CRISES AND THE VOLATILITY OF INDONESIAN MACRO-INDICATORS[1]

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Abstract

This paper examines the volatility of some of Indonesian macroeconomic indicators, namely the Bank Indonesia rate, inflation, and exchange rates. It is argued that after the financial crisis the variability of these variables increases and this makes it more difficult to predict them. The estimated ARCH parameters increases overtime, indicating higher contribution of shock over several periods. From the random walk, historical mean, moving average and simple regression, it was found that the quality of prediction after the crisis decreases. Financial manager and other policy makers may adjust their strategy to account for this increase in variability.

Introduction

Financial time series, such as stock prices, exchange rates, and inflation rates often exhibit the phenomenon of volatility clustering, that is, periods in which their prices show wide swings for an extended time period followed by periods in which there is relative calm. Knowledge of volatility is of crucial importance in many areas. For example, financial planners may benefit from understanding the volatility of inflation (prices) in exercising financial plans, whereas importers, exporters, and traders in foreign exchange markets may be affected by the variability in the exchange rates as that might mean huge losses or profits. Likewise, for investors in the stock market, for high volatility in stock prices could mean huge losses or gains, and hence, greater uncertainty.

A series of financial crises have hit the Indonesian economy and the world for the last two decades. With the 2008 financial crises being the latest, the world has experienced crises in response to increase

in oil prices (1974, 1978, 1984, and 2007–2008), and financial crises in 1998 and 2008. Such increase in oil prices raises the question if the macro-economic indicators have been more volatile recently. The main purpose of this research was to test whether there is evidence of increase in volatility of the Indonesian macro-economic indicators. Increased volatility means increased difficulty in predicting the indicators that may raise the risk and uncertainty to speculator. As a consequence, policies to influence the macro-indicators such as inflation targeting, may not be effective or may be difficult to achieve. So, accurate information on the macro-economic behaviour can be beneficial to both fund managers and policy makers.

This paper is outlined as follows. The next section provides the theoretical background for the study followed by the estimation strategy. Section four describes the recent development of macro-economic indicators. Section five reports the estimation results and the last section concludes.

Literature Review

Volatility is the variability of the asset price changes over a particular period of time and it is sometimes difficult to predict correctly and consistently. Financial market volatility presents a strange paradox to the market participants, academicians, and policy makers – without volatility superior returns cannot be earned, since a risk free security offers meager returns. On the other hand, if it is high, it may lead to losses for the market participants and represent costs to the overall economy. However, there is question as to what model should be used to calculate volatility? The answer is not clear as different volatility models were proposed in the literature and were being used by practitioners and these varying models lead to different volatility estimates. In the past two decades this has been a fertile area for research in financial economics for both academicians as well as practitioners. Unfortunately most of the work was done in the context of developed markets in the context of stock and foreign exchange markets.

Poon and Granger (2003) provided an extensive review of the literature related to forecasting volatility. They divided the existing research into two general categories: (1) papers using historical data only and (2) papers using index volatility (IV) alone or in addition to historical data. In general, the latter studies had found that IV contains a significant amount of information and that it is often superior to models that rely on historical information alone. Since it is reasonable

to assume that different markets have differing degrees of efficiency, the forecasting power of IV for one asset class does not necessarily mean that the IV will have equivalent capabilities in another. While the testing methodologies may be similar, the results of the IV tests should be considered according to asset class. As a consequence, it is argued that using the historical data may still be reasonable to forecast volatility.

A characteristic most of financial time series is that in their level form, they are random walks; that is, they are non-stationary. On the other hand, in the first difference form, they are generally stationary. Therefore, instead of modeling the levels of financial time series, its first difference is often considered, but these first differences often exhibit wide swings, or volatility, suggesting that the variance of financial time series varies over time. A model that fits with this behaviour is the Autoregressive Conditional Heteroscedasticity (ARCH) by Engle (1982).

Let x be the variable that is considered, then x^2 is used as a measure of volatility (close to the variances or conditional variances). Being a squared quantity, its value will be high in periods when there are big changes, for example in the prices of financial assets and its value will be comparatively small when there are modest changes in the prices of financial assets. As x^2 measures volatility, the following AR(1), or ARIMA (1, 0, 0), model is considered as:

$$x_t^2 = \beta_0 + \beta_1 x_{t-1}^2 + u_t \tag{1}$$

This model postulates that volatility in the current period is related to its value in the previous period plus a white noise error term. If β_1 is positive, it suggests that if volatility was high in the previous period, it will continue to be high in the current period, indicating volatility clustering. If β_1 is zero, then there is no volatility clustering.

A more complex model after the ARCH is GARCH (Generalised Autoregressive Conditional Heteroscedasticity) by Bollerslev (1986). The simplest form of GARCH is that the conditional variance of error at time t depends not only on the squared error term in the previous time period (as in ARCH(1)) but also on its conditional variance in the previous time period. The conditional variance of error at time t depends not only on the squared error term in the previous time (t-i, as in ARCH(1)) but also on its conditional variance in the previous time (t-i).

$$u_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 x_{t-1}^2 \qquad (2)$$

It is then identified which one is stronger between α_1 (the ARCH coefficient) and α_2 (the GARCH coefficient). The ARCH coefficient measures the reaction of the conditional variance to shocks while the GARCH coefficient measures persistence. The stronger the ARCH coefficient then indicates that the larger shocks influence the conditional variances, which implies difficulties in predicting the variance.

Estimation Strategy

In this research, the evaluation of the volatility of the Indonesian macro economic indicators by using the GARCH model is proposed to and assess the difficulty in predicting the indicators by using: the random walk model, the moving average, and the simple regression.

Random Walk Model

As per this model, the best forecast for this period's volatility is the last period's realised:

$$x_t^2 = x_{t-1}^2 \qquad (3)$$

Moving Average Model

In the historic mean model, the forecast is based on all the available observations and each observation, whether it is very old or immediate, is given equal weight, and this may lead to stale prices affecting the forecasts. This is adjusted in a moving average method, which is a traditional time series technique in which the volatility is defined as the equally weighted average of realised volatilities in the past i months. The choice of i is rather arbitrary and in this paper, only the three month average was investigated.

$$x_t^2 = \frac{1}{3}\sum_{i=1}^{3} x_{t-i}^2 \qquad (4)$$

Simple Regression

In this method, the familiar regression of actual volatilities on lagged values is run. In other words, it is the first autoregression performed

on the first part of data which is meant for estimating the parameters, and the estimates thus obtained were used for forecasting the volatility for the next month. Accordingly the first part involves running the following regression:

$$x_t^2 = \alpha + \beta x_{t-1}^2 \tag{5}$$

α and β are estimated over the periods of observation. It is assumed that the agent revises its parameters within these periods, i.e. the time varying parameters are only applied in three periods.

Forecast Evaluation

A qualitative forecast evaluation was used in this study. Following Naik and Leuthold (1986), a comparison of the actual and predicted turning point was performed. A 4x4 matrix was modified to document the change in variability, whether they have a smile, inverted smile, straight increase or decrease in every three months observation, and other changes were also added: constant-increase, increase-constant, constant-decrease, decrease-constant, and constant-constant. The shaded cells in the matrix (Table 1) represent the correct predictions and this paper will report the percentage errors in prediction.

A Bird's-eye View on Indonesian Macroeconomic Indicators

The period of observation was divided into three periods to indicate the change in the fluctuation in response to international changes. The following is a description of the development of the data.

Bank Indonesia Rate

The Bank Indonesia rate (BI rate) is the Bank Indonesia Certificate (Sertifikat Bank Indonesia) offered to the banks that will deposit their money with Bank Indonesia. There is a clear fluctuation, especially after the crisis in 1998. The root mean squares error increased from 1.24 (for period before the crisis 1998) to 2.65 (for period 1990-2008). The highest fluctuation occurred in 1998 when the domestic interest rate jumped up to 75% per year. The impact of the world financial crisis from the US was not dominant, since it was observed that the interest rate only increased slightly. In fact the recent rate was down, around 7%.

Table 1

The Matrix used in this Study

		Predicted								
		Smile	Inverted Smile	Straight Increase	Straight Decrease	Constant Increase	Increase Constant	Constant Decrease	Decrease Constant	Constant Constant
Actual	Smile	▓								
	Inverted Smile		▓							
	Straight Increase			▓						
	Straight Decrease				▓					
	Constant Increase					▓				
	Increase Constant						▓			
	Constant decrease							▓		
	Decrease Constant								▓	
	Constant Constant									▓

Figure 1. The Bank Indonesia (BI) Rate, January 1990-December 2008.

Indonesian Rupiah Exchange Range

A sharp change observed for the Indonesian Rupiah exchange rates. After the 1998 crisis, the rate fluctuated wildly. As the following figures show, the exchange rate was stable around Rp 2000 per US dollar before the 1998, then jumped to Rp 10000 in January 1998. After that the rate was moving at around this level. The root means squared error also jumped from 124.5 to 969.5, confirming the above fluctuation.
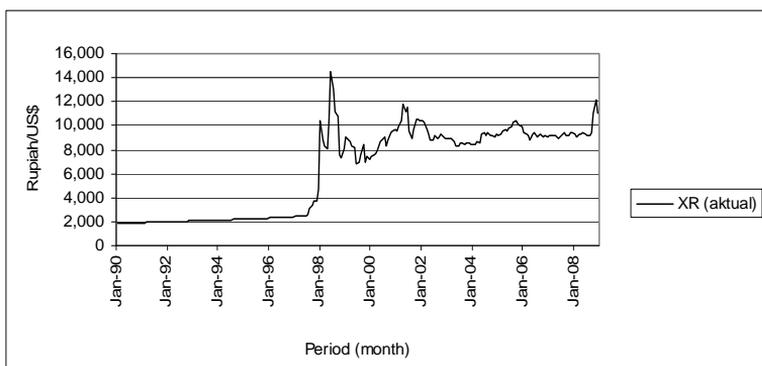
Figure 2. The Indonesian Rupiah Exchange Rates, XR (Rupiah/ US$).

Inflation Rates

The behaviour of the inflation was similar. Before the 1998 crisis, the inflation rates varied around 8%, while after the crises it, was around 10%. The range of fluctuation seems wider after the crises representing its higher variability. The big jump occurred during the 1998 crises.
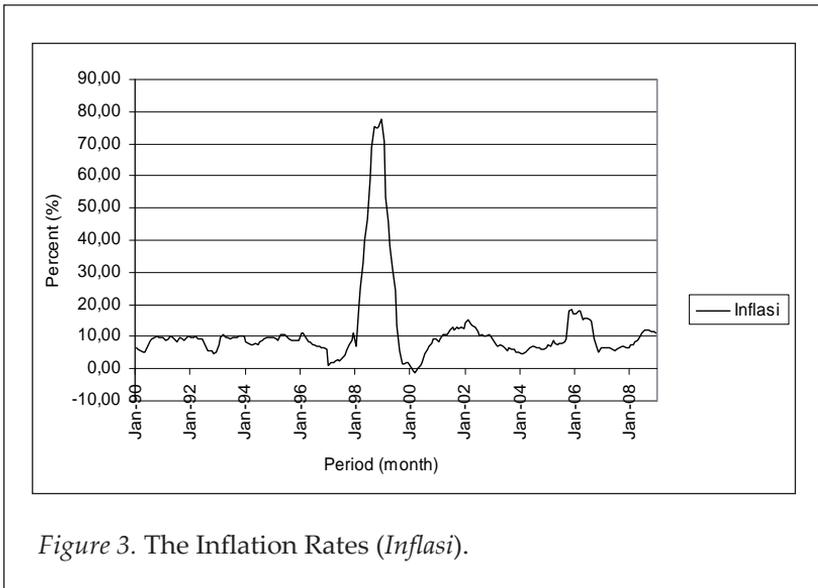
Figure 3. The Inflation Rates (*Inflasi*).

Estimation Results

In general there are two methods used in this study: (1) the predictability of the macro-indicators by using the random walk, historical mean, moving average, and simple regression, and (2) the estimation using GARCH. The predictability analysis was based on the matrix comparing the actual and the predicted, while the GARCH was used to indicate the ease of estimating the variables.

As mentioned, it is argued that when the volatility increases, the quality of prediction decreases. Table 1 reports the percentage errors in prediction. In general, the quality of prediction was not good. The values of percentage error of prediction were more than 50%. This may indicate the quality of the method used in general. Other than that situation, inclusion of the 1998 crises period causes the prediction error of all periods 1990–2005 to become higher than those of 1990–1997.

The BI rate prediction error increased from 62.5% to 86.4% (using the random walk). Surprisingly, the prediction error was zero when the moving average estimates were used. The exchange rates have been difficult to predict as well. The error in prediction increased from 43% to 60% (using the random walk model), 40% to 58%, but decreased from 90% to 85% (using moving average).

When the period of observation was extended (1990–2008) the percentage error of prediction were not worse compared to those of period 1990–1997. It is argued that the longer the period, the better the quality of prediction. The complete report on prediction quality are presented in Appendix 1.

Table 1

Percentage Error of Prediction: Random Walk, Moving Average, and Simple OLS

		1990–1997	1990–2005	1990–2008
BIRATE	Random Walk	62,5	86,4	62,5
	Moving Average	0,0	0,0	0,0
	Simple OLS	56,3	56,3	57,6
Xrates	Random Walk	43,8	56,3	60,5
	Moving Average	96,9	85,1	85,7
	Simple OLS	40,6	53,1	58,7
Inflation	Random Walk	62,5	48,4	60,5
	Moving Average	0,0	0,0	0,0
	Simple OLS	53,3	63,8	60,0

The above analysis did not provide a firm conclusion, whether the variables had become difficult to predict after the crisis. The following are the ARCH and GARCH estimates to account for further variability. As Table 2 reports, in all of the estimations it was observed that almost all of the ARCH and GARCH coefficients are significant. These indicated that both the shock and the persistence (the past variance) determine the current conditional variance. All of the GARCH coefficients are higher than those of the ARCH, indicating that the persistence of variances are higher compared to the temporary shocks. In terms of variability, the comparison of the three periods showed that the ARCH coefficients are more significant, confirming the increase significance of the shock. The ARCH coefficients increase

steadily over the three periods, supporting the importance of shock in forming the variance. The forecast and adjusted samples also confirm the above estimated ARCH and GARCH. The figure are reported in Appendix 2.

Table 2

ARCH and GARCH Coefficient Estimates and their z Statistics

	1990–1997		1990–2005		1990–2008	
	α_1	α_2	α_1	α_2	α_1	α_2
BI Rate	0.425	-0.04	2.17	0.21	2.09	0.22
	(5.86)***	(-14.9)***	(6.05)***	(8.27)***	(7.37)***	(9.43)***
Exchange Rate	0.39	0.94	1.65	0.51	2.12	0.44
	(10.0)***	(120.0)***	(9.32)***	(12.7)***	(12.3)***	(13.5)***
Inflation Rate	−0.01	1.03	0.79	−0.04	0.73	−0.04
	(−1.05)	(514)***	(5.61)***	(224)***	(6.04)***	(−365)***

Notes. Figures in parentheses are z statistics: significant at 0.1, ** 0.5, and *** 0.01.

Conclusion

This research tested whether many Indonesian macroeconomic indicators have become more volatile after the financial crises of 1998 and 2008. In order to examine that behaviour, the Bank Indonesia rates, inflation, and exchange rates were used. Three methods of estimation were implemented, namely random walk, moving average, and simple OLS, which employed ARCH and GARCH estimates. The observation was also divided into three periods: 1990–1997, 1990–2005, and 1990–2008, to account for the changes in these periods.

It was concluded that the volatility of the selected macroeconomic indicators increased after the 1998 crises. The shock component (the ARCH parameter) increased after the crises, both in terms of the size of the parameters and their significant levels. A peculiar change was observed in the exchange rates, which also rose from Rp 3000 per US dollar to around Rp 10000 per US dollar.

Policy makers should be aware that the Indonesian macroeconomic indicators have increased their volatility. Traders and fund managers

should consider such increase in variability as an opportunity to define an accurate trading decision to gain from the fluctuation.

This study did not obtain estimators that show a consistent increase of the prediction error after the crises. Other estimators may be explored in future studies to measure the variability of the indicators.

Acknowledgements

Endnotes

1.   In this research, the indicators are: exchange rates, interest rate (BI rate), and inflation (CPI).

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Appendix 1. Qualitative Prediction Evalution

AKTUAL BIR (1990-1997), Random Walk

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		2		1					
turun-naik					3				
naik-naik			6		1				
turun-turun		1		6			2		1
naik-tetap			1			1			
tetap-naik									
turun-tetap								2	
tetap-turun		1		3					
tetap-tetap								1	

AKTUAL XR (1990-2005)

PREDIKSI	naik-turun	Turun-naik	naik-naik	Turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		2		1					
turun-naik			3	1	3				
naik-naik	1		6	1	1				
turun-turun		1	1	11			2		1
naik-tetap						1			
tetap-naik			3						
turun-tetap								2	
tetap-turun				1					
tetap-tetap						1		1	

AKTUAL XR (1990-2008)

PREDIKSI	naik-turun	turun-naik	naik-naik	Turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		2		1	1				
turun-naik			3	1	3				
naik-naik	1		7	1	1			1	
turun-turun		1	1	14			2		1
naik-tetap						1			
tetap-naik			4						
turun-tetap								2	1
tetap-turun				3					
tetap-tetap						1		2	1

Moving Average AKTUAL BIR (1990-1997)

PREDIKSI	naik-turun	Turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun									
turun-naik		4							
naik-naik			7						
turun-turun				10					
naik-tetap					4				
tetap-naik						1			
turun-tetap							3		
tetap-turun								3	
tetap-tetap									

AKTUAL BIR (1990-2005)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	Turun-tetap	Tetap-turun	tetap-tetap
naik-turun	1								
turun-naik		1							
naik-naik			12						
turun-turun				15					
naik-tetap					1				
tetap-naik						2			
turun-tetap							3		
tetap-turun								3	
tetap-tetap									

AKTUAL BIR (1990-2008)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	Naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun	1								
turun-naik		1							
naik-naik			14						
turun-turun				20					
naik-tetap					1				
tetap-naik						2			
turun-tetap							4		
tetap-turun								5	
tetap-tetap									2

Simple OLS

AKTUAL BIR (1990-1997)

PREDIKSI	naik-turun	turun-naik	naik-naik	Turun-turun	naik-tetap	tetap-naik	turun-tetap	Tetap-turun	tetap-tetap
naik-turun		2		1					
turun-naik		2							
naik-naik			7		1	1			
turun-turun		1		5			3		
naik-tetap									
tetap-naik									
turun-tetap								2	
tetap-turun		1		4					
tetap-tetap					1			1	

AKTUAL BIR (1990-2005)

PREDIKSI	naik-turun	turun-naik	naik-naik	Turun-turun	naik-tetap	tetap-naik	turun-tetap	Tetap-turun	tetap-tetap
naik-turun		2		1					
turun-naik		2	4						
naik-naik	1		7		1	1			
turun-turun		1		12			3		
naik-tetap						1			
tetap-naik			2						
turun-tetap								2	
tetap-turun		1		4					
tetap-tetap					1	1		1	

AKTUAL BIR (1990-2008)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	Tetap-turun	tetap-tetap
naik-turun		2		1					
turun-naik		2	4						
naik-naik	1		8		1	1			
turun-turun		1		15			3		
naik-tetap						1		1	
tetap-naik			3						
turun-tetap								2	1
tetap-turun		1		6			1		
tetap-tetap					1	1		1	1

Random Walk

AKTUAL XR (1990-1997)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun	▨	1							
turun-naik		▨	3						
naik-naik	3	1	18 ▨		1				
turun-turun		2		▨				1	
naik-tetap						2			
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

AKTUAL BIR (1990-2005)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun	▨	5	1	3					
turun-naik	2	▨	8						
naik-naik	5	1	23 ▨		1				
turun-turun		6		5 ▨				1	
naik-tetap				1		2			
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

AKTUAL BIR (1990-2008)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun	▨	5	1	3					
turun-naik	3	▨	11						
naik-naik	9	1	24 ▨		1				
turun-turun		8		6 ▨				1	
naik-tetap				1		2			
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

Moving Average

AKTUAL XR (1990-1997)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun			1						
turun-naik									
naik-naik									
turun-turun	3	3	20	1	1	2	1		
naik-tetap									
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

AKTUAL xr (1990-2005)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun			1						
turun-naik									
naik-naik									
turun-turun	7	14	31	10	1	2	1		
naik-tetap									
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

AKTUAL xr (1990-2008)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun			1						
turun-naik									
naik-naik									
turun-turun	10	16	35	11	1	2	1		
naik-tetap									
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

Simple OLS

	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		2							
turun-naik		1	3						
naik-naik	3	1	18		1				
PREDIKSI turun-turun							1		
naik-tetap						2			
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

AKTUAL xr (1990-2005)

	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		5		1					
turun-naik	2	1	9						
naik-naik	5	1	23	1	1				
PREDIKSI turun-turun		5		6			1		
naik-tetap				1		2			
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

AKTUAL xr (1990-2008)

	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		5		1					
turun-naik	3	1	13						
naik-naik	8	1	23	1	1				
PREDIKSI turun-turun		7		7			1		
naik-tetap				1		2			
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

AKTUAL INFLASI (1990-1997)

	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		2		1					
turun-naik	4		2						
naik-naik	5		6						
turun-turun		6		6					
naik-tetap									
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

AKTUAL INFLASI (1990-2005)

	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		4		3					
turun-naik	7		8						
naik-naik	8		12						
turun-turun		8		11					
naik-tetap									
tetap-naik			1						
turun-tetap						1			
tetap-turun				1					
tetap-tetap									

AKTUAL INFLASI (1990-2008)

	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		5		3					
turun-naik	8		8						
naik-naik	8		15						
turun-turun		9		15					
naik-tetap									
tetap-naik			1		1				
turun-tetap						2			
tetap-turun				1					
tetap-tetap									

Moving Average

AKTUAL INFLASI (1990-1997)

	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun	9								
turun-naik		8							
naik-naik			8						
turun-turun				7					
naik-tetap									
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

PREDIKSI

AKTUAL INFLASI (1990-2005)

	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun	14								
turun-naik		13							
naik-naik			21						
turun-turun				15					
naik-tetap									
tetap-naik						1			
turun-tetap									
tetap-turun									
tetap-tetap									

PREDIKSI

AKTUAL INFLASI (1990-2008)

	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun	15								
turun-naik		15							
naik-naik			24						
turun-turun				19					
naik-tetap					1				
tetap-naik						2			
turun-tetap									
tetap-turun									
tetap-tetap									

PREDIKSI

Simple OLS

AKTUAL INFLASI (1990-1997)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		1		1					
turun-naik	3	2	1						
naik-naik	4		6						
turun-turun		6		6					
naik-tetap									
tetap-naik									
turun-tetap									
tetap-turun									
tetap-tetap									

AKTUAL INFLASI (1990-2005)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		2		3					
turun-naik	6	2	7						
naik-naik	6		10		1				
turun-turun		9		9					
naik-tetap									
tetap-naik		1							
turun-tetap						1			
tetap-turun				1					
tetap-tetap									

AKTUAL INFLASI (1990-2008)

PREDIKSI	naik-turun	turun-naik	naik-naik	turun-turun	naik-tetap	tetap-naik	turun-tetap	tetap-turun	tetap-tetap
naik-turun		3		3					
turun-naik	7	2	7						
naik-naik	6		13		1				
turun-turun		10		13					
naik-tetap									
tetap-naik			1		1				
turun-tetap						2			
tetap-turun				1					
tetap-tetap									

Appendix 2: Predicted and Actual Macro Indicators

Indonesian Narrow Money (M1)

Bank Indonesia Rate

Forecast: BIRATEF
Actual: BIRATE
Forecast sample: 1990:01 1997:12
Adjusted sample: 1990:02 1997:12
Included observations: 95

Root Mean Squared Error	1.240759
Mean Absolute Error	0.597504
Mean Abs. Percent Error	4.151589
Theil Inequality Coefficient	0.042122
Bias Proportion	0.000698
Variance Proportion	0.001472
Covariance Proportion	0.997831

Forecast: BIRATEF
Actual: BIRATE
Forecast sample: 1990:01 2005:12
Adjusted sample: 1990:02 2005:12
Included observations: 191

Root Mean Squared Error	2.651061
Mean Absolute Error	1.106494
Mean Abs. Percent Error	5.566769
Theil Inequality Coefficient	0.068612
Bias Proportion	0.015319
Variance Proportion	0.000000
Covariance Proportion	0.984681

Forecast: BIRATEF
Actual: BIRATE
Forecast sample: 1990:01 2008:05
Adjusted sample: 1990:02 2008:05
Included observations: 220

Root Mean Squared Error	2.470067
Mean Absolute Error	0.984789
Mean Abs. Percent Error	5.105371
Theil Inequality Coefficient	0.067249
Bias Proportion	0.013858
Variance Proportion	0.000016
Covariance Proportion	0.986126

Exchange Rates

Forecast: XRF
Actual: D(XR)
Forecast sample: 1990:01 1997:12
Adjusted sample: 1990:02 1997:12
Included observations: 95

Root Mean Squared Error	124.5755
Mean Absolute Error	31.58220
Mean Abs. Percent Error	156.5061
Theil Inequality Coefficient	0.645917
Bias Proportion	0.007135
Variance Proportion	0.191289
Covariance Proportion	0.801575

Forecast: XRF
Actual: D(XR)
Forecast sample: 1990:01 2005:12
Adjusted sample: 1990:02 2005:12
Included observations: 191

Root Mean Squared Error	969.5699
Mean Absolute Error	380.4515
Mean Abs. Percent Error	308.0992
Theil Inequality Coefficient	0.683187
Bias Proportion	0.000001
Variance Proportion	0.000000
Covariance Proportion	0.999999

Forecast: XRF
Actual: D(XR)
Forecast sample: 1990:01 2008:05
Adjusted sample: 1990:02 2008:05
Included observations: 220

Root Mean Squared Error	909.5981
Mean Absolute Error	361.6202
Mean Abs. Percent Error	297.1897
Theil Inequality Coefficient	0.683476
Bias Proportion	0.000000
Variance Proportion	0.000000
Covariance Proportion	1.000000