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A CAUSAL TEST OF FISCAL SYNCHRONISATION HYPOTHESIS IN INDIA

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Abstract

Using the annual data from 1960-61 to 1996-97, this paper attempts to test the causal nexus between total central government expenditures and total central government revenues in the case of India, within the empirical framework of causality, cointegration and error correction mechanism in the presence of a structural break. Identifying a structural break in both budget expenditures and revenues around the period 1990-91, this study finds support for a long-run equilibrium relationship between budget expenditures and revenues. Furthermore, this study finds evidences of a unidirectional causality from expenditure to revenue thereby invalidating the fiscal synchronisation hypothesis in India during the study period.

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I. Introduction

Western experience of the Great Depression exposed the vulnerability of the classical *mantra* of total reliance on market forces. Subsequently, Keynesian economics suggested government intervention as a remedy for market failure. Since then the size of governments all over has increased considerably, leading to high government expenditure, revenue mobilization and ultimately budget deficit. Since budget deficit is a very debatable issue for its economic consequences, the aim of any fiscal policy is to control budget deficit by altering either government expenditure or receipt or both. From this point of view, examining the causal nexus between tax revenue and expenditure has retained its significance.

The literature attempting to explore the nexus between budget expenditures and revenues has put forth three fundamental hypotheses. They are (i) Fiscal Synchronisation Hypothesis (ii) Tax-and-Spend Hypothesis and (iii) Spend-and-Tax Hypothesis. In accordance with the fiscal synchronisation hypothesis, government expenditures and revenues are determined simultaneously, suggesting that they mutually reinforce each other through a feedback causality between them. Meltzer and Richard (1981), Marlow and Manage (1986), while investigating the relationship between US federal budget outlays and tax receipts found support for bi-directional causality between receipts and expenditures. Similarly, Owoye (1995), while attempting to investigate the causal nexus between expenditures and revenues within the empirical framework of cointegration and error correction mechanism (ECM), finds evidence for the fiscal synchronisation hypothesis in all the G7 countries except Italy and Japan. Ram (1988) also finds a bi-directional causal relationship between expenditures and revenues for the U.S. economy within the empirical framework of cointegration.

In contrast to the fiscal synchronisation view, Tax-and-Spend hypothesis favours a unidirectional causality from government revenues to government expenditures. Supporting the Tax and Spend view, Friedman (1972) argued that raising taxes would lead to an increase in expenditures. Furthermore, Buchanan and Wagner (1977, 1978) propose that tax revenues determine the level of government expenditure. Blackley (1986), using Granger and Sims causality tests, also finds support for Tax and Spend hypothesis. Further claims made by the supply side economists [like Joulfian and Mookerjee (1990) and Bohm (1991)], that revenue causes expenditure strengthens the Tax-and-Spend hypothesis.

At the same time Barro's (1989) theory of deficit advocates the Spend-and-Tax hypothesis, whereby government expenditures cause government revenues. Peacock and Wiseman (1979), in their pioneering work, found that government spending causes changes in taxes. Similarly, von Furstenberg et al (1986), using Vector Autoregreessions, found support for one-way causality from spending to revenue in the U.S.

Interestingly, most of the empirical work in this area has focussed on the U.S. economy and a few advanced OECD countries. But analyzing the nexus between budget expenditures and revenues and identifying the causal pattern in a developing economy may prove to be more fruitful. Hence, there is a need for focussing on research in developing countries with different levels of economic development. In the Indian context, with the exception of the study by Bhat *et al* (1991), there is no empirical work in this area. Bhat *et al* (1991), using Granger causality test and Multiple Rank F-test, found support for a unidirectional causality from tax revenue to total expenditure. In verifying the Wagner's law, however, Mohsin *et al* (1992) have employed cointegration and error correction models in the Indian context.

Of late, studies concerning investigation of cause-and-effect relationship between budget expenditures and revenues have moved out of the conventional tests of causality and embraced the econometric framework of cointegration and error correction mechanism. In this framework, investigating the stationary properties of the relevant variables has been conducted through conventional unit root tests, which is somewhat objectionable on the grounds that, in the conventionally used unit root tests the deterministic trend is assumed to be specified exactly. But, with shocks in the form of strong policy interventions or economic upheavals (like prolonged recession or oil crisis) the deterministic trend in the variables of interest is unlikely to remain isolated in the long run. Therefore, a sudden shift (break) in the deterministic trend is quite admissible. Hence, it is more appropriate to employ the unit root tests, which accommodate structural or trend break in the deterministic trend of revenue and expenditure before proceeding to investigate the causal nexus between them.

In the light of the above discussion, this paper examines the direction of causality between annual total central government expenditures and total central government revenues within the empirical framework of cointegration and error correction mechanism by applying the unit root tests which take care of possible one time period break (exogenous as well as endogenous) in the deterministic trend of the variables under investigation. Since there are no studies of this kind in the Indian context to date, the present paper attempts to fill the gap, by utilising the annual data of the Indian economy spanning the period 1960-61 to 1996-97.

The rest of the paper is organized as follows: Section II explains the methodology employed in this paper. Section III discusses the empirical results of structural break, unit roots, and the causality pattern obtained from cointegration and ECM methodology. Concluding remarks are reported in section IV.

II. Methodology

The Grangerian framework for testing the bivariate causal relationships is based on the assumption that the given pair of variables is stationary, i.e., integrated of order zero, denoted by I(0). This implies that the first basic step in this direction is to confirm that there is no unit root in each of the variables. In case the variables are found to be non-stationary of the same order (i.e., integrated variables), they should be cointegrated. In such a case, an error correction mechanism (ECM), which is bound to exist for a cointegrated system, should be exploited to search for an additional source of causation [see Engle Granger (1987, 1988)]. This additional source of causation through the ECM rules out one of the possibilities of the Granger test that the variables are not related at all. This avoids spurious causal inferences. The next basic step is to test for cointegration and estimation of ECM [see Miller and Russek (1990)]. The methodology of the present study falls in line with the above logic.

Econometric literature in the recent past has experienced an explosion of unit root tests for testing the stationarity of time series. As a matter of fact, most of the studies routinely use Dickey-Fuller (DF), Augmented DF and Phillips Perron (PP) tests for testing unit roots. There are however several problems with these tests, particularly their inability to account for a structural break in the time series. One major drawback of unit root tests is that they are based on the implicit assumption that the deterministic trend is correctly specified. Perron (1989) argues that if there is a break in the deterministic trend, then unit root tests will lead to a misleading conclusion that there is a unit root, when in fact there is not. This controversy has led to the development of a class of unit root tests which account for the existence of structural break in the time series. In this paper, we have used three alternative unit root tests for checking the simultaneous existence of structural break and unit roots, namely (i) Banerjee, Lumsdaine and Stock (BLS) recursive and sequential test for unit root and trend break (ii) Perron's test for an endogenous time break (iii) Augmented Perron unit root test for an exogenous break.

Since the present study deals with only two variables viz., budget expenditure (E_t) and budget revenue (R_t), the simple two-stage Engle - Granger (EG) procedure is adopted for testing cointegration. According to EG procedure, if the results of unit root test indicate that both the variables E_t and R_t are I(1), then the system comprising these two variables is said to be cointegrated provided the two residual series obtained from regressing one upon the other are I(0). In other words, the OLS regression yields a 'super consistent' parameter estimator if the variables in question are integrated. Keeping in mind the problems of low power and size distortion of conventionally used unit root tests [see Schwert (1989)], we have used ERS test due to Elliott, Rothenberg and Stock (ERS-1996) for testing unit root as the null. As a confirmatory test for the stationarity of the two residual series we have also employed Kwatkowski, Phillips, Schmidt and Shin (KPSS, 1992) unit root test, in which stationarity as the null is tested.

According to Granger's representation theorem, cointegrated variables must have an ECM representation. If

E_t and R_t are cointegrated, an ECM representation could have the following form:

$$\Delta R_t = a_0 + a_1 \ (\Delta E_{t-1} - \Delta R_{t-1}) + u_t \qquad \text{........(1)}$$

$$\Delta E_t = b_0 + b_1 \ (\Delta E_{t-1} - \Delta R_{t-1}) + \varepsilon_t \qquad \text{........(2)}$$

Where Δ is the difference operator; a_0, a_1, b_0, and b_1 are parameters; t stands for time; and u_t and ε_t are white noise disturbance terms. According to ECM methodology, the short-run behavior of the system is affected by the deviation from long-run equilibrium. Any deviation from long-run equilibrium implies that $|(\Delta E_{t-1} - \Delta R_{t-1})| > 0$. Long-run equilibrium is achieved when $\Delta E_{t-1} = \Delta R_{t-1}$, which means that the budget is in balance. Given that ΔE_t and ΔR_t are stationary, the right-hand side of equations (1) and (2) should also be stationary, i.e., I(0). In this sense, if u_t and ε_t are stationary I(0), then the linear combination $(\Delta E_t - \Delta R_t)$ is also stationary. A more general specification of the system of equations (1) and (2) can be expressed in the form:

$$\Delta R_t = a_0 + a_1\theta_{t-1} + \Sigma a_{2i} (1\text{-}L)\Delta R_{t-i} + \Sigma a_{3i} (1\text{-}L)\Delta E_{t-i} + u_t \text{.....(3)}$$

$$\Delta E_t = b_0 + b_1 \pi_{t-1} + \Sigma b_{2i} (1\text{-}L)\Delta R_{t-i} + \Sigma b_{3i} (1\text{-}L)\Delta E_{t-i} + \varepsilon_t \text{.....(4)}$$

where L is the lag operator and θ_{t-1} and π_{t-1} are error correction terms. The error correction term θ_{t-1} in equation (3) is the lagged value of the residuals from the OLS regression of R_t on E_t while the π_{t-1} in equation (4) corresponds to the lagged value of the residuals from the OLS regression of E_t on R_t. In equations (3) and (4) ΔR_t, ΔE_t, u_t, and ε_t are stationary, implying that their right- hand side must also be stationary. It is obvious that equation (3) and (4) constitute a bivariate VAR in first differences augmented by the error correction terms θ_{t-1} and π_{t-1}, indicating that ECM model and Vector Autoregressions are equivalent representations.

According to Granger (1987,1988), in a cointegrated system of two series, expressed by an ECM representation, causality must run in at least one way. Within the ECM formulation [equations (3) and (4)], E_t does not Granger cause R_t if all $a_{3i} = 0$ and $a_1 = 0$ and, equivalently, R_t does not Granger cause E_t if all $b_{2i} = 0$ and $b_1 = 0$

III. Empirical Analysis

In the present study both annual total central government expenditures (E_t) and total central government revenues (R_t) are in nominal terms. The study period is 1960-61 to 1996-97. The data relating to the study are collected from various issues of RBI and EIS Bulletins (published by Reserve Bank of India and Centre for Monitoring Indian Economy respectively). Considering the drastic policy changes experienced by the Indian economy in the mid- 80's and early- 90's, a break in the trend of either R_t or E_t or both is quite possible. Therefore, in the first place one needs to ascertain whether such a structural break ever occurred at all. After confirming this, the exact break period needs to be identified. Using the knowledge about the exact break point, the stationary properties of R_t and E_t can be investigated.

In light of the above discussion, we have employed the BLS[1] (1992) procedure, which endogenizes the break point in the time series under consideration. The test for

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1 The BLS procedure computes the Sequential Minimum Augmented Dickey-Fuller test statistics. The degree of AR polynomial considered in this exercise is zero. 0.15 fraction at begining and end of the total sample are not considered for the test.

structural break is conducted by testing the shift in trend of the time series. As evident from Table 1, the BLS sequential testing procedure for unit root and trend break hypothesis indicate that the variables R_t and E_t have unit roots in their levels. But there is a shift in the slope i.e., a structural break has occurred in both the series in the year 1991. BLS test for the variables in their first differences reject the null of unit roots but confirms the structural break in the period 1991.

Table - 1

BLS Test Statistics for Unit Roots and Trend Break: Period 1960-61 to 1996-97

	Levels		First Differences	
Variables	ADF#	Break	ADF#	Break
Only constant, No Time Trend				
R_t	-0.26	1991	-5.38*	1990
E_t	-0.002	1991	-3.31**	1990
Constant with Time Trend				
R_t	-0.677	1991	-8.9262*	1990
E_t	-0.303	1991	-3.7028**	1990

Note : # *Sequential minimum Augmented Dickey-Fuller test statistic*

* *Significant at 1% level;*

** *Significant at 5% level*

Critical values are obtained from BLS (1992).

We have also used the Perron's (Perron, 1997) unit root test while accounting for an endogenous time break (see appendix, Section - I) which assumes that the date of possible change in the intercept or the slope is not fixed *a priori*.

Similar to the inferences drawn from the BLS test, the Perron's test also provides evidence for existence of unit root in the levels of the variables. That is, both R_t and E_t are found to be I(1). The test confirms that both the series have a break around the period 1989-1991. The results for Perron's unit roots and endogenous time break are reported in Table2.

Table - 2

Perron's Test Statistics for Unit Roots and Endogenous Structural Break: 1960-61 to 1996-97

		Levels			First Differences		
Variable	Model	t statistics	Lag	Break	t statistics	Lag	Break
R_t	io1	-1.95	3	1988	-7.25*	0	1991
	io2	-2.46	3	1988	-7.16*	4	1991
E_t	io1	0.695	4	1991	-7.08*	2	1990
	io2	0.904	2	1991	-8.11*	1	1990

Note: * *Significant at 1% level*

Critical values are obtained from Perron (1997).

Utilizing the information regarding the exact break obtained from Perron's endogenous structural break test, we have checked for unit roots through Perron's exogenous structural break test (see Appendix, Section - II) in which the break date is assumed to be given exogeneously, the results of which are presented in Table 3. Similar to the conclusion drawn from Perron's endogenous trend break analysis, Perron's exogenous trend break and unit root test reveals that both E_t and R_t are I(1).

Table - 3

Perron's Test Statistics for Unit Roots and Exogenous Structural Break: 1960-61 to 1996-97

	Levels			First Differences	
Variable	Model	Break	t statistics	Break	t statistics
R_t	(a)	1988	1.14(-3.75)	1991	-9.878(-3.75)*
R_t	(b)	1988	-0.37(-3.82)	1991	-7.978(-3.82)*
R_t	(c)	1988	-0.10(-4.04)	1991	-9.045(-4.04)*
E_t	(a)	1991	4.03(-3.75)	1990	-4.089(-3.75)*
E_t	(b)	1991	3.62(-3.82)	1990	-5.356(-3.82)*
E_t	(c)	1991	4.37(-4.04)	1990	-5.211(-4.04)*

***Note** : Figures in parentheses refer to critical values at 5% significance level. Symbols a, b & c are the varying models of Perron's augmented unit root test allowing under both null and alternative hypothesis for the presence of one time change in the level or in the slope of the trend function using three different linear regression models which are constructed by nesting the corresponding null and alternative hypothesis. Critical values are obtained from Perron (1989). These models are given in the appendix (Section - II).*

Having confirmed that both E_t and R_t characterize a structural break around 1990-91, and that they are first differenced stationary, we perform Engle- Granger cointegration test to examine whether they possess common trends. As required by the Engle-Granger methodology, the error series μ_t is obtained by regressing R_t on E_t. Then the error series (μ_t) is tested for the presence of unit roots[2]. Table-4, presents the results obtained from ERS (see Appendix, Section - III) and KPSS[3] tests for unit roots in the error series (μ_t). As evident from Table 4, the series μ_t does not have a unit root. In other words it is trend stationary. This finds support for integration of the two variables E_t and R_t.

Table - 4
Engle Granger Cointegration Procedure
Unit root tests for the error series μ_t obtained by regressing R_t on E_t

	ERS Test(lag = 0)		KPSS Test (lag = 0)	
Variable(μ_t)	**$P_T(0.5)$**	**DF_{GLS}**	**ETA(mu)**	**ETA(tau)**
Only Constant No Time Trend	4.94(3.96)*	-4.718(-3.48)*	0.18(0.347)**	0.099(0.119)**
Constant with Time Trend	4.83(3.96)*	-4.96(-3.48)*	0.099(0.347)**	0.099(0.119)**

Note : Figures in parentheses refer to the critical values for the respective test statistics

* *Critical values for the test statistics at 1% level;*

** *Critical values at 10% level.*

Since the series Rt and Et are nominal in nature, detrending is done by fixing an intercept (constant) and linear time trend. Critical values are obtained from ERS (1996) and KPSS (1992).

Having verified that the system of series (E_t, R_t) is integrated, we next investigate the causality pattern between E_t and R_t within the ECM framework. In Table 5, we report the parameter estimates obtained from ECM methodology. Three lags are used for the cointegrated system. The lag length is reduced to 3 to conserve degrees of freedom. The error correction terms θ_{t-1} and π_{t-1} reflect long-run dynamics and appear in the set of regressors. The significance level of the coefficients of θ_{t-1} and π_{t-1} are expected to provide meaningful insights into the long-run causal direction

2 *The inference regarding the stationarity of the error series remain unaltered when the error series is generated by regressing E_t on R_t.*

3 *KPSS procedure calculates ETA(mu) and ETA(tau) statistics. The null hypothesis in ETA(mu) test is that the series X(t) is stationary around a level. But, in ETA(tau) the null hypothesis is X(t) is trend stationary.*

between E_t and R_t. The coefficients on the lagged values of ΔE_t and ΔR_t are short-run parameters measuring the immediate impact on the system of variables ΔE_t and ΔR_t.

In Table 5, the ECM results within the bivariate system suggest that the budget expenditures have powerful long and short-run effects on budget revenues. θ_{t-1} is found to be statistically significant in the regression equation of ΔR_t. On the other hand, in the regression equation ΔE_t the error term π_{t-1} carries an insignificant t statistic, indicating that revenues have no long-run consequences upon expenditures. However, the ECM estimates provide weak evidence of short-run effects of revenues on expenditures. Overall ECM estimates indicate a one-way causality from ΔE_t to ΔR_t in the long as well as short run. Such an interpretation is seen to be consistent with spend-and-tax hypothesis. The adjusted R^2 statistics indicate that the estimated ECM model fit the data adequately.

Table - 5

Estimates of ECMs for ΔR_t and ΔE_t : 1960-61 to 1996-97

Variables	ΔR_t	ΔE_t
Constant	1895.61(3.051)*	728.307(1.397)
ΔE_t (-1)	-1.7116(-4.198)*	0.0886(0.259)
ΔE_t (-2)	-0.7466(-2.610)**	-0.3801(-1.585)
ΔE_t (-3)	-0.8892(-3.503)*	0.4862(2.284)**
ΔR_t (-1)	1.2607(4.3116)*	0.5235(2.135)**
ΔR_t (-2)	1.8756(5.8157)*	0.4511(1.668)
ΔR_t (-3)	1.1854(4.7619)*	-0.1004(-0.481)
π_{t-1}	-	-0.2010(-0.784)
θ_{t-1}	-1.8600(-6.088)*	-
$\bar{R}^2$	0.8759	0.9028

Note: * Significant at 1% level ** Significant at 5% level
Figures in parentheses are 't' statistics

IV. Concluding Remarks

The main focus of this paper is to investigate the causality between total central government expenditures and revenues in India. Using annual data of the Indian economy over the period 1960-61 to 1996-97, the study finds evidence of a structural break (trend break) around the period 1990-91. This is in conformity with the timing of policy changes initiated in India. Based on cointegration analysis, ECM strategy and bivariate Granger causality, the study finds a significant unidirectional causality from expenditure to revenue both in the long and short run. Budget expenditures and revenues in India, being cointegrated suggests that there exist fiscal harmony in the long run. But, evidence of a unidirectional causality from expenditures to revenues in the short run and long run fails to find a case for fiscal synchronisation hypothesis in India. This finding is more relevant to the Indian economy, wherein low per capita income is reasoned out for low budgetary receipts. Thus, attempts made to raise the level of budgetary receipts must be preceded by a higher level of budgetary expenditure. A policy implication that might emerge here is that in India any effort to eliminate budget deficit must necessarily be initiated by influencing budget expenditure.

Appendix

Section - I

Perron's Test for Unit Roots and Endogenous Structural Breaks (1997)

Perron's Endogenous Test procedure for Unit Root and Trend Break implements several tests on breaking trend functions when the date of possible change in the intercept or the slope is not fixed *a priori*. The two tests implemented in this study are:

io1: Innovational outlier with a change in the intercept

io2: Innovational outlier with a change in the intercept and the slope

The method employed to choose the optimal break date is that of minimizing 't' statistics. Perron's endogenous structural break procedure determines the appropriate lag differences by adding lags until the Ljung Box test fails to reject no serial correlation.

Section - II

Perron's Test for Unit Roots and Exogenous Structural Breaks (1989)

Perron's exogenous testing procedure is executed by testing the following three models:

a. Crash model:

$$Y(t) = c + \theta\ DMU(t) + \beta\ Trend\ (t) + d\ DTB(t) + \alpha\ Y(t-1) + b_1\ DY(t-1) + \ldots\ldots. + b_p\ Y(t-p) + \varepsilon_t$$

b. Changing Growth Model:

$$Y(t) = c + \theta\ DMU(t) + \beta\ Trend(t) + \gamma\ DTS(t)$$
$$+ \alpha\ Y(t\text{-}1) + b_1\ DY(t\text{-}1) + \dots\dots\dots + b_p\ DY(t\text{-}p) + \varepsilon_t$$

c. Model allowing for crash as well as changing growth model:

$$Y(t) = c + \theta\ DMU(t) + \beta\ Trend(t) + \delta\ DT(t) + d\ .DTB(t)$$
$$+ \alpha\ Y(t\text{-}1) + b_1\ DY(t\text{-}1) + \dots\dots\dots + b_p\ DY(t\text{-}p) + \varepsilon_t$$

Where c is a constant, θ , β, d, α, γ , δ and b's are parameters, Trend (t) is a linear trend and DTB is a dummy defined as:

DTB = 1, if t = (TB) + 1, 0 otherwise. {TB is Time Break}

The other dummy variables are defined as :

In model (a), DMU(t) = 1, if t > TB and DMU(t) = 0, if t $\leq$ TB

In model (b), DTS(t) = t - TB, if t >TB and DTS(t) = 0, if t $\leq$ TB

In Model (c), DMU(t) = 1, and DT(t) = t, if t >TB and DMU(t) = DT, if t $\leq$ TB

ε_t are white noise, which is the necessary condition for the test to be valid.

Perron's Exogenous test procedure determines the optimum number of lagged differences by adding lags until the Ljung Box test fails to reject no serial correlation.

The null hypothesis of a unit root in the presence of an exogenous trend break imposes the following restrictions on the parameters of each model:

a. $\alpha = 0, \; \beta = 0, \theta = 0, d \neq 0$

b. $\alpha = 0, \gamma = 0, ,\beta = 0, \theta \neq 0$

c. $\alpha = 0, ,\beta = 0, \gamma = 0, , \theta \neq 0$ and $d \neq 0$

The alternative hypotheses are framed accordingly.

Section - III

ERS Unit Root Test (1996)

Elliott, Rothenberg and Stock (ERS-1996), derived the assymptotic power envelope for point optimal test of a unit root in the Auto regressive representation of a Gaussian time series under various specifications of the trend. After developing the assymptotic power envelope, ERS propose a family of tests whose power functions are tangent to the power envelope at one point and are never too far below the envelope. One such test is called $P_T(0.5)$. Then, they suggest the DF_{GLS} test as one that has the limiting power function close to that of the $P_T(0.5)$ test.

Considering y_t as the process, the DFGLS 't' test is performed by testing the hypothesis: $a_0 = 0$, in the regression:

$$\Delta y^d_t = a_0 \, y^d_{t-1} + a_1 \, \Delta y^d_{t-1} - 1 + \ldots\ldots\ldots\ldots + a_p \, y^d_{t-p} + \varepsilon_t$$

Where y^d_t is obtained by locally detrending the series y_t.

The local detrending depends upon the regression specification. In one specification both drift and a linear trend is considered and in the other only drift is considered. The critical values for P_T and DF_{GLS} tests are obtained from ERS (1996).

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