

Monetary Instruments and Inflation: Econometric analysis based on Malaysia economy

Abstract

The relationship between inflation and monetary policy is widely discussed in the research paper. The rise in inflation can be the sign of continuous growth in the country. Therefore, it is crucial for the government to keep the country's inflation under control by adopting the right policies such as monetary policy. This paper assessing the impact of monetary instrument towards controlling inflation rates in Malaysia over the period of 1970 to 2010. The analysis begins with testing the unit root test to determine the stationarity of the data. All the variables are found to have a long run relationship from the Johansen Juselius cointegration test. Besides that, from the causality test, there exist unilateral causality for all variable of CPI, interest, reserve and money supply for Malaysia. There are few practical suggestions that can be implemented by the policymaker based on the findings of this paper. First, the authority must constantly monitor the level of reserve requirement in the country. Second, controlling the amount money supply in order to control money volume in the market is also an important measurement to reduce the excess demand of goods and services. Third, the central bank needs to monitor the level of interest rate closely in order to control the inflation problem in the country.

Keywords: Inflation; Monetary Policy; Financial Economics

1. Introduction

Interaction between inflation and economic is a matter of great importance and debate among the macroeconomists. Inflation also gives the negative effect for the long term growth. Although the debate about the precise relationship between inflation and growth remains open, the question of the existence and nature of the link between inflation and economic growth has been the subject of considerable interest and debate. According to Mallik, G. and A. Chowdhury (2001), different schools of thought offer different evidence on this relationship. For example, structuralist believes that inflation is essential for economic growth, whereas the monetarist see inflation as detrimental to economic growth.

Based on the economic view, inflation rate refers to the increasing of the general prices on the good and services in countries over a period of time. The increased in the general level of prices of the daily goods and services in the country will cause the same amount of money can only buy fewer goods and services. To conclude, higher inflation in the country will results in the low purchasing power, higher cost of living, and low quality of life. Monetarists believed and agree that high inflation rate is due to excessive growth of money supply of the country. As compared to Keynesian point of view, they believed that excessive demand in the economy due to rapid growth lead towards higher inflation in the country. The two forms of inflation that commonly occur in the country are demand pull inflation cost push inflation. Fischer (1993), De Gregorio and Jose (1993) suggest that high or hyper-inflation will retard economic growth, although there could be a positive relationship between inflation and economic growth when the inflation rate is low. Inflation may have a negative impact on economic growth through the investment channel. Many of the counties used contractionary monetary policy to curb their inflation problem instead of using contractionary fiscal policy.

2. Background of the studies

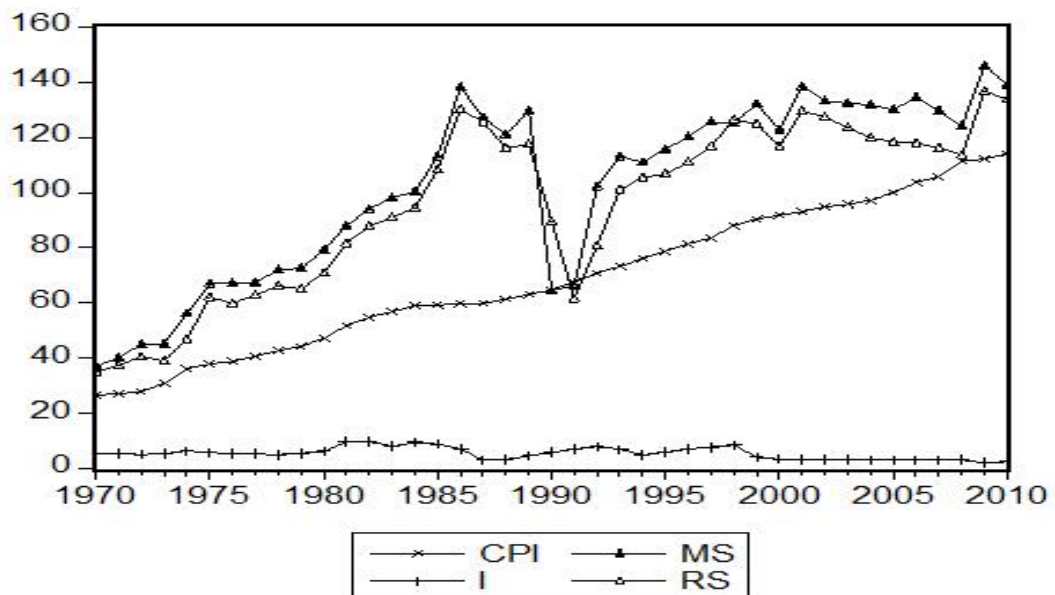
Table 1: Growth rate in GDP and Inflation for Malaysia, 1990 - 2000

Year	%GDP	%Inflation
1991	9.5	3.0
1992	8.9	5.1
1993	9.9	3.3
1994	9.2	3.8
1995	9.8	3.4
1996	10.0	3.3
1997	7.3	3.1
1998	-7.4	5.3
1999	6.1	2.5
2000	8.3	2.7

Source: Figure calculated from BNM Quarterly Economic Bulletin

Table 1 above show the percentage of GDP and percentage of inflation in Malaysia from 1991 to 2000. Overall the highest inflation rate recorded in Malaysia was 5.3 in 1998 while it achieved the lowest at 2.5% in 1999. The average growth rate in Malaysia during the period is about 8%.

Diagram 1: CPI, I,MR and RS



The diagram above show the level of inflation (CPI), deposit rate (I), money supply (MS) and reserve requirement (RS) over the period between 1970 up to 2010. The inflation rate in Malaysia was recorded at 1.50% in February of 2013 as reported by the Department Statistics of Malaysia. Historically from 1970 until 2010, Malaysia rate averaged from 3.65 percent to an all time high of 23.90% in March of 1974 and a record low of -2.40 percent in July of 2009. In Malaysia the most important categories in the consumer price index (CPI) are food and non-alcoholic beverages (30% of total weight) followed by housing, water, electricity, gas and others fuels (23% of total weight). Others include transport (15%); communication (6 percent); recreation and culture (5%) and

furnishing, household equipment and routine household maintenance (4%). The remaining components are restaurant and hotels at (3.2%) and miscellaneous goods and services at 6.3%. The level of money supply and reserve requirement show a similar trend where both facing increasing trend throughout the years except a sharp fall during early 1990s.

Undeniable that monetary policy has played a major role in maintaining this low inflation, and thereby supporting the conditions for high rate of real output growth. These conditions did not persist over an extended period as 1998 episode of financial crisis has brought severe turmoil to Malaysia, with massive depreciation of local currency and thus caused a sharp increase in domestic price. Prior to the mid-1990s, the monetary policy strategy had been implemented based on targeting monetary aggregates (M1, M2 or M3). Government first started focused targeting with M1 and shift in focus to M3 when the financial liberalization and innovation has rendered M1 less reliable for policy targeting. Evidence proves that velocities of M1 and M3 and their average values over the last ten years have diverged from their long trend. Even though M2 showed divergent trend, nevertheless the divergence is comparatively smaller than that of M3. Thus, we employ M2 as monetary targets to examine its efficiency in attaining the stability of output growth and low inflation rate.

This paper intends to explore the most significant policy instruments under monetary policy that can be used to control the level of inflation in Malaysia by implementing extensive series of econometric testing to justify the finding of the research.

3. Literature review

Earlier studies on detecting the relationship between inflation and economic growth by Fischer (1993) and Gregorio and Jose (1993) suggest that hyper-inflation able to retard economic growth, although there could be a positive relationship between inflation and economic growth when the inflation rate is low. Inflation may have a negative impact on economic growth through the investment channel. Taylor and Moosa (2000) found that an increase in inflation or expected inflation will increase the domestic nominal interest rate and reduce the attractiveness of new investment projects that do not generate high enough returns. Thus, high inflation will increase the uncertainty about the future returns from investments. Chatrath *et.al.* (1997), on the other hand have found that an increase in the growth rate in India have led to the decline in inflation rate rather than vice versa. The study is contrast from the finding of Ahmed and M Khalid (2005) who found that inflation in Pakistan is driven by the growth in the country.

The factors contributed to inflation should be investigated so as the policy maker can do something beneficial to their nation. In this case, we try to list down all the factors. There are interest rates, interbank and TB discount rate was proved by Arief and Ramayandi (2007), monetary growth or money supply by Latifah (2004); and interest rate and exchange rate Fahad and Svetlana, (2010). Arief and Ramayandi sees the movement in the nominal interest rate in the ASEAN-5 region tends to be correlated with the movement in inflation rate. Besides that, the correlation between interbank rate and TB discount rate the two series during the period where both series are available is very high was about 97 per cent. Latifah, Merican and Cheong. (2004) on the hand found that monetary growth (M3) was shown to be positively and highly correlated with inflation. Fahad and Svetlana (2010) found the evidence that policy interest rate does not have influence on inflation as it is decoupled from the market rate and does not affect financial decisions of economic agents and the supply of credit. This result contradicts to the exchange rate where it has strong impact on prices with a large degree of dollarization.

Monetary policy plays a key role in managing economic fluctuations. Most past studies tried to identify which instrument in monetary policy influenced the inflation. Studies done by Friedman

and Kuttner (1992) found the significant relationships between money and real income or prices separately. Their result indicating cointegration of real income and real money with the effect of interest rates and concluded that M1 aggregate statistically does have predictive power over income. In addition, Azali and Matthews (1996) have proven the evidences of causality between money (M2) and output in the post-liberalization, money dominated credit. As compared to Tan and Baharumshah (1999), they found M1 and M3 appear to have significant effect on output and prices using VECM but not in M2. Besides, Richard *et al* (1999) found that the monetary policy is credible to fight inflation. Arief and Ramayandi (2007) found that the behaviour in conducting monetary policy in Thailand, Malaysia and the Philippines does not appear to change significantly while in the case of Indonesia, it significantly shift in the conduct of monetary policy. In the same line, fiscal policy also can be used to cater the inflation problem.

There have been various studies that examined the possibility of a causal relationship between deficit financing and the general price level. While most of these studies indicate budget deficit as fuelling inflation, a few others found no evidence to confirm that deficit financing is a major cause of inflation (Chimobi, 2010). They found that inflation forecast targeting is important with monetary policy. Besides, Matthieu *et al* (2012) had studied the monetary policy stabilization under rational expectations and perfect credibility by central bank. In this context a monetary authority committed to delivering a given inflation target can successfully steering expectation in the face of inflationary disturbances and achieve appropriate inflation volatility.

4. Methodology and Sources of Data.

The model proposed for this paper as follow:-

$$CPI = f(MS, RS, I) \text{ -----(1)}$$

The level of inflation (CPI) is determined by the level of interest rate (I), money supply (MS) and the reserve requirement (RS).

We then transform the model into log form to avoid heteroscedasticity problem.

$$LNCPI = \beta_0 + \beta_1 LNMS_t - \beta_2 LNRS_t - \beta_3 LNI_t + \varepsilon_t \text{ -----(2)}$$

It is expected that:-

$$\beta_1 > 0, \beta_2 \text{ and } \beta_3 < 0$$

Money supply, β_1 is the amount of fiat money circulated in the economy. It has positive relationship with the level of inflation in the country. Higher amount of money supply means more money are circulated in the country lead to more consumption or investment activities and therefore lead to higher demand for more goods and services. This excess demand of goods and services lead to higher inflation.

Reserve requirement, β_2 is expected to have negative relationship with the level of inflation, CPI. Reserve requirement is referred to an amount of interest that commercial bank need to deposit into central bank account for each deposit received from the public. Lowering the reserve requirement lead to higher excess reserve, which refer to the amount of loan that the commercial bank can use to borrow to their potential customer. This will also lead to higher spending activities and higher level of inflation in the country.

Interest rate, β_3 is expected to have negative relationship with the level of inflation, CPI. For example, when the country's interest rate is high, it will lead to higher cost of borrowing. Higher cost of borrowing will reduce the people's desire to loan more for consumption or investment activities. These will reduce the excess demand for goods and services and lead to a lower inflation rate in the country.

The tests that we run using this model are:-

I. Unit Root Test:

The general idea of unit root test is to test whether **each variable** has stationary or non stationary properties in time series analysis. It is important to identify the unit root properties to avoid spurious estimates in the model (error term not normally distributed with means not zero and variance is not constant

II. Johansen Juselius Cointegration Test:

After all data contain no unit root problem, the cointegration test can be done. The general idea about cointegration test is to know the long-run relationship between variables. If there have cointegration, there will be a stable long-run equilibrium in the model and all variables move together to single equilibrium. But this study must find at least one cointegration factor before we proceed with VECM.

III. Vector Error Correction Model (VECM):

The VECM is investigating the short-run relationship in the models. VECM stands for Multi Error Correction Models, means the models are more than one. VECM is used to investigate dynamic relationship and use together with Granger Causality analysis. The purpose of using VECM in this study is to know if there exists single stable equilibrium or not (error correction term is *diverge or converge*).

IV. Granger Causality Test:

Granger Causality test is used to know the specific correlation between variables in the model. It means Granger is a test for each variables whether if it is correlated or causality to other variables. If both variables are causing each other, it means that the model is a good. But it also depends on the study and hypotheses.

V. Impulse Response Function (IRF) and Variance Decomposition (VDC):

Variance decomposition (VDC) can be described as causality test outside the estimation period. VDC decomposes variations in an endogenous variable in the VAR. It shows the percentage of forecast error variance for each variable that may be attributed to its own shocks and to fluctuations in the other variables in the system. IRF on the other hand measures the predictable responses to a standard deviation shock to one of the system's variables on other variables in the system.

The main aim of this paper is to detect the relationship between monetary instruments and inflation. The results also can be used to help policymaker to make a better decision making to curb inflation problem in Malaysia.

Sources of Data

The data for the variables used in this paper is obtained from World Development Indicator 2011 International Monetary Fund statistical database and Bank Negara Malaysia annual report. This paper used annual data starting from 1970 up to 2010 with 41 number of observation. CPI data used is based on 2005, deposit interest rate (%) is used as a proxy for interest rate, M2 is used to represent money supply while a liquid liability to GDP (%) is used to represent reserve requirement.

5. Empirical Results.

The analysis begin by testing the stationarity of the data by using Dickey Fuller/Augmented Dickey Fuller (DF/ADF) and Phillip Perron (PP) unit root test for the variables used in the model. Based on DF/ADF unit root tests from table 2, we found that the variables are not stationary at level while stationary between 1% to 5% significance level after first difference except for LNCPI which shown not stationary at first difference for no trend. In order to proceed with Johansen Juselius cointegration test, it is compulsory for the variables to stationary at first difference. Therefore, we used Phillip Perron (PP) test, a more powerful unit root test to test back the stationarity of the data. More weight was given to the Phillips-Perron unit root as this test has been shown to be more reliable than Dickey-Fuller test in presence of large amounts of heteroscedasticity. The PP unit root test proposed by Phillips and Perron (1988) has an advantage as it propose a nonparametric method of controlling for higher-order serial correlation in a series. All the data is found to be non stationary at level but stationary only after the first difference. Therefore, it fulfils the requirement to precede the analysis with Johansen-Juselius cointegration test (JJ).

Johansen-Juselius Cointegration test.

The optimum lag is detected through residual for each variables used in the model. The optimum lag is detected by making sure that all the residual probability must be larger than 5% significant level in order to avoid autocorrelation problem. The process will begin from the lowest lag, up to the point that all the variables residual is greater than 5% significant level. Here, lag 2 was detected as the optimum lag for the study. By following max-eigen value statistics from table 3, it indicates the existence of at least 3 cointegrating vector between the variables where the null hyphothesis ($r \leq 2$) is rejected at 5% significant level. Since there is more than one cointegrating vector, the analysis using VECM and granger causality test was proceeded.

VECM model

The VECM model from table 4 shows that all the variables have a corrected sign and supported orthodox school of monetarist that CPI, has negative correlation with interest rate (I) and reserve (RS) and positive relationship with money supply (MS). To be more specific, a 1% increase in MS lead to 0.54% increase in CPI. The evidence was consistent with the past finding of Latifah (2004) and Fahad and Svetlana (2010) as they found out that broad money growth or money supply is found to be highly significant in determining inflation in both the short and long terms of inflation, especially in the long run. Besides, a 1% increase in I and RS will lead to the reduction of CPI by 0.419% and 1.639% decrease respectively. Here, it can be concluded that RS gave the highest impact to inflation (CPI) followed by MS and I.

Granger Causality test

Result of Granger causality can be viewed in Table 5. To summarize, MS has bidirectional relationship with CPI, RS has bidirectional with MS. MS and I have two way relationships besides

CPI and I. The granger causality test is detected by following F-statistic. The negative value of ECT_{t-1} has proven that all the variables will converge in the long run. To simplify, if there is any change in CPI value (dependent variable), it will narrow down the gap value in the model, which means in the long run there only exist single stable equilibrium point. So this is the proof that there actually has strong relationship between inflation (CPI) with other variables (MS and RS) and weak relationship with I.

Impulse response Function

Following Figure 1, most of the responses from one variable to another variable is a temporary shock (the straight line coming back to mean) except for CPI to CPI and CPI to MS where it shows a permanent shock (the straight line does not move to mean).

As an alternative check, dynamic simulations are used to calculate VDC and visualize the IRF in order to corroborate the result obtained through VECM. An analysis of the IRF is presented in Figure 2. A ten-period horizon is employed to allow the dynamics of the system to work out. Shocks to variables in particular LNI have an impact on LNCPI, LNRS, LNI and LNMS. Besides LNRS also has significant shock towards LNCPI, LNMS, LNI and LNRS as the line decreased throughout the horizon and seem to be significant and persistent. The shock can also be detected between LNMS and LNCPI, LNI, LNRS and LMS. Weak shock is detected between LNCPI towards LNI, LNRS and LNCPI except for LNMS. Therefore, the IRF appears to be almost consistent with the earlier VECM results.

Variance decomposition

The result of VDC is reported in Table 6. A ten-period horizon is employed to convey a sense of the dynamics of the system. The Granger-causal chain implied by the analysis of VDC tends to suggest that RS is the relatively endogenous since it has the lowest percent 19.03% (at year 10) compared to MS, CPI and I. I is relatively exogenous because the percentage change seems small from 82.69% in period 1 to 76.62% in period 10. 76.62% of the variance can be explained by itself (exogenous). I is a leading variable in this case, followed by CPI, MS and RS. Decomposition of CPI, besides being explained by its own variables, CPI can be explained by I. The same can be said for I, in addition to be explained by the variable itself, it is explained by variable CPI.

6. Policy recommendation and conclusion.

This paper helps to clearly determine the best monetary instrument adopted by central bank of Malaysia used to combat inflation in Malaysia. We have adopted more advanced econometric tests to forecast and evaluate more deeply the contribution of each of the variables used in the model. Interest rate (I) is found to have negative relationship with consumer price index (CPI) that capture inflation. Higher interest rate means higher cost of borrowing and therefore reducing the intention of Malaysian people to borrow money to purchase goods and services. The reduction in excess demand for good and services will able to control the level of inflation in the country. Besides, money supply, (MS) has a positive relationship with the inflation and thus has proven the quantity theory of money developed by Irving Fisher. The difference is that we failed to find a proportional relationship between the MS and CPI. The last variable, reserve, (RS) or required reserve ratio also found a negative relationship with CPI. Higher required reserve ratio means higher amount of share from each deposit enter into central bank, lowering the excess reserve and therefore lead to lower borrowing to the people and inflation level. In summary, this paper found that the best instruments used under monetary policy to curb the problem of inflation in Malaysia are the reserve requirement, followed by money supply and interest rate. Central bank need to carefully set up the amount of reserves requirement towards the commercial banks in order to control the amount of deposit or

loan available to the public besides setting the right level of money supply and interest rate in the country.

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Appendix

Table 2: Unit Root Test

Country	DF/ADF Unit Root Test			
Malaysia	Level		First Difference	
	No Trend	With trend	No Trend	With Trend
LNCPI	-1.953 (9)	-3.169 (1)	-1.179 (6)	-3.688 (8)**
LNI	-1.524 (0)	-3.046 (1)	-5.215 (0)***	-5.190 (0)***
LNMS	-2.462 (0)	-2.823 (0)	-5.743 (1)***	-5.969 (1)***
LNRS	-2.337 (0)	-2.682 (1)	-5.273 (1)***	-5.567 (1)***
Note: (*),(**),(***) indicate significant at 10%,5% and 1% significant level respectively. Number in bracket represents number of lag. The test used Schwarz Info Criterion.				
Country	PP Unit Root Test			
Malaysia	Level		First Difference	
	No Trend	With trend	No Trend	With Trend
LNCPI	-4.092 (7)	-1.969 (9)	-3.614 (0)***	-4.431 (2)***
LNI	-1.555 (4)	-2.240 (5)	-5.700 (12)***	-6.963 (14)***
LNMS	-2.821 (6)	-2.195 (6)	-5.507 (1)***	-5.955 (4)***
LNRS	-2.468 (5)	-2.281 (3)	-4.988 (3)***	-5.135 (6)***
Note: (*),(**),(***) indicate significant at 10%,5% and 1% significant level respectively. Number in bracket represents number of lag. The test used Schwarz Info Criterion.				

Table 3: Johansen-Juselius Cointegration Test

Hypotheses	Eigen value	Trace statistic	Critical value (5%)	Max-Eigen value	Critical value (5%)
Ho : $r = 0$	0.654	73.630**	47.856	40.428**	27.584
Ho : $r \leq 1$	0.473	33.202*	29.797	24.365*	21.131
Ho : $r \leq 2$	0.206	8.836	15.494	15.780*	14.264
Ho : $r \leq 3$	0.001	0.055	3.841	0.055	3.841
Note: Lags = 2 are determining after testing with Correlogram test and it is free from autocorrelation problem (testing with each variables residual). r indicates the number hypotheses of cointegration factor (r=0 means 1 cointegration, r=2 means at least two cointegration factor). *means 5% and ** means 1% significant level (α). Data also using SIC criterion.					

Table 4: VECM model

$LCPI_{t+1} = 2.921 - 0.419LI_t + 0.541LMS_t - 1.639LRS_t + \mu$
Orthodox monetarist state that Interest (LI) has -ve correlation, Money Supply (MS) +ve and Reserve (RS) has -ve relation to inflation.

Table 5: VECM Granger Causality Test and Diagram

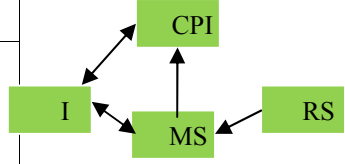
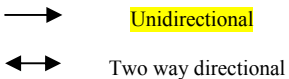
Dependent Variables	Granger Causality Chi-square statistic (probabilistic)				VECM _{t-1} Value (t-statistic)	Causality Diagram
	D(CPI)	D(LI)	D(LMS)	D(LRS)	ECT _{t-1}	
D(CPI)	-	3.156	2.212	0.872	-0.071	
D(LI)	2.422	-	4.812	9.689		
D(LMS)	0.369	15.849	-	1.875		
D(LRS)	1.085	2.801	7.501	-		
Note: VECM_{t-1} is value to determine the short run relationship. This value is important because if significant, changing in independent variables will affect widening or narrowing the dependent variables. ECT_{t-1} is Error Correction Term, where CPI = inflation, I= interest, MS = Money Supply, RS = reserve and L = Pure logarithm. This test also using 10% significant level. The granger causality test is based on F-statistic.						

Figure 1: Impulse Response Function

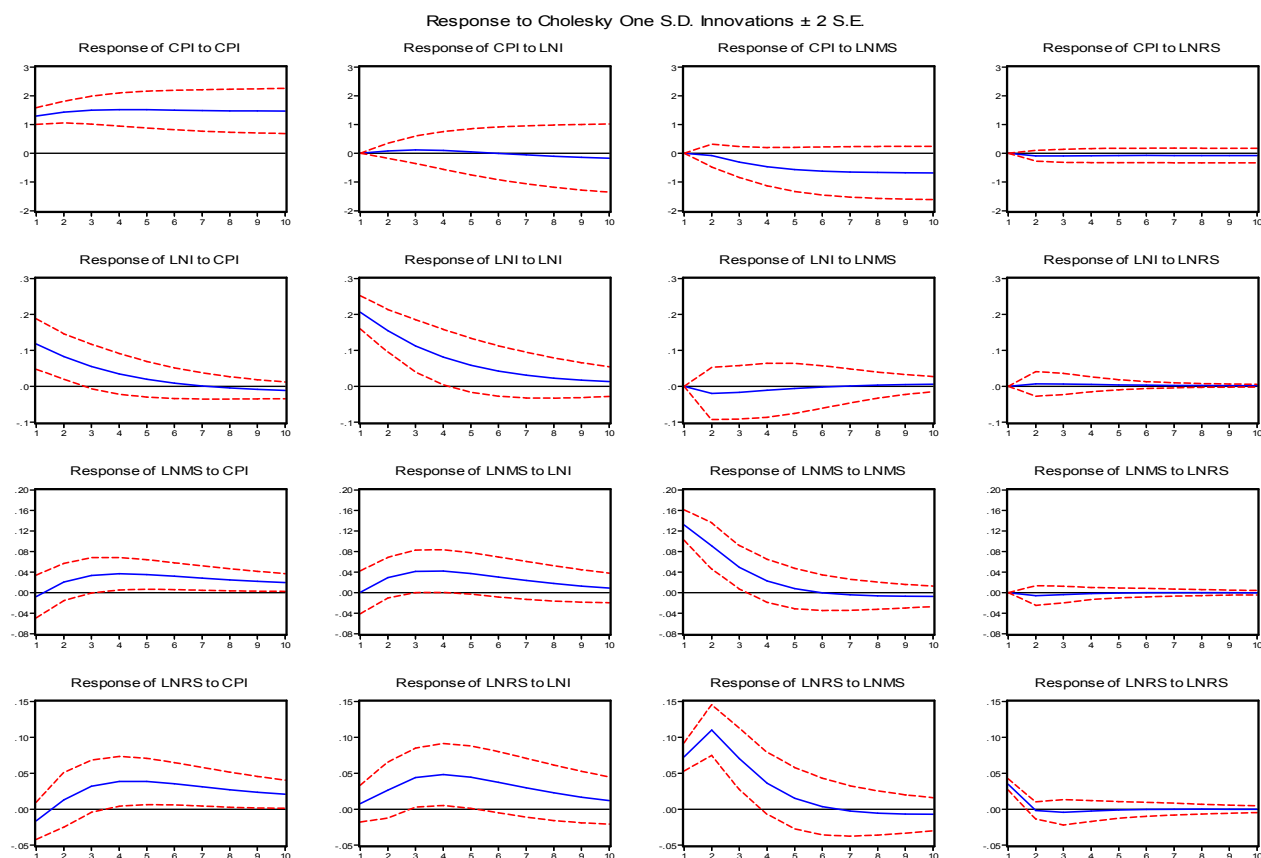


Figure 2 : Impulse Response Function of One Standard Deviation Shocks/Innovations

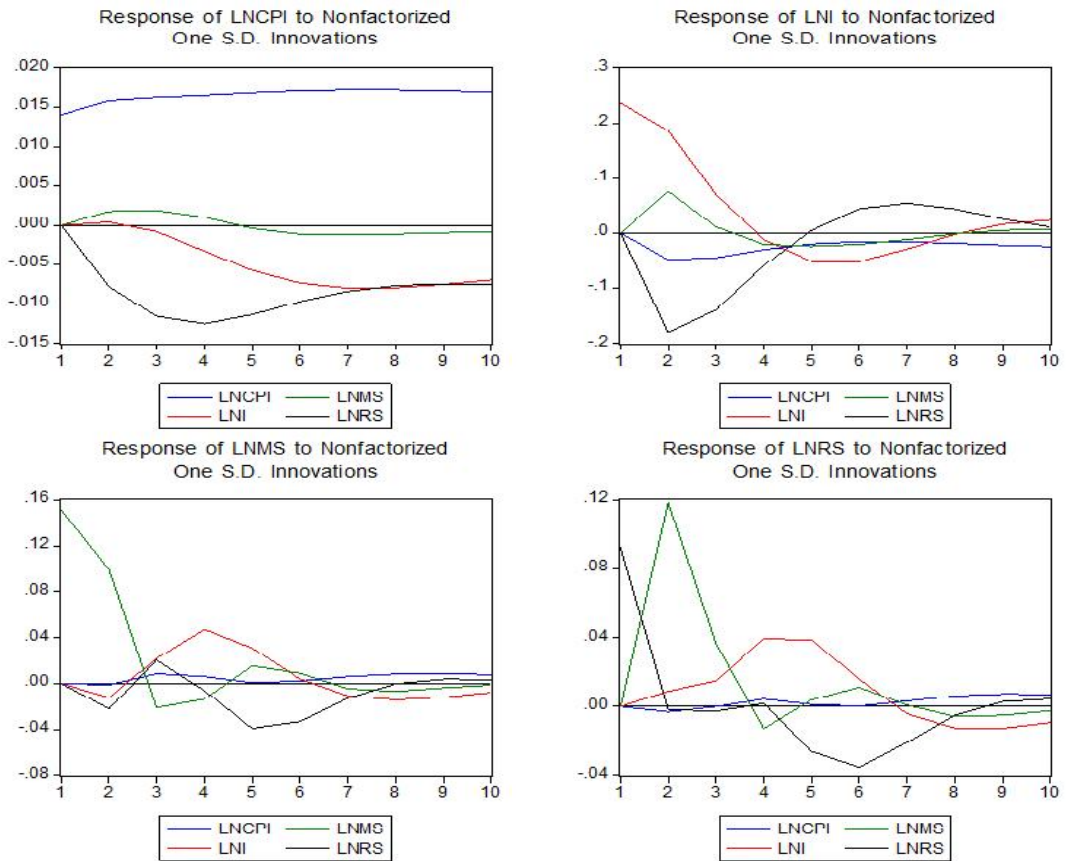


Table 6: Variance Decomposition

Variance Decomposition of LNCPI:				
Period	LNCPI	LNI	LNMS	LNRS
1	100.0000	0.000000	0.000000	0.000000
2	91.51510	0.005638	4.183008	1.594359
3	82.04942	0.085786	8.276825	2.783205
4	74.44853	0.691821	11.46135	3.380206
5	68.68582	1.858276	13.47601	3.494344
6	63.97206	3.248747	14.37545	3.402071
7	59.75034	4.535881	14.58608	3.259707
8	55.82491	5.519748	14.50111	3.123955
9	52.09478	6.162760	14.34398	3.014835
10	48.59602	6.541359	14.21384	2.937368
Variance Decomposition of LNI:				
Period	LNCPI	LNI	LNMS	LNRS
1	16.08376	82.69043	0.000000	0.000000

2	14.80494	79.46786	6.273997	4.924559
3	13.30550	79.30939	14.81151	6.582813
4	12.76404	79.74061	18.04320	6.710850
5	13.43565	78.95106	17.80914	6.519361
6	14.64942	77.90181	17.37663	6.495981
7	15.65492	77.18652	17.70393	6.616249
8	16.24821	76.80226	18.24022	6.688787
9	16.54645	76.65672	18.52063	6.677812
10	16.71254	76.62082	18.55102	6.636551
Variance Decomposition of LNMS:				
Period	LNCPI	LNI	LNMS	LNRS
1	6.175251	0.892644	91.49956	0.000000
2	6.452646	2.144009	72.91537	0.246496
3	7.007643	3.668436	58.30016	0.441028
4	9.111081	9.141648	46.39358	0.416134
5	10.24123	10.66009	39.06318	1.041383
6	10.56069	10.46195	35.10568	1.472961
7	10.60289	10.59582	32.35717	1.523352
8	10.59016	10.94374	29.92356	1.514333
9	10.57998	11.21558	27.71724	1.514540
10	10.59824	11.33208	25.80382	1.516722
Variance Decomposition of LNRS:				
Period	LNCPI	LNI	LNMS	LNRS
1	14.19175	0.000299	70.84519	56.87093
2	9.132829	0.045087	85.04189	32.86215
3	8.679683	0.488921	85.34591	29.02522
4	10.00912	5.922078	79.01844	25.09565
5	11.54899	9.874100	73.57826	21.41360
6	12.15588	10.14250	72.22435	19.86473
7	12.25395	10.04275	72.08447	19.33902
8	12.21722	10.37427	71.82355	19.14908
9	12.17572	10.75699	71.50522	19.06744
10	12.15851	10.96678	71.31776	19.03200