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RELATIONSHIP BETWEEN MONEY SUPPLY, OUTPUT AND PRICE LEVEL IN INDIA

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ABSTRACT

This paper investigates causal relationships among three macroeconomic variables for India. For that purpose, study has undertaken time series data for the period from 1950-51 to 2016-17. Lag length is selected using standard criteria – LR, FPE, AIC, SC and HQ through VAR estimation. Long run and short run estimates have been investigated using Johansen Co-integration and Vector Error Correction approached. Causal relationships have been observed using Granger causality test. The estimation of vector error correction model based on VAR indicates that there exists a bidirectional causality relationship between price level and growth of output in India whereas there are unidirectional causal relationship runs from money supply to inflation and growth of output in the long run. However, in the short-run, the bidirectional causality exists between money supply and price level and unidirectional causality exists from output to price level. Study concludes that money supply is effective tool to tame inflation in India. It has a positive effect on inflation as expected. Growth of Output has negative effects on inflation. Monetary theories indicate that an increased money supply in an economy often helps to increase or moderate inflationary targets. The supply side of inflation is a key component for the rising inflation in India and an increase in GDP may positively persuade the control of inflation.

Key words: Price Level, Cointegration, VECM, Granger Causality.

Introduction

Continuous increase in general price level of the economy is known as inflation. The rise in price index and value loss in money is the process of inflation; rapid economic growth often has an unintended consequence of increased inflation. In fast-growing developing countries such as India, the problem of inflation takes major importance as the rising inflation has far-reaching economic and social implications. From a business and economic point of view, the inflation rate directly relates to money supply, gross domestic product etc. In determining the price level of an economy, important macroeconomic variables of money and output growth predominantly play an essential role. A major contributing factor in the increase in general price level is a continuous and substantial increase in money supply in India is due to being very responsive to the production of goods and services. The fall in production of goods and services is the originating cause in the India case, creating a good shortage situation comparative to demand and therefore leading. The close association between these two significant macro variables guides us to the effect on price.

Due to high inflation, people need more money to make day to day transactions and every consumer has to carry more money with them owing to higher price level as value of money turns down. Due to the corrosion of the real value of money, the effect of inflation rigorousness is more social than economic. The current inflationary environment in the country may be responsible for lower deposit growth and lower savings to some extent. Therefore, the government follows a combination of several policy measures such as appropriate fiscal and monetary policies to control the budget deficit, the productivity development of all the sectors of the economy, the growth of investment to encourage output and market controls on prices of essential consumer goods.

The study of the causal relationship among the variables such as money supply, price and output has been an important issue for economists, researchers and policy makers because such relationship reveals the effectiveness of different monetary policies. The relationship among these variables has occupied central place in history of economic thought. The Keynesians emphasize that a change in income causes changes in money stocks through the demand for money, which means that there exists a unidirectional causality from income to money without any feedback. The Monetarists, on the other hand, claim that money supply as a main factor leads to changes in income and prices. Therefore, the direction of causation runs from money to income and prices without any feedback. These theoretical frameworks have provided a justification for empirical investigations to shift argument away from theoretical debate to that of empirical question. We discuss on how these three macroeconomic variables interact both in the short-run and long-run that has become an empirical issue.

1. Review of literature

Nachane and Nadkarni (1985) examined the causality relationship between money, output and price level in India over the period from 1960-61 to 1981-82 and used four tests: viz., Sims, Hsiao's Final Prediction Error (FPE), Cross-correlation test and Transfer function test. They found that money supply is a major determinant of nominal national income in India and found that the test results were a uniformity, indicating a unidirectional causality from money supply to price level. Dhanasekaran (1996) examined the relationship between money, output and prices in India during the period from 1970 to 1992. The study applied price equation static and dynamic models and found that a rise in the growth rate of national output accompanied by a control of money supply would reduce the price level in India. Domac and Carlos (1998) examined the performance and determinants of inflation in Albania. The study applied Granger Causality tests and the result showed that M1 and the exchange rate have significant foretelling content for CPI. The results of cointegration and error correction technique made sure that inflation is positively connected to the real income in the long run.

Mishra et al., (2010) Investigated the causality relationship between money supply, price level and output in India using annual data for the period from 1950-51 to 2008-09. The study employed Johansen cointegration and VECM (Vector Error Correction Model) test. The result found that in the long-run, bidirectional causality exists between money supply and output while unidirectional causality runs from price level to money supply and output. But in the short-run, the bidirectional causality exists between money supply and price level while unidirectional causality exists from output to price level. Sahadudhen I (2012) conducted a study on the determinants of inflation in India on the quarterly data 1996 Q1 to 2009 Q3 by employing the cointegration and VECM test. The study concluded that GDP and broad money have positive effects on inflation. On the other hand, The exchange rate and interest rates affect the inflation negatively.

Lim and Sek (2015) tested the data of 28 high and low inflation countries during 1970-2011 by applying VECM and ARDL models. The study stated that growth of GDP and imports impact long run inflation in low inflation countries. Money supply, national ex-penditure and GDP growth rate determine the inflation in the long run in high inflation countries.

Yaucer (2017) examined the relationship between money and prices in Albania from 1995 to 2013. The study employed Johansen cointegration and the Granger Causality Test. The study showed that unidirectional causality runs from money supply to price level in Albania.

2. Methodology

2.1. Objectives of the Study

- To evaluate long run and short run causality relationship between money supply, output and price level in India using Co-integration test and Vector Error Correction Model.
- To analyze how wholesale price level respond to macroeconomic variable shocks by estimating Impulse response functions and Variance decomposition

2.2. Hypotheses of study

Based on the stated objectives of this study, the following hypothesis have been framed and tested

- Money supply influences the output and therefore, there is a unidirectional causation running from money supply to the output. Output affects the money supply. Thus, there is a unidirectional causation running from output to the money supply. A bidirectional causal relationship between money supply and output exists.
- Money supply influences the price level and therefore, there is a unidirectional causation running from money supply to the price level. Price level affects the money. Thus, there is a unidirectional causation running from price level to the money supply. A bidirectional causal relationship between money supply and price level exists.

- Output affects the price level and therefore, there is a unidirectional causation running from output to the price level. Price level affects the output. Thus, there is a unidirectional causation running from price level to the output. A bidirectional causal relationships exists between these variables.

2.3 Methodology and Data Sources:

In the present paper, we inspect the issues of causality between money supply (M3) defined by RBI, price level (Wholesale Price Index), Output as measured by GDP at factor cost. The required data were collected from the Annual Reports of Reserve Bank of India, annual data for M3, GDP at factor cost and WPI for 1950 to 2017.

2.3.1. Stationarity test

First, all the variables were converted into natural logarithmic form for reducing variations. In the second step, if the mean and variance of a time series is constant over time, it is stationary. This means that the series does not have an upward or downward trend over time. Further, the standard estimation procedures cannot be applied to a model that contains a nonstationary variable. In this case, if we apply the standard estimation procedures to the model of a nonstationary variable, it results in spurious regression. Therefore, there is a need for testing whether or not the series is stationary before applying to a model. Then, nonstationary series is transformed into stationary by taking the first differences or the number of differencing operation it takes to make the series stationary. The stationarity of variables included in the analysis were examined by a Unit Root test. In this context, the Augmented Dickey Fuller (ADF) test was employed to check the stationarity of the selected variables and the following three models were estimated.

Model I (without any constant and trend)

$$\Delta Y_t = \theta Y_{t-1} + \gamma i \sum_{i=1}^{P} \Delta Y_{t-i} + \varepsilon_t \tag{1}$$

Model II (with constant but no trend)

$$\Delta Y_t = \beta_1 + \theta Y_{t-1} + \gamma i \sum_{i=1}^{P} \Delta Y_{t-i} + \varepsilon_t \tag{2}$$

Model III (with constant and trend).

$$\Delta Y_t = \beta_1 + \beta_2 t + \theta Y_{t-1} + \gamma i \sum_{i=1}^{P} \Delta Y_{t-i} + \varepsilon_t \tag{3}$$

In this context, the Phillips-Perron (PP) test was employed to check the stationarity of the selected variables and three models were estimated. Dickey-Fuller test requires that the error term is serially uncorrelated and homogeneous while the Phillips-Perron test is valid even if the disturbances are serially correlated and heterogeneous. The Phillips-Perron test is based on the following models:

Model I (without any constant and trend)

$$\Delta K = \rho K_{t-1} + \phi \left[t - \frac{T}{2} \right] + \sum_{i=1}^{m} \lambda_i \Delta k_{t-i} + \nu_t \tag{4}$$

Model II (with constant but no trend)

$$\Delta \mathrm{K} = \alpha_1 + \rho \mathrm{K}_{t-1} + \phi\left[t - \frac{T}{2}\right] + \sum_{i=1}^{m} \lambda_i \Delta k_{t-i} + \nu_t \tag{5}$$

Model III (with constant and trend).

$$\Delta \mathrm{K} = \alpha_1 + \beta_{2t} + \rho \mathrm{K}_{t-1} + \phi\left[t - \frac{T}{2}\right] + \sum_{i=1}^{m} \lambda_i \Delta k_{t-i} + \nu_t \tag{6}$$

Both ADF and PP test represents the first difference operator. Y_t and K_t are the time series under examination Where α_1 and β_1 is intercept. t is linear time trend. p and m are the number of lagged first differences. ε_t and ν_t are pure white noise. The null hypothesis is unit root and the alternative hypothesis is level stationarity. The null hypothesis of unit root is tested using the t-statistic with critical values calculated by Mackinnon. If the coefficient of the lag of $\mathrm{Y}_{t-1}(\theta)$ and $\mathrm{K}_{t-1}(\rho)$ is significantly different from zero, then the null hypothesis is rejected. The equations (1) and (4) are without any drift and trend whereas the equations (2) and (5) includes only drift and the equations (3) and (5) includes both drift and a deterministic trend. All three models were tested with Unit Root test in both methods (i) First Difference When the value of ADF and PP is statistically significant, is considered as stationarity of series. All of the empirical tests have been carried out using the E-views 7 econometrics package. An essential step of time series empirical analysis is to first determine the order of integration for each of the three variables used in the analysis. The Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were carried out to verify the stationarity of the time series data. The tests were carried out with the null hypothesis of non stationarity (unit root) for each data series and the results indicate all the three data series are at the non-stationary level and become stationary after first-order difference. It is clear that the null hypothesis of unit roots for all the time series are rejected at their first differences since the ADF test and PP test statistic values are less than the critical values at 10%, 5% and 1% levels of significances. Thus, the variables are stationary and integrated of same order, i.e., I(1).

2.3.2. Cointegration test

Unit root is confirmed for a data series and then the next step is to examine whether there exists a long-run equilibrium association among variables. This is known as cointegration analysis; it is very significant to avoid the risk of spurious regression. Cointegration analysis is important as the VAR model in the first difference is improperly specified due to the effects of a common trend if two non-stationary variables are cointegreted. Once the cointegration association is identified, then the next step is to include residuals from the vectors (lagged one period) in the dynamic VECM system. In this stage, cointegrating association among the variables is identified by using Johansen's cointegration test. To establish the presence of cointegrated vectors in non-stationary time series, Johansen's test applies the maximum likelihood procedure. The testing hypothesis using the Johansen maximum likelihood procedure is the null of non-cointegration against the alternative of existence of cointegration.

The estimation of an unrestricted closed p^{th} order VAR in k variables is the first step in the Johansen framework. The VAR model as considered in this study is as follows:

$$Z_t = A_1 Z_{t-1} + A_2 Z_{t-2} + ... + A_n Z_{t-n} + BY_t + \nu_t \tag{7}$$

Where Z_t is a *K* -vector of non-stationary I(1) endogenous variables, Y_t is a *d* -vector of exogenous deterministic variables, $A_{1..........\,....} A_P$ *and B* are matrices of coefficients to be estimated, and ν_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

The VAR model stated above is generally estimated in its first-difference form as most economic time series are non-stationary. The form is as:

$$\Delta Z_t = \Pi Z_{t-1} + \sum_{i-1}^{n-1} \Gamma_i \Delta Z_{t-i} + BY_t + \nu_{t^{..}} \tag{8}$$

Where

$$\Pi = \sum_{i-1}^{n} A_{i-1,} and \Gamma_i = -\sum_{J=i+1}^{n} A_J \tag{9}$$

Granger's representation theorem states that if the coefficient matrix Π has condensed rank *r* < *k*, then there is *k* × *r* matrices λ *and* γ each with rank *r* such that $\Pi = \lambda\gamma$ *and* $\gamma' Y_t$ is I (0). Each column of γ is the co-integrating vector and *r* is the number of co-integrating relations (the *co-integrating rank*). Measuring the speed of adjustments in ΔZ_t. *is executed by* λ is the matrix of error correction parameters. The trace test statistic and the maximum eigenvalue test statistic are the two important statistical tests based on which The Johansen approach to cointegration test is executed.

Trace test statistic

The trace test statistic can be specified as: $\tau_{trace} = -T \sum_{i=r+1}^{k} \log(1-\delta_i)$. The *i th is* largest eigenvalue of matrix Π and the number of observations is T. In this trace test, the null hypothesis is examined that the number of different cointegrating vector(s) is less than or equal to the number of cointegration relations (*r*).

Maximum eigenvalue test

The maximum eigenvalue test studies the null hypothesis of accurately *r* cointegrating relations against the alternative of *r* +1 cointegrating relations with the test statistic: $\tau_{\max} = -T \log(1-\delta_{r+1})$, where δ_{r+1} the $(r+1)^{th}$ largest squared eigenvalue. In the trace test, the null hypothesis of r = 0 is examined against the alternative of r + 1 cointegrating vectors. It is well known that the choice of lag length is extremely sensitive in the Johansen's Cointergation test. So, first, In order to find an suitable lag structure, a VAR model is integrated to the time series data and then five different criteria viz. The Akaie Information Criterion (AIC), Schwarz Criterion (SC), HQ (Hannan-Quinn Information Criterion, FPE Final Predication Error and the Likelihood Ratio (LR) test have been used to select the appropriate lag order required in the cointegration test.

2.4 Vector Error Correction Model (VECM)

Cointegration is found existing between variables. Then, construction of error correction mechanism to model dynamic relationship is required. The construction of error correction is obligatory in order to indicate the speed of adjustment from the short-run equilibrium to the long-run equilibrium state.

A Vector Error Correction Model (VECM) is a restricted VAR designed for using with nonstationary series that are known to be cointegrated. VECM explains on the model examined is adjusting in each time period towards its long-run equilibrium state when the equilibrium conditions are enforced. If it is that the variables are to be cointegrated, then, in the short run, deviations from long- run equilibrium will react to the changes in the dependent variables so that they can be forced their movements towards the long-run equilibrium state. Therefore, each of the error correction terms derived from the cointegrated vectors point out an independent direction where a stable meaningful long-run equilibrium state exists. The VECM has cointegration relations constructed into the specification, which restricts the long run behavior of the endogenous variables to meet to their cointegrating relationship while allowing for short-run adjustment dynamics. The cointegration term is the error correction term because of the deviation from long-run equilibrium corrected progressively through a series of partial short-run adjustments. The deletion of the insignificant variables is allowed by the dynamic specification of the VECM when the error correction term is retained.

The speed of adjustment of any disequilibrium in the direction of a long-run equilibrium state is pointed out by the size of the error correction term. In this study, Hendry's error correction model is used. The general form of the VECM is given below:

$$\Delta Y_t = \gamma_0 + \delta_1 EC_{t-1}^1 + \sum_{i-1}^{p} \gamma_i \Delta Y_{t-i} + \sum_{j-1}^{q} \gamma_j \Delta Z_{t-j} + v_{1t} \tag{10}$$

$$\Delta Z_t = \lambda_0 + \delta_2 EC_{t-1}^2 + \sum_{i-1}^{p} \lambda_i \Delta Z_{t-i} + \sum_{j=1}^{q} \gamma_j \Delta Y_{t-j} + v_{2t} \tag{11}$$

Where Δ is the first difference operator; EC_{t-1} is the error correction term lagged one period; l is the short-run coefficient of the error correction term ($-1<\delta<0$); and v is the white noise. The error correction coefficient (δ) is significant in this error correction estimation as the greater the coefficient specifies higher speed of adjustment of the model from the short-run to the long-run.

The error correction term stands for the long-run relationship. The occurrence of long-run causal relationship is pointed out by a negative and significant coefficient of the error correction term. When both the coefficients of the error correction term in both the equations are significant, it implies the bidirectional causality. When only one coefficient as λ_1 is negative and significant, it evokes a unidirectional causality from Z to Y indicating that Z drives Y in the direction of long-run equilibrium but not in the opposite direction. Correspondingly, when only another one coefficient as λ_2 is negative and significant, it points out a unidirectional causality from Y to Z, implying that Y drives Z in the direction of long-run equilibrium but not in the opposite direction.

Further, the short-run cause and effect relationship between the two variables is pointed out by the lagged terms of ΔY_t and ΔZ_t emerged as explanatory variables. Hence, it is meant that Z causes Y only when the lagged coefficients ΔZ_t become significant in the regression of ΔY_t while in contrast, Y causes Z only when the lagged coefficients ΔY_t become significant in the regression of ΔZ_t.

3. Analysis, results and discussion

3.1 Stationary analysis of macro variables

The stationary of the data were checked using unit root test. The results obtained from the Augmented Dickey Fuller (ADF) and Phillips-Parron (PP) unit root tests on residuals are presented in table 7.1. In this study, the researcher has checked the unit root at different levels (base, first difference level) by estimating value and using 1% Mackinnon's critical value. The stationary f variable is proved only when the estimated value is less than the critical value at 1% level of significance.

Table 1: Unit root results for the macro variables in the study periods

Variables in their first differences with intercept	ADF statistics	Critical values	Intercept coefficient	Decision
LD WPI	-6.0569*	At 1% : -3.5420	-0.7405*	I(1)
LDMS	-5.2698*	At 5% : -2.9100	-0.3683*	I(1)
LDGDP	-7.8171*	At 10% : -2.5926	-0.9809*	I(1)
PP adj t-statistics				
LDWPI	-6.0982*	At 1%: -3.5420	-0.7405*	I(1)
LDMS	-5.3822*	At 5% : -2.9100	-0.3682*	I(1)
LDGDP	-7.9186*	At 10%: -2.5926	-0.9809*	I(1)

As an important step in the time series empirical analysis, the order of integration for each of the three variables used in the analysis is required to be determined. For this purpose, The Augmented Dickey-Fuller (ADF) and Phillips-Parron (pp) unit root test is used and the result of such test is shown in Table 1. It is proved that at the first difference, the null hypothesis of unit roots for all the time series are rejected, as the statistic values of ADF and PP test are less than the critical values at 10%, 5% and 1% levels of significances. Hence, the variables are stationary and integrated of same order, I (1).

3.2. Lag Order Selection

Five different criteria viz. 1) LR : sequential modified LR test statistic (each test at 5% level) 2) FPE : Final prediction error 3) AIC : Akaike information criterion 4) SC : Schwarz information criterion 5) HQ : Hannan-Quinn information criterion have been used to determine the significant lag values. The below table: 2 shows the values of various lag order selection criteria

Table 2: VAR lag order selection criteria

Lag	logL	LR	FPE	AIC	SC	HQ
0	341.5379	NA	3.03e-09	-11.09960	-10.99579	-11.05892
1	373.9774	60.62461	1.41e-09	-11.86811	-11.45286	-11.70537
2	384.8042	**19.16893***	**1.33e-09***	**-11.92801***	**-11.47914***	**-11.93458***
3	390.4271	9.402167	1.49e-09	-11.81728	-10.77915	-11.41043
4	396.6033	9.719864	1.66e-09	-11.72470	-10.37512	-11.19579
5	405.0573	12.47313	1.72e-09	-11.70680	-10.04578	-11.05583

* *indicates lag order selected by the criterion*

The table 2 shows that 5 out of 5 criteria LR, FPE, AIC, SC and HQ indicate selection of lag order 2.

The existence of a long-run relationship among LDWPI, LDMS and LDGDP, i.e. a cointegrating relationship was tested by using the Johansen procedure.

Table 3: Johansen cointegration test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No.of CE (S)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob****
None*	0.335962	43.35565	29.79707	0.0008
At most 1*	0.228539	17.15299	15.49471	0.0279
At most 2	0.008510	0.546997	3.841466	0.4595
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No.of CE (S)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob****
None*	o.335962	26.20266	21.13162	0.0089
At most 1*	0.228539	16.60600	14.26460	0.0209
At most 2	0.008510	0.546997	3.841466	0.4595

Note: *Trace test and Max-eigenvalue test indicates 2 Cointegrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values*

In the next step, Johansen's Trace and Maximum Eigenvalue tests were used to test the cointegration among the stationary variables. Table (3) indicates that the Trace tests point out the existence of two cointegrating equation at 5% level of significance as well as the maximum eigenvalue tests, which confirms this result. It is concluded that LDMS and LDGDP variables are cointegrated with aggregate price level independently. Therefore, aggregate price level, money supply, and real output have long run equilibrium relationships between them. The objective of this study is to observe the associations of aggregate price to money supply and Real GDP since the variables are cointegrated. Therefore, the aggregate price level normalizes the cointegrating vectors.

Table 4: Normalized cointegrating coefficients

LDWPI	LDMS	LDGDP	C
1.000000	0.749557	-0.721174	-3.907572
	(0.06482) [-7.92813]	(0.19112) [2.16849]	

Note: *Standard errors in () and t- statistics in []*

The table (4) shows the normalized coefficients of long run relationship and it is seen that long run effect of money supply on aggregate price level is positive and that is statistically significant at 1% level. It is observed that if money supply increases by 1%, it will result the increase of inflation level by 74.96%. Therefore, there exists a positive direction of relation where as Real GDP is negatively related to aggregate price in the long run and it is statistically significant at 1% level. The general price level decreases by 72.12% to the extent of economic growth increases by 1%. Hence, these findings are consistent with monetarist view that when keeping output constant in the long run, only a change in money supply will lead to price change.

Therefore, there exists a long-run equilibrium relationship among the three variables of this study and in the short-run, deviations from this equilibrium likely exist. Hence, there is a need for verifying whether such disequilibrium meets to the long-run equilibrium or not. Further, Vector Error Correction Model can be used to generate this short-run dynamics and the short-run dynamics can be generating by using Vector Error Correction Model. The error correction mechanism gives a means whereby a proportion of the disequilibrium is corrected in the next period. Hence, the short-run and long run behavior are reconciled by means of the error correction mechanism.

Table 5: Vector error correction model (dependent variable: wholesale price index)

Error Correction	D (LWPI)	D (LMS)	D (LGDP)
CointEq1	-0.13659 (0.0608) [-2.2285] {0.0130}	0.1100 (0.0351) [3.1399] {0.0027}	-0.1151 (0.0399) [-2.8833] {0.0056}
D(LWPI(-1))	0.1428 (0.1366) [1.0458] {0.3001}	-0.2021 (0.0828) [-2.4403] {0.0179}	0.0372 (0.0942) [0.3942] {0.6950}
D(LWPI(-2))	0.0220 (0.1059) [0.2078] {0.8361}	0.0646 (0.0642) [1.0057] {0.3189}	0.0674 (0.0731) [0.9225] {0.3602}
D(LMS(-1))	0.6745 (0.1921) [3.5119] {0.000}	0.3538 (0.1164) [3.0208] {0.0036}	0.1398 (0.1325) [1.0551] {0.2959}
D(LMS(-2))	-0.1178 (0.2018) [-0.5841] {0.5615}	0.3695 (0.1223) [3.0208] {0.0038}	-0.0502 (0.1392) [-0.3604] {0.7199}
D(LGDP(-1))	-0.6597 (0.1938) [-3.4042] {0.0012}	0.1620 (0.1223) [1.3794] {0.1732}	-0.0983 (0.1337) [-0.7355] {0.4651}
D(LGDP(-2))	-0.4612 (0.2088) [-2.2086] {0.0313}	0.1580 (0.1266) [1.2485] {0.2170}	-0.0655 (0.1441) [-0.4544] {0.6513}
Constant	0.0322 (0.0200) [1.6098] {0.1130}	0.0325 (0.0121) [2.6835] {0.0096}	0.0391 (0.0138) [2.8309] {0.0064}

Note: *Standard error in ( ), t-statistics in [ ] and p-value in {}*

The above table (5) shows the result of Vector Error correction Model (VECM) and is observed that error correction term in LDWPI equation is strongly significant at 1% level with a negative sign and implies that long run relationship runs from money supply and economic growth to inflation. The speed of adjustment of any disequilibrium toward long run equilibrium is adjusted to about 13.65% of the disequilibrium in inflation each year, implying an effective adjustment mechanism.

According to the money supply equation, the error correction term in money supply equation is statistically significant at 1% level but not negative sign and implies the non-existence of long run causality from inflation and economic growth to money supply.

According to LDGDP equation, the error correction term in LDGDP equation is strongly significant at 1% level with a negative sign and implies that there exists a strong long run relationship running from inflation and money supply to economic growth. The speed of adjustment of any disequilibrium towards long run equilibrium is adjusted about 11.51% of the disequilibrium in economic growth every year.

Therefore, table (5) shows that there exists a bidirectional causality relationship between price level and growth of output in India whereas there is unidirectional causal relationship runs from money supply to inflation and growth of output in the long run.

In addition, the existence of Granger causality at least in one direction is implied by the existence of cointegration. The existence of a long-run causality between the variables of the study is pointed out by the negative and statistically significant value of error correction coefficient.

The coefficients of the first difference of LDWPI lagged one periods in LDMS equation in Table (5) is statistically significant which indicates the presence of short-run causality from price level to money supply based on VECM estimates. In the LDWPI equation, the coefficients of LDMS lagged one period are statistically significant, indicating the existence of short-run causality from money supply to general price level. The coefficients of the first difference of LDGDP lagged one and two periods in LDWPI equation are statistically significant, indicating the existence of short-run causality from output to general price level. However, in LDGDP equation no such short-run causality is indicated. Based on VECM estimation, the result of the short-run causality between the first difference of the three macro variables like LDMS, LDWPI and LDGDP was proved.

The results of Granger causality test between the macroeconomic variables are given in table (6). It Indicates that the null hypotheses of LDWPI does not Granger cause LDMS. LDMS does not Granger cause LDWPI. Therefore, they are rejected at the 1% level of significance. Thus, in the short-run, bidirectional causality exists between money supply and general price level. This result indicates that causality running from money supply to general price level. The implication of the result is that money supply growth has valuable information in forecasting the values of general price level in the short run. In table 6, the null hypotheses that growth of output does not Granger causes general price level is rejected at 5% level of significance. This implies that growth of output significantly suggests something about short run behavior of general price level while general price level does not predict anything about the short run properties of growth of GDP in India. These results support the previous results obtained from VECM which indicated the existence of short-run causality at the 5% level of significance.

Table 6: Results of Granger causality test – the causal relationship between money supply, output and price level

Null hypothesis:	F-statistic	Probability
LDMS does not Granger cause LDWPI	6.4682	0.0029
LDWPI does not Granger cause LDMS	3.9835	0.0238
LDMS does not Granger cause LDGDP	0.8372	0.4308
LDGDP does not Granger cause LDMS	0.9305	0.4001
LDGDP does not Granger cause LDWPI	3.6823	0.0367
LDWPI does not Granger cause LDGDP	0.0232	0.9770

Supported by the causality tests, it can be said that the change in the price level and the change in growth of output cause each other in the long-run but in the short-run, change in growth of output causes change in general price level. Second, change in money supply causes change in general price level in the long-run, but in the short-run change in the general price level causes change in money supply also change in money supply causes change in the general price level. Third, a change in the money supply causes change in growth of output in the long run, but not in the short run.

3.3 Variance decompositions based on VECM result

Table (7) shows the result of the variance decomposition of the wholesale price index for the horizon of 10 periods. The decomposition divided the variance into parts explained by each explanatory variable in the model. The second column contains the standard deviation, which is the forecast error of the price level for the forecast horizon. The remaining columns give the percentages of the variances of the money supply and Economic growth. In the model of the growth of price level, after 10 periods, the money supply changes the growth of price level for approximately 12.36% of variation, while the Economic growth can change the growth of price level for approximately 12.76% of variation during the same period.

Table 7: The result of WPI's variance of decomposition

Variance Decomposition of LDWPI				
Period	**S.E.**	**LDWPI**	**LDGDP**	**LDMS**
1	0.0447	100	0	0
2	0.0506	79.6182	9.6193	10.7625
3	0.0518	76.7096	12.2760	11.0144
4	0.0521	75.9325	12.6062	11.4612
5	0.0523	75.4221	12.7198	11.8481
6	0.0523	75.1862	12.7609	12.0529
7	0.0524	75.0586	12.7687	12.2532
8	0.1524	74.9822	12.7646	12.3008
9	0.1524	74.9368	12.7623	12.3306
10	0.1525	74.9090	12.7603	12.3608
Variance Decomposition of LDGDP				
1	0.0345	2.4738	97.5262	0.0000
2	0.0349	2.6183	96.7162	0.6654
3	0.0354	3.2725	95.7459	0.9816
4	0.0355	3.3377	95.4660	1.1962
5	0.0356	3.3668	95.2426	1.3905
6	0.0356	3.3802	95.1053	1.5144
7	0.0356	3.3848	95.0178	1.5973
8	0.0356	3.3865	94.9619	1.6515
9	0.0356	3.3873	94.9263	1.6863
10	0.0356	3.3876	94.9039	1.7085
Variance Decomposition of LDMS				
1	0.0275	4.24413	2.8905	92.8654
2	0.0309	13.0666	2.4857	84.4477
3	0.0324	11.8653	2.2568	85.8778
4	0.0336	11.3575	2.2161	86.4264
5	0.0343	11.1332	2.2575	86.6093
6	0.0347	10.9531	2.2788	86.7681
7	0.0349	10.8435	2.3034	86.8531
8	0.0351	10.7761	2.3214	86.9025
9	0.0352	10.7331	2.3337	86.9332
10	0.0353	10.7061	2.3419	86.9520

3.3.1 Variance decomposition of wholesale price index

According to LDWPI's response to its own shock, forecast error variance explained 100% in the first year while LDGDP and LDMS contributed nothing in the first period to innovation. The contribution of LDWPI to its own shock follows a decreasing order in the remaining nine periods. The contributions of LDGDP and LDMS to the variation in LDWPI in the second period are 9.62% and 10.76% respectively. The contribution of both LDGDP and LDMS to the shock in LDWPI averaged 11.10% and 10.62% respectively for the remaining nine periods. It is seen from the table 7 the variation in LDWPI contributed by LDMS and LDGDP follows an increasing trend. Shocks from LDGDP between periods from second to tenth fluctuate throughout the periods and observed maximum contribution is in the tenth year (12.76%). The shock to LDGDP to the variation in LDWPI gets at its lowest point in period second accounted for 9.26%. Shock from LDMS between periods from second to tenth fluctuate throughout the periods and its maximum contributions observed in the tenth year accounted for 12.33%. The effect of LDMS to the variation in LDWPI attains its lowest point in period second accounted for 10.76%.

3.3.2 Variance decomposition of gross domestic product

It is obvious in Table (7), in the first year, shock to LDGDP account for 97.53% fluctuation in itself while shock to LDWPI and LDMS caused 2.47% and 0% fluctuation in LDGDP respectively. The variance to the LDGDP significantly explained by own variation account for 97.53% in the first period and the contribution shows a declining trend standing at 96.72%, 95.24%, 94.96% and 94.90% in the second, fifth, eight and tenth periods respectively. However, the contribution of LDMS to the variation in LDGDP accounts for 0% in the first period and is increasingly significant throughout the remaining periods. Further, the contribution of LDMS to the variation in LDGDP attained its peak in the tenth year and accounted for about 1.71%. The contribution of LDWPI to LDGDP variation account for 2.47% in first period and rising progressively to an average accounted for 3.20% in the remaining nine periods. The variation in LDGDP attributed to its own shock diminished over time and from the second year, a slight variations contributed from LDMS accounted for 0.66%. However, a slight variation in LDGDP contributed from LDMS and LDWPI averaged to 1.24 and 3.20% respectively.

3.3.3 Variance decomposition of money supply

In the first forecast year, shock to LDMS accounted for 92.87% fluctuation in itself while shock to LDWPI caused 4.24% fluctuation in LDMS. In the tenth year, shock to the LDMS accounted for 86.95% variation in itself while shock to LDWPI caused 10.71% fluctuation in LDMS. On the other hand, in the first year, shock to LDGDP caused 2.89% fluctuation in LDMS while in the tenth year, shock to LDGDP caused 2.35% variation in LDMS. The averaged contribution of both LDGDP and LDWPI to the shock in LDMS accounted for 2.36% and 10.57% respectively for the remaining periods.

3.4 Impulse response function (IRF)

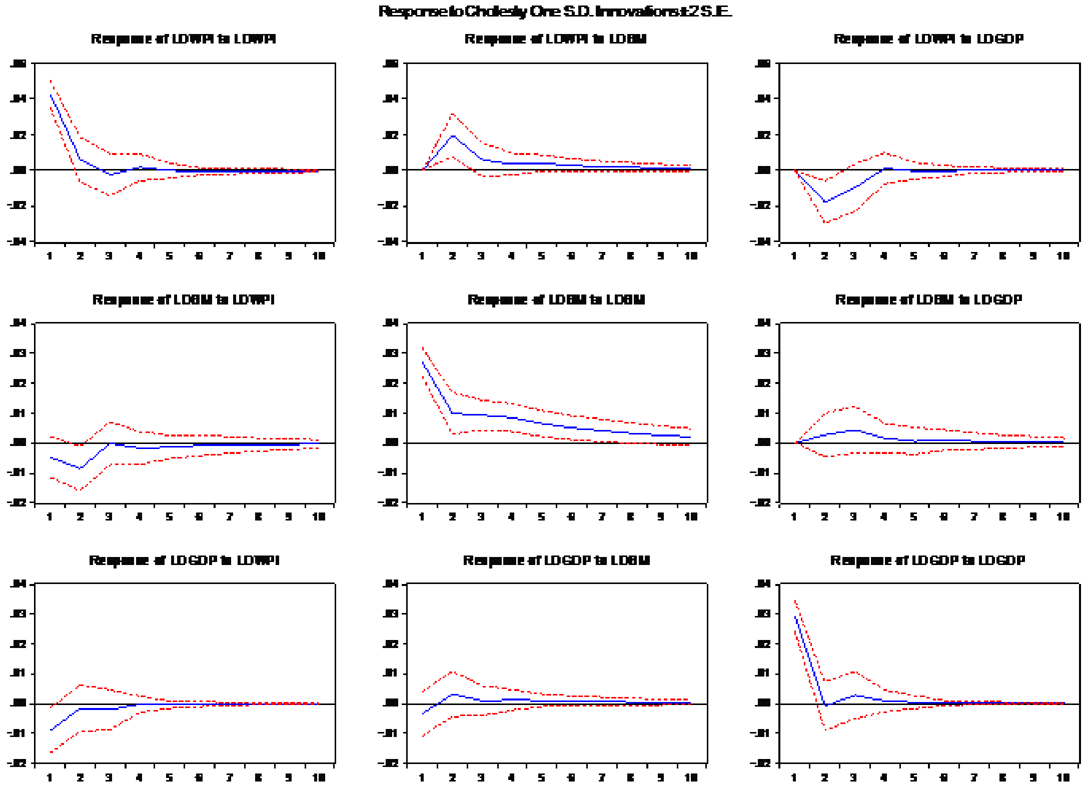
The IRFs obtains from the Moving Average (MA) representation of the original VAR model. They (IRFs) depict the dynamic response of a particular endogenous variable to a one-period standard deviation shock to the system. As it were, impulse responses trace out the responsiveness of dependent variables in a VAR to shocks to each of the variables.

Table (8) shows that the response of LDWPI has a positive response to one standard deviation innovation to LDMS and decreases sharply between the first forecast year to 10th forecast year. The response of LDWPI to one standard deviation innovation to LDGDP is negative and decreases gradually between the 2nd forecast year to 10th forecast year. LDGDP contributes nothing in the 1st period to the innovation. The response of LDGDP to one standard deviation innovation to LDWPI is negative and decreases gradually between the 1st forecast year to 10th forecast year. The response of LDGDP to one standard deviation innovation to LDMS is positive and however decreases steadily between the 1st forecast year to 10th forecast year. The response of LDMS to one standard deviation innovation to LDGDP is negative and decreases sharply from 1st to 3rd year on the other hand it increases from 4th and 5th year. Further, it decreases from 6th to 10th forecast year. The response of LDMS to one standard deviation innovation to LDWPI is negative and decreases sharply from 1st to 3rd year, while it increases negatively in 4th year. Further, it decreases negatively from 5th to 10th forecast year.

Table 8: The results of WPI's impulse response functions

Impulse Response to Cholesky One S.D. Innovations			
Response of LDWPI:			
Period	LDWPI	LDGDP	LDBM
1	0.04474	0	0
2	0.00647	0.019721	0.0166
3	-0.00403	0.005957	0.0044
4	0.00151	0.003596	0.0039
5	9.87E-0	0.004126	0.0036
6	-0.00035	0.002910	0.0025
7	-0.00019	0.002151	0.0019
8	-0.00022	0.001789	0.0016
9	-0.00020	0.001412	0.0012
10	-0.00016	0.001110	0.0009
Response of LDGDP:			
1	-0.0054	0.0341	0
2	-0.0015	0.0036	0.0028
3	-0.0030	0.0052	0.0021
4	-0.0010	0.0014	0.0016
5	-0.0007	0.0010	0.0015
6	-0.0004	0.0002	0.0012
7	-0.0003	9.35E-0	0.0010
8	-0.0002	-3.62E-0	0.0008
9	-0.0001	-6.99E-0	0.0006
10	-0.0001	-8.09E-0	0.0005
Response of LDMS:			
1	-0.0057	-0.0047	0.0266
2	-0.0096	-0.0013	0.0099
3	-0.0005	-0.0001	0.0099
4	-0.0018	-0.0011	0.0085
5	-0.0016	-0.0012	0.0064
6	-0.0010	-0.0009	0.0052
7	-0.0008	-0.0008	0.0041
8	-0.0006	-0.0007	0.0033
9	-0.0005	-0.0005	0.0026
10	-0.0004	-0.0004	0.0021

Figure 1: General price level response for one standard deviation shock from each of the variables



From the Figure (1) given above, it is seen that the response of LDWPI to one standard deviation shock in LDMS is positive for just the 1st year to 8th year and afterwards its outcome was less active. The response of LDMS to one standard deviation shock in LDWPI is negative for the 1st year to 5th year and it became neutralized in the 6th year. The response of LDWPI to one standard deviation shock in LDGDP is negative for the 1st period to 5th period and it died off in the 6th year. The response of LDGDP to one standard deviation shock in LDMS is negative in the 1st period to 6th period and its effect became nil from the 7th year onwards. The response of LDGDP to one standard deviation shock in LDWPI in the 1st period to 4th period is negative and its effect became nil after the 5th period. The response of LDMS to one standard deviation shock in LDGDP is positive for the 2nd period to 4th period and its effect became nil in the 5th period and onwards.

3.5 Inferences drawn

The following inferences have been made on the hypotheses stated.

- Change in the money supply causes change in growth of output in the long run, but not in the short run. Therefore, the above inference led to partial acceptance of the first hypothesis.
- Change in money supply causes change in general price level in the long-run, but in the short run change in the general price level causes change in money supply also change in money supply causes change in the general price level and therefore it results in partial acceptance of the second hypothesis.
- Change in the price level and change in growth of output cause each other in the long-run. But in the short-run, change in growth of output causes change in general price level and therefore, it led to a partial acceptance of the third hypothesis.

4. Conclusion and recommendations

The result of this study implies that increase of money supply is likely to increase the inflationary pressure in India and therefore, the tight monetary policy is needed to be exercised by the Reserve Bank of India. Further, the study reveals that the change in money supply causes inflation. However, the execution of tight monetary policy is not alone an efficient anti-inflationary tool because supply-side policy is likely to have inflation on the basis of negative causal effect of GDP growth on inflation.

Although there is an upward adjustment in various monetary aggregates, a gap between money supply and economic growth is seen. Because of this, the harmonization of the two policies viz., contractionary and expansionary are mandatory to reduce the rate differential between productive and unproductive sectors of the economy in order to increase the flow of output to the country. Therefore, the monetary authorities of the country should take steps to go with the policies.

In order to control inflation, the production of essential commodities should be increased. If the raw materials are not available for such commodities within the country, it should be imported on preferential basis. The government should take necessary efforts to increase the productivity of all the sectors of the economy. The policy of rationalisation of industries increases the production and productivity efficiency of industries and therefore it should be adopted as a long term measure by the government.

In order to increase the production of consumer goods, the government should provide all possible support to the industries of different consumer goods in the form of financial help, subsidies, tax benefit and liberalization of license policy to the new industries.

The changes in money supply and real GDP influence greatly the behavior of price level in India. Monetary theories always indicate that an increased money supply in an economy often helps to increase or moderate inflationary targets. The supply side of inflation is a key ingredient for the rising inflation in India and an increase in GDP may positively influence the control of inflation. The models used in this study also explain that the economic growth impacts inflation negatively over the periods. The price level is reduced as a result of basic sources of economic growth being non-inflationary like increase in production and productivity. On the other hand, an increase in money supply more than the real output creates problems of too much money chasing too few goods resulting in inflation. The economic growth decreases inflation because more goods produced result in lowering the price of goods. The growth rate of price level declines when the growth rate of real GDP increases keeping constant the growth rate of money supply and velocity of money. An increase in economic growth rate means more goods for money to chase and it forces the downward pressure on the inflation rate. This study concludes that a rise in the growth rate of real output accompanied by control of the money supply would reduce the price level.

REFERENCES

1. Dhanasekaran, K.(1996). Money, output and prices in India (1970-92). *The Asian Economic Review*, *38*, 133-140.
2. Domaç, I., & Elbirt, C. (1999). *The main determinants of inflation in Albania*. The World Bank Policy Research, Working Paper No. 1930.
3. Lim, Y. C., & Sek, S. K. (2015). An examination on the determinants of inflation. *Journal of Economics, Business and Management*, *3*(7), 678-682.
4. Yaucer, M.J. (2017). Relationship between money and prices in Albania. *International Journal of Innovative Research and Knowledge*, l.2(1), 94-102.
5. Mishra, P. K., Mishra, U. S., & Mishra, S. K. (2010). Money, price and output: A causality test for India. *International Research Journal of Finance and Economics*, *53*(2), 26-36.
6. Nachane, D. M., & Nadkarni, R. M. (1985). Empirical testing of certain monetarist propositions via causality theory: The Indian case. *Indian Economic Journal*, *33*(1), 13-41.
7. Sahadudheen, I. (2012). A cointegration and error correction approach to the determinants of inflation in India. *International Journal of Economic Research*, *3*(1), 105-112.