
QUANTITY THEORY OF MONEY: THE EMPIRICAL EVIDENCE IN NIGERIA

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ABSTRACT

The objective of this paper is to assess the relevance of the quantity theory of money in Nigeria. In doing this, a recursive vector autoregression (VAR) model is estimated using data from first quarter 2000 to fourth quarter 2013. The response of consumer price index (CPI) to money supply ranges from zero to 0.014 and it is on the average, 0.009. The variance decomposition of CPI to money supply ranges from zero percent to 31.147 percent and it is on the average, 23.376 percent. In line with the quantity theory of money, the price level is directly and significantly related with money supply but the change in the price level is not proportional with the change in money supply. Although the change in the price level is not proportional with the change in money supply, in line with the quantity theory of money, the monetary expansion is the main causal factor of the persistent increase in the price level in Nigeria.

Keywords: Money supply, Price level, Impulse response, Variance decomposition.

1 Introduction

The reduction of money supply is the traditional means through which central banks fight, moderate or prevent inflation. This is based on the quantity theory of money that inflation is always and everywhere a monetary phenomenon. The findings by Akinbobola (2012) indicate that in the long run, money supply has significant inverse effects on inflationary pressure in Nigeria. The findings by Omanukwe (2010) show the weak unidirectional causality from money supply to core consumer prices in Nigeria. The findings by these two scholars have raised doubt about the validity of the quantity theory of money and if I may ask, is the quantity theory of money not relevant in Nigeria?

The quantity theory of money states that the change in the price level is directly and proportionately related with the change in money supply. If the money supply rises without a corresponding increase in output, the additional money supply will simply bid up prices. The quantity theory of money is based on the belief that there is only one channel through which the impact of an increase in money supply is transmitted to the price level. Specifically, it is based on the perception that the impact of an increase in money supply is only transmitted directly to the price level.

While one agrees that money supply is all that matters in the price determination, it is not true that there is only one channel through which the impact of an increase in money supply is transmitted to the price level. Besides the direct transmission mechanism from money supply to the price level, the impact of an increase in money supply may be transmitted to the price level through a decrease in interest rate. As interest rate falls, exchange rate depreciates. Moreover, based on the purchasing power parity, the change in money supply is directly and proportional to the change in the price level; and the change in the price level is directly and proportional to the change in exchange rate. That is, a 10 percent increase in the money supply leads to a 10 percent increase in prices, and 10 percent depreciation in the exchange rate. The depreciation of exchange rate may be transmitted to the price level through a decrease in the consumer goods and services that are supplied from foreign countries or through an increase in the price of capital goods imported by the manufacturers as inputs or through an increase in net exports and aggregate demand. When all the variables in the transmission mechanism from money supply to the price level are included in the model, the proportional relationship between money supply and the price level may not hold. The objective of this paper is to assess the relevance of the quantity theory of money in Nigeria.

The paper consists of seven sections. The next section is literature review. Section 3 presents the methodology. The results are discussed in section 4 and section 5 concludes. Section 6 gives an account of the strengths and weaknesses of the work and section 7 provides suggestions for further studies.

2 Literature Review

Bozkurt (2014) examines money, inflation and growth relationship in Turkey by using co-integration test. For this purpose, quarterly data of money supply (M2), GDP, velocity of money and deflator are used for the period of 1999:2 – 2012:2. According to the results from this paper, money supply and velocity of money are the main determinants of inflation in the long run in Turkey. On the other hand, 1% decreases in income directly reduces inflation by 1%.

Koyuncu (2014) uses the time-series approach to investigate the impact of budget deficit and money supply on inflation in Turkey for the period of 1987-2013. They find that while there is no causality from inflation to money supply, there is causality from money supply to inflation in Turkey.

Al-Fawwaz and Al-Sawai'e (2012) analyze the short run relationship between money, the price, and the gross domestic product (GDP) growth for the Jordanian economy. Time series methods are used for the annual data for the period 1976-2009. The result indicates that there is a causal relationship from money supply to inflation, with low degree of 0.21.

Mbongo, Mutasa and Msigwa (2014) examine the effects of money supply on inflation in Tanzania. The study applies OLS, VAR and ECM techniques to examine the effect of selected variables on inflation in Tanzania. OLS and ECM results show that money supply and exchange rate have significant impact on inflation in the short and long run. The VAR findings indicate that the current inflation can be influenced by the past state inflation.

Abate and Nandeeswara (2015) show the causality effect between money supply growth and price level in Ethiopia using a co-integrated vector auto regressive (VAR) model over the period 1975 to 2012. To explore the short-run direction of causality between money supply and consumer price index (CPI), granger causality test has been applied and in order to investigate the existence of long-run relationship, co-integration analysis has been employed. The causation runs from money supply to prices, but price level does not causes money supply. The co- integration analysis established that money supply and CPI are found to be co-integrated suggesting an existence of long-run relationship.

Ahmed and Suliman (2011) examine the long-run relationships between real gross domestic product (GDP), money supply (MS) and price level (CPI) for the Sudan economy using annual data for the period of 1960 to 2005. To explore the short-run direction of causality between GDP, MS and CPI, granger causality test has been applied and in order to investigate the existence of long-run relationship, co-integration analysis has been employed. The causation runs from money supply to prices, but price level does not causes money supply. The co-integration analysis established that the real GDP, money supply and CPI are found to be co-integrated suggesting an existence of long-run relationship.

Mbutor (2014) determines the exact portion of the changes that occur in aggregate prices that could be attributed exclusively to the growth in money supply in Nigeria for the period of 1970 to 2012. The gross domestic product, nominal exchange rate, and the maximum lending rate are control variables, while inflation, proxy by the consumer price index and broad money supply are focus variables. All variables enter in logarithm forms, except interest rate. The impulse response function shows a persistent positive relationship between inflation and money supply. The variance decomposition of inflation shows that money supply accounts for up to 34.5 per cent of aggregate price changes until the tenth period.

Olorunfemi and Adeleke (2013) examine money supply and inflation rate in Nigeria for the period of 1970-2008. The study uses vector auto regressive (VAR) model. Results from the causality test indicate that there exists a unidirectional causality between money supply and inflation rate. The causality test runs from money supply to inflation.

Umeora (2010) examines the effects of money supply (M2) and exchange rates on inflation in Nigeria for the period of 1982 to 2009 using annual data. The data are analyzed using multiple regression analysis (with SPSS). The results show that money supply and exchange rate have positive and negative effects on inflation in Nigeria respectively. The two variables account for only about 12% of the variation of inflation in Nigeria.

Odiba, Apeh and Daniel (2013) investigate the effect of money supply and aggregate demand on inflation in Nigeria for the period of 1986-2009. The data are analyzed using ordinary least square regression. The results show that money supply and aggregate demand are the main determinants of inflation in Nigeria during the review period.

Akinbobola (2012) aims at providing quantitative analysis of the dynamics of money supply, exchange rate and inflation in Nigeria. The sample covers quarterly data from 1986:01 to 2008:04. The model was estimated using vector error correction mechanism (VECM). The empirical results show that in the long run, money supply and exchange rate have significant inverse effects on inflationary pressure in Nigeria.

Omanukwe (2010) examines the modern quantity theory of money using quarterly time series data in Nigeria for the period 1990:1-2008:4. The granger causality is used to examine the causality between money and prices. The result shows the weak unidirectional causality from money supply to core consumer prices in Nigeria.

Adesoye (2012) examines the co-integration causality between price, monetary aggregate and real output in Nigeria from the period 1970 to 2009 using the inflationary gap model that emanates from the quantity theory of money. The causality is found to significantly run from money supply to price. The econometric findings suggest that inflation in Nigeria is a monetary phenomenon.

The evidences from empirical literature on the effect of the change in money supply on the price level have been mixed. This paper re-examines this issue in Nigeria. The paper contributes to the existing literature by including in the model for the study all the variables in the transmission mechanism from money supply to the price level in Nigeria.

3 Methodology

3.1 Theoretical Framework of the Study

The quantity theory of money, the purchasing power parity and the money supply and demand framework show how the monetary policy shocks are transmitted to the price level. The well – known quantity theory of money equation is:

$$MV = PY \quad \text{--- (1)}$$

Where:

M = Money supply

V = Velocity of circulation of money

P = Price level

Y = Full employment output

As V and Y are constants, equation (1) can be rearranged to give:

$$P = \frac{1}{v} \left(\frac{M}{Y} \right) \quad \text{--- (2)}$$

Therefore, percentage change in money supply is equal to percentage change in the price level. So, changes in the money supply have a directly proportional impact on the price level. If the money supply rises without a corresponding increase in output, the additional money supply will simply bid up prices. The price level is everywhere a monetary phenomenon, with inflation just a product of excessive money supply growth. As the price level rises, the exchange rate depreciates based on the purchasing power parity theory (Chamberlin and Yueh, 2006).

Given the demand for money, the rise in money supply causes a fall in domestic interest rate. The fall in domestic interest rate leads to an increase outflow of short-term finance from the country and a reduce inflow, as depositors seek to take advantage of relatively higher interest rate abroad. The supply of the domestic currency on the foreign exchange market rises and the demand falls. This causes a depreciation of the exchange rate (assuming the authorities allow it) [Sloman, 2006].

Thus, the monetary policy shocks may be transmitted to exchange rate through the price channel or interest rate channel or both. Consequently, this study adopts an approach in which these two channels of the transmission mechanism from money supply to exchange rate are hybridized. As such, the following specification of the VAR which reveals both simultaneity and interaction among the variables that are closely related to exchange rate and inflation can be stated as in equation (3).

$$(CPI, MSP, INTR, EXCHR) \quad \text{--- (3)}$$

Where: CPI = consumer price index representing the price level, MSP is money supply,

INTR = interest rate and EXCHR is exchange rate.

In order to establish the transmission mechanism from exchange rate to consumer price index, this study complements the quantity theory of money, the purchasing power parity theory and the money supply and demand framework with the demand pull and cost push theories of inflation. On demand pull theory of inflation, the depreciation of the exchange rate causes a rise in demand for exports, since they are now cheaper for people abroad to buy. It also causes a fall in demand for imports, since they are now more expensive. The rise in exports and a fall in imports will lead to an increase in net exports and aggregate demand and will cause a multiplied rise in national income (sloman, 2006). But, in a short run, faster real growth may be associated with more rapid inflation. Often, this is because strong growth is the result of a rise in aggregate demand that causes real output to increase at the same time as it bids up prices (Tabi and Ondo, 2011). Based on the demand pull theory of inflation, the net exports (NEXP) that is also closely related to exchange rate and inflation is included in the VAR model as specified in equation (4).

$$(CPI, MSP, INTR, EXCHR, NEXP) \quad \text{---} \quad (4)$$

In the system of floating exchange rates, exchange rates fluctuations can have a strong impact on the level of prices through the aggregate demand and aggregate supply. On the aggregate supply, depreciation (devaluation) of domestic currency can affect the price level directly through imported goods that domestic consumers pay. However, this condition occurs if the country is the recipient countries of international prices (international price taker). Non direct influence from the depreciation (devaluation) of currency against the price level of a country can be seen from the price of capital goods (intermediate goods) imported by the manufacturers as inputs. The weakening of exchange rate will cause the price of inputs more expensive, thus contributing to a higher cost of production. Manufacturers will certainly increase the cost to the price of goods that will be paid by consumers. As a result, the price level aggregate in the country increases or if it continues it will cause inflation (Achani, Fauzi and Abdullah, 2010). That is as exchange rate depreciates, the import price index increases and an increase in import price index will lead to an increase in producer price index. The increase in producer price index will lead to an increase in wholesale and retail price index and an increase in wholesale and retail price index will lead to an increase in consumer price index. Based on the cost-push theory of inflation, the import price index, producer price index, and wholesale and retail price index that are related to exchange rate and consumer price index are also included in the model as follows:

$$(CPI, MSP, INTR, EXCHR, NEXP, IPI, PPI, WRPI) \quad \text{---} \quad (5)$$

Where: IPI is import price index, PPI is producer price index, WRPI is wholesale and retail price index and all other variables are as previously defined.

3.2 Model Specification

This paper uses an eight variable vector autoregression (VAR) approach following Mbutur (2014) to determine the proportion of the change in the price level that can be attributed to the growth in money supply. The model is summarized in the reduced-form VAR:

$$Y_t = \alpha_0 + \sum_{i=1}^n \beta_i Y_{t-i} + U_t \quad \text{---} \quad (6)$$

Where Y_t is a 8×1 vector of variables (CPI, MSP, INTR, EXCHR, NEXP, IPI, PPI, and WRPI); β_i are coefficient matrices of size 8×8 and u_t is the one-step ahead prediction error with variance-covariance matrix Σ , α_0 is the intercept. The t is time and i is the lag length.

The VAR methodology deals with several endogenous variables together. But each endogenous variable is explained by its lagged, or past, values and the lagged values of all other endogenous variables in the model; usually, there are no exogenous variables in the model.

Since there are eight variables, the VAR technique is employed because it is very useful in dealing with multivariable causality. Forecasting is an important part of econometric analysis, for some people probably the most important. Vector autoregression has become quite popular method of forecasting economic variables.

As in any standard VAR model analysis, the way the variables enter the model is extremely important for the interpretation of the results. The most appropriate ordering is: CPI - MSP - INTR - EXCHR - NEXP - IPI - PPI - WRPI. The level of CPI has great influence on the amount of money supply. Money supply affects exchange rate indirectly through CPI channel. So, CPI or money supply should come first in the VAR. Money supply affects the exchange rate, possibly indirectly through the interest rate channel. The exchange rate may affect CPI directly. The exchange rate may also affect CPI indirectly through an increase in net exports and aggregate demand or through an increase in import price index, producer price index, and wholesale and retail price index.

3.3 Estimation Method

The VAR model is estimated using e-view 7.0. The time series properties of the data are analyzed using the Augmented Dickey-Fuller (ADF) unit root test of Dickey and Fuller (1979). Test of co-integration are carried out using the Johansen (1988) maximum likelihood procedure. The lag length is to be determined by the likelihood ratio (LR), final prediction error (FPE), Akaike information criteria (AIC), Schwarz information criteria (SC), and Hannan-Quinn information criteria (HQ). The VAR residual portmanteau tests for autocorrelations are used to verify the assumption of no autocorrelation. The inverse roots of autoregressive (AR) characteristic polynomial and VAR residual normality tests are used to verify whether the VAR model satisfy the stability and normality assumptions respectively.

3.4 Data

The empirical analysis is conducted using quarterly data. The time span covered is first quarter 2000 to fourth quarter 2013. The choice of 2000 as the base year is due to the fact that the data of import price index can only be obtained from that year.

The Consumer price index (CPI) of November 2009=100 is used as a measure of consumer prices. The quarterly data of narrow money supply (M_1) is chosen as the measure of money supply rather than broad money supply (M_2), as M_2 includes foreign currency deposits and is therefore, more difficult for monetary authorities to control. The treasury bill rates (average discount rates on 3-month instruments) is the interest rate which is used to reflect changes in the Central Bank's behaviour. Exchange rate data are weighted average nominal exchange rate of the naira per unit of U.S. dollar. The U.S. dollar is used since it is the currency of Nigeria's major trading partner. The annual data of net exports are interpolated into quarterly data series using E-view. The quadratic-match average method of data processing is selected in

interpolation. The import commodity price index of January 2007=100 is used as import price index. An average implicit price deflator for agricultural and industrial goods and services is used as a measure of producer price index. Implicit price deflator for wholesale and retail trade is used as a measure of wholesale and retail price index.

The interest rate data are obtained from various publications of Central Bank of Nigeria (CBN) Statistical Bulletin. The data for other variables are obtained from CBN Statistical Bulletin (December, 2013 online edition: www.cbn.gov.ng). The data of all the variables are transformed to logarithms in order to be of the same standard. A plot of the logarithms of money supply and CPI is shown in Figure 1. From Figure 1, the money supply and CPI have shown a general upward trend for most of the periods. All the variables except interest rate are expected to have a positive relationship with CPI.

4 Results

4.1 Unit Root Test and Co-integration Analysis

The ADF test indicates that the logs of the variables are of different order of integration (zero, one and two) at 5 % level of significance (Table 1). So, the co-integration test procedure is conducted. Table 2 reports the results of the Johansen test. Both the trace and maximum eigenvalue tests denote rejection of no co-integration at 5 % level.

4.2 Vector Autoregression (VAR) Estimation

The results of the lag length selection presented in Table 3 reveals that all the five criteria except Schwarz information criterion (SC) indicate 4 lags as the optimal model. Since the logs of the variables are co-integrated, the VAR is estimated in log level with 4 lags based on Akaike information criterion (AIC).

4.3 Diagnostic Tests

A battery of tests was conducted to evaluate the statistical properties of the model. The VAR residual portmanteau tests for autocorrelations shows that the residuals of the VAR model are not correlated. The inverse roots of autoregressive (AR) characteristic polynomial show that at least, one root is equal to 1 which indicates that the VAR model is unstable. However, the VAR model satisfies the normality condition. Having satisfied to some extent the statistical prerequisites, impulse response function and variance decomposition are used to determine the effect of the change in money supply on the price level.

4.4 Impulse Response Analysis

Figure 2 presents the response of CPI to variables shocks. The response of LCPI to log of money supply [Figure 2(b)] ranges from zero to 0.014 during the ten periods and it is on the average, 0.009. In line with the quantity theory of money, the impulse response of CPI to money supply is positive indicating a positive relationship between money supply and the price level. That is, in line with the quantity theory of money, as money supply changes, the price level changes directly with the change in money supply. The positive and significant response of LCPI to log of money supply is based on the proposition that inflation is always and everywhere a monetary phenomenon.

Figure 2 shows that the theoretical expectations of all the explanatory variables, except wholesale and retail price index are met. The negative response of LCPI to log of interest rate [Figure 2(c)] is based on the premise that an increase in interest rate leads to a fall in the price level because higher interest rate can reduce aggregate demand by discouraging borrowing by households and firms. The response of LCPI to log of exchange rate [Figure 2(d)] ranges from -0.002 to 0.010 during the ten periods. It is positive indicating a positive relationship between exchange rate and CPI. The result shows that exchange rate depreciation leads to an increase in the price level through a decrease in the consumer goods and services that are supplied from foreign countries.

The positive response of LCPI to log of net exports [Figure 2(e)] is because an increase in net exports leads to an increase in aggregate demand and in monetarist view, an increase in aggregate demand causes a rise in real output or price or both. The positive response of LCPI to log of import price index [Figure 2(f)] is based on the fact that an increase in import price index affects the price level directly through imported goods that domestic consumers pay. The positive response of LCPI to log of producer price index [Figure 2(g)] is based on the fact that the increase in producer price index leads to a higher cost of production and manufacturers add the increase in the cost of production to the price of goods that are paid by consumers. The justification for the negative response of LCPI to log of wholesale and retail price index [Figure 2(h)] is that many wholesalers and retailers will simply reduce their mark-ups and profit margins in order to keep the price stable in a perfectly competitive market when the exchange rate is depreciating. The positive and significant response of LCPI to its own shocks [Figure 2(a)] indicates that inflation process in Nigeria has significant inertia, which implies that inflation expectations are largely determined by past events.

4.5 Variance Decomposition

Figure 3 shows the variance decomposition of CPI to variables shocks. The variance decomposition of LCPI to log money supply [Figure 3(b)] ranges from zero percent to 31.147 percent during the ten periods and it is on the average, 23.376 percent. This result indicates that a 100 percent increase in the money supply leads to 23.376 percent increase in prices. In line with the quantity theory of money, the relationship between money supply and the price level is statistically significant but the change in the price level is not proportional to the change in money supply.

Figure 3 shows that the increase in CPI are mainly due to its own shocks and the increase in money supply in the long run suggesting that inflation is a product of excessive money supply growth. Because inflation has the characteristic of inertia, current low inflation will lead to the low inflation in the future and high inflation normally predicts incoming high inflation in the future.

5 Conclusions

The response of CPI to money supply ranges from zero to 0.014 and it is on the average, 0.009. The variance decomposition of CPI to money supply ranges from zero percent to 31.147 percent and it is on the average, 23.376 percent. In line with the quantity theory of money, the price level is directly and significantly related with money supply but the change in the price level is not proportional with the change in money supply. Although the change in the price level is not proportional with the change in money supply, in line with the quantity theory of money, the monetary expansion is the, main causal factor of the persistent increase in the price level in Nigeria. Therefore, the quantity theory of money is very relevant in the formulation of anti-inflationary policy in Nigeria. For effective inflation control in Nigeria, both monetary policy and fiscal policy must be well coordinated to prevent excessive monetary expansion.

6 Strengths and Weaknesses of the Work

A supply shock, demand shock, and external shock together with domestic price indices are employed in a recursive VAR framework. A VAR model is useful in allowing for endogenous interactions between money supply and other macroeconomic variables. With the use of VAR model, this paper was able to establish the relevance of the quantity theory of money in Nigeria.

However, the data of the wholesale and retail price indices that are used for this study are lumped together. The unavailability of a separate data for wholesale price index and retail price index could not enable this paper to determine the effect of each of these variables on the price level in Nigeria separately. Moreover, the transmission mechanism from money supply to the price level in Nigeria has not been established.

7 Suggestions for Further Studies

Since forecasting is in the heart of economic models, such forecasts may be as robust as should be expected by its advocates if the necessary data are made available to implement them. The officially designated data collection and processing institutions in Nigeria should be able to collect separate data on wholesale and retail price indices. If this is done, then, this paper can be improved if the effects of the wholesale price index and retail price index on the price level are estimated separately.

There are two channels through which the change in money supply is transmitted to the price level. The change in money supply may be transmitted to the price level through money - price link or through the money – interest link. This paper will be improved if the channel through which the impact of the change in money supply is transmitted to the price level in Nigeria is established.

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Table 1. Augmented Dickey-Fuller Test

Variables	Levels		First Differences		Second Differences		Order of Integration
	ADF-Statistic	Prob*	ADF-Statistic	Prob*	ADF-Statistic	Prob*	
LMSP	-1.571	0.792	-8.376	0.000	-	-	I(1)
LINTR	-2.879	0.117	-7.991	0.000	-	-	I(1)
LEXCHR	-2.561	0.299	-5.399	0.000	-	-	I(1)
LNEXP	-2.482	0.335	-3.282	0.080	-8.272	0.000	I(2)
LIPI	-3.694	0.031	-9.509	0.000	-	-	I(0)
LPPI	-1.524	0.807	-2.118	0.523	-7.163	0.000	I(2)
LWRPI	-1.420	0.843	-18.544	0.000	-	-	I(1)
LCPI	-3.381	0.065	-7.405	0.000	-	-	I(1)

Test critical values: 1% -4.166

5% -3.059

10% -3.184

*MacKinnon (1996) one sided ρ -values

Source: Author's Computation.

Table 2. Johansen Test for Co-integration Vectors

Hypothesized No. of CE(s)	Trace			Maximum Eigenvalue		
	Trace Statistic	0.05 Critical Value	Prob**	Max-Eigen Statistic	0.05 critical value	Prob**
None*	393.925	159.530	0.000	139.646	52.363	0.000
At most 1*	254.279	125.615	0.000	77.574	46.231	0.000
At most 2*	176.704	95.754	0.000	49.041	40.078	0.004
At most 3*	127.663	69.819	0.000	45.499	33.877	0.001
At most 4*	82.164	47.856	0.000	33.384	27.584	0.008
At most 5*	48.780	29.797	0.000	22.253	21.132	0.035
At most 6*	26.526	15.495	0.001	19.490	14.265	0.007
At most 7*	7.036	3.841	0.008	7.036	3.841	0.008

*denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) ρ -values

Source: Author's Computation.

Table 3. VAR Lag Order Selection

Lag	LR	FPE	AIC	SC	HQ
0	NA	5.36e-12	-3.250	-2.958	-3.137
1	620.585	7.78e-17	-14.414	-11.817*	-13.397
2	127.996	3.08e-17	-15.494	-10.485	-13.562
3	107.043	1.25e-17	-16.866	-9.431	-14.007
4	105.589*	1.64e-18*	-20.081*	-10.175	-16.283*

*indicates lag order selected by the criterion

Source: Author's Computation.

Figure 1. Logarithms of Money Supply and CPI

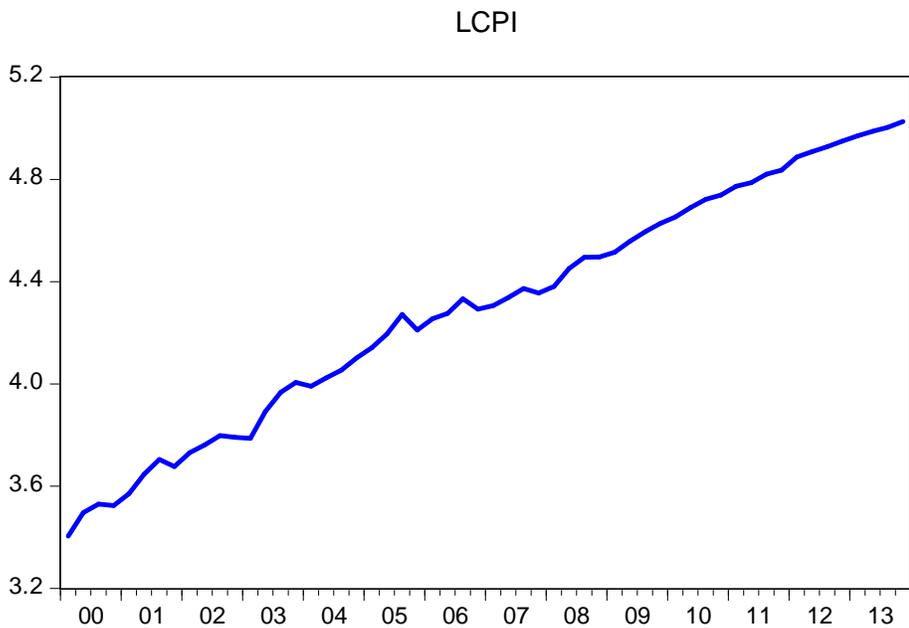
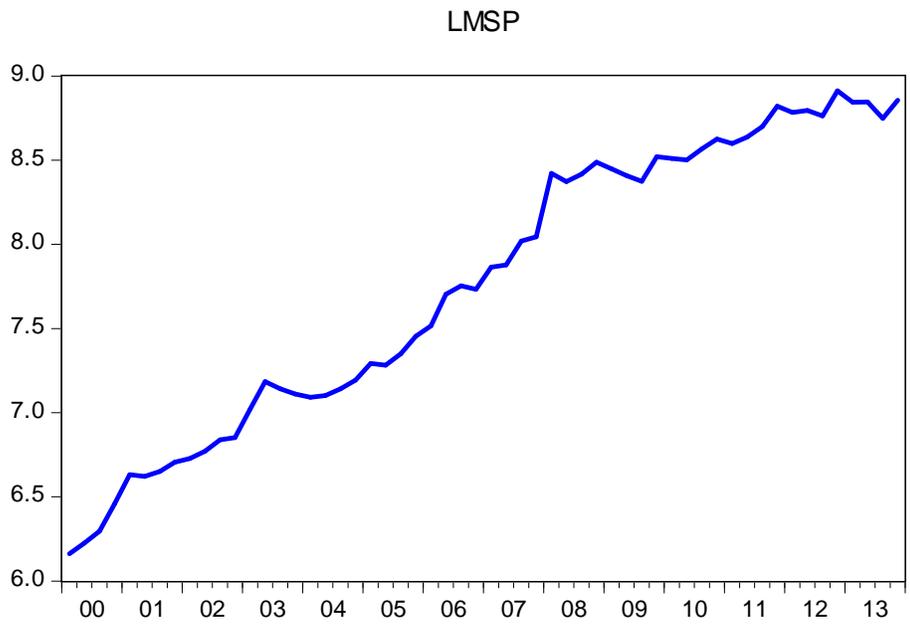


Figure 2. Response of Consumer Price Index to Variables Shocks

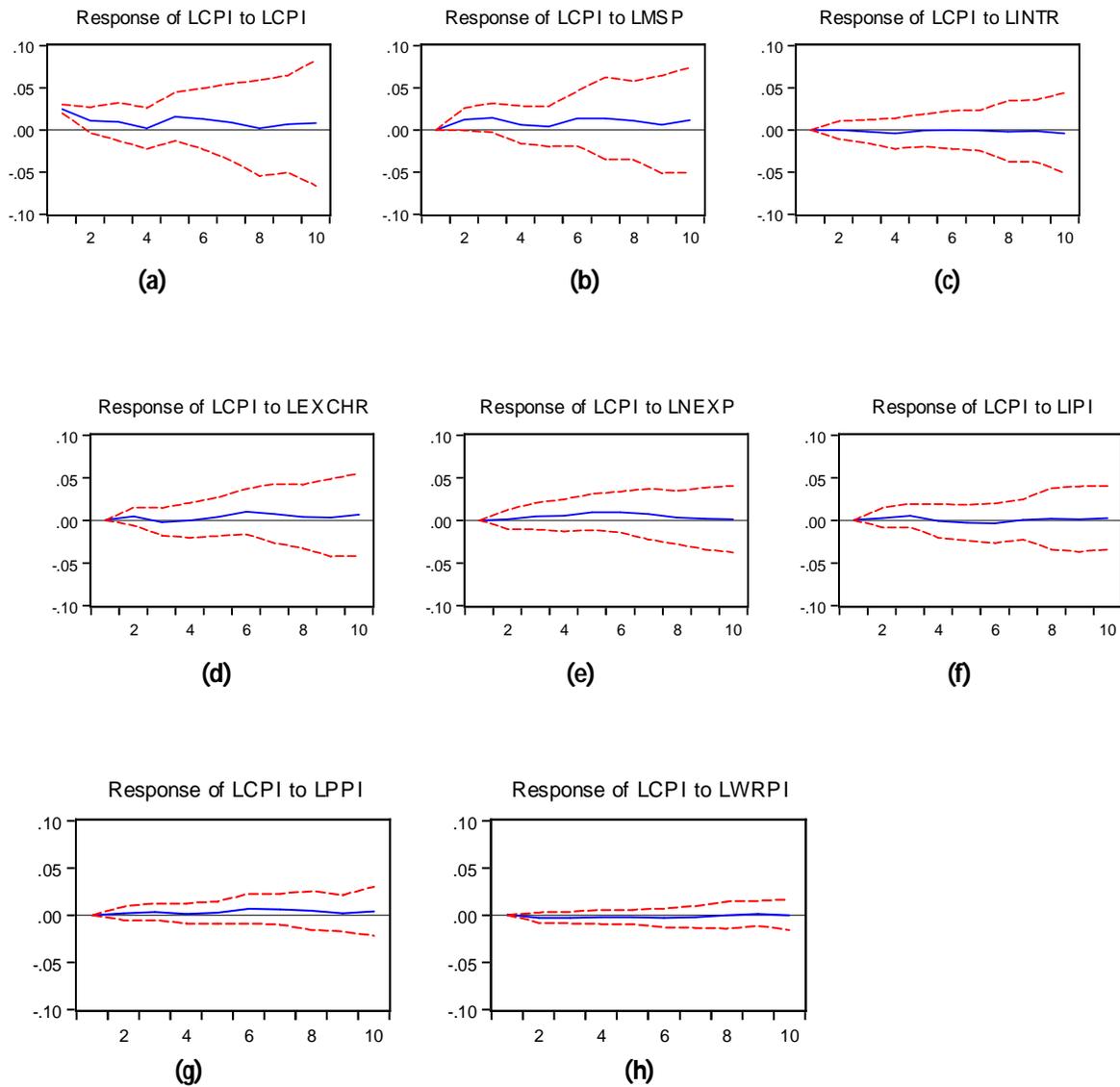


Figure 3. Variance Decomposition of Consumer Price Index to Variables Shocks

