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Establishing the Link between Fiscal Indicators in India: A VAR Analysis (1980-2013)

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ABSTRACT

In this paper, the relationship between the three major fiscal indicators: central government revenues, development expenditure of the Central government and real GDP in India has been established for the period 1980-2013. The vector autoregressive model is used for studying the relationship and the direction of causality between the variables determined using the Granger causality test. Granger causality test shows that there is causality running from growth of central government revenue to growth of central government development expenditure supporting the tax spend hypothesis. Also, GDP growth is granger causing the growth of revenues of the central government but the causality in the reverse direction is not true.

1. Introduction

The study of the nexus between government expenditures and revenues is important since that will guide the government in formulating optimal fiscal policies and managing its fiscal deficits. In a developing country like India, the government has to carefully allocate expenditure between development and non - development sectors. All expenditures that promote growth and development are termed as development expenditures. Expenditure on social services, infrastructure development, public enterprises or development of agriculture increase productive capacity in the economy and bring income to

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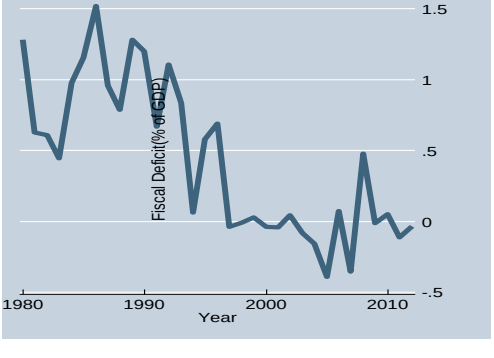
government. Expenditures in the nature of consumption such as defense, interest payments, expenditure on law and order, public administration that do not create any productive asset which can bring income or returns to the government are non-development expenditures. Development sectors such as infrastructure, health and education are always in need of government expenditure as they are determinants of long term growth of the country. At the same time, due to administrative bottlenecks and presence of a large informal sector, the government faces problems in collecting taxes through an effective policy of direct and indirect taxation. When the expenditures of the government exceed its revenues, the government has a fiscal deficit. When government finances its excess expenditures, it borrows from domestic or foreign sources. Borrowing by the government leads to increase in interest rates which reduces private investment and consumer spending. This further causes reduction in the Gross Domestic Product (GDP) that reduces the capital receipts and also the tax base of the government. Thus, it is necessary that the government finds ways to control the fiscal deficit for which it is necessary to establish the relationship between the variables associated with the government's fiscal deficit.

In the 1980's, considerable fiscal deterioration took place which eventually became unsustainable reflecting the problem of rising resource gap. These fiscal imbalances spilled over to the external sector and led to the macroeconomic crisis of 1991. The reforms of 1991 aimed at augmenting revenues and simplification and rationalization of the tax system. In August 2003, the Central government enacted the Fiscal Responsibility and Budget Management Act to consolidate the fiscal structure. Also the expenditures reform Commission, suggested a number of measures to curb unnecessary expenditures. Figure 1 shows the growth of fiscal deficit in India since 1980 till 2012.



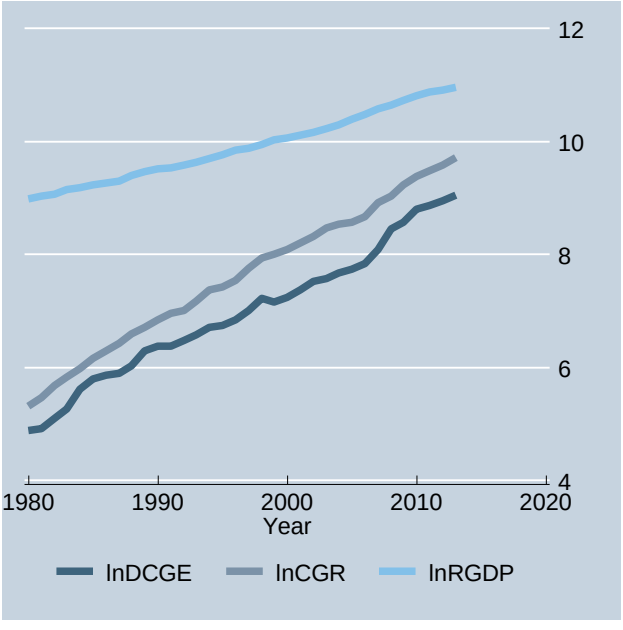
Source : Own calculations using RBI data

Figure 1: Trends of growth of fiscal deficit in India (1980-2013)

The above figure shows that the growth of fiscal deficit had been increasing in the 1980's and is somewhat declining after the reforms of 1991. The deficit growth had been considerably decreasing since around 2003 perhaps due to the impact of the FRBM act. Again, it shows a peak in 2008 that coincides with the global economic crisis of 2008. But overall it seems that the growth of fiscal deficit has declined considerably since 1980. This indicates increasing parity between the central government expenditures and revenues through better fiscal management.

In order to enable the government to formulate better policies for fiscal management, it is very important to establish the relationship between government expenditures and revenues and to determine the direction of causality between them. There are basically three hypotheses regarding the direction of causality between government expenditures and revenues. According to Friedman, the direction of causality between them runs from revenue to expenditure. This means that raising taxes may not necessarily curb fiscal deficit growth instead it will only lead to further increase in government expenditure. This is known as the tax-spend hypothesis. Another hypothesis postulated by Peacock and Wiseman, says that increase in government expenditure leads to permanent increase in government taxes. This is known as the spend-tax hypothesis. The third theory states that government revenues and expenditures vary simultaneously together i.e. they both cause each other and this is known as the fiscal synchronization hypothesis.

In this study, instead of the total expenditures of the Central Government, only its expenditure on development sectors is used. The general idea is that the government's expenditure on development sectors will translate into economic growth and greater revenues for the government even though the effect may occur with a significant time lag. Also, GDP has been used as another variable in the model since it has significant impact on the fiscal environment of a country. Ina nutshell, this paper is attempting to establish a relationship between Central government revenues, its development expenditures and GDP and the direction of causality between them. Figure 2 shows the plot of Central government revenues, its development expenditures and the country's real GDP between 1980-2011 (with all variables in their log natural forms).



Source: Own calculations using RBI data

Figure 2: Plot showing trend of development expenditure, revenue and real GDP

2. Literature Review

Few studies have been carried out to establish the relationship between government expenditure and revenue across time in case of India and other developing countries. Yashobanta et.al. (2012) have attempted to analyze the causal relationship for the period 1970-2008 and their studies support the fiscal synchronization hypothesis in the long run and the spend tax hypothesis for the short run. Another study was carried out by K.Dhanasekaran (2001)[8] for the period 1960-1999. He showed that different tests led to different conclusions regarding the direction of causality for the long run as well as the short run. He also showed that the direction of causality varies between different specifications of the model. Also, P.K.Narayan performed a study to figure out the causality between government expenditures and revenues for various Asian countries and found that no cointegration exists between government expenditure and revenue in India. In case of Saudi Arabia, Khalid Al-Qudair (2005)[3] has shown that government expenditure and revenue are cointegrated and share a long run equilibrium. Also, using an error correction model, he shows that the causality

runs in both directions indicating that fiscal synchronization hypothesis may hold in case of Saudi Arabia. Zinaz Aisha and Samina Khatoon (2009) show that in case of Pakistan, although there is cointegration between government revenues and expenditures, unidirectional causality runs from expenditure to revenue.

Apart from these, there are a few works regarding the relationship between government expenditure and GDP growth in developing countries. Vijay Gangal and Honey Gupta (2013) study the relationship between government expenditure and GDP growth for the period 1998-2012 and show that they are both cointegrated and the causality runs from government expenditure to growth and not vice versa. Balbir Singh and Balbir S. Sahni (1984) show that there is a feedback type relationship between government expenditure and growth in India for the period 1960-1981. Abu Nurudeen et.al. make use of expenditure disaggregated into its various components to find that certain components of the expenditure such as expenditure on education and capital expenditure have a negative impact on growth while expenditure on health and transport and communication have a positive effect on growth. Finally, I refer to a paper by Khalifa H. Ghali (1999) who studies and compares the relationship between government size, economic growth and other variables in case of 10 OECD countries. He finds that the variables are cointegrated in all the countries though the extent and direction of causality differs across countries.

In this paper, I try to establish the relationship between government expenditure, revenues and real GDP. In the next section, I describe the data and the methodology used for the purpose. In the subsequent section, I report my empirical findings. Finally, the results are summed up and conclusions are drawn.

3. Data and Methodology

For the purpose of this study, data downloaded from Reserve Bank of India's Handbook of statistics is used. Development expenditures and total revenues of the Central government are obtained from the major heads of central government's expenditure (GE) and revenue (GR) respectively for the period 1980-2013. Also, GDP at constant prices (at factor cost) is obtained which is the real GDP (RGDP) for the above mentioned period. All the variables in this model are endogenous. In this study, all variables are taken in their natural log form so that their first differences approximated for the growth rates of the variables. All these variables and their first differences were tested for stationarity using the

Phillip Perron test for unit root and all were found to be non stationary in their levels but stationary in their first differences.

In order to test for cointegration between the three non stationary time series i.e. the natural log of central government revenues, development expenditures and real GDP, Johansen's method for testing for cointegration is used. It is based on the likelihood ratio test to determine the number of cointegration vectors in the regression. This test is based on two test statistics i.e. the trace test and the maximum eigenvalues test statistics. The trace test is defined as:

$$Trace = \sum_{i=1+r}^{n} \log (1\gamma_i)$$

The null hypothesis for the trace test is that the number of cointegration vectors is r=r*<k, vs. the alternative that r=k. Testing proceeds sequentially for r*=1, 2, etc. and the first non-rejection of the null is taken as an estimate of r. The maximum eigenvalue test is defined as:

$$\gamma_{max} = -T \log (1 - \gamma_i)$$

The null hypothesis for the "maximum eigenvalue" test is as for the trace test but the alternative is r=r*+1 and, again, testing proceeds sequentially for r*=1,2 etc., with the first non-rejection used as an estimator for r. This test is found to have better small sample properties compared to the Engle Granger method*.

Selection order criteria (AIC and BIC) are used to find the number of significant lags in the model to be used for the purpose of estimation. Since the variables in the model are found not to be cointegrated, a Vector Autoregressive (VAR) model is used for the purpose of estimation. Since the level variables are non-stationary, the first differences of all three independent variables is used. The VAR used in this paper is based on the following set of equations:

$$\partial R_t = \alpha_0 + \alpha_1 \partial R_{t-1} + \alpha_2 \partial E_{t-1} + \alpha_3 \partial G_{t-1} + e_1$$

$$\partial E_t = \beta_0 + \beta_1 \partial R_{t-1} + \beta_2 \partial E_{t-1} + \beta_3 \partial G_{t-1} + e_2$$

$$\partial G_t = \delta_0 + \delta_1 \partial R_{t-1} + \delta_2 \partial E_{t-1} + \delta_3 \partial G_{t-1} + e_3$$

where,

(1) ∂R_t is the growth rate of the total revenue of the central government at time period t.
(2) ∂E_t is the growth rate of central government's development expenditure at time period t.
(3) ∂G_t is the growth rate of real GDP at time period t.
(4) α_0, β_0 and δ_0 are the constant terms, $\alpha_1, \alpha_2, \alpha_3$; $\beta_1, \beta_2, \beta_3$; $\delta_1, \delta_2, \delta_3$ are the respective coefficient terms and e_1, e_2 and e_3 are the error terms.

The Granger causality test is used to determine the direction of causality among all three variables with respect to each other. These show how the variables in the model affect each other in the short run. Finally, the eigenvalue stability test is used to show that the VAR model is stable. The stability of VAR can be examined by calculating the roots of:

$(I_n – AL – AL^2 - ....)\ y_t = A(L)\ y_t$

The characteristic of the polynomial is defined as:

$\Pi(z) = (I_n – A_1z – A_2z^2 - ....)$

The roots of $\Pi(z) = 0$ will give the necessary information about the stationarity or nonstationarity of the process. The necessary and sufficient condition for stability is that all characteristic roots lie outside the unit circle. Then π is of full rank and the variables are stationary.

In the next section, these methods are applied to study the relationship between Central Government revenues, development expenditure and RGDP on the data and present the empirical results so obtained.

4. Empirical findings

4.1. Unit root tests

The Phillip Perron test is used to test for the presence of unit roots. The results of the test are reported below in table 1 :

Table 1 : Test results for unit roots

Variable	PP (without trend)	PP (with trend)
R	-1.427(0.5694)	-2.937(0.1507)
E	-0.207(0.9376)	-1.963(0.6213)
G	2.085(0.9988)	-1.441(0.8485)

∂R	-4.751(0.0001)	-4.787(0.0005)
∂E	-4.653(0.0001)	-4.570 (0.0012)
∂G	-4.248(0.0005)	-4.673(0.0008)

Source: Own calculations

*****The values in parenthesis are the p-values of the test statistics. The 5% critical values are -2.980 (without trend) and -3.572 (with trend).

The above table shows that natural log of all three variables are non stationary both with and without including a deterministic trend. This is so since we are unable to reject the null hypothesis that a unit root is present. Also, the first differences of all the natural log of these variables are found to be stationary both with and without including a deterministic trend. This is because the null hypothesis indicating a unit root at 5% level of significance is rejected. Therefore, the natural log of all these variables is integrated of order 1 while their first differences are integrated of order 0.

4.2. Testing for cointegration

Since all the variables in my model are integrated of order 1 at their levels, there may be a long run relationship between the variables i.e. they may be cointegrated. A test for cointegration between the variables is performed using Johansen's test for cointegration. The result of this test is as follows:

Table 2: Test result for cointegration

Max. rank	Paramater	LL	Eigenvalue	Trace statistic	5% critical value	Max statistic	5% critical value
0	12	172.09409		23.5099	29.68	14.5698	20.97
1	17	179.37899	0.36575	8.9401	15.41	8.7333	14.07
2	20	183.74565	0.23884	0.2068	3.76	0.2068	3.76
3	21	183.84905	0.00644				

Source: Own calculations
*The trace statistic and the max statistic are the test statistics associated with the trace test and the maximum eigenvalue test from the Johansen's cointegration test.
**We take the number of lags as 2 since the AIC and BIC statistics for the VAR model are significant for 2 lags at 5% level of significance.

The above table shows that the null hypothesis is not rejected for both the trace test as well as the maximum eigenvalue test for $r \geq 1$ as well as $r=0$. Therefore, there are no cointegrating vectors between the variables in our model indicating

the absence of any cointegration between them. This shows that there is no long run relationship between the variables in our model.

4.3. Vector Autoregression and testing for Granger causality:

Since it is found that there is no cointegration between the variables in their level, we construct a vector autoregressive model using the first differences of the variables. Since the level variables are all in their natural logs, their first differences approximate their growth rates. The number of lags is chosen for the VAR model using pre-estimation lag selection criteria which gives us one significant lag at 5% level of significance. The results of the VAR are as follows:

Table 3: Vector Autoregression results:

Dependent variable	Independent variable	Coefficient	p>|z|
∂G_t	∂G_{t-1}	0.2396782	0.164
	∂E_{t-1}	0.0220295	0.603
	∂R_{t-1}	-0.0204173	0.791
	Constant	.0454289	0.002
∂E_t	∂G_{t-1}	1.536578	0.027
	∂E_{t-1}	-0.0003453	0.998
	∂R_{t-1}	0.6213908	0.045
	Constant	-0.0462661	0.432
∂R_t	∂G_{t-1}	-0.0871727	0.838
	∂E_{t-1}	0.1342213	0.200
	∂R_{t-1}	0.0233351	0.902
	Constant	0.1177472	0.001

Source: Own calculations

The Granger causality test is then used on the above VAR model. The Granger causality test shows the direction in which the causality is running in the short run. It is based on the Wald's Chi square test for a small sample. The result of the Granger causality test is as follows:

Table 4: Granger causality Wald test results:

Dependent variable	Causal variable	Chi Square statistic	P value
∂R	∂E	1.6413	0.2
∂R	∂G	0.04189	0.838
∂E	∂R	4.0009	0.045
∂E	∂G	4.878	0.027
∂G	∂R	0.07036	0.791
∂E	∂E	0.26993	0.603

Source : Own calculations

The above table shows that the following:

1) The growth rate of central government revenue is granger causing the central government development expenditure at 5% level of significance. The causality in the reverse direction is not true.

2) The growth rate of central government revenue is not granger causing real GDP growth and the causality in the reverse direction is also not true.

3) The growth rate of central government's development expenditure is not Granger causing the real GDP growth but the causality in the reverse direction is true.

4.4. Stability test:

The eigenvalue stability test shows that the VAR model is stable. The result of this test is as follows:

Table 5: Eigenvalue stability condition:

Eigenvalue	Modulus
0.3801148	0.380115
-0.3276784	0.327678
0.2102316	0.210232

Source: Own calculations

*All the eigenvalues lie inside the unit circle. VAR satisfies stability condition.

5. Interpretation of the results

The results obtained from our model will be briefly explained in this section. Table 3 shows that the growth of development expenditure of the government as a dependent variable is affected positively by the growth of central government revenues with a one year lag and is significant at 5% level of significance. Similarly, the previous year GDP growth positively affects the growth of current development expenditure of the central government. The VAR coefficients show that a 1% increase in growth rate of GDP in the previous year leads to an increase in the current development expenditure of the central government by 1.536578%. Similarly, if the central government revenue last year grew by 1%, the development expenditure will grow by 0.6213908%.

These results are very obvious, straightforward and seem to be consistent with theory. The increase in revenue growth in the previous period would provide the government with greater resources left over for spending on development sectors once the fixed non-development expenses are taken care of. Similarly, increase in GDP growth in the previous period enhanced economic activity and income in the economy, which is to be complemented with increase growth of development sector spending in order to support the growing need for infrastructure and human development in a dynamic economy.

The results of the Granger causality tests show that the causality between the growth of central government revenue and development expenditure run in the direction from revenue growth to growth of development expenditure while the causality in the opposite direction is insignificant at 10% level of significance. Therefore, the results support Friedman's tax spend hypothesis. Also, the GDP growth significantly Granger causes growth of development expenditure while causality in the reverse direction does not hold. This shows that the government's fiscal policies don't seem to have much impact on economic growth. The absence of reverse causality both in case of GDP growth as well as revenue growth shows that these are not determined endogenously in this model.

6. Conclusion

The results of this study have shown that there is no long run relationship between central government revenues, its development expenditure and the real GDP. The short run relationship between the growth rate of these variables has been deciphered through the vector autoregressive model. The Granger causality

test indicates that the causality runs in the direction from central government revenue growth to growth of development expenditure. Also, the growth of GDP Granger causes growth of development expenditure. The policy implication of this result underscores the need for better synchronization between government revenues and development expenditure so as to achieve rapid growth in the economy. Moreover, it is important for the government to judicially allocate resources on development sectors that are more growth inducing so as to optimize returns from its expenditure. Since, development expenditure on the whole does not seem to affect economic growth, there is need to determine the disaggregated effect of various development sectors on economic growth which provides scope for further research.

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