CHAPTER V

RESULTS AND DISCUSSION

CHAPTER 5

RESULTS

5.1 Introduction

This chapter presents the results and discussion of the empirical evidence from analyzing the effects of monetary policy shocks in the nominal rate of interest to inflation expectation and real interest rates in Malaysia after the financial crisis (1997-1998)

The augmented Dickey-Fuller (ADF) unit root test procedures, Johansen and Juselius (1990) cointegration test, and VAR analysis are conducted to achieve the objectives of he study.

5.2 Unit Root Test

The first step in the empirical application is to determine if the variables are stationary or non stationary in levels. The results of the Augmented Dickey Fuller (ADF) test for unit roots (Ho: presence of unit roots) are presented in table 5.2.1

Table 5.2.1 : Unit Root Test Results

Variable	ADF Test Statistic		1% critical value	
	Levels	First Difference	Levels	First Difference
I	-22.35934	-	-3.5625	-
E		-4.329955	-3.5625	3.5653
LR1	-8.464826	-	-3.5625	-
LR5		-4.247478	-3.5625	-3.5653
LR10		-4.095296	-3.5625	-3.5653

Note*Rejection of the null at 1% level. The critical value for ADF (level-trend) at 1% is -3.5625. the critical value for ADF (First difference-without trend) at 1% of level significance is -3.5653

Table 5.2.1 presents the ADF test results for all series involved in the analysis in level and also in first differences. Results show that the null hypothesis can be rejected for all the involved series when they are first differences. There are three variables that rejected in level form and proceed to differences. Namely, inflation expectation, real interest rate for 5 year maturity and 10 years maturity. The results are consistent with the view that most macroeconomic variables are non stationary in level but stationary in the first differences (Nelson and Ploster, 1982). This means, for all the variables or data series under consideration, are integrated of order 1 or I (0) and the variables can be use in the cointegration test.

5.3 Johansen Cointegration Test

The Johansen-Juselius Cointegration procedure are to be applied after we consider the series to be I (1) process. This test is based on the maximum likelihood estimation technique. There are two statistics to be used to identify the number of cointegration vectors, known as λ-max and λ-trace. The result indicates that the order of VAR at 4 is acceptable by the data representation. In implementing the test, we place emphasis on the requirement that the error terms need to be serially uncorrelated. Namely, we increase the lag length successively until the error terms of the estimated VAR are white noise. The results of the test are given in appendix 1.

We will be using different value of lags interval until we get cointegrating relationship among variables. As may be observed from the table, we find evidence that there is non cointegrating relationship between the variables. In short, the results show evidence for the presence of a long run relationship among the variables in all series we estimated.

Table 5.3.1: Summarized of the test results for Johansen cointegration test

Variable	Critical Value	Null hypothesis			
		R = 0	r ≤ 1	r ≤ 2	r ≤ 3
I	68.52	127.6145**	223.7483**	77.02884**	67.83366
E	4721	67.81300**	73.01307**	35.43871	38.91000
R1	29.68	22.83642	27.04600	16.54441	17.17113
R5	15.41	10.61048	12.20216	7.368594	6.971464
R10	3.76	1.162177	1.915590	2.840260	0.882118

In this study, the Johansen and Juselius (1990) procedure is utilized to test for the presence (or absence) of cointegration relationship. If the computed likelihood ratio exceeds the critical value from the table at 5 or 1 percent level of significance, we reject the null hypothesis. Given that there were five variables in the model, there can be at most a maximum of 3 cointegrating vectors, so that r could be equal to 0, 1, 2 and and 3.

Results from using the Johansen Juselius indicate that the values of the test statistics for all variables are rejected by likelihood ratio. The result indicates that the order of VAR at 4 is acceptable by the data representation. In implementing the test, we place emphasis on the requirement that the error terms need to be serially uncorrelated. Namely, we increase the lag length successively until the error terms of the estimated VAR are white noise.

5.4.1 VAR Analysis

In this section we will discuss the statistics of the main sample series, estimation of coefficients, covariance and correlation matrices and impulse responses of monetary shock to variables.

5.4.1 Summary statistics of Main Sample Series

In this section we present the sample statistics of these series. Table 5.4.1 shows the sample series and figure 5.4.1 we plotted the series (Appendix 1). BNM's overnight interbank rate shows the rate declined after 3 months while maintaining the same trend. But for inflation expectation, the trend rose. Real interest rate showed a declining trend. The real interest rates decreased as the nominal interest rates fell. Inflation expectations rose faster than the fallen of the nominal interest rates.

Table 5.4.1: Summary statistics of main sample series

	Mean	Median	Maximum	Minimum	S.D	Skewness	Kurtosis
I	2.877	2.760	5.290	2.510	0.601	3.464	13.800
E	1.092	1.220	4.380	-2.270	2.078	-0.044	1.709
LR1	1.163	1.107	1.783	1.037	0.159	2.519	9.494
LR5	1.426	1.358	1.889	1.099	0.246	0.110	1.498
LR10	1.600	1.577	1.934	1.235	0.226	-0.100	1.491

The above data series are monthly averages of daily observations in Malaysia during data period of Jan 1999 – July 2003. the series are: I = overnight interbank rate of BNM; E = monthly expectations for the next 12 months extracted from MGS (Price) and CPI; R1 = the annualized yield to maturity of a 1 year cagamas bond; R5,R10 = the annualized 5 year and 10 year respectively, forward real rates of interest.

5.4.2 Coefficient estimation

This part illustrates the advantage of the VAR response function estimates on simple regression estimates. Due to high autocorrelations in the explanatory variables, and response lags being longer than the lags included in the regression equations, the estimated coefficients appear to be insignificantly related to the endogenous variables. In Malaysia's case, a significant impact is reported below and the adjusted R square is high.

Table 5.4.2 : Coefficients estimates in the basic VAR model

	I	E	LR1	LR5	LR10
I(-1)	0.586899	-0.213897	0.029848	-0.057011	-0.044412
	(0.18857)	(0.36517)	(0.05771)	(0.05714)	(0.05016)
	(3.11236)	(-0.58575)	(0.51722)	(-0.99776)	(-0.88548)
I(-2)	-0.033415	-0.184591	0.008065	0.044939	0.041384
	(0.15050)	(0.29145)	(0.04606)	(0.04560)	(0.04003)
	(-0.22203)	(-0.63336)	(0.17510)	(0.98543)	(1.03380)
E(-1)	0.282837	0.794604	0.039656	-0.004954	0.003611
	(0.06966)	(0.13491)	(0.02133)	(0.02111)	(0.01853)
	(4.06000)	(5.89007)	(1.86010)	(-0.23469)	(0.19490)
E(-2)	-0.269927	0.137407	-0.047183	-0.013675	-0.017063
	(0.07052)	(0.13656)	(0.02158)	(0.02137)	(0.01876)
	(-3.82780)	(1.00621)	(-2.18635)	(-0.63997)	(-0.90971)
LR1(-1)	o.681707	-1.018730	0.845750	0.160757	0.005835
	(0.68316)	(1.32294)	(0.20907)	(0.0700)	(0.18171)
	(0.99788)	(-0.77005)	(4.04534)	(0.77659)	(0.03211)
RL1(-2)	0.039957	1.884494	-0.490805	-0.172711	-0.147299
	(0.63093)	(1.22181)	(0.19309)	(0.19118)	(0.16782)
	(0.06333)	(1.54238)	(-2.54191)	(-0.90340)	(-0.87774)
LR5(-1)	-0.512653	0.965739	-0.057162	0.898350	0.4290620
	(0.85063)	(1.64727)	(0.26032)	(0.25775)	(0.22625)
	(0.60267)	(0.58627)	(-0.21958)	(3.48534)	(1.28449)
LR5(-2)	0.319714	-1.417950	0.126231	-0.023558	0.056079
	(0.85063)	(1.73246)	(0.27378)	(0.27108)	(0.23795)
	(0.35737)	(-0.81846)	(0.46106)	(-0.08690)	(0.23567)
LR10(-1)	-0.099076	-0.388026	0.082296	0.278896	0.947923
	(0.89080)	(1.72505)	(0.27261)	(0.26992)	(0.23694)
	(-0.11122)	(-0.22494)	(0.30188)	(1.03324)	(4.00074)
LR10(-2)	0.046713	0.024091	-0.008514	-0.344193	-0.399295
	(0.86485)	(1.67479)	(0.26467)	(0.26206)	(0.23003)
	(0.05401)	(0.01438)	(-0.03217)	(-1.31342)	(-1.73581)
C	0.690367	1.553702	0.414397	0.340129	0.405490
	(0.86485)	(0.88644)	(0.14009)	(0.13870)	(0.12175)
	(1.50818)	(1.75275)	(2.95817)	(2.45221)	(3.33043)
Adj. R-squared	0.818016	0.976263	0.793457	0.955921	0.962344

The model is estimated with two lags. Number in parenthesis in the explanatory variables designate the lag of the variable. Numbers in parenthesis in the table(under each estimate) are the asymptotic standard errors of the estimated coefficients. The above data series are monthly averages of daily observations in Malaysia during data period of Jan 1999 – July 2003. the series are: I = overnight interbank rate of BNM; E = monthly expectations for the next 12 months extracted from MGS (Price) and CPI; R1 = the annualized yield to maturity of a 1 year cagamas bond; R5,R10 = the annualized 5 year and 10 year respectively, forward real rates of interest.

5.4.3 Covariance and Correlations Matrices

Covariance and correlation matrices indicate that the residuals, both of the inflation expectation series and the BNM overnight rate's residuals, seems uncorrelated statistically. The BNM monetary policy residuals are significantly correlated with the residuals of the 1 year real interest rates (0.780697) which they precede in the sequence of effects we estimated. This means that simultaneous shocks to the system do not seem to be a major concern in our estimation of the impact of monetary policy shocks. The correlation and covariance matrices for the system are shown in table 5.4.3

Table 5.4.3: Covariance and Correlation Matrices

	I	E	L R1	LR5	L R10
Covariance matrix					
I	0.020710	-0.008088	0.004948	0.000732	0.000229
E	-0.008088	0.077663	-0.001056	-0.000203	0.001010
LR1	0.004948	-0.001056	0.001940	0.000814	0.000454
LR5	0.000732	-0.000203	0.000814	0.001901	0.001269
LR10	0.000229	0.001010	0.000454	0.001269	0.001465
Correlation matrix					
I	1.000000	-0.201682	0.780697	0.116645	0.041533
E	-0.201682	1.000000	-0.086064	-0.016732	0.094685
LR1	0.780697	-0.086064	1.000000	0.423792	0.269454
LR5	0.116645	-0.016732	0.423792	1.000000	0.760560
LR10	0.041533	0.094685	0.269454	0.760560	1.000000

5.4.4 Impulse Response Function

a) The reaction of the interbank rates to changes in investor inflation expectations

The estimated reaction of the Central Bank monetary control – the overnight interbank interest rates BNM charges banks to a one standard deviation increase (which is about 7.88 percentage points) in investor inflation expectations (Appendix 1: Impulse response). The observed reaction to a one standard deviation increase inflation expectations accumulates to roughly about half a percentage point increase in the bank's nominal interest rates, peaking about 2 months after the shocks to the expectations. The response of real interest rate to the changes in investor inflation expectation is peak on the second period. These estimates suggest that, the bank's interest rate policy responds to changes in inflation expectation, albeit with a few months lag. In short, an increase in inflation expectation led to increase in nominal interest rates in a Fisher effect[‡].

b) The reaction of real interest rates and inflation expectation to monetary policy shocks.

[‡] This Fisher hypothesis also has substantial support from "Nominal Interest Rate and Inflation across Latin America" in 1992 and 1993 (Blanchard, 1997)

In the same figure, we present the estimated reactions of real interest rates and of inflation expectations to a one standard deviation increase in the BNM's overnight interbank interest rate. In appendix 1 for impulse response function also shows that, real interest rates and inflation expectation react in the directions to an increase in the BNM overnight rate. An increase in the Central Bank's rate responds positively for the first period and it is offset by fall in investor's inflation expectations especially in the seventh period and this gradually converges only to roughly -8.9 percentage points. The inflation expectation is not so responsive to the change of the nominal interest rate because of the structural characteristic of Malaysian macroeconomic background. Generally an increase in the Central Bank's rate lowers investor inflation expectations. This suggests that the BNM monetary policy is considered credible by investors.

Generally, there is negative response in real rate (1 year maturity) to the monetary shock in the first six periods. The response achieves a deep peak in the sixth period (roughly at -0.06 percentage points) and there is a positive impact of central bank's rate on real rate with 1 year maturity starting from sixth period with a peak of roughly at 0.35 percentage points achieved in the seventh period before converge. But for the real interest rate with 5 year (positive response after deep peak at 0.12 percentage points at fourth period) maturity and 10 year maturity rate(peak at tenth period with 5 percentage points after deep peak as low as -2 percentage points), they have a positive response with BNM's rate. This means, the responses for BNM's

rate on the real interest rates as overall is smaller than the effect on BNM rate to inflation expectation. This finding suggests that monetary policy has no *real effect* on the economy through its impact on the real cost of capital in the economy and the effects on firm's investment decisions.

The Central Bank's policy affects longer term real interest rates via investor substitution across maturities. Meaning that monetary policy does not affect interest rates at the very short end of the maturity spectrum alone. So, because investors consider yield across the whole maturity spectrum when choosing investment portfolios, the monetary policy may impact long term real interest rates and real economy activity.

We report the estimated impact of a one standard deviation increase in the BNM's rate as well. Recall that we use the forward real rate of interest rate. By doing so we neutralize the effect of a change in the short term spot rates on longer term spot rates that exists because of the long term spot rates contain the short term yields as well the forward yield from the short maturity to the long maturity (M. Kahn, 2002). On the other hand, by using forward rates we separately estimate the impact of a monetary policy shock on the real interest rate of individual years, 1, 5, and 10. We will see the comparison of the impact of the BNM's monetary policy shocks on the term structure of real rates of interest.

A figure shows that the estimated reaction of the 5 year real interest rates is react opposite direction to an increase in the BNM's overnight rates. As one might expect, an increase in the Central Bank rates lowers the real interest rates (5 years maturity). So, estimated reaction of the 5 year real interst rates is roughly 3 times lower the reaction of the 1 year real interest rates to a given change in the BNM overnight rate.

The reaction of the 10 year real interest rates is not significantly different from zero either statistically or economically. This suggest that the Central Bank's monetary policy real impact is largely concentrated in the short term end of the structure of real interest rates. This does not mean that monetary policy shocks do not affect long term spot rates. Long term spot rates reflect short term spot rates.

In conclusion it appears that, in the Malaysian economy, monetary policy shocks lower one-year-ahead inflation expectation, decrease real interest rates, mostly in the short term end of the term of structure of real interest rates:1-5 years forward, and little effect the long term end of the real interest rate term structure. Findings are similar to that of M.Kahn et al (2002) except for the 1 year maturity rates which exhibit different responses.

Conclusion

This chapter presents both the empirical results of the analysis as well as the interpretation of estimation results. The findings of the empirical analysis are also given (refer tables and figures) in this chapter. The details results are also provided in the appendix.

Follow the hypothesis of Fisher : changes in inflation expectation will effect the nominal interest rate but does not affect real rate.