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FISCAL DEFICIT AND INFLATION: WHAT CAUSES WHAT? THE CASE OF INDIA

ABSTRACT

This study has made an attempt to examine the direction of causality among the fiscal deficit, government expenditure, money supply, and inflation. In the present study we have employed Dolado and Lütkepohl (DL) (1996) and standard Granger-causality approach to examine the direction of the causality among the test variables. However, we have found conflicting results for India. Causality analysis based on DL approach suggests that both government expenditure and money supply Granger-cause fiscal deficit while standard Granger-causality test indicates that only government expenditure Granger-cause fiscal deficit. And money supply Granger-cause government expenditure and fiscal deficit Granger-cause money supply.

Key words: Fiscal deficit, inflation, government expenditure, DL approach, granger-causality

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INTRODUCTION

The twin problems of fiscal deficit and inflation occupy immense importance in public policy domain in India. In decade of 2000s, the average percentage annual growth rate of inflation was negative. It turned positive in 21st century. In last few years, percentage annual growth rate of inflation increased rapidly. Significantly, in 2008-09 it crossed the level of double digit. However, average percentage annual growth rate of fiscal deficit has declined since 1980s to 2000s. But it has increased in 21st century more than twice of that of average percentage annual growth rate in 2000. Estimates reveal that average percentage annual growth rate of money supply has been more or less constant in all the decades. When we consider total government expenditure, it is found that it has increased not only in absolute numbers but also in terms of average percentage annual growth rate and percentage annual growth rates. Detailed estimates of all variables are given in Table 1 below.

There is argument in the economic theories that higher deficit policies coupled with monetization of the central bank lead to inflation. However, interestingly this is not always the case and even in the absence of monetization by central banks, higher deficit policies can lead to higher inflation. As correctly pointed out by Ackay et al. (1996) that there are two other possible channels through which higher deficits lead to higher inflation. Firstly, the government's borrowing requirements normally increase the net credit demands in the economy, driving up the interest rates and crowding out private investment. The resulting reduction in the growth rate of the economy will lead to a decrease in the amount of goods available for a given level of cash balances and hence the increase in the price level. Second is the case when central banks do not monetize the debt when the private sector monetizes the deficits. This takes place when high interest rates induce the financial sector to develop new interest bearing assets that are almost as liquid as money and are risk free. Thus, the government debt is not monetized by the Central Bank, but monetized by the private sector and the inflationary effects of higher deficit policies prevail. However, in the present study we have limited ourselves to discuss the issue related to the relationship of inflation with the monetized deficit.

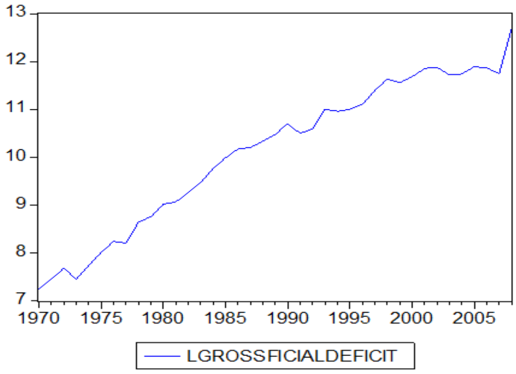
Table 1: Annual Growth Rates (in percentage)

Year	CPI	Fiscal deficit	M3	Government expenditure
1971-72	1.03	22.66	14.41	22.55
1972-73	10.71	26.17	16.35	14.00
1973-74	21.20	-20.47	19.85	4.59
1974-75	34.60	32.83	13.62	20.91
1975-76	-3.95	31.58	12.48	24.59
1976-77	-13.82	25.52	19.88	10.32
1977-78	10.58	-3.21	19.92	13.54
1978-79	-2.16	55.16	20.39	21.02
1979-80	9.15	11.94	20.20	1.04
1980-81	14.16	29.83	16.38	20.07
Avg. growth rate	8.15	21.20	17.35	15.26
1981-82	12.41	4.42	17.32	10.97
1982-83	5.18	22.63	14.59	21.87
1983-84	11.35	22.61	17.60	15.40
1984-85	0.19	33.66	18.27	22.79
1984-85	0.19	33.66	18.27	22.79
1985-86	4.80	25.51	16.58	20.70
1986-87	4.76	20.51	17.60	19.46
1987-88	9.97	2.66	17.26	8.50
1988-89	12.56	14.34	17.28	15.89
1989-90	5.37	15.23	19.02	17.44
1990-91	7.64	25.26	16.66	13.34
Avg. growth rate	7.42	18.68	17.22	16.64
1991-92	19.30	-18.61	17.20	5.81
1992-93	12.32	10.59	17.73	10.06
1993-94	3.53	49.99	15.92	15.69
1994-95	11.94	-4.24	19.83	13.31
1995-96	10.75	4.40	15.63	10.91
1996-97	-81.46	10.77	16.22	12.75
1997-98	3.13	33.27	17.02	15.45
1998-99	10.98	27.45	19.85	20.38
1999-00	4.44	-7.62	17.17	6.70
Avg. growth rate	-0.56	11.78	17.40	12.34
2000-01	-0.33	13.46	15.92	9.24
2001-02	1.31	18.63	16.01	11.28
2002-03	3.24	2.92	16.05	14.06
2003-04	3.76	-15.03	12.96	14.02
2004-05	2.72	2.05	13.96	5.74
2005-06	3.82	16.41	15.43	1.50
2006-07	7.65	-2.64	20.48	15.35
2007-08	7.63	-10.98	22.14	22.16
2008-09	10.02	157.28	20.42	26.42
Total Avg. annual growth rate	4.43	20.23	17.04	13.31

Data source: Reserved Bank of India (Handbook of Statistics of Indian Economy)(compiled by the authors)

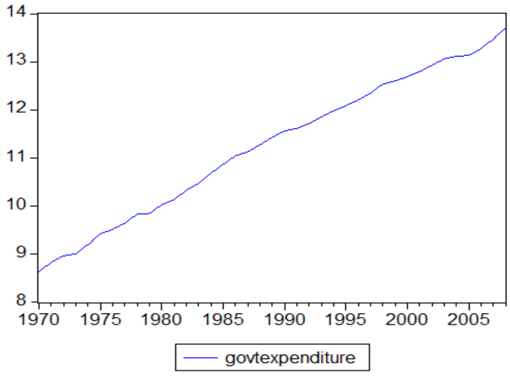
It is evident from Figure 1, 2, and 3 that gross fiscal deficit, government expenditure and money supply have increased considerably over the years. However, Figure 4 indicates that inflation has increased up to 1995 and suddenly it has fallen considerably and again it has got momentum since 2000.

Figure 1: Gross Fiscal Deficit



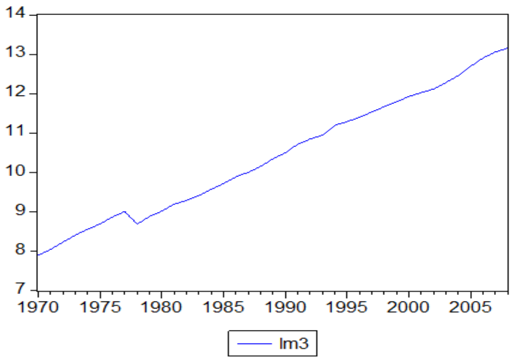
Data source: Reserve Bank of India

Figure 2: Government Expenditure



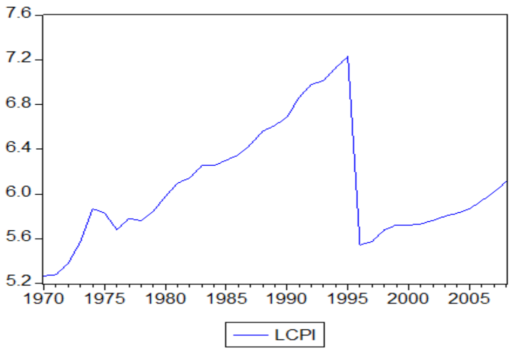
Data source: Reserve Bank of India

Figure 3: Money Supply



Data source: Reserve Bank of India

Figure 4: Inflation



Data source: Reserve Bank of India

Rest of the paper is organized as follows: literature review, discussion on data source, variables definition and methodology adopted for empirical analysis, results of data analysis, and, finally, conclusions drawn from the empirical analysis.

LITERATURE REVIEW

In the theory of economics according to the classical view, which is rooted in the quantity theory of money (QTM), fiscal deficits cause inflation because governments that run persistent fiscal deficits tend, over time, to resort to money creation to finance the deficits. On the other hand, according to more recent studies leading to a fiscal theory of price level (FTPL)[1], money creation may not be the only channel through which fiscal policy becomes the leading factor and budget deficits cause inflation. In other words, FTPL theory says that a fiscal dominant (i.e., non-Ricardian situation) regime may arise when fiscal policy is not sustainable and government bonds are considered net wealth (see for

[1] These were developed by Woodford (1994, 1998), Leeper (1991), Sims (1994), and Cochrane (1998, 2001) and extended to an open economy by Daniel (2001).

details Woodford, 1998). These wealth effects could endanger the objective of price stability, irrespective of central bank commitment to down inflation. Thus according to the FTPL theory it is fiscal, not monetary, policy that determines the price level and becomes the nominal anchor. The FTPL theory therefore challenges the conventional wisdom uttered by the QTM, which implies that Ricardian regimes are the norm and that sooner or later fiscal policy will have to adjust to guarantee the solvency of the government intertemporal budget constraint. Hamburger and Zwick (1981) argued from the monetarist view that budget deficits can lead to inflation, but only to the extent that they are monetized. Hence, according to the monetarist (and neo-classical) approach, changes in the inflation rate is highly correlated to changes in the money supply. Normally, the budget deficit on its own does not cause inflationary pressures, but rather affects the price level through the impact on money aggregates and public expectations, which in turn trigger movements in prices. The money supply link of causality rests on Milton Friedman's famous theory of money, which dictates that inflation is always and everywhere a monetary phenomenon (Solomon and de Wet, 2004). Hence, the monetarist view postulates that abiding and persistent growth of prices is necessarily preceded or accompanied by a sustained increase in money supply and therefore, in the present study we have focused on this aspect and limited ourselves to the monetarist approach.

Let us define the fiscal budget identity of the following form:

$$GE_{(t)} + i_{(t-1)}D^{T}_{(t-1)} = T_{(t)} + \left(D^{T}_{(t)} - D^{T}_{(t-1)}\right) + RCB_{(t)} \tag{1}$$

where $GE_{(t)}$ is government expenditure on goods, services, and transfers, $i_{(t-1)}D^{T}_{(t-1)}$ is interest on the outstanding debt (where $D^{T}_{(t)}$ is the total debt and $i_{(t)}$ is the interest rate)[2], $T_{(t)}$ is tax revenue, $RCB_{(t)}$ denotes direct receipts from the central bank. The Equation (1) is based on the view that the link between fiscal and monetary policy is established through the budget constraints of the fiscal authority and the central bank. In other words, the above accounting identity is based on presumption that every budget deficit must be financed by selling bonds either to the public or to the central bank. Hence, Equation (1) points out that today's fiscal-monetary decisions have implications for the number of bonds that will have to be sold to the public today, and thus for the feasible set of fiscal-monetary combinations in future periods.

Further, as the monetary authority (or central bank) also has a budget identity that links changes in its assets and liabilities which can be expressed as follows:

$$\left(D^{M}_{(t)} + D^{M}_{(t-1)}\right) + RCB_{(t)} = i_{(t-1)}D^{M}_{(t-1)} + \left(HM_{(t)} - HM_{(t-1)}\right) \tag{2}$$

where $D^{M}_{(t)} + D^{M}_{(t-1)}$ is central bank purchase of government debt, $i_{(t-1)}D^{M}_{(t-1)}$ is the central bank‘s receipt of interest payments from the Treasury and $\left(HM_{(t)} - HM_{(t-1)}\right)$ is the change in the high-powered money (or monetary base).

[2] Total debt includes foreign debt, which is affected by foreign interest and exchange rate movements.

Now, assume that $D = D_{(t)}^{T} + D_{(t)}^{M}$ is the stock of government interest-bearing debt held by the public. By combing Equation (1) and Equation (2) we get consolidated budget constraint as follows:

$$GE_{(t)} + i_{(t-1)}D_{(t-1)} = T_{(t)} + \left(D_{(t)} - D_{(t-1)}\right) + \left(HM_{(t)} + HM_{(t-1)}\right) \tag{3}$$

This consolidated budget constraint is based on presumption that government spending plus interest payments on outstanding debt must be funded by tax receipts and an increase in public debt as well as high-powered money. Let us define the real interest factor as:

$$(1 + r) = \frac{1+i}{\left(p_{(t)}/p_{(t-1)}\right)} \tag{4}$$

Now dividing Equation (3) by the price level, $p_{(t)}$ yields the budget constraint in inflation adjusted or real terms (with lower case denoting real terms), which after re-arranging yields:

$$(1 + r)d_{(t)} + ge_{(t)} = t_{(t)} + d_{(t)} + s_{(t)} \tag{5}$$

where $s_{(t)}$ is the real increase in high-powered money or seigniorage, i.e., the increase in high-powered money adjusted for the level of prices. Iterating Equation (5) forward we obtain:

$$(1 + r)d_{(t)} = \sum_{i=0}^{T} \frac{t_{(t+i)} - ge_{(t+i)}}{(1+i)^i} + \sum_{i=0}^{T} \frac{s_{(t+i)}}{(1+i)^i} + \sum_{i=0}^{T} \frac{d_{(t+i)}}{(1+i)^i} \tag{6}$$

Equation (6) is the intertemporal budget constraint, which shows how the government resources and spending are connected over time. Further this also indicates that the government must plan to raise enough revenue (in the present value terms) through taxation and seigniorage to pay for its existing debt and planned expenditures. The interesting implication of the intertemporal budget constraint represented by Equation (6) is that any government with a current outstanding debt must run, in the present value terms, future surpluses (see for example Walsh, 2003). One way to generate a surplus is to increase revenues from seigniorage, which brings in the implications of budget deficits for future money growth. Further, Equation (6) also provides insights on the link between deficits and inflation. If the monetary authority must act to ensure that the government intertemporal budget is balanced, then fiscal policy is set independently, so that the monetary authority generates enough seigniorage to satisfy the intertemporal budget condition, which is described as a situation of fiscal dominance (or Non-Ricardian fiscal policy). When monetary policy is dependent, it responds to fiscal policy so that seigniorage revenue becomes an important component of government finance. In this case, the treasury might decide to run permanent deficits, a situation that may require seigniorage to make up the gap between the value of the public debt and the present discounted value of budget surpluses. One would expect to see a link between deficits and inflation since monetary policy makers respond to deficit spending.

There are a number of empirical evidences available to analyze the relationship between fiscal deficit, money supply, and inflation. Most of the studies have analyzed how fiscal deficit and money supply affect inflation. Very few attempts have been made to analyze the causation running from both ways, i.e., how inflation affects fiscal deficit and fiscal deficit affects inflation. The noteworthy are Miller (1983), Agheveli and Khan (1978), and Ndebbio (1998), etc.

Miller (1983) points out that fiscal deficit in all cases (whether monetized or not) lead to generate inflationary pressure in the economy. Ndebbio (1995) has investigated the link among the fiscal deficit, inflation and money supply on one hand and money supply and inflation on the other hand. He found that for the Keynesian economy budget deficit affects growth of monetary base and money supply affects interest and hence inflation. Ikhide (1995) examined the methods of deficit financing and found that whether the deficit is financed by barrowing from banks, from abroad or the public, in most of the cases any way of financing will generate inflationary pressure. Ackay et al. (1996), in case of Turkey, by employing cointegration tests, showed that budget deficit growth had a positive effect on increased price levels in Turkey. Solomon and de Wet (2004) studied the coexistence of a relatively high inflation rate and high fiscal deficits for a prolonged period for the economy of Tanzania. The research established a causal link that runs from the budget deficit to the inflation rate over the period 1967 to 2001. The study concluded that "due to monetization of the budget deficit, significant inflationary effects are found for increases in the budget deficit." Alavirad and Athawale (2005) investigated the impact of budget deficit on inflation in the Islamic Republic of Iran for the period from 1963 to 1999. The study verified that budget deficits as well as liquidity do have a major impact on inflation rates in the Islamic Republic of Iran. Catao and Terrones (2003) showed that there is a strong positive relationship between fiscal deficits and inflation among high-inflation and developing country groups, but not among low-inflation advanced economies. Agha and Khan (2006) investigated the long-run relationship between inflation and fiscal indicators in Pakistan using annual data from Fiscal Year (FY) 1973 through FY 2003. The empirical results, using Johansen cointegration analysis, suggested that in the long-run inflation is not only related to fiscal imbalances but also to the sources of financing fiscal deficit, assuming the impact of real GDP and exchange rate as exogenous. In VECM model, inflation has significant error correction coefficients that implicitly conclude that inflation is affected by government's bank borrowing for budgetary support as well as fiscal deficits. Therefore, in Pakistan, they concluded that fiscal sector is dominant in explaining price movements. Makochekanwa (2011) for the Zimbabwean economy examined the deficit-inflation nexus and established the causal link that runs from the budget deficit to the inflation rate using Johansen (1991, 1995) cointegration technique over the period 1980 to 2005. Due to massive monetization of the budget deficit, significant inflationary effects are found for increases in the budget deficit. Tiwari and Tiwari (2011) examined the linkage between fiscal deficit and inflation in India by taking into account all factors that can affect the status of fiscal deficit. They found that inflation is not at all cause for the fiscal deficit. However, government expenditure and money supply were found to be important determinants of mounting fiscal deficit.

DATA, OBJECTIVES, VARIABLES DEFINITION, AND ECONOMETRIC METHODOLOGY

In this section the first subsection presents the nature and source of the data and the objectives set for the study. The second subsection presents the econometric methodology to be used for the empirical analysis.

Data and objectives

In the present study we have taken time series data for the period 1970-71 to 2008-09 from Hand Book of Statistics of Indian economy of Reserve Bank of India (RBI). From the literature review it is evident that there is unconformity regarding the direction of the causality between fiscal deficit, inflation, money supply and government expenditure. Therefore, this study has made an attempt to retest the direction of causality among the test variables (i.e., fiscal deficit, inflation, money supply and government expenditure).

In this study money supply has been measured through the measure of M3 (Broad money), inflation has been measured through consumer price index of all level, gross fiscal deficit has been taken as a measure of deficit and government expenditure has been measured by total expenditure of central government. All variables are measured in nominal terms.

Estimation methodology

In this study natural log (ln) of all variables has been taken in order to make series of less order of autoregressive, i.e., to minimize fluctuations in the series. To know the causality among the test variables the standard test to be used in the study is Engle-Granger approach in VECM framework. But this approach requires certain pre-estimations (like testing the stationarity of the variables included in the VECM analysis and seeking the cointegration of the series) without which, conclusions drawn from the estimation will not be valid. Granger non-causality test in an unrestricted VAR model can be simply conducted by testing whether some parameters are jointly zero, usually by a standard (Wald) F-test. This approach in integrated or cointegrated systems has been examined by Sims, Stock, and Watson (1990) and Toda and Phillips (1993). These studies have shown that the Wald test for non-causality in an integrated or cointegrated unrestricted VAR system will have nonstandard limit distributions.

These results have given rise to alternative testing procedures, such as Toda and Phillips (1993) and Mosconi and Giannini (1992), but they require sequential testing and are computationally burdensome. Toda (1995) has shown that pretesting for cointegration rank in Johansen-type error correction mechanisms (ECMs) are sensitive to the values of the nuisance parameters, thus causality inference based upon ECM may be severely biased. Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) propose a method of estimating a VAR for series in levels and test general restrictions on the parameter matrices even if the series are integrated or cointegrated. This method is theoretically simpler and computationally relatively straightforward in causality tests. They develop a modified version of the Granger causality test which involves a modified Wald (MWALD) test in an intentionally augmented VAR model. Once the optimal order of the VAR process, *p*, is selected, Toda and Yamamoto (TY) (1995) propose estimating a *VAR*(p + *dmax*) model where *dmax* is the maximal order of integration that we suspect might occur in the true generation process. Linear or nonlinear restrictions on the first *p* coefficient matrices of the model can therefore be tested using standard Wald (F-) tests ignoring the last *dmax* lagged vectors of the variables. Dolado and Lütkepohl (DL) (1996) also propose estimating an augmented VAR with the difference that they add only one lag to the true lag length of the model. One estimates the VAR(p+1) model and perform the standard Wald (F-) tests ignoring the last lag of the vector. The advantage of DL and TY are that they are computationally relatively simple and do not require pretesting for integration or cointegration of the data series. These tests are especially attractive when one is not sure whether series are stationary or integrated of order one. Toda and Yamamoto (1995) proves that the Wald (F-) statistic used in this setting converges in distribution to a χ^2 random variable, no matter whether the process is stationary or nonstationary. The preliminary unit root and cointegration tests are not necessary to implement the DL test, since the testing procedure is robust to the integration and cointegration properties of the process. Consider the following VAR(p) model:

$$Y_{(t)} = \gamma + A_1 Y_{(t-1)} + \cdots + A_p Y_{(t-p)} + \varepsilon_{(t)} \tag{7}$$

where $Y_{(t)}$, γ, and $\varepsilon_{(t)} \sim (0, \Omega)$ are n-dimensional vector and A_k is an $n \times n$ matrix of parameters for lag *k*. to implement the TY test the following augmented *VAR(p+d)* model to be utilized for the test of causality is estimated,

$$Y_{(t)} = \hat{\gamma} + \hat{A}_1 Y_{(t-1)} + \cdots + \hat{A}_p Y_{(t-p)} + \hat{A}_{p+d} Y_{(t-p-d)} + \hat{\varepsilon}_{(t)} \tag{8}$$

where the circumflex above a variable denotes its Ordinary Least Square (OLS) estimates. The order p of the process is assumed to be known, and the d is the maximal order of integration of the variables. Since the true lag length p is rarely known in practice, it can be estimated by some consistent lag selection criteria. In the present study we have used SIC (preferably) and AIC. It is important to note that if the maximal order of integration is $d = 1$, then TY test becomes similar to DL test. The j^{th} element of $Y_{(t)}$ dose not Granger-cause the i^{th} element of $Y_{(t)}$, if the following null hypothesis is not rejected.

H_o: The row *i*, column *j* element in $\mathrm{A_k}$ equals zero for k =1,…, p.

The null hypothesis is tested by Wald (F-) test which is named modified Wald (MWALD) test in case of the augmented VAR outlined above. For example, in a bivariate VAR model with the optimal lag length, suppose it is 3, Equation (8) is re-estimated by OLS setting the lag length 4 (3+1) as suggested by DL test.

$$\begin{bmatrix} LX_{(t)} \\ LY_{(t)} \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11}^1 & a_{12}^1 \\ a_{21}^1 & a_{22}^1 \end{bmatrix} \begin{bmatrix} LX_{(t-1)} \\ LY_{(t-1)} \end{bmatrix} + \begin{bmatrix} a_{11}^2 & a_{12}^2 \\ a_{21}^2 & a_{22}^2 \end{bmatrix} \begin{bmatrix} LX_{(t-2)} \\ LY_{(t-2)} \end{bmatrix} + \begin{bmatrix} a_{11}^3 & a_{12}^3 \\ a_{21}^3 & a_{22}^3 \end{bmatrix} \begin{bmatrix} LX_{(t-3)} \\ LY_{(t-3)} \end{bmatrix} + \begin{bmatrix} a_{11}^4 & a_{12}^4 \\ a_{21}^4 & a_{22}^4 \end{bmatrix} \begin{bmatrix} LX_{(t-4)} \\ LY_{(t-4)} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

where L denotes logarithms of $X_{(t)}$ and $Y_{(t)}$ variables. The hypothesis that $X_{(t)}$ does not Granger-cause $Y_{(t)}$ can be constructed as:

$$H_0: a_{12}^1 = a_{12}^2 = a_{12}^3 = 0$$

whereas the hypothesis that $Y_{(t)}$ variable does not Granger-cause $X_{(t)}$ can be constructed as:

$$H_0: a_{21}^1 = a_{21}^2 = a_{21}^3 = 0$$

and these joint hypothesis can be tested by MWALD test. In this context, we proceed as follows. First, we will follow the methodology proposed by Dolado and Lütkepohl (1996) and Toda and Yamamoto (1995) to test for linear causality between Indian electricity consumption and GDP. Second, we will follow the traditional methodology of causality i.e., Engle-Granger causality in order to check the robustness of the causality results reported by Dolado and Lütkepohl (1996) and Toda and Yamamoto (1995) causality analysis.

To precede for Granger-causality in traditional framework the first step is to check the stationary properties of the data series of variables. To verify that a series is stationary or not, first test used for analysis is Dickey and Fuller (DF) (1979) that is most popular test for testing the stationarity property of the variables. The test assumes in the null hypothesis that series is nonstationary that is series has a unit root and if critical value (which is based on Mackinnon [1996]) exceeds the calculated value in absolute terms (less in negative terms) null hypothesis will not be rejected implying that that series is nonstationary. Another test for stationarity was suggested by Phillips and Perron (1988). Augmented DF (ADF) tests use a parametric autoregression to approximate the ARMA structure of the errors in the test regression but Phillips-Perron (PP) test ignore any serial correlation in the test regression. Under the null hypothesis the PP test statistics have the same asymptotic distributions as the ADF test. PP tests are robust to general forms of heteroskedasticity in the error term and also not to specify a lag length for the test regression. In this test to select appropriate lag length default procedure is adopted that is Newey-West using Bartlet kernel method. For all models MacKinnon (1996) critical values has been used in analysis.

When it is found that variables used in this study are nonstationary and having same order of integration one can precede for cointegration analysis. Economic theorists usually use the term cointegration to refer to an equality between desired and actual transactions. However, in econometrics it is used to refer the long-run relationship among nonstationary variables. Cointegration does not require that the long-run relationship be generated by market forces or by the behavioral rules of the individuals while in Engle-Granger's use of the term, the equilibrium relationship may be causal, behavioral, or simply a reduced form relationship among similarly trending variable (Enders, 2004: 322). The components of the vector X_t are said to cointegrated of order (d, b), which is denoted by $X_t \sim CI(d, b)$ if:

1. All components of X_t are integrated of order d[3].

2. There exist a cointegrating vector β such that the linear combination $\beta_1 X_{1t} + \beta_2 X_{2t} + \ldots + \beta_n X_{nt}$ is integrated of order (d-b), where $d \geq b \geq 0$, CI is symbol of Cointegration, and vector of the coefficients, β, is known as cointegrating vector.

To proceed for cointegration all test variables included in any model must have same order of integration and preferably integration of order one, I(1). However, Harris (1995: 80) shows that it is not necessary for all variables in the model to have same order of integration, especially if theory a priori suggests that such variable should be included. Thus, a combination of I(0), I(1), and I(2) of variables can be tested for cointegration. In most cases it has been found that if I(1) variables are combined, their linear combination will be also I(1). However, if variables have different order of integration, their combination would be having an order of integration of highest order (Brooks, 2008: 335). Brooks shows that a linear combination of I(1) variables will only be I(0), if the variables are cointegrated. This analysis has its policy implication in the direction to identify which variables move together overtime. This implies that there are some variables which are bound to have some relationship with each other in long run.

There are broadly two ways to carry out cointegration analysis. First, tests that are based on residual approach for example Engle-Granger approach and second, that are based on Maximum Likelihood (ML) estimation on a VAR system, for example Johansen and Juselius (1990) method.

Since Engle-Granger approach suffers from a number of problems, for example simultaneous equation bias (which implies that this approach will not be able to detect the direction of causality run from one variable to another), and if there are more than two variable in the equation, this OLS based approach will not be able to detect the number of cointegration vectors that exists. Therefore in this study we have preferred Johansen and Juselius (1990) method which employs VAR system to test for numbers of cointegration vectors. Its estimation procedure is based on Maximum Likelihood (ML) method. This method can be briefly described as follows. Assume a vector $X_t = [\text{Fiscal Deficit (FD)}, \text{Inflation (Inf)}, \text{Money Supply (MS)}, \text{Government Expenditure (GE)}]^T$ and assume that the vector has a VAR representation. Following Johansen (1988) and Johansen and Juselius (1990) VAR representation of column vector X_t can be written as follows:

[3] A series is integrated of order d if it must be differenced d times in order to become stationary.

$$X_{(t)} = \Pi_1 X_{(t-1)} + \Pi_2 X_{(t-2)} + \cdots + \Pi_k X_{(t-k)} + \varepsilon_{(t)} \qquad (t = 1, \dots, T) \tag{9}$$

$X_{(t)}$ is column vector of *n* endogenous variables. Since most of the macroeconomic time series variables are nonstationary, VAR of such models are generally estimated in first-difference forms. First differencing of series has an important property of time series is that series is stationary. However, first-differencing will remove much of valuable information about the equilibrium relationships between the variables. Following Johansen (1988) and Johansen and Juselius (1990) the first differencing of the Equation (9) in form of VECM specification, can be specified as follows:

$$\Delta X_{(t)} = \psi_1 \Delta X_{(t-1)} + \psi_2 \Delta X_{(t-2)} + \cdots + \psi_{k-1} \Delta X_{(t-k-1)} - \Pi X_{(t-k)} + \varepsilon_{(t)} \quad (t = 1, \dots, T) \tag{10}$$

where $\psi_i = -\sum_{i=1}^{k-1} \Pi_i$ and $\Pi = \sum_{i=1}^{k} \Pi_i - I$.

The Johansen and Juselius (1990) cointegration test is to estimate the rank of the Π matrix (r) from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π. The purpose of cointegration test is to determine whether a group of nonstationary variables is cointegrated or not. It is important to note that there are three possible cases. The rank of Π can be zero. This takes place when all elements in the matrix Π are zero. This means that the sequences are unit root processes and there is no cointegration. The variables do not share common trends or move together over time. In this case, the appropriate model is a VAR in first differences involving no long-run elements. The rank of Π could be full. In this case, the system is stationary and the two variables can be modelled by VAR in levels. It represents a convergent system of equations, with all variables being stationary. Finally, the rank of Π can be reduced. In this case, even if all variables are individually I(1), the level-based long-run component would be stationary. In this case, there are $n-1$ cointegrating vectors. The appropriate modelling methodology here is a VECM. Further, in case of reduced rank of Π i.e., $(0 < r < n)$ then there exists $(n \times r)$ matrix of α and β such that:

$$\Pi = \alpha\beta^T \tag{11}$$

where r represents the number of cointegrating relationships amongst the endogenous variables included in $X_{(t)}$, α is a matrix of error correction parameters that measures the speed of adjustment in $\Delta X_{(t)}$, which indicates the speed with which the system responds to last period's deviations from the equilibrium relationship, and β is the matrix of long run coefficients which contains the element of r cointegrating vectors and has the property that the elements of $\beta' X_{(t)}$ are stationary.

Johansen (1988) and Johansen and Juselius (1990) have demonstrated that the β matrix which contains the cointegrating vectors can be estimated as the eigenvectors associated with the r largest eigenvalues of the following equation:

$$|\lambda S_{kk} - (S_{k0}S_{0k})/S_{00}| = 0 \tag{12}$$

where S_{00} contains residuals from a least square regression of $\Delta X_{(t)}$ on $\Delta X_{(t-1)}, \dots, \Delta X_{(t-k+1)}$, S_{kk} is the residual matrix from the least square regression of $X_{(t-1)}$ on $\Delta X_{(t-k+1)}$, and S_{0k} is the cross-product matrix. These eigenvalues can be used to construct a Likelihood Ratio (LR) test statistic in order to find the number of cointegrating vectors.

However, before proceeding to cointegration analysis and testing the rank of Π, there are some issues that need to be addressed. First, since JJ test is found to be sensitive to lag length chosen for the analysis. When the order of VAR, i.e., lag length is too short, problem of serial correlation among the residuals arises and test statistic will become unreliable. Conversely, if lag length (order of VAR) is too high there will be an upward bias in the test statistics, again causing doubts on the reliability of the estimates of parameters. Therefore, it is very important to choose appropriate lag length in VEC modelling. For this purpose lag length selection test which was based on VAR and VECM analysis (using Stata.10) has been carried out. In both cases (in case of VAR and VECM) results obtained were same. Stata.10 provides lag length selection criteria of Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC), and Hannan-Quinn Information Criteria (HQIC). However, for analyses this study has employed in all models SIC, because it is found that it has performed well in Monte Carlo studies (Kennedy, 2003: 117).

The next issue is related to the choice of deterministic assumptions that the JJ test requires in testing the cointegration. There are basically five types of VARs that can be estimated using five different assumptions. Model 1 Assume no deterministic trend in data and no intercept or trend in the VAR and in the cointegrating equation. Model 2 Assume no deterministic trend in the data, but an intercept in the cointegrating equation and no intercept in VAR. Model 3 Assume a linear trend in the data an intercept in cointegrating equation and test VAR. Model 4 Assume a linear deterministic trend in the data, intercept and trend in cointegrating equation and no trend in VAR. Model 5 Assume a quadratic deterministic trend in the data, intercept and trend in VAR, and linear trend in VAR.

It is found that first and fifth model is unrealistic and should not be used unless some kind of test shows that any one of the model can be used for the analysis. Johansen (1991) suggests "Pantula Principal" due to that to choose right model we should test the joint hypothesis of the rank order and the deterministic components. As it is not very sure that in data used in this study whether deterministic trend is present and VAR also has linear trend or not we have carried out joint test for all five models. Here again if there are inconsistencies among the results obtained from AIC and SIC, SIC has been preferred for further analysis. That model has been chosen which minimizes the value of SIC and in case if it is found that two models are giving the minimum value of SIC, the better (theoretically appropriate) has been chosen which minimizes the value of SIC of VEC modeling.

Once the appropriate VAR order (k) is determined and appropriate assumption is identified to carry out analysis, next step is to test the rank of Π matrix. JJ test provides two Likelihood Ratio (LR) test statistics for cointegration analysis. First test is trace (λ_{trace}) statistics and the second one is maximum eigenvalue (λ_{max}) statistics. These are specified as follows:

$$\lambda_{\mathrm{trace}}(\mathrm{r}) = -\mathrm{T}\sum_{\mathrm{i=r+1}}^{\mathrm{N}} \ln\left(1-\hat{\lambda}_i\right) \tag{13}$$

and

$$\lambda_{\max}(\mathrm{r},\mathrm{r}+1) = -\mathrm{T}\ln\left(1-\hat{\lambda}_{r+1}\right) \tag{14}$$

where r is the number of cointegrating vectors under the null hypothesis and $\hat{\lambda}_i$ is the estimated value for the i^{th} ordered eigenvalue from the matrix Π. The trace statistics tests the null hypothesis that the number of cointegrating relations is r against of k cointegration relations, where k is the number of endogenous variables. The maximum eigenvalue test, tests the null hypothesis that there are r cointegrating vectors against an alternative of $\mathrm{r}+1$ cointegrating vectors. To determine the rank of matrix Π, the test values obtained from the two test statistics are compared with the critical value from Mackinnon, Haug, and Michelis (1999) which differs slightly from those provided by Johansen and Juselius (1990). For both tests if the test statistic value is greater than the critical value, the null hypothesis of r cointegrating vectors is rejected in favor of the corresponding alternative hypothesis.

However, if it is found that there is no consensus in both tests on number of cointegrating vectors, this study has accepted the test statistics based on trace test as Luintel and Khan (1999) have shown that trace test is more robust than the maximum eigenvalue statistic in testing of cointegration. Finally, if, by following the procedure mentioned above it is found that trace statistic and maximum eigenvalue statistics rejects the hypothesis of maximum possible cointegrating vectors in that case to choose lag length in VAR this study has not followed SIC instead study has employed lag length suggested by majority of the selection criteria, preferably AIC. For example, suppose we have three variable models in this case at most two cointegrating vectors can exist but if we found that the null hypothesis of two cointegrating vectors is rejected by Johansen and Juselius (1990) test in favor of more than two cointegrating vectors which is an impossible case (suggesting that cointegrating matrix has full rank) in that case we have used AIC preferably, to choose appropriate lag length in VAR and then using that lag length suggested by AIC we have again determined which model (assumptions regarding trend in data etc.) is suites to data and then we have again determined (using same lag length suggested by AIC and appropriate assumptions for model suggested by SIC) the number of cointegrating vectors exist.

Once the cointegrating vectors have been estimated among a set of variables one can proceed to carry out VEC modeling. This will enable to understand the direction of causality among the same set of variables those are used in testing of number of cointegration vectors as cointegration alone does not talk about the direction of causality and it tells only that in long run test variables will be in equilibrium. VECM not only gives the direction of causality amongst some set of variable but also explains about short run and long run Granger-causality. The long run causal relationship is explained through the significance of (using t-test) lagged error correction term and the short run causal relationship is explained through first difference of explanatory variables. The Granger (1969) approach to the question of whether $X_{(t)}$ causes $Y_{(t)}$ is to determine how much of the current $Y_{(t)}$ can be explained by past values of $Y_{(t)}$, and then to see whether adding lagged values of $X_{(t)}$ can improve the explanation. $Y_{(t)}$ is said to be Granger-caused by $X_{(t)}$ if $X_{(t)}$ helps in the prediction of $Y_{(t)}$, or if the coefficients on the lagged $X_{(t)}'s$ are statistically significant. Note that two-way causation is frequently the case: $X_{(t)}$ Granger causes $Y_{(t)}$ and $Y_{(t)}$ Granger causes $X_{(t)}$.

It is important to note that the statement "$X_{(t)}$ Granger causes $Y_{(t)}$" does not imply that $Y_{(t)}$ is the effect or the result of $X_{(t)}$. Granger causality measures precedence and information content but does not of itself indicate causality in the more common use of the term. It is better to use more rather than fewer lags in the test regressions, since the Granger approach is couched in terms of the relevance of all past information. It is necessary to pick a lag length, k, which corresponds to reasonable beliefs about the longest time over which one variable could help predict the other. If two series are co-integrated, then a Granger causality test must be applied to determine the direction of causality between the variables under consideration. If the time series of a variable is nonstationary and series of nonstationary variables is not cointegrated, the variable is converted into then the Granger-causality test can be applied for example for two variables as follows:

$$\Delta X_{(t)} = \alpha_x + \sum_{i=1}^{k} \beta_{x,i} \Delta X_{(t-i)} + \sum_{i=1}^{k} \gamma_{x,i} \Delta Y_{(t-i)} + \varepsilon_{x,t} \tag{15}$$

$$\Delta Y_{(t)} = \alpha_y + \sum_{i=1}^{k} \beta_{y,i} \Delta Y_{(t-i)} + \sum_{i=1}^{k} \gamma_{y,i} \Delta X_{(t-i)} + \varepsilon_{y,t} \tag{16}$$

where $\Delta X_{(t)}$ and $\Delta Y_{(t)}$ are the first difference of time series variable while the series is nonstationary. However, if a variable is nonstationary and cointegrated, the Granger-causality test will be run based on the following equations:

$$\Delta X_{(t)} = \alpha_x + \sum_{i=1}^{k} \beta_{x,i} \Delta X_{(t-i)} + \sum_{i=1}^{k} \gamma_{x,i} \Delta Y_{(t-i)} + \varphi_x ECT_{x,t-i} + \varepsilon_{x,t} \tag{17}$$

$$\Delta Y_{(t)} = \alpha_y + \sum_{i=1}^{k} \beta_{y,i} \Delta Y_{(t-i)} + \sum_{i=1}^{k} \gamma_{y,i} \Delta X_{(t-i)} + \varphi_y ECT_{y,t-i} + \varepsilon_{y,t} \tag{18}$$

where, φ_x and φ_y are the parameters of the Error-Correction (ECT) term, measuring the error correction mechanism that drives the $X_{(t)}$ and $Y_{(t)}$ back to their long run equilibrium relationship.

The null hypothesis (H_0) for the equations (15) and (17) is $H_0: \sum_i^k \gamma_{x,i} = 0$ suggesting that the lagged terms $\Delta Y_{(t)}$ do not belong to the regression i.e., it do not Granger cause $\Delta X_{(t)}$. Conversely, the null hypothesis (H_0) for the (16) and (18) is $H_0: \sum_i^k \gamma_{y,i} = 0$, suggesting that the lagged terms $\Delta X_{(t)}$ do not belong to regression, i.e., it do not Granger cause $\Delta Y_{(t)}$. The joint test of these null hypotheses can be tested either by F-test or Wald Chi-square (χ^2) test. In the present study Wald Chi-square (χ^2) test has been preferred.

If the coefficients of $\gamma_{x,i}$ are statistically significant, but $\gamma_{y,i}$ are not statistically significant, then $X_{(t)}$ is said to have been caused by $Y_{(t)}$ (unidirectional). The reverse causality holds if coefficients of $\gamma_{y,i}$ are statistically significant while $\gamma_{x,i}$ are not. But if both $\gamma_{y,i}$ and $\gamma_{x,i}$ are statistically significant, then causality runs both ways (Bi-directional). Independence is identified when the $\gamma_{x,i}$ and $\gamma_{y,i}$ coefficients are not statistically significant in both regressions.

The statistical significance of the F-tests applied to the joint significance of the sum of the lags of each explanatory variable and/or the t-test of the lagged error-correction term(s) will indicate the Granger causality (or endogeneity of the dependent variable). The non-significance of both the t-test(s) as well as the F-tests in the VECM will imply econometric exogeneity of the dependent variable. The F-tests of the 'differenced' explanatory variables give us an indication of the 'short-term' causal effects, strict exogeneity of the variables. On the other hand, the significance of the lagged error-correction term(s) will indicate the 'long-term' causal relationship[4]. The coefficient of the lagged error-correction term, however, is a short-term adjustment coefficient and represents the proportion by which the long-term disequilibrium (or imbalance) in the dependent variable is being corrected in each short period. The non-significance or elimination of any of the lagged error-correction terms affects the implied long-term relationship and may be a violation of theory. The non-significance of any of the 'differenced' variables which reflects only the short-term relationship, does not involve such a violation because, the theory typically has nothing to say about short-term relationships.

Finally, stability of VECM analysis has been performed as in order to draw the conclusions from the above system, it is necessary that the VECM be stable or stationary. If the estimated VECM is stable then the inverse roots of characteristics Autoregressive (AR) polynomial will have modulus less than one and lie inside the unit circle. There will be kp roots, where $\mathbf{k}$ is the number of endogenous variables and $\mathbf{p}$ is the largest lag.

DATA ANALYSIS AND EMPIRICAL FINDINGS

Table 2 presents descriptive statistics (in terms of Mean, Median, Standard Deviation (S.D.), and Coefficient of Variation (C.V.), Skewness, Kurtosis and Jarque-Bera (J-B) statistics) of variables used for empirical analysis in the present study. From the table 2 it is evident that S.D. of money supply is highest (1.57) and inflation has lowest S.D. (0.51). Since S.D. is not better measure to measure fluctuations in the series therefore C.V. has been calculated which shows that C.V. of fiscal deficit is highest and C.V. of money supply is second highest while C.V. of inflation is lowest. J-B statistics shows that all

4 The lagged error-correction term contains the log-run information, since it is derived from the long-term cointegration relationship(s). Weak exogenity of the variable refers to ECM-dependence, i.e., dependence upon stochastic trend.

variables are having lognormal distribution as data do not support to reject the null hypothesis that variables under consideration follow normal distribution.

Table 2: Descriptive Statistics

	Ln (GE)	Ln (Inf)	ln (FD)	Ln (MS)
Mean	11.26	6.06	10.13	10.42
Median	11.44	5.87	10.48	10.35
Maximum	13.71	7.23	12.70	13.16
Minimum	8.64	5.27	7.25	7.90
Standard Deviation (S. D.)	1.50	0.51	1.56	1.57
Coefficient of variation (C.V.)	13.36	8.42	15.42	15.02
Skewness	-0.15	0.71	-0.39	0.13
Kurtosis	1.79	2.69	1.90	1.77
Jarque-Bera (Probability)	2.53 (0.28)	3.43 (0.18)	2.96 (0.23)	2.56 (0.28)

Granger-causality analysis using Dolado and Lütkepohl's (DL) and VECM approach

Using DL approach requires the prior knowledge of appropriate lag to be used in VAR. Since we don't know the appropriate lag structure to be used therefore, we have carried out lag length selection test[5]. Result of lag length selection is reported in Table 3. All criteria (i.e., FPE, AIC, HQIC, and SBIC) of lag length selection suggest one lag to be used in VAR.

Table 3: Lag Length Selection

Lag length selection test								
Lag	LL	LR	Df	P	FPE	AIC	HQIC	SBIC
0	-98.84				.00	-5.70	-5.70	-5.70
1	1146.29	2490.3*	16	0.00	1.3e-33*	-75.94*	-75.69*	-75.23*
2	1143.5	-5.58	16	.	3.2e-33	74.87	-74.37	-73.44
3	1151.67	16.34	16	0.43	4.2e-33	-74.42	-73.68	-72.29
4	1152.11	.89	16	1.00	8.9e-33	-73.53	-72.55	-70.69

Note: (1)*denotes significance at 5% level; (2) Selection-order criteria (lutstats)

Therefore, we have carried out VAR analysis using 2 (=1+1) lags as suggest by DL. Result of VAR analysis is reported in Table 4.

[5] In the process of determining lag length we have fixed maximum lag length four as our sample size is too small.

Table 4: Result of VAR Analysis

Vector auto regressive estimates				
Independent variables (k)	Dependent variables			
	ln (FD)	Ln (GE)	Ln (Inf)	Ln (MS)
Ln (FD)(-1)	-0.03	-0.01	-0.18	0.09
	(.26)	(.08)	(.41)	(.12)
Ln (FD(-2))	-0.02	0.06	-0.32	-0.44*
	(.31)	(.09)	(.47)	(.14)
Ln (GE)(-1)	2.07*	1.08*	0.92	0.18
	(.70)	(.21)	(1.06)	(.31)
Ln (GE)(-2)	-0.27	-0.23	0.57	0.57***
	(.68)	(.21)	(1.04)	(.30)
Ln (Inf)(-1)	-0.05	0.00	0.76*	0.00
	(.68)	(.03)	(.16)	(.05)
Ln (Inf)(-2)	0.11	0.01	-0.07	-0.01
	(.10)	(.03)	(.15)	(.04)
Ln (MS)(-1)	-0.42	0.24**	0.36	0.95*
	(.37)	(.11)	(.57)	(.17)
Ln (MS)(-2)	-0.30	-0.14	-1.30**	-0.32***
	(.43)	(.13)	(.66)	(.19)
C	-2.55**	0.29	-0.04	-1.01**
	(.43)	(.31)	(1.58)	(.46)
VAR Model summary				
R-squared	0.99	1.00	0.72	1.00
Adj. R-squared	0.98	1.00	0.65	1.00
Sum sq. resids	1.00	0.09	2.36	0.20
S.E. equation	0.19	0.06	0.29	0.08
F-statistic	265.16	2688.61	9.20	1429.83
Log likelihood	14.38	58.22	-1.60	44.39
Akaike AIC	-0.29	-2.66	0.57	-1.91
Schwarz SC	0.10	-2.27	0.96	-1.52

Note: (1) *, **, and ***denotes significance at 1%, 5%, and 10% level respectively; (2) Figures in the parenthesis denotes standard errors; (3) k denotes lag length.

It is evident from the Table 4 that it is last year's government expenditure which (positively) affects fiscal deficit and other variables do not affect significantly the fiscal deficit. While government expenditure is (positively) affected by last year's government expenditure and money supply. This implies that increase in the money supply and government expenditure in the current year will significantly increase the government expenditure in the next year. As for as inflation is concerned it is (positively) affected by last year's inflation and negatively by money supplied just two year back. This implies that inflation in the year t increases the inflationary pressure in the year t+1 while money supply in the current year decreases the inflation in the year t+2. It is also found that money supply is significantly affected by two years back fiscal deficit (negatively), government expenditure (positively), and money supply (negatively); while money supply of the last year is also significantly positively affects the money supply of the current year.

Further, we have carried out Granger-causality analysis for VAR model by removing the second lag from the VAR system. Result of Granger-causality analysis has been presented in the following Table 5.

Table 5: Granger-causality Analysis in DL Approach

VAR granger causality (modified wald test/χ^2)				
Independent variables	Dependent variables			
	Ln (FD)	Ln (GE)	Ln (Inf)	Ln (MS)
Ln (FD)	------	0.08	0.01	0.00
Ln (GE)	10.06*	------	0.22	0.26
Ln (Inf)	0.61	0.65	------	0.24
Ln (MS)	5.56**	1.59	0.63	------

Note: (1) *, **and ***denotes significance at 1%, 5%, and 10% level respectively; (2) k denotes lag length.

It is evident from the Table 5 government expenditure and money supply Granger-cause fiscal deficit. No other direction of Granger-causality is found among the test variables. Further, we have carried out VAR stability analysis as if any root lies outside the unit circle the results reported by table will not be valid. Result of VAR is reported in the Table 6.

Table 6: VAR Stability Analysis

Roots of characteristic polynomial and lag specification (1, 1)	
Endogenous variables: D(Ln(FD)) D(Ln(GE)) D(Ln(Inf)) D(Ln(MS))	
Root	Modulus
1.00	1.00
0.88	0.88
0.67	0.67
-0.04	0.04

Note: No root lies outside the unit circle. Therefore VAR satisfies the stability condition.

It is evident from the table that no root lies outside the unit circle therefore VAR stability condition is satisfied and we can say that Granger-causality results are valid. Next we have proceeded to carry out Granger-causality analysis in traditional framework. Therefore first of all unit root test has been conducted[6] to check the stationarity property of data series of variables. Result of unit root analysis has been presented in Table 7.

[6] First of all graphical presentation of variable has been done and then unit root analysis has been performed employing drift or trend and drift assumption basing upon as the graphs suggest.

Table 7: Results of Unit Root Analysis

Variables	Unit root test statistics			
	Constant	Constant and Trend	DF/ADF (k)†	PP (k)ψ
Ln (GE)	-----	Yes	-1.94	-1.94 (3)
D(ln(GE))	Yes	-----	-5.49*	-5.45*
Ln(Inf)	-----	Yes	-2.034	-2.04
D(Ln(Inf))	Yes	-----	-5.99*	-5.99* (2)
Ln(FD)	-----	Yes	-2.29	-2.29
hD(Ln(FD))	Yes	-----	-6.08*	-6.03* (1)
Ln(MS)	-----	Yes	-1.94	-1.94
D(Ln(MS))	Yes	-----	-6.30*	-6.31* (2)

Note: (1) *denotes significance at 1% level; (2) k denotes lag length used to avoid problem of serial correlation; (3) D denotes first difference of the variable; (4) † denotes maximum lag selection is based on SIC; (5) ψ denotes Newey-West using Bartlett kernel method has been used to select appropriate lag length; (6) Critical values of DF/ADF test for level form are -4.219126, -3.533083, -3.198312 at 1%, 5% and 10% level of significance respectively, and critical values of DF/ADF test for first difference form are -3.621023, 2.943427, 2.610263 at 1%, 5% and 10% level of significance respectively; (7) Critical values of PP test for level form are -4.219126, -3.533083, -3.198312 at 1%, 5% and 10% level of significance respectively, and critical values for PP test for first difference are -3.621023, -2.943427, -2.610263 at 1%, 5% and 10% level of significance respectively.

It is evident from Table 7 that all variable are non stationary in their level but stationary in first difference form. Next step is to select appropriate model to check for cointegration among the non stationary series of the variables. Using lag order 1 (as it was suggested by all lag selection criteria's) we have carried out joint test of cointegrating equations and five different models, which is also known as Pantula Principals. Result of joint test is reported in Table 8.

Table 8: Model Selection Test

Model selection test (Lags interval: 1 to 1)					
Models [Data trend (Test type)]	None (No intercept & no trend)	None (Intercept & no trend)	Linear (Intercept & no trend)	Linear (Intercept & trend)	Quadratic (Intercept & trend)
AIC					
0	-4.65	-4.65	-4.91	-4.91	-4.79
1	-4.74	-5.03	-5.30*	-5.28	-5.20
2	-4.60	-5.02	-5.13	-5.11	-5.08
3	-4.28	-4.76	-4.81	-4.85	-4.87
4	-3.85	-4.38	-4.38	-4.47	-4.47
SIC					
0	-3.96	-3.96	-4.04	-4.04	-3.74
1	-3.70	-3.94	-4.08*	-4.01	-3.81
2	-3.21	-3.54	-3.56	-3.45	-3.34
3	-2.54	-2.88	-2.89	-2.80	-2.78
4	-1.76	-2.11	-2.11	-2.03	-2.03

Note: (1) * denotes significance at 5% level (Critical values based on MacKinnon, Haug, and Michelis [1999]); (2) r denotes number of cointegration to be estimated. r=0, 1, 2, 3, 4.

It is evident from the table both SIC and AIC preferred model 3 to be used in for cointegration analysis. Therefore, by using lag length one and model three we have carried out cointegration analysis. Result of cointegration analysis is presented in the Table 9.

Table 9: Cointegration Test

Cointegration test (Trend assumption: linear deterministic trend [restricted] lags interval [in first differences]: 1 to 1)

Unrestricted cointegration rank test (trace)

H_0	H_a	Eigenvalue	Trace Statistic	5% Critical Value	Prob.**
None	At most 1	0.56	44.14	47.86	0.11
At most 1	At most 2	0.24	14.01	29.80	0.84
At most 2	At most 3	0.10	4.06	15.49	0.90
At most 3	At most 4	0.00	0.04	3.84	0.84

Unrestricted cointegration rank test (maximum eigenvalue)

H_o	H_a	Eigenvalue	Max-Eigen Statistic	5% Critical Value	Prob.**
None *	At most 1	0.56	30.13	27.58	0.02
At most 1	At most 2	0.24	9.95	21.13	0.75
At most 2	At most 3	0.10	4.027	14.26	0.86
At most 3	At most 4	0.00	0.04	3.84	0.84

Note: (1) * denotes rejection of the hypothesis at the 5% level; (2) ** denotes MacKinnon, Haug, and Michelis (1999) p-values; (3) Trace test indicates no cointegration at the 5% level while Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 5% level.

It is evident from Table 9 that Trace statistic of JJ test, (as Johansen and Juselius (1990) and Luintel and Khan (1999) have shown that trace test is more robust than the maximum eigenvalue statistic in testing of cointegration) shows that there is no cointegrating vector. Since the test variable in the long run is not found to be cointegrated (i.e., they do not move together), therefore we cannot go ahead in VECM framework. Therefore, we have carried out causality analysis using standard Granger-causality test (that is we have not incorporated residual in our analysis) with the same lag that is one. Results of Granger-causality analysis are reported in Table 10.

Table 10: Granger-causality Analysis in Standard Granger Approach

VAR granger causality (wald F-test)

Independent variables	Dependent variables			
	D(Ln(FD))	D(Ln(GE))	D(Ln(Inf))	D(Ln(MS))
D(Ln(FD))	------	0.24	0.27	3.66***
D(Ln(GE))	3.40***	------	0.00	0.69
D(Ln(Inf))	0.31	7.39E-06	------	0.00
D(Ln(MS))	0.35	2.83***	0.72	------

Note: (1) *, **, and ***denotes significant at 1%, 5%, and 10% level respectively; (2) D denotes first difference; (3) k denotes lag length.

It is evident from the table that there is unidirectional causality running from government expenditure to fiscal deficit, from money supply to government expenditure and from fiscal deficit to money supply. Further, since this approach is also based on VAR, therefore again we have carried out stability checks of VAR. Results of roots and modulus indicate that VAR is stable.

Table 11: VAR Stability Analysis

Roots of characteristic polynomial and lag specification (1, 1)
Endogenous variables: D(Ln(FD)) D(Ln(GE)) D(Ln(Inf)) D(Ln(MS))

Root	Modulus
-0.268961 - 0.241689i	0.36
-0.268961 + 0.241689i	0.36
0.20	0.20
-0.04	0.04

Note: No root lies outside the unit circle. Therefore, VAR satisfies the stability condition.

CONCLUSIONS

This study has made an attempt to test the direction of causality among government expenditure, inflation, money supply and fiscal deficit. We have also found conflicting results for India. Since causality analysis based on DL approach suggests that both government expenditure and money supply Granger-cause fiscal deficit while standard Granger-causality test indicates that only government expenditure Granger-cause fiscal deficit. And money supply Granger-cause government expenditure and fiscal deficit Granger-cause money supply. Further, the most interesting one, we found that inflation does not Granger-cause any of the test variable included in the model and no variable included in the model Granger-cause fiscal deficit. The last finding is very much similar to Tiwari and Tiwari (2011) which found that inflation in the Indian context has no impact on the fiscal deficit but contrary to Makochekanwa (2011) for the Zimbabwean economy which found that due to massive monetization of the budget deficit, significant inflationary effects are found for increases in the budget deficit.

Our findings imply that past values of government expenditure contains important information to predict fiscal deficit. Similarly, past values of money supply contain important information to predict government expenditure and fiscal deficit contains important information to predict fiscal deficit. Therefore, while deciding upon the fiscal policies government must use the important information contained by these variables. An important implication of this study is that while financing of deficit through the banking system from printing of new money and creating interest-bearing bonds decreases fiscal deficit, increasing government expenditure is the main cause of mounting fiscal deficit. This may be due to deficient and inefficient social programs as Tanzi (2000) reveals that in Latin American countries disequilibrium between public budget and budget deficit results from governments' wrong policies such as using borrowing in order to finance the deficit as found by Egeli (2000). It may be construed here that government's consumption expenditure is much more propelling force for fiscal deficit growth as compared to its investment-inducing expenditure programmes. Hence, an efficient prioritisation of public spending is needed for fiscal consolidation. Increased accountability and transparency may control government expenditure and thereby fiscal deficit. Reduction in fiscal deficit may contain 'crowding out' and thus boost investment which concomitant with increase in productivity and production may help control inflation. Thus, in order to analyze this issue in depth one can go for empirical analysis in this direction for India. Besides, the present study can be extended by analyzing the impact of different components of government expenditure on fiscal deficit. This may give more insights about the problem.

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