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PRICE-OUTPUT BEHAVIOR AND MONEY SHOCKS MODELLING: CASE STUDY OF PAKISTAN

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Abstract

This research contributes over the identification of the nature exist in the relationship between money supply and output behavior. With the help of using time series data covering duration of 1961 to 2011, this study focuses on the case study of Pakistan, employing VAR Model. The Methodology surrounds over Variance Decomposition Techniques and Impulse Response Functions. Study concludes that the impact of money shocks on output and price remain significantly positive. Similarly the findings endorse the notion of money non-neutrality and its non-exogenousity in the long run. The results prove that money supply is foremost ingredient for price stabilization in Pakistan and its expansion can have some serious impact on the economy.

Keywords: Non-neutral money, VAR, Pakistan, Price-Output Behavior

INTRODUCTION

The efficacy and suitability of any monetary policy depends largely on how such macroeconomic variables namely money supply, price and output relate over the course of the business cycle. The ways these variables interact really matter to economic scholars and policy makers who have genuine interest in the use of monetary policy to advance the economy. The question of whether money supply is an endogenous factor determined by price and output or an exogenous factor affecting price and output in an economy has become something of great interest to researchers across economies and regions. This has become an issue and has received much attention from the economic writers of all ages.

Theoretically, the quantity theory of money states that, an increase in money supply would all things being equal leads to a proportionate increase in the overall price level. Expressing this theory in a simple way, it is simply saying that if money supply is doubled output will also double. This implies that money supply is an exogenous factor that affects the price level in an economy. However, Cagan (1965) sees money supply both as endogenous and exogenous. He actually proposed that money supply is endogenously determined by changes in the real sector of the economy. He stresses that in the long-run, secular trend movements in money supply are independent of real sector and are exogenously determined. To Keynes and the Keynesians, money supply does not play any significant role in output and price changes. They are of the view that output change causes changes in money supply through demand for money which implies a unidirectional causality from output to money. They argue further that structural factors are responsible for changes in the price level. To the monetarists, changes in money supply affect output and prices. An increase in money supply may raise output in the short-run, but only affects prices in the long-run. This school of thought sees the existence of Phillips curve as a vague. The emphasis is that there is unidirectional causality running from money to output and prices. These theoretical frameworks have provided a justification for empirical investigations to shift argument away from theoretical debate to that of empirical question. The debate on how these three macroeconomic variables interact both in the short-run and also in the long-run has become an empirical issue.

More importantly, based on the author's knowledge, there is no specific study on Pakistan exploring how price and output respond to money shocks using Variance Decomposition and impulse response techniques within the time frame of 1961 to 2011. This study therefore is set to determine the interaction between price output and money shock using Pakistan as a specific country of study. The rest of this paper is organized as follows: review of some of the latest empirical literature related to the issue at hand; data and econometric methodology designed to be adopted; the empirical analysis and finally the conclusion of the paper.

LITERATURE REVIEW

There have been several studies in the literature trying to explore how money, price and output relate in an economy. Empirical findings are mixed on the nature of these relationships. Researchers have used different countries with variation in sample sizes and econometric methodology. This section briefly reviews some of the latest empirical studies on this topical issue.

In the work of Das (2003), the long-run relationship between money, price and output was determined for India, the study come out with three fold results; first a bidirectional causality between money and price; second, a bidirectional causality between output and price, and finally, a unidirectional causality from money to output showing that output is a result and not a cause. Ashra et al. (2004) conducted a study on same topic for India and found a bidirectional causality running from money to price and conclude that money is not neutral and that money is not exogenous in the long-run.

Mishra et al. (2010) in their own study on same topic for India employing VAR/VECM modeling technique and found a long-run bidirectional causality between money and output. They also found a long-run unidirectional causality running from price to money and from price to output.

Also, their findings revealed a short-run bidirectional causality between money and price and short-run unidirectional causality running from output to price. Herwartz and Reimers (2006) conducted a study analyzing the dynamic relationships between money, price and output using an unbalanced panel of 110 countries. Their findings could not reject the hypothesis of homogeneity between price and money especially for high inflation economies. The study suggests that central bank, even in high inflation countries, can improve price stability by controlling money supply.

Saatcioglu and Korap (2008) in their own study explore the long-run relationships between money, price and real output in the quantity theory of money perspective for Turkey. The results show that money is non-exogenous for the long-run evolution of prices and real output. Sharma et al. (2010) investigate the relationships between money, price and output using a bivariate methodology developed by Lemmens et al. (2008). The study provides empirical evidence for money-output trade-off in the short-run while in the long-run, money supply determines prices but not output. Money supply is also found to be an exogenous factor.

From this review, we can see that empirical findings are mixed as relate to money-price-output relation across countries and regions. However, studies vary in sample size, measurement of variables and econometric methodology employed.

METHODOLOGY

This study intends to contribute to this debate by focusing on the interaction between price output and money shocks using Pakistan economy Time series data spanning the period from 1961 to 2011 were collected on variables such as money proxy by broad money aggregate (M2), domestic prices proxy by (CPI) and real output proxy by (RGDP). This data was sourced from Economic data section of State Bank of Pakistan. Meanwhile the massive floods in 2011 affected millions of people, destroyed large number of houses besides damaging agricultural lands and infrastructure. However this study does not incorporate this exogenous shock as it adversely affected the price and output figures itself. All variables are expressed in their natural logarithm forms to checkmate the problem of heteroscedasticity.

Model specification

The study begins by specifying the functional forms of the ensuing relationship between money, price and output. Each equation expressed a variable as a function of its own lag and lags of other variables. We thus have:

$$Y = f(lagY, lagM, lagP). \qquad (1)$$

$$M = f(lagY, lagM, lagP) \qquad (2)$$

$$P = f(lagY, lagM, lagP) \qquad (3)$$

Where,

Y= Output, ***M*** = Money, ***P*** = Price

We proceed by specifying the VAR version of Equations 1 to 3. We obtain the three variables, 2nd order VAR model of the form:

$$Y_t = \beta_0 + \beta_{11}Y_{t-1} + \beta_{12}M_{t-1} + \beta_{13}P_{t-1} + \alpha_{11}Y_{t-2} + \alpha_{12}M_{t-2} + \alpha_{13}P_{t-2} + \epsilon_{Yt} \qquad (4)$$

$$M_t = \phi_0 + \theta_{21}Y_{t-1} + \theta_{22}M_{t-1} + \theta_{23}P_{t-1} + \varphi_{21}Y_{t-2} + \varphi_{22}M_{t-2} + \varphi_{23}P_{t-2} + \epsilon_{Mt} \qquad (5)$$

$$P_t = \Omega_0 + \lambda_{31}Y_{t-1} + \lambda_{32}M_{t-1} + \lambda_{33}P_{t-1} + \delta_{31}Y_{t-2} + \delta_{32}M_{t-2} + \delta_{33}P_{t-2} + \epsilon_{Pt} \qquad (6)$$

In a more compact form, the trivariate VAR (2) model in Equations 4 to 6 can be expressed in matrix form as:

$$\begin{bmatrix} Y_t \\ M_t \\ P_t \end{bmatrix} = G_0 + G_1[\mathrm{L}] \begin{bmatrix} Y_{t-1} \\ M_{t-1} \\ P_{t-1} \end{bmatrix} + G_2[\mathrm{L}] \begin{bmatrix} Y_{t-2} \\ M_{t-2} \\ P_{t-2} \end{bmatrix} + \begin{bmatrix} U_{Yt} \\ U_{Mt} \\ U_{Pt} \end{bmatrix} \qquad (7)$$

Where,

G_0 is a 3×1 intercept vector of VAR, G_1[L] and G_2 [L] are 3×3 matrix polynomials in the lag operator L, and U_{YT}, U_{MT} and U_{PT} are serially independent error terms.

The VAR system can be transformed into its moving average representation in order to analyze the system’s response to money shocks. The moving average representation is used to obtain the forecast error variance decomposition and the impulse response functions. The variance decomposition shows the proportion of the unanticipated change of a variable that is attributable to its own innovations and shocks to other variables in the system.

The moving average representation of the VAR system thus becomes:

$$Z_t = \omega_0 + \sum_{i=0}^{k} \phi_i U_{t-i} \qquad (8)$$

Where Z_t represents the endogenous variables in the language of VAR.
Where w_0 is the mean of the process
φ_i the identity matrix

To identify the order of integration of each of the variables in the VAR system, the study employed Augmented Dickey Fuller (ADF) and Philips-Peron (PP) unit root tests. The study specified Augmented Dickey-Fuller (ADF) unit root regression equation of the form

$$Z_t = \eta_0 + \eta_{1t} + \eta_2 Z_{t-1} + \sum_{j=1}^{p} \eta_j \Delta Z_{t-j} + e_{1t} \qquad (9)$$

The equation regressed the first differences of the series on a constant, time trend, one lag of the series at level and lags of the series at first differences. In order to apply Philips-Peron unit root test, the study followed a regression equation of the form:

$$K_t = \Psi_0 + \mu_{1t} + \rho K_{t-1} + \phi\left[t - \frac{T}{2}\right] + \sum_{i=1}^{m} \xi_i \Delta K_{t-i} + e_{2t} \qquad (10)$$

The regression equation (9) was implemented for this study because of the possibility of any slight structural break in 1971 during the separation of East Pakistan. In both the Equations 9 and 10, represents the first difference operator, Z_t and K_t are the time series under examination η_0 , Ψ_0 are the constants terms,$e_{1t}$and $e_{2t}$are covariance stationary random error terms, p and m are the lag length to be used in the estimation. The lag length will be chosen based on Schwarz Information Criterion (SC).The null hypothesis of unit root is tested using the t-statistic with critical values calculated by Mackinnon (1991). The null hypothesis of unit root is rejected in both Equations 9 and 10 if$\eta_2$and ρ and are less than zero that is, if they are statistically significant.

ANALYSIS & DISCUSSION OF FINDINGS

Unit Root Test

The study employed Augmented Dickey Fuller (ADF) and Philips-Peron (PP) unit root tests. The results of the ADF and PP test are presented below. From Table 1, it is obvious that all the variables used in this study are non-stationary, that is, they follow a I(1) process. The hypothesis of unit root was rejected only on the first differences of each of the variables at 5% level of significance.

Table 1. Result of Unit Root Test

Variable	ADF-test			PP-Test		
	Level	1st Difference	Order of integration	Level	1st Difference	Order of integration
LGDP	P>0.05	P<0.05	I(1)	P>0.05	P<0.05	I(1)
LM2	P>0.05	P<0.05	I(1)	P>0.05	P<0.05	I(1)
LCPI	P>0.05	P<0.05	I(1)	P>0.05	P<0.05	I(1)

Cointegration Test

After the unit root test, the study proceeded by testing for cointegration using the two maximum likelihood ratio test statistics namely the trace statistic and Max-Eigen statistic traceable to Johansen and Juselius (1990). A vector of I(1) variables is cointegrated if there exists linear combination of the variables, which are stationary. This statement is evidenced in the work of Damodar NG (1995), Johansen S (1988), Johansen S (1989) and Johansen S (1995). Following this approach, the results as presented in Table 2a and 2b revealed that there exists no cointegration relationship among the variables. The two test statistics indicate that the hypothesis of no cointegration cannot be rejected.

Table 2a. Result of Johansen Multivariate Cointegration Test
- Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.228772	12.46904	21.13162	0.5021
At most 1	0.106192	5.388691	14.26460	0.6922
At most 2	0.000466	0.022380	3.841466	0.8810

Trace test indicates no cointegration at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values.

Table 2b. Result of Johansen Multivariate Cointegration Test
- Unrestricted Cointegration Rank Test (maximum eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical value	Prob.**
None	0.228772	12.46904	21.13162	0.5021
At most 1	0.106192	5.388691	14.26460	0.6922
At most 2	0.000466	0.022380	3.841466	0.8810

Max-eigenvalue test indicates no cointegration at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values

Impulse response functions (IRF)

This study employed the impulse response functions to trace out the response of current and future level of output and prices to one standard deviation change in the current value of money supply innovation. The impulse response functions help to trace out the response of output and prices to one standard deviation shock in money supply. The shock to money supply was identified based on a standard Cholesky factorization, ordering money supply first followed by prices and output.

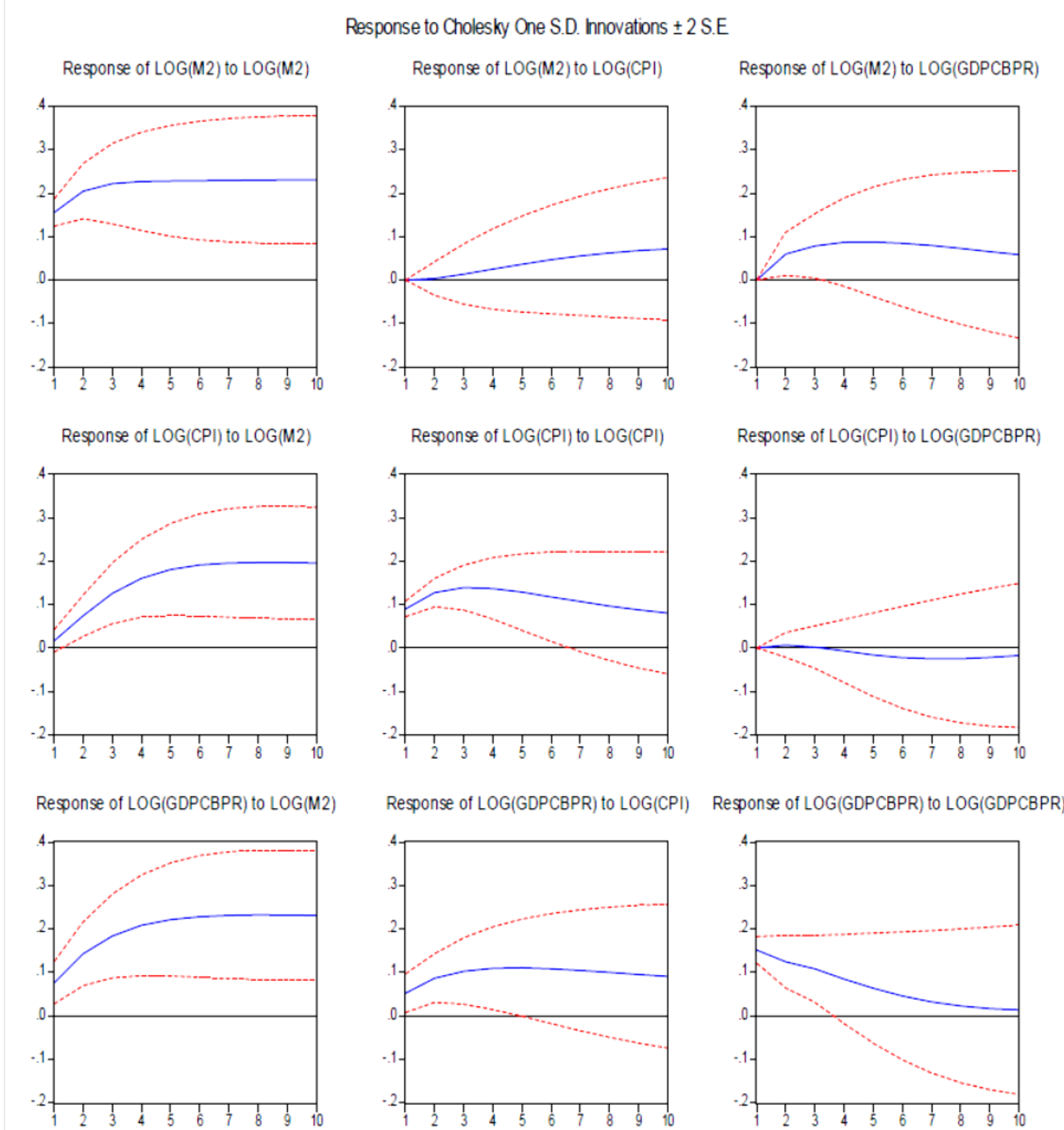
We thus assume that money supply does not respond contemporaneously to innovations to either the prices or output but price and output respond contemporaneously to innovations in money supply. This assumption is fairly reasonable considering the exogeneity nature of price and output to money supply.

The result of the impulse response functions is presented both in tabular and graphical forms below. It is clear from the table 3 (see next page) that both price and output respond positively to money shocks throughout the ten periods. It is also obvious that money shocks have greater effect on output than on price throughout the ten periods.

Table 3. Result of Impulse Response Functions

Period	LM2	LCPI	LGDP
1	0.155 (0.016)	0.000 (0.000)	0.000 (0.000)
2	0.205 (0.032)	0.003 (0.019)	0.060 (0.025)
3	0.222 (0.046)	0.013 (0.035)	0.078 (0.037)
4	0.227 (0.057)	0.025 (0.046)	0.087 (0.051)
5	0.228 (0.064)	0.036 (0.055)	0.088 (0.063)
6	0.229 (0.068)	0.047 (0.063)	0.085 (0.073)
7	0.230 (0.071)	0.055 (0.069)	0.079 (0.081)
8	0.230 (0.073)	0.062 (0.074)	0.073 (0.088)
9	0.231 (0.073)	0.068 (0.078)	0.066 (0.092)
10	0.231 (0.073)	0.072 (0.082)	0.059 (0.096)
LCPI			
1	0.016 (0.013)	0.089 (0.009)	0.000 (0.000)
2	0.074 (0.024)	0.127 (0.016).	0.006 (0.014)
3	0.125 (0.035)	0.139 (0.026)	0.002 (0.024)
4	0.160 (0.045)	0.137 (0.035)	-0.007 (0.036)
5	0.180 (0.053)	0.128 (0.044)	-0.016 (0.048)
6	0.191 (0.059)	0.118 (0.052).	-0.022 (0.059)
7	0.195 (0.062)	0.107 (0.058).	-0.025 (0.067)
8	0.197 (0.064)	0.096 (0.063)	-0.025 (0.074)
9	0.196 (0.065)	0.088 (0.067)	-0.022 (0.079)
10	0.195 (0.064)	0.080 (0.070)	-0.018 (0.083)
LGDP			
1	0.075 (0.024)	0.052 (0.022)	0.152 (0.015)
2	0.142 (0.037)	0.087 (0.028).	0.124 (0.030)
3	0.184 (0.048)	0.103 (0.038).	0.108 (0.038)
4	0.208 (0.058)	0.109 (0.048)	0.085 (0.051)
5	0.222 (0.065)	0.110 (0.056)	0.063 (0.063)
6	0.228 (0.070)	0.108 (0.063)	0.045 (0.074)
7	0.231 (0.073)	0.104 (0.070)	0.032 (0.082)
8	0.232 (0.074)	0.100 (0.075)	0.023 (0.089)
9	0.232 (0.075)	0.095 (0.079)	0.017 (0.094)
10	0.231 (0.075)	0.091 (0.083)	0.013 (0.098)

Figure 1. Impulse Response (Graphical Presentation)



Variance decomposition:

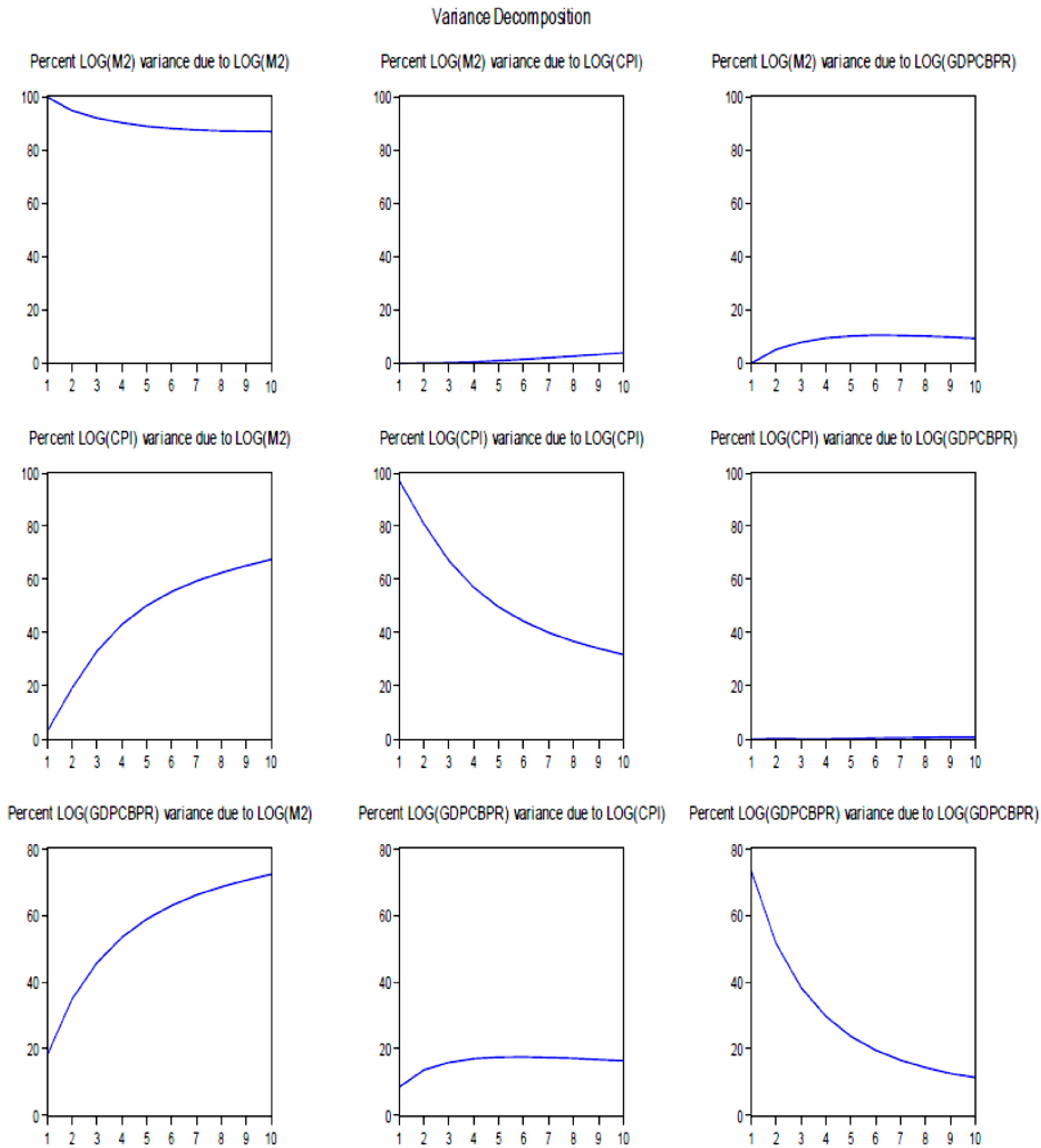
The study employed variance decomposition to measure the proportion of forecast error variance in one variable explained by innovations in itself and that of other variables. The variance decomposition suggests that shocks to money supply as shown in Table 4, explained about 3% of shocks to price in the first period, it increases in effects to about 50% in the fifth period and further increases to 67% in the tenth-period.

Table 4. Result of Variance Decompositions

Period	S.E	LM2	LCPI	LGDP
1	0.155	100.00	0.000	0.000
2	0.264	94.81	0.014	5.176
3	0.354	92.07	0.147	7.782
4	0.430	90.22	0.435	9.349
5	0.496	88.97	0.865	10.161
6	0.555	88.14	1.397	10.456
7	0.608	87.61	1.992	10.403
8	0.657	87.23	2.605	10.127
9	0.703	87.07	3.206	9.773
10	0.746	86.97	3.774	9.256
LCPI				
1	0.091	2.96	97.04	0.00
2	0.173	19.03	60.84	0.13
3	0.255	32.96	66.97	0.07
4	0.331	43.00	56.91	0.09
5	0.398	50.15	49.63	0.23
6	0.457	55.39	44.20	0.41
7	0.509	59.40	40.03	0.57
8	0.555	62.59	36.73	0.68
9	0.595	65.22	34.05	0.73
10	0.632	67.44	31.84	0.73
LGDP				
1	0.177	18.07	8.52	73.41
2	0.273	34.81	13.63	51.56
3	0.361	45.74	15.88	38.38
4	0.439	53.39	16.95	29.66
5	0.508	58.90	17.39	23.70
6	0.569	63.02	17.47	19.52
7	0.624	66.17	17.33	16.50
8	0.674	68.66	17.07	14.27
9	0.719	70.68	16.74	12.58
10	0.761	72.35	16.38	11.27

Money shocks also significantly contribute to shocks to price and output but with greater effects on output than on price. This is evidenced in Table 4 where money shocks explained about 18% of shocks to output in the first period. This has increased to about 72% in the tenth period. This suggests that money shocks turned out to have positive and significant effects on output.

Figure 1. Variance Decomposition (Graphical Presentation)



CONCLUSION

The findings presented in this study was based on the results obtained from the econometric analysis of the Pakistan Economy, data covering variables such as money supply, consumer price index and gross domestic product from the period of 1961 to 2011. The findings demonstrate that money shocks have positive effect on output and price. Both output and price responds positively to shocks in money supply. However, the findings revealed that money supply generated as the major source of deviation to output while output constituted the larger source of shocks to money supply. The results also demonstrated that the long-run effect of money shocks on price and output is greater than its short-run effect. This implies that money shocks have significant effect on price and output both in the short-run and in the long-run. On the whole, we found an empirical justification for the proposition that monetary policy is an important tool for stabilization in price, especially in highly inflated economies like that of Pakistan's. So study concludes that money is non-exogenous.and non-neutral in long-run.

There are certain limitations of this study as at times, governments tried to show a better picture of the economy through distorted figures and manipulated data in its official public documents which should be kept in mind while observing findings of this study. Moreover, due to limited availability of time and merely a case study, the scope of this research does not allow us to generalize these results for most of the developing countries which shows that there exist huge scope for further development in these findings.

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