Public Sector Spending and Economic Growth in India

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The paper analyses the dynamic interaction between the public sector expenditure and national income in India for the period 1960-61 to 1996-97. It finds a stable long-run relationship between public sector expenditure and national income in India, with the causality running strictly from the former to the latter. The study also indicates that long-run positive impact of public sector expenditure on national income would turn adverse if the growth of the former is excessive. In the short-run, however, there is a trade-off between growth in public sector expenditure and income. Thus, though national income growth in India seems to be investment or demand led, there is the need for maintaining a proper balance between public sector expenditure and investment for economic growth.

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Introduction

In the economic literature, there are two propositions on the relationship between public sector expenditure and national income. Wagner's 'law of increasing state activity', owing to German political economist Adolph Wagner (1835-1917), hypothesises that as the economic activity grows, there is a tendency for the government activities to increase. Keynesian macroeconomic models, on the other hand, treat government spending as an exogenous policy instrument that cause changes in aggregate real output.

During the post World War II period, with governments in the Western economies seeking to control the economy, there was a rise in the share of public sector in the national income. This spawned interest in the long-term trends in public expenditures and the causes of its growth in the 1960s, and increasing attention was paid in testifying Wagner's law. On the other hand, the reverse Keynesian pattern of public sector expenditure facilitating economic growth has been somewhat underplayed. In the latter, it is important to note that while a moderate rise in public sector expenditure leads to growth in national income, its excessive growth could be detrimental to economic growth due to its crowding out effect.

The present study empirically tests whether the causality between public sector expenditure and national income in India runs in terms of Wagner's hypothesis or in the Keynesian fashion. This is tested on six alternative models, which have their own interpretations and implications. A comparative analysis between them help in drawing a number of inferences. Thus, besides the test for applicability of the two hypotheses in the Indian context, the paper also attempts to draw various inferences on the dynamic interaction between public sector expenditure and national income. In addition, a third variable, namely total investment, is considered for explaining growth in national income in each of the six models.

The remaining part of the paper has the following sections. Section I is a brief review of the empirical tests on the relationship between government spending and national income in the literature in order to draw an analytical framework of the paper. An overview of the data and the method of estimation are briefly explained in section II. The formal investigation and the empirical results are presented in section III. Section IV contains the concluding remarks.

Section I
A Brief Review of Empirical Estimates for Analytical Framework

Most of the empirical estimates on the relationship between public sector expenditure and national income in the literature have been done with a view to offer exposition of Wagner's law. Initially, the investigations into the relationship were on analysing the time pattern of covariance between some measure of government sector growth and the rate of economic growth (Peacock and Wiseman (1961), Musgrave (1969), Gupta (1967) and Pryor (1968)). Towards the end of the 1970s till the mid-1990s, with the advent of causality analysis, the focus shifted to discerning the patterns of causal links between public expenditure and economic growth. Some of these studies are Mann (1980), Murthy (1993), Ram (1986, 1987), Abizadeh and Gray (1985), Singh and Sahni (1984), Murthy (1993), Ganti and Kolluri (1979), Vatter and Walker (1986), Kyzyzaniak (1974), Pluta (1979) and Gyles (1991).

Peacock and Scott (2000), however, point out that the law does not necessarily imply causation between the two macroeconomic variables since Wagner implied only regularities or empirically observed uniformity in the pattern of growth of government expenditure and the national income. They opine that these latter articles seem to be more concerned vying with one another in the sophistication of testing procedures rather than their purport to offer exposition of the 'law'. Furthermore, even if rising share of public sector expenditure in national income is validated during a given period, the process cannot continue forever since there should be a limit to this share.

As the law itself is open to various interpretations, there is no precise, but six broad categories of models defining the relationship. In all the six, some variant of the measure of national income explains alternate measures of public sector expenditure. The causation, however, could be in the reverse directions in each of these six models, which are:

$$LTE = f(LY) \qquad (I)$$
$$LCE = f(LY) \qquad (II)$$
$$LTE = f(LYN) \qquad (III)$$
$$LTEY = f(LYN) \qquad (IV)$$
$$LTEN = f(LYN) \qquad (V)$$
$$LTEY = f(LY) \qquad (VI)$$

where LTE is the logarithm of real total government expenditure, LCE is the logarithm of real government consumption expenditure, LY is the logarithm of real gross domestic product, LYN is the logarithm of the per capita gross domestic product, LTEY is the logarithm of the ratio of real total government expenditure to real gross domestic product and LTEN is the logarithm of the per capita real total government expenditure. In models (I) to (VI), f' is expected to be > 0.

Total public sector expenditure as a function of national income in model I above was adopted by Peacock-Wiseman (1961) and Musgrave (1969) to testify the law. In Pryor (1968), Wagner's law holds when consumption component of public sector expenditure increase with the rise in national income (model II). Gofman (1968) and Mann (1980) define the law as increase in total public sector expenditure due to rise in per capita national income (model III). Musgrave (1969), Murthy (1993) and Ram (1987) tested the law in terms of model IV, by which, growth in per capita national income leads to rise in the share of total public sector expenditure in national income. In Gupta (1967), model V, *i.e.,* per capita total public sector expenditure rising with per capita national income, was tested for validity of the law. Mann (1980) also considered rise in the share of total public sector expenditure in the national income as a result of growth in national income (model VI), as validating the law.

The above studies and many others adopting either one or more of the six models have been both cross-country and country-specific covering different time periods. The results, however, have been mixed. Ram (1986) for 63 countries covering the period 1950 to 1980 find limited support to public sector expenditure rising with growth in national income. On the other hand, Abizadeh and Gray (1985) for 55 countries covering a shorter period (1963 to 1979) find general support to rise in the share of public sector in national income in the case of wealthier countries but not for the poorest countries.

Country specific studies include Gupta (1967), Singh and Sahni (1984) and Ram (1986) for Canada, Mann (1980) and Murthy (1993) for Mexico, Ganti and Kolluri (1979) and Vatter and Walker (1986) for the United States, Kyzyzaniak (1974) for Turkey, Pluta (1979) for Taiwan, and Gyles (1991) for the United Kingdom. Majority of these studies provide support to rising share of public sector expenditure with the growth of national income. Peacock and Wiseman (1961), Musgrave (1969, 1988), Michas (1975), Mann (1980), Ram (1987) and Courakis *et al* (1993) have also provided support to the evidence. Hondroyiannis and Papapetrou (1995) using Johansen's cointegration analysis find no evidence of any long-run relationship between public sector expenditure and national income in Mexico.

The major drawbacks in the above studies are that the empirical tests in many of them are carried out without testing the properties of time series data for stationarity thereby lending suspicion to possible cases of spurious regression. Secondly, they are mostly bivariate models whose estimates may be biased. It is also important to note that a positive relation in any one of the models does not necessarily imply a similar positive relation in the other. For example, when growth in national income leads to increase in total public sector expenditure, it does not necessarily imply that the share of public sector expenditure in national income would also rise *i.e.,* when there is a positive relationship in model I, the relationship in model VI need not necessarily be positive. In fact, the causation in model VI can be negative such that, as the national income grows, the share of public sector expenditure in national income declines. Thus, the validity of the law for a country during given a period of time would depend upon the type of model tested.

Further, in the above studies, the reverse directions of causation are hardly emphasised. In the case of reverse causation, the simultaneous estimation of the six models and interpretation of the results can help in drawing number of inferences. For instances, they allow comparison of the differential impact of rise in public sector consumption expenditure and total expenditure (including investment) on national income. Similarly, a comparison between the impact of absolute increase and relative increase in public sector expenditure on growth of national income can be made in the sense that while increase in public sector expenditure *per se* may lead to growth in national income, a more than proportionate increase may have an adverse impact. In other words, even though public sector expenditure leads to growth in national income, excessive growth by way of rise in its share in national income can dampen income growth by crowding out private investment.

Besides public sector expenditure, inclusion of other important macroeconomic variables determining national income in the model also assumes crucial importance, otherwise the estimated relationships may be biased. Both monetary and debt policies have been found to influence the pattern of causality between growth of public expenditure and growth of national income (see for examples, Ahsan, Kwan and Sahni (1992) for USA and Jha and Seth (1995) for India.

In the Indian context there are two studies which deal with the exposition of the Wagner law. Upender (1995) for the period 1970-71 to 1991-92 finds the elasticity of public sector expenditure to national income to be more than one. In other words, the share of public sector expenditure in national income rose during 1970-71 to 1991-92. The shortcoming of this study is that it is a bivariate model and the estimation is made through simple OLS regression without verifying the nature of the time series data *i.e.,* whether they are stationary or not. Therefore, it does not resolve the problem of spurious regression and biased estimate.

The second study, by Jha and Seth (1995), employed Granger's testing procedure for the period 1951 to 1989 by transforming the data series to stationary time series using Box-Jenkins method. Both bivariate and trivariate models using monetary policy instruments, with M_1 as the variable, are tried out. The findings are as follows: in the bivariate case, causality runs from real gross domestic product to real government expenditure and in per capita terms, causal link runs from per capita real government expenditure to per capita real gross domestic product; in trivariate models with money supply growth included, the pattern of causality alters from the bivariate models and money supply growth and per capita government expenditure have positive effects on output growth.

In the present study, the direction of long-run relationship in the Indian context for each of the six models is first ascertained *i.e.,* whether Wagner's law holds or Keynesian hypothesis predominates. The appropriate long-run relationships and short-run dynamics in an error correction framework are then estimated in order to draw inferences, alternatively with and without total investment as the third variable for each of the models.

Section II
Estimation Method and Data

The standard approach to investigate both the long-run relationship and short-run dynamics between economic variables is the cointegration analysis and its error correction model (ECM) representation. In this approach, the well known Engle-Granger (1987) and Johansen (1991) procedures require the data series to be integrated of the same order[1] . For variables integrated of different order, an alternative procedure in cointegration analysis is that of autoregressive distributed lag (ARDL) procedure advanced by Pesaran and Shin (1995, 1996). In this procedure, the dependent and the explanatory variables with different degrees of integration can enter the regression with different lags. It involves two stages of estimation. In the first stage, the existence of long-run relation between the variables is investigated by computing the F-statistic for testing the significance of the lagged levels of the variables in the error correction form of the ARDL model. The second step is to estimate the coefficient of long-run relation and the short-run dynamics for drawing inferences. The estimation procedure[2] is given below. For three variables, the error correction version of ARDL model of the following type is considered in the first stage.

$$\Delta Y_t = a_0 + \sum_{i=1}^{p} b_i \, \Delta Y_{t-i} + \sum_{i=1}^{q} c_i \, \Delta X_{t-i} + \sum_{i=1}^{r} d_i \, \Delta Z_{t-i} + \delta_1 Y_{t-1} + \delta_2 X_{t-1} + \delta_3 Z_{t-1} + u_t \qquad (1)$$

where X, Y and Z are the three variables, p, q and r are the order of lags for the three variables, respectively and a_0 is the fixed effect[3] .

The stability tests or the tests for existence of long-run relationship involve testing the null of non-existence of the long-run relationship, $H_0 : \delta_i = \delta_2 = \delta_3 = 0$ i.e., all the coefficients of lagged levels of the variables in (1) are equal to zero, against $H_1 : \delta_i \neq 0, \delta_2 \neq 0, \delta_3 \neq 0$. This is done by estimating the F-statistic for joint significance of δ_1, δ_2 and δ_3.

Rejection of the null implies that the coefficient of the lagged levels of the variables are jointly different from zero and there exist long-run relationship between the variables. Since in this case, Y is the explained variable, X and Z are the long-run forcing variables *i.e.,* the change in long-run value of Y would be explained by movements in the values of X and Z, and if there is any long-run causality between Y, X and Z, it would run from X and Z to Y. However, the reverse directions of long-run relationship and causation can also exist. This can be checked by computing the F-statistics following the same procedure for each of the variable as the dependent variable. If the null is rejected only for one particular variable then it is inferred that the long-run relationship between the variables is unidirectional and the causality, if any, would run from the other variables to this dependent variable. Similarly, rejection of the null for two variables and three variables would imply bidirectional and tri-directional long-run relationship between the variables with possible bi-directional and tri-directional long-run causality, respectively[4] .

The second stage involves estimating the long-run coefficients by selecting the optimum lag for each of the variable based on various model selection criterions, such as, Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC), and then estimating the error correction model for the selected lags of the variables. The representative error correction model would be of the following type:

$$\Delta Y_t = \propto_0 + \sum_{i=1}^{p} b^*_i \, \Delta Y_{t-i} + \sum_{i=0}^{q} c^*_i \, \Delta X_{t-i} + \sum_{i=0}^{r} d^*_i \, \Delta Z_{t-i}$$

$$+ \varphi \, [Y_t - \phi_1 X_t - \phi_2 Z_t]_{t-1} + u_t \qquad (2)$$

In (2), $[Y_t - \phi_1 X_t - \phi_2 Z_t]_{t-1}$ is the error correction term obtained from the estimated long-run relationship $[Y_t = \phi_1 X_t + \phi_2 Z_t, + \varepsilon_t]$ and ϕ_1 and ϕ_2 are the long-run coefficients of the two explanatory variables. φ is the coefficient of the error correction term which measures the speed of adjustment toward the long-run equilibrium following disturbances, and when statistically significant with right sign, it shows long-run causality of Y by X and Z. The short-run dynamics are represented by the coefficients of first differences of the variables *viz.,* b^*_i , c^*_i and d^*_i[5].

The time series is the annual data for the period 1960-61 to 1996-97 at 1980-81 prices culled out from the National Accounts Statistics, Central Statistical Organisation[6] . The Government is represented by the entire public sector as defined in the system of national accounts (SNA). Government transfers are excluded from the total expenditures of public sector though researchers debate over the inclusion/exclusion of transfer payments in defining government expenditure[7]. Thus, total expenditure consists of consumption expenditure of government administration and investment of public sector.

All the variables are in real terms and have been converted to logarithm form. The total investment in the economy (LCF) is included as the third variable. The rationale for using investment is that lack of it is often the constraining factor on growth in a developing economy. Secondly, public sector expenditure would interact with the overall investment in the economy as it can either preempt if it is excessive or complement private sector investment[8] . Thus, level of investment in the economy would be an important long-run forcing variable on income growth.

Section III
Empirical Results

To preempt the appropriate choice of technique of cointegration analysis, the variables are first tested for the order of integration. To ensure robustness of the result, the DF, ADF and PP tests were performed, both with and without trend.

It is seen from the results presented in Table1 that, except for LTE, LCF and LTEN, different tests show contradictory results reflecting different degrees of integration. There are also contradictions in the test results obtained with trend and without trend. Thus, no robust results are obtained on the degree of integration of the data series[9] . Consequently, the ARDL procedure of cointegration analysis as explained above has been adopted.

Table 1: Unit-Root Tests for Selected Variable (1960-61 to 1996-97)

Variable	DF Test Levels	DF Test First Differences	ADF Test Levels	ADF Test First Differences	Phillips-Perron Test Levels	Phillips-Perron Test First Differences
I. With a constant and no trend						
LTE	-0.44	-6.26*	-0.41	-5.91*	-2.09	-6.30*
LCE	-0.34	-4.19*	-0.40	-4.10*	-1.94	-5.58*
LY	2.02	-8.24*	4.42*	-4.52*	4.46*	-8.3*
LTEY	-2.11	-7.08*	-1.77	-5.63*	-4.24*	-8.52*
LTEN	-0.60	-6.31*	-0.44	-5.94*	-2.37	-6.33*
LYN	1.33	-8.1*	4.09*	-4.38*	3.12*	-8.14*
LCF	0.64	-7.42*	1.35	-4.69*	0.72	-10.83*
II. With a constant and trend						
LTE	-2.77	-6.15*	-2.64	-5.80*	-3.24	-6.67*
LCE	-1.66	-4.12*	-2.33	-4.01*	-3.66*	-6.29*
LY	-1.92	-9.18*	-0.08	-4.97*	-1.52	-10.2*
LTEY	-1.74	-7.12*	-1.02	-5.83*	-1.83	-12.1*
LTEN	-2.94	-6.21*	-2.81	-5.86*	-3.50	-6.66*
LYN	-2.32	-9.20*	-0.04	-4.94*	-1.45	-10.3*
LCF	-2.92	-7.82*	-1.84	-4.80*	-3.41	-11.18*

* Indicates rejection of the null hypothesis of unit root at the 95% confidence level. DF and ADF tests were performed using maximum lag length of 4, and from this maximum, the appropriate lag length for each of the variable was chosen based on SBC.

Bivariate Model

The stability test, or the test for existence of long-run relationship, is conducted for all the six models mentioned in section II. The ARDL of order 4 with an intercept and no trend were estimated for the purpose[10] .

Table 2: Test for Long-Run Relationship in Bivariate Models(1960-61 to 1996-97)

	Formulations	F-Statistics	F-Statistics
I.	LTE and LY	LTE on LY = 0.34	LY on LTE = 7.61*
II.	LCE and LY	LCE on LY = 1.16	LY on LCE = 7.84*
III.	LTE and LYN	LTE on LYN = 0.99	LYN on LTE = 8.53*
IV.	LTEY and LYN	LTEY on LYN = 4.33	LYN on LTEY = 8.50*
V.	LTEN and LYN	LTEN on LYN = 0.61	LYN on LTEN = 8.50*
VI.	LTEY and LY	LTEY on LY = 3.76	LY on LTEY = 8.86*

* denotes rejection of null at 99% confidence level based on the critical value bounds computed by Pesaran *et al* (1996).

The results are presented in Table-2. It can be seen that the F-statistics are significant at 99% confidence level when various forms of public sector expenditure form the long-run forcing variables on the national income (column 3). For the reverse long-run relationships (column 2), none of the F-statistics are significant at the 95% confidence level. Thus, it follows that if there exist any stable long-run relationship between public sector expenditure and national income in India, it is the former that has long-run influences on the latter or its per capita, and not the reverse. In other words, there is no evidence for validity of Wagner's law in the Indian context. Rather, the relationship between public sector expenditure and national income in India works in the Keynesian fashion.

The second stage estimate ascertains the exact nature of the long-run influence of public sector expenditure on national income and the associated short-run dynamics in the error correction framework. The long-run coefficients are estimated based on the SBC and AIC model selection criterion[11]. As can be seen from Table 3, SBC despite selecting lower order of ARDL model estimates relatively much lower value of standard errors, and thus the models selected by this criterion were preferred.

Table 3: Estimates of Long-Run Coefficients for Bivariate Models (1960-61 to 1996-97)

	Formulations	Schwarz Bayesian Criterion	Akaike Information Criterion
I.	LY on LTE	ARDL(1,4) LTE = 1.01 (0.232)* C = 2.28 (1.82)	ARDL(1,4) LTE = 1.01 (0.232)* C = 2.28 (1.82)
II.	LY on LCE	ARDL(1,0) LCE = 1.02 (0.39)** C = 2.53 (3.0)	ARDL(3,0) LCE = 1.77 (3.49) C = -2.92 (25.6)
III.	LYN on LTE	ARDL(2,0) LTE = 1.14 (1.73) C = -5.64 (16.1)	ARDL(4,4) LTE = -2.14 (13.2) C = 24.35 (120.5)
IV.	LYN on LTEY	ARDL(1,1) LTEY = -0.52 (.209)** C = 3.91 (0.36)* T = 0.028 (0.0026)*	ARDL (4,3)LTEY = -0.77 (0.42) C = 3.42 (0.78)* T = 0.038 (0.012)**
V.	LYN on LTEN	ARDL(4,4) LTEN = -3.96 (24.3) C = 16.96 (74.25)	ARDL(4,4) LTEN= -3.96 (24.3) C = 16.96 (74.25)
VI.	LY on LTEY	ARDL(1,0) LTEY = -0.65 (0.19)* C = 9.79 (0.32)* T = 0.050 (0.002)*	ARDL(1,0) LTEY = -0.65(0.19)* C = 9.79 (0.32)* T = 0.050 (0.002)*

Figures in the parentheses are the standard errors. * and ** denote significance at 1% and 5%, respectively. 'C' stands for constant term and T stands for trend.

The estimates of the long-run coefficients in the models show that public sector expenditure, either the total (LTE) or only consumption component (LCE) has positive effect on the national income or its per capita (models (I) to (III)). Of these three, the coefficients are significant in models (I) and (II) only, and in both the cases, the values are close to one[12] . On the other hand, when public sector expenditure is in per capita term or scaled by the national income (models (IV) to (VI)), the sign of the coefficients are negative. The negative coefficient, however, is not statistically significant in (V). These negative coefficients in (IV) and (VI), combined with positive coefficients in (I) and (II), would imply that there is a limit to the positive impact of public sector expenditure on national income. In other words, while public sector expenditure *per se* has a positive impact on income growth, excessive growth that leads to rise in its share to national income would have a negative impact on national income.

Table 4: Estimated Error Correction Models for Bivariate Models (1960-61 to 1996-97)

Formulations	Estimated Equations and Diagnostic Tests
I. LY←LTE	$\Delta LY = 0.19 + 0.076\Delta LTE - 0.29\Delta LTE_{(-1)} + 0.09\Delta LTE_{(-2)} - 0.27\Delta LTE_{(-3)} - 0.08E_{(-1)}$ (0.62) (0.84) (-3.2)* (1.1) (-3.3)* (-1.01) R-bar square = 0.35; F (5,27) = 4.65 (0.003) DW = 2.19
II. LY←LCE	$\Delta LY = 0.19 + 0.077\Delta LCE - 0.075E_{(-1)}$ (0.41) (0.99) (-0.74) R-bar square = 0.055; F (2,30) = 1.93 (0.163) DW = 2.35
III. LYN←LTE	$\Delta LYN = -0.26 + 0.053\Delta LTE - 0.463\Delta LYN_{(-1)} - 0.047E_{(-1)}$ (-1.34) (1.22) (-2.71)** (- 0.44) R-bar square = 0.22; F (3,29) = 4.05 (0.016) DW = 2.15
IV. LYN←LTEY	$\Delta LYN = 1.38 + 0.01\ Trend - 0.369\Delta LTEY - 0.354E_{(-1)}$ (2.59)** (2.91)* (-4.42)* (-2.71)** R-bar square = 0.44; F (3,29) = 9.82 (0.00) DW = 2.29
V. LYN←LTEN	$\Delta LYN = -0.33 + 0.11\Delta LTEN - 0.22\Delta LTEN_{(-1)} + 0.24\Delta LTEN_{(-2)} - 0.21\Delta LTEN_{(-3)}$ (-1.0) (1.1) (-1.91)*** (2.55)** (-2.22)** $- 0.55\Delta LYN_{(-1)} - 0.41\Delta LYN_{(-2)} - 0.53\Delta LYN_{(-3)} + 0.02E_{(-1)}$ (-2.72)** (-2.03)*** (-3.03)* (0.19) R-bar square = 0.49; F (8,24) = 4.90 (0.001) DW = 2.26
VI. LY←LTEY	$\Delta LY = 3.44 + 0.018Trend - 0.23\Delta LTEY - 0.35E_{(-1)}$ (3.03)* (3.60)* (-3.57)* (-3.21)* R-bar square = 0.35; F (3,29) = 6.77 (0.001) DW = 1.97

Figures in the parentheses are the t-values. * , ** and *** denote significance at 1%, 5% and 10%, respectively. The terms E in the estimates are the error correction terms.

The error correction models in Table 4, however, show that the coefficients of the error correction term defining the speed of adjustment toward the long-run equilibrium between the variables are significant and are of the right sign in models (IV) and (VI) only. In other words, long-run causality in the bivariate models are discerned only when total public sector expenditure is scaled to national income, and the nature of the causality is such that rise in the share of public sector expenditure in national income leads to decline in the growth of national income and its per capita income. However, there are short-run interactions among the variables in almost all the models.

The results in Table 3 and Table 4 may be summarised as follows: Growth of public sector expenditure, either the total or the consumption component, is indicated to have a positive long-run relationship with national income. However, the estimated relationships are not in equilibrium and do not show any long-run causality *i.e.,* there is lack of adjustment and the long-run relationship cannot persist. In contrast, rise in the share of total public sector expenditure in national income causes decline in both the national income and its per capita, and are indicated to be stable relationships with any deviations from these equilibriums following shocks being corrected by about 35.0 percent within a year.

In the short-run, there are strong indications that public expenditure, whether absolute or scaled to national income or in per capita, has a negative impact on national income. When there are scarcities of investment fund in the economy at the margin, increase in public sector expenditure would crowd out private investment and adversely impact income growth. Wherever relevant, the lag effects of per capita income is negative, indicating inherent built-in stability in the growth of per capita income *i.e.,* decline in the post-boom and *vice versa.*

The lack of long-run causality in most of the bivariate models above may follow due to omission of relevant variable. Further, introducing such variable may alter the results and the inferences drawn.

Trivariate Case

The corresponding trivariate models are estimated by including total investment as the third variable. The tests for long-run relationship between the three variables are presented in Table 5. The F-statistics are statistically significant, either at the 99% or at the 95% confidence level, only for national income or its per capita as the dependent variable and public sector expenditure (either absolute or relative) and investment as the long-run forcing variables (column 4). Reverse relationships (in column 2 and 3) are not statistically significant for any of the models.

Table 5: Test for Long-Run Relationship in Trivariate Models (1960-61 to 1996-97)

	Formulations	F-Statistics	F-Statistics	F-Statistics
I.	LTE , LY & LCF	LTE on LY, LCF = 0.2	LCF on LY, LTE = 2.94	LY on LTE, LCF = 6.52*
II.	LCE , LY & LCF	LCE on LY, LCF = 1.17	LCF on LY, LCE = 2.05	LY on LCE, LCF = 4.72**
III.	LTE , LYN & LCF	LTE on LYN, LCF = 06	LCF on LYN, LTE = 1.51	LYN on LTE,LCF = 5.77**
IV.	LTEY, LYN & LCF	LTEY on LYN, LCF = 3.9	LCF on LYN, LTEY = 1.25	LYN on LTEY,LCF= 5.60**
V.	LTEN, LYN & LCF	LTEN on LYN, LCF =0.86	LCF on LYN, LTEN = 1.25	LYN on LTEN,LCF= 5.60**
VI.	LTEY, LY & LCF	LTEY on LY, LCF = 2.75	LCF on LY, LTEY = 2.9	LY on LTEY,LCF = 8.61*

*denotes rejection of null at 99% confidence level and ** at 95% confidence level based on the critical value bounds computed by Pesaran *et al* (1996).

The long-run coefficients, therefore, need to be estimated only for income as the dependent variable[13] . The results presented in Table 6 show that, whether by SBC or AIC criterion, the coefficients of investment (LCF) are significant at 1% significance level, and are also positive in all the models. As in the bivariate models, the coefficients of public sector expenditure are not significant in (III) and (V), and in the rest, they are significant and are also of the same sign as in bivariate case. However, the absolute values of the coefficients are much lower than those estimated under bivariate models, particularly (I) and (II). The models selected by SBC, except in (II), have been selected for the error correction models, as the standard error for similar or larger coefficients are lower.

Table 6: Estimates of Long-Run Coefficients for Trivariate Models (1960-61 to 1996-97)

	Formulations	Schwarz Bayesian Criterion	Akaike Information Criterion
I.	LY on LTE, LCF	ARDL(1,4,0) LTE = 0.29 (0.14)** LCF = 0.60 (0.15)*, C=2.8(.38)*	ARDL(1,4,0) LTE = 0.29 (0.14)**, LCF = 0.60 (0.15)* , C=2.8(.38)*
II.	LY on LCE, LCF	ARDL(1,0,0) LCE = 0.28 (0.15)** LCF = 0.60 (0.17)*, C=2.97(.50)*	ARDL(1,4,0) LCE = 0.31 (0.12)* LCF = 0.54 (0.14)*, C= 3.32(0.4)*
III.	LYN on LTE, LCF	ARDL(1,0,0) LTE = -0.12 (0.12) LCF = 0.59 (0.13)*, C=0.37(0.32)	ARDL(4,4,0) LTE = -0.06 (0.27) LCF = 0.75 (0.43)*, C=-1.6(2.6)
IV.	LYN on LTEY, LCF	ARDL(1,1,0) LTEY = -0.22 (0.12)** LCF = 0.49 (0.03)*, C=-0.13(0.44)	ARDL(4,4,0) LTEY = -0.13(0.22) LCF = 0.56 (0.1)*, C=0.65(1.1)
V.	LYN on LTEN, LCF	ARDL(1,1,0) LTEN = -0.16 (0.17) LCF = 0.57 (0.11)*, C=0.02(0.5)	ARDL(4,4,0) LTEN= 0.02 (0.42) LCF = 0.68 (0.37)*, C=-1.6(2.9)
VI.	LY on LTEY, LCF	ARDL(1,0,0) LTEY = -0.41 (0.13)* LCF = 0.30 (0.12)*, C=7.4(1.0)* T = 0.033 (0.006)*	ARDL(1,0,1)LTEY = -0.53 (0.2)* LCF = 0.13 (0.21)*, C=8.8(1.7)* T = 0.042 (0.012)*

Figures in the parentheses are the standard errors. * and ** denote significance at 1% and 10%, respectively. 'C' stands for constant term and T stands for trend.

The findings on long-run coefficients may be summarised as follows: Public sector expenditure, total (LTE) or the consumption component (LCE), have long-run positive impact on national income as in the bivariate models. The magnitude of the positive impact (about 0.29), however, is much lower than indicated in the bivariate case (about 1.0) due to total investment in the economy explaining more for economic growth than public sector expenditure[14]. As in bivariate models, rise in the share of public sector expenditure in national income (LTEY) leads to decline in both the national income (LY) and its per capita (LYN). Irrespective of the specification, investment in the long-run positively impact income growth. Thus, the inclusion of investment as the third variable neither changes the directions of causation nor seriously alters the significance level of the explanatory variables as obtained in bivariate models, *albeit* the absolute value of the coefficients of public sector expenditure are dampened markedly.

Table 7: Estimated Error Correction Models for Trivariate Models (1960-61 to 1996-97)

Formulations	Estimated Equations and Diagnostic Tests
I. LY←LTE, LCF	$\Delta LY = 0.84 + 0.044\Delta LTE - 0.28\Delta LTE_{(-1)} + 0.042\Delta LTE_{(-2)} - 0.27\Delta LTE_{(-3)} + 0.18\Delta LCF - 0.3\,E_{(-1)}$ (2.27)* (0.54) (-3.5)* (0.54) (-3.7)* (2.61)* (-2.75)* R-bar square = 0.47; F (6,26) = 5.88 (0.001) DW = 2.23
II. LY←LCE, LCF	$\Delta LY = 1.35 + 0.022\Delta LCE - 0.041\Delta LTCE_{(-1)} + 0.053\Delta LCE_{(-2)} - 0.32\Delta LCE_{(-3)} + 0.22\Delta LCF - 0.3\,E_{(-)}$ (2.48)* (0.16) (-0.34) (0.47) (-3.0)* (2.94)* (-2.95)* R-bar square = 0.33; F (6,26) = 3.78 (0.001) DW = 2.01
III. LYN←LTE, LCF	$\Delta LYN = 0.18 - 0.055\Delta LTE + 0.28\,\Delta LCF - 0.474E_{(-1)}$ (0.94) (-0.99) (3.40)* (-3.39)* R-bar square = 0.30; F (3,29) = 5.63 (0.004) DW = 2.37
IV. LYN←LTEY, LCF	$\Delta LYN = -0.064 - 0.32\Delta LTEY + 0.239\,\Delta LCF - 0.487E_{(-1)}$ (-0.30) (-4.33)* (4.23)* (-3.99)* R-bar square = 0.56; F (3,29) = 14.75 (0.00) DW = 2.18
V. LYN←LTEN, LCF	$\Delta LYN = 0.007 - 0.08\Delta LTEN + 0.27\Delta LCF - 0.48E_{(-1)}$ (0.03) (-1.0) (3.58)* (-3.39)* R-bar square = 0.30; F (3,29) = 5.64 (0.004) DW = 2.33
VI. LY←LTEY, LCF	$\Delta LY = 3.65 + 0.016Trend - 0.204\Delta LTEY + 0.148\,\Delta LCF - 0.49E_{(-1)}$ (3.39)* (3.45)* (-3.36)* (2.12)* (-4.0)* R-bar square = 0.42; F (4,28) = 6.82 (0.001) DW = 1.80

Figures in the parentheses are the t-values. * denotes significance at 5%. The terms E in the estimates are the error correction terms.

The estimated error correction models, however, differ significantly from that of the corresponding bivariate models. Table 7 shows that all the ECM equations without exception now pass the diagnostic tests and the equations are also much more precisely estimated than the corresponding bivariate models. The coefficients of the ECM terms are also significant at least at the 5% significance level in all the equations. The signs are also correct implying that the long-run causalities flow from public sector expenditure to national income, either positively or negatively, depending upon the degree of its growth. Interestingly, the speed of adjustment towards equilibrium defined by the coefficients of the ECM terms are also of equivalent magnitudes for similar specification of public expenditure. Thus, for public sector expenditure when not scaled (LTE and LCE), the speed of adjustment is about 30.0 percent within a year (models (I) and (II)). When scaled by population or national income (models (III) to (VI)), the speed of adjustment is uniformly about 48 to 49 percent within a year. Where the bivariate models show unstable equilibrium, the corresponding trivariate models now show a stable long-run equilibrium. For models (IV) and (VI) whose bivariate models also show stable equilibrium, the speeds of adjustment are higher in the trivariate models.

With regard to short-run dynamics, irrespective of the model formulation, growth in investment leads to rise in national income and its per capita. On the other hand, increase in public sector expenditure, irrespective of its specification, has net negative impact on income growth, as the coefficients which are statistically significant have negative signs on balance.

Interestingly, the magnitudes of the impact are similar between comparable bivariate and trivariate models ((I), (IV) and (VI)).

Section IV
Concluding Remarks

The paper attempts to analyse the dynamic interaction between the public sector expenditure and national income in India during the period 1960-61 to 1996-97 for both bivariate models and trivariate models, with total investment included as the third variable in the latter. It finds the existence of a stable long-run relationship between public sector expenditure and national income in India and the causality strictly running from the former to the latter. This is in contrast to Jha and Seth (1995) who found the causality in the reverse direction[15] . Public sector expenditure has a long-run positive impact on national income, but the same increase in public sector expenditure does not lead to increase in per capita income. This again is in contrast to the positive effect found in Jha and Seth (1995). On the other hand, if public sector expenditure growth is more than national income growth, that is, the share of public sector expenditure in national income rises, then it reduces the growth in both the national income and also its per capita. This indicates that excessive growth of public sector expenditure has a long-run detrimental effect on growth, which would follow as a result of higher public sector expenditure leading to excessive draft on private sector savings and investment.

In the short-run, the impact of growth in public sector expenditure on income growth is unambiguously negative. In a resource scarce economy, when there are competitions for funds at the margin, rise in public sector expenditure may preempt fund for the private sector such that overall investment and growth in the economy is dampened in the short-run irrespective of whether there is crowding in or crowding out effect in the long-run. For investment, whether it is the long or the short-run, its increase leads to growth in income.

National income growth in India, thus, seems to be investment or demand led. Though public sector expenditure has a positive impact on national income, it is detrimental to income growth when excessive, as private sector investment would be crowded out. Thus, there is the need for maintaining a proper balance between public sector expenditure and investment for economic growth in India.

Notes :

[1] There are at least three methods *viz.,* Dicky Fuller (DF), Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests for testing the order of integration of the data series.

[2] For detailed derivation of the testing and estimation procedure, refer to Pesaran and Shin (1995, 1996). The following is based on Pesaran and Pesaran (1997).

[3] In this error correction version employed for the first stage, the current values of the explanatory variables ?X and ? Z are not considered as it is not known a priori whether X and Z are the long-run forcing variables for the explained variable Y. Once the existence of the long-run relationship is established by the stability tests, they are included in the second stage estimating the long-run coefficients and the error correction model (Pesaran and Pesaran, (1997)).

[4] Unlike the Engle-Granger and Johansen procedure which estimates error correction models for each of the

variables involved in the cointegration analysis, in this procedure, the number of error correction models required to be estimated depends upon the number of long-run relationships determined by the stability tests.

[5] It may be noted that the lag lengths p, q and r in (1) and (2) are not the same. They have been retained only for notational convenience. In (1) they are the maximum order of lag length assigned to the variables for conducting the stability tests. In (2) the lag orders are the appropriate lags selected for each of the variables from the maximum lags based on the selection criterion adopted for the estimation of long-run coefficients. It may also be noted that, as explained in footnote (4), the instantaneous values of the explanatory variables are included in this error correction framework.

[6] This is the old national income series, but has been preferred as the new series covering the period up to 2000-01 reflects some inconsistency among various tables. Information on public sector investment at constant prices for the period prior to 1960-61 is not available.

[7] Ram (1986, 1987) argues that transfer payments should be excluded to make total government spending definition truly compatible with Wagner's ideas. On the other hand, Bird (1970), Musgrave and Musgrave (1988) favour its inclusion in government spending.

[8] Objection may be raised that public sector investment is a part of both total investment and total public sector expenditure, which are two separate variables in the models. However, it is true that national income also includes part of public sector expenditure, which is public sector investment, though they are the two variables tested for relationship in the literature.

[9] For the ratio variables LTEY, LTEN and LYN, it is indicated that the correct model specification for unit root tests should be without including a time trend while for variables which are not ratios i.e., LTE, LCE and LY, the tests should be with the inclusion of a trend. Even then the alternative tests contradict each other for some of the variables. For examples, LCE is non-stationary by Phillips-Perron test with trend while LYN and LTEY are non-stationary by the same test without trend. Thus, at least one of the variable appears to be non-stationary in each of the six models.

[10] There is no set criterion for selecting ARDL of order 4, which is the maximum order of lags, in the stability tests. This order was chosen as it gave the best F-statistics on the stability test and the coefficients for higher lags were found to be statistically insignificant. The number of data points was also kept in view while selecting the order.

[11] The F-statistics obtained from variable deletion tests suggest inclusion of a trend component for models (IV) and (VI), while in the rest, inclusion of trend are rejected. Therefore, the long-run coefficients for models (IV) and (VI) were estimated with a deterministic trend.

[12] That the impact of public consumption expenditure and total public expenditure has the similar impact on national income may indicate the unimportance of distinction in public sector expenditure and/or the problem of biased estimate due to omission of variables determining national income.

[13] F-tests indicate that a trend should be included in the case of model (VI).

[14] The impacts of total expenditure and consumption components of expenditure on national income are similar as in the bivariate models. The crowding in/out effect of public investment on private investment, and therefore, on national income depends upon the sector in which public investments are made. Public consumption expenditure also has a positive impact on private consumption expenditure (see for example, Report on Currency and Finance, 2000-01, RBI). Interestingly, in the estimation of national income in India, hike in wages and salaries of public sector employees, which is part of public sector current expenditure, is reflected in the growth of national income as public sector's contribution to national income is calculated on the cost of public services provided.

[15] The definition and the source of information on real public sector expenditure and also the time period in this referred study differ from the present study. It may be noted that National Accounts Statistics by Central Statistical Organisation (CSO) in India, the present source of information, has not published data on real public sector investment for the period prior to 1960-61, though the referred study covers the period 1950-51 to 1960-61.

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