	1.54805	1.09806	149.387	16006.8
Jun-09	1.55223	1.09822	148.936	15871.6
Jul-09	1.55333	1.09869	148.079	15409
Aug-09	1.56606	1.0973	145.174	15754.6
Sep-09	1.58437	1.082	142.229	15338.3
Oct-09	1.58989	1.07425	145.284	15175.5
Nov-09	1.61018	1.07181	139.683	15264.5
Dec-09	1.56769	1.08822	144.322	14736.3
Jan-10	1.55419	1.11284	139.644	14555
Feb-10	1.53258	1.12939	136.783	14306.6
Mar-10	1.51824	1.12637	141.576	13838.8
Apr-10	1.51112	1.1349	142.136	13618.2

Appendix - E

May-10	1.47433	1.19796	134.606	13534.3
Jun-10	1.4789	1.2052	131.031	13432.8
Jul-10	1.51852	1.16558	131.352	13593.8
Aug-10	1.50891	1.18999	127.126	13642.1
Sep-10	1.55619	1.14023	129.786	13887.4
Oct-10	1.57179	1.13429	126.655	14032.9
Nov-10	1.52578	1.17386	128.394	13751.9
Dec-10	1.54003	1.15254	125.435	13846.4
Jan-11	1.56194	1.14077	128.157	14146.5
Feb-11	1.57305	1.13709	128.518	13879
Mar-11	1.5855	1.116	131.803	13808.1
Apr-11	1.62096	1.09082	133.016	13898.1
May-11	1.60077	1.11281	129.422	13665.8
Jun-11	1.60045	1.10735	129.188	13759.1
Jul-11	1.599	1.12132	124.002	13604.3
Aug-11	1.60936	1.11374	123.261	13805.1
Sep-11	1.56162	1.1565	119.667	13778.2
Oct-11	1.5859	1.1327	125.603	14011.4
Nov-11	1.55156	1.15633	121.099	14227.8
Dec-11	1.53527	1.18654	119.321	13921.8
Jan-12	1.55108	1.1772	118.44	13959.7
Feb-12	1.55602	1.15749	125.493	14136.4
Mar-12	1.54909	1.15985	127.258	14220.6
Apr-12	1.55055	1.17341	125.827	14249.6
May-12	1.51026	1.21766	119.008	14445.6
Jun-12	1.51755	1.20536	120.342	14386.4
Jul-12	1.50833	1.22788	117.876	14306.5
Aug-12	1.52201	1.20689	119.402	14550.4
Sep-12	1.54219	1.19272	119.628	14786.5
Oct-12	1.54057	1.18569	122.691	14812.6
Nov-12	1.53481	1.1819	126.545	14741.9
Dec-12	1.53692	1.16486	133.02	14862
Jan-13	1.54134	1.13752	140.37	14947.9
Feb-13	1.51483	1.1538	140.091	14643.9
Mar-13	1.49802	1.16987	141.039	14559.3
Apr-13	1.50924	1.15456	149.113	14672.8
May-13	1.49877	1.15237	151.421	14690.9
Jun-13	1.50513	1.15071	147.713	14944.4
Jul-13	1.51474	1.14105	148.626	15568.5
Aug-13	1.51528	1.1449	148.997	16552.9
Sep-13	1.53408	1.13593	149.956	17815.3
Oct-13	1.544	1.132	151.576	17340.13
Nov-13	1.535	1.129	155.624	18387.21

Dec-13	1.54	1.117	162.162	18771.06
Jan-14	1.5342	1.135099	157.7464	18757.13
Feb-14	1.5474	1.120249	157.5253	18002.45
Mar-14	1.54563	1.120997	158.968	17626.36
Apr-14	1.54969	1.11891	158.9672	17871.03
May-14	1.540777	1.132009	157.036	17889.97
Jun-14	1.54589	1.131857	156.5987	18502.76
Jul-14	1.53131	1.144562	157.388	17749.41
Aug-14	1.51838	1.151335	157.4712	17790.86
Sep-14	1.48258	1.17824	162.1498	18105.27
Oct-14	1.47833	1.180398	163.4589	17861.18
Nov-14	1.46424	1.172987	173.0878	17857.87
Dec-14	1.44881	1.19332	174.7844	18023.2