3

Methodological Issues

“Empirical testing of hypotheses in economics particularly over the past ten years has undergone a great deal of change. (...) Given the complexities of empirical research as well as its limitations, there is a constant need to continue the search for a bigger and better toolbox to further our understanding of the economics and politics of the public sector”

--Ott and Cebula, (2006, Preface and Introduction)
CHAPTER 3

METHODOLOGICAL ISSUES

As chronicled by various commentators, the methodological revolutions in the discipline of economics, public economics not excepted, have been no less than the revolutions in human history, albeit sans the tears, sweat and bloodshed the latter has inevitably involved. This chapter discusses some issues relating to the researcher’s and economist’s “tool-box” at disposal, in other words, methodological issues and the specific aspects pertaining to the study at hand.

In analyzing government expenditure in India over our chosen period, the methodological concerns we have encountered stem from two aspects. First, defining and expressly elaborating on what is being studied, viz., explaining the concepts being used and various classification conventions followed in Indian public expenditure statistics. The second aspect relates to how it is being studied, viz. the analytical techniques that have been employed to carry out the study. This chapter, then, comprises the following sections:


3.2 Classification of Government Expenditure in India: A Note

3.3 Analyzing Nominal vs. Real Growth: The Issue of Deflators

3.4 Analyzing Time Series Macro Data: Some Methodological Considerations

We begin this chapter by first discussing the conceptual and measurement problems and issues that arise when researching the aspect of government expenditure. Revisiting the question as to why we are focusing on government expenditures, and not revenues instead, the justification, reiterated earlier in the Introductory Chapter, is reinforced by the following excerpt from Neck & Getzner (2007) ... “To obtain a picture of the development of the public sector, we concentrate on ratios of government expenditures to gross domestic product. This is superior to a ratio of government revenues to GDP, because expenditures (including those financed by public borrowing) give a better indication of the amount of economic resources absorbed by and allocated through the public sector” (Neck & Getzner 2007, emphasis added).

At the outset of analyzing government expenditure, the precise scope and terms being studied need to be clarified. Here we must explicitly define the ideas of government expenditure and national income magnitudes that are being studied. By government expenditure, here we are referring to central government expenditure. The justification of looking at central level, and not of that of the whole public sector as a whole or excluding State governments, is a pertinent question that we address first.

First of all, in the Federal set-up of the Indian fiscal structure, it is the budgetary imbalances at the central government level that caused widespread concern starting in the mid 1980s and leading subsequently to the 1991 economic reforms, culminating in a policy package embracing fundamental corrective measures,
including on the fiscal front, that were to have far-reaching consequences for the economy. The contemporary mounting government expenditures at the Central level, therefore, demand separate study and analysis.

Secondly, state finances in India are much too heterogeneous to club them together for analysis leading to meaningful insights. The considerable heterogeneity among states so far as leading indicators of public finance dimensions are concerned provides strong justifications in favour of our decision to focus on the Central Government.

The third point relates to the Centre’s inherent importance in the Indian Union fiscal structure. The tendency towards fiscal centralization has been variously sought to be addressed and resolved by the successive Finance Commissions (13 till date), and as the RBI data on Central and State’s combined Finances indicatee, the percentage share of Central Expenditure in combined Finances, despite marked fluctuations, shows a gradual declining tendency over our study period 1970-71 to 2007-08, implying an unmistakable trend towards decentralization even if rather slow and uneveni. Even so, however, the Centre’s own share has averaged above 50% throughout, excepting the period between 2004-2007, again climbing up subsequently during the Global Financial Crisis years. Given the Centre’s importance in the overall Federal finances, thus, ascribing separate analytical role to the Centre, as this study proposes to do, assumes significance. These considerations led us to the decision to pay separate attention to Central Finances and reserve an analysis of State finances for further research.

The final justification comes from the results of a 2001 (Rangarajan et al, NIPFP) study analyzing the heterogeneous nature of time properties where three Indian states were considered. The time properties of public expenditure across even this
limited number of states were found to be non-uniform across states. Such a finding suggested to us the advisability of treating Central government expenditure separately in its own right.

Next we come to the exact scope of our analysis, that is, the entity we refer to as government expenditure. A useful representation of the federal tiered system of government and its administrative components is presented in Fig 3.1.

**Fig 3.1: GOVERNMENT STRUCTURE: THE FEDERAL GOVERNMENT OF INDIA**

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GOVERNMENT ADMINISTRATION

- CENTRE
- STATES
- LOCAL GOVERNMENTS & UNION TERRITORIES

DEPARTMENTAL UNDERTAKINGS

NON-DEPARTMENTAL UNDERTAKINGS
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*Source: Based on Reddy (1972), Bhattacharya (1984)*

The public sector in India includes government administration (ADM), Departmental Undertakings (DU) and Non-departmental Undertakings (NDU). Government administration covers the central, state, and the local governments, and the union territories. The revenue and expenditure of government administration are covered by the Union and State Annual Financial Statements through the budgetary process (Bhattacharya 1984, Reddy 1972, Reddy et al 1984). The Union Budget in India is presented for the Central Administration while budgets for Railways etc. are presented separately. In treating government expenditure therefore, there is a need to distinguish between these entities.
In our analysis, we have followed the classification as per the Indian Public Finance Statistics and Economic and Functional Classification of Central Budgets as brought out by the Ministry of Finance, and for some further details, the National Accounts of India. In the definitions and classifications adopted in our study, therefore, the guidelines are those as provided by the Ministry of Finance and CSO.

**National Income**

Coming next to the concept of National Income, an extensive debate exists on which concept is most suitable to analysis of government expenditure (Peacock and Wiseman 1969, Goffman 1971, among others). Very briefly, the argument is this. National income by definition includes only final expenditure (by government, domestic households and business and foreigners) on current domestic production of goods and services. On the other hand, government expenditure comprises not only final expenditure (government final consumption and gross capital formation), but a sizeable extent of transfer payments as well. So, there is a conceptual problem involved in trying to normalize government expenditure figures by deflating with national income.

The second problem is the choice of the National Income concept itself. As is well-known, GDP (alternatively, GNP), may be measured both at factor cost which excludes all taxes/ subsidies, or can be valued at market price which includes the
taxes and subsidies imposed by government. The choice between GDP valued at factors cost / market price is therefore another conceptual issue facing the researcher.

Given the present analytical problems at hand, we have followed the practice adopted and advised by Bird (1971) and employed the concept of GDP factor cost.

3.2 Classification of Government Expenditure in India: A Note

Our analysis of public sector expenditure emerged out of our main discussion on budgetary imbalances in India that became more pronounced at the Central Government level over the 1980s.

At the outset, it must be mentioned that the practice of repeated reclassifications adopted in Union Budgets of India, and the frequent changes in definitions and conventions typically used to place the researcher in Indian public expenditure in an unenviable and difficult position, where attempts to carry out Time-series analysis would pose an uphill task of deciphering the data over reasonably long period of time and collating data that is consistent, comparable and comprehensive enough. While we do still have a long way to go in providing researchers and scholars comprehensive and consistent data in desirable format, the fortunate present availability of databases from the Ministry of Finance, RBI etc. (both electronic and print) has lessened this difficulty to a great extent, although the problem of
differences in conventions and assumptions followed among leading authoritative data sources, and hence the problem of discrepancies, continues to remain.

In our analysis, we have relied mainly upon data from the Indian Public Finance Statistics (Ministry of Finance, GOI) and the National Accounts Statistics published by the CSO. Database provided by the RBI, Statistical Abstracts of India, as well as various Budget Documents of the Ministry of Finance, have also been consulted extensively wherever necessary. Before elaborating on the data sources and their rationale, we first note certain basic classification conventions adopted in Indian Budgets.

CUSTOMARY BASIS OF CLASSIFICATION IN BUDGETS OF THE GOI:

Concerning government expenditure, the classification conventions in extensive use are:

- **“Administrative”**, which is the essential scheme along which Budgets are presented, and represent mainly Purpose-wise or Functional Heads.

- **Functional**: An allied categorization deriving from the above whereby budgetary items are shown, again, along essentially along purpose-specific categories.

- **“Economic”**, derived from the Economic-cum-Functional Classification of Government Budget provided along with the Budget Documents, where items relate to the diverse economic aspects of government expenditure such as
Government Consumption Expenditure, Capital Formation by the Government
and so on..

The distinction is significant for a number of reasons. Of particular interest to us in
the immediate context are the implications of such alternative classifications so far
as deriving real magnitudes for government expenditure is concerned.

India has long followed the tradition of presenting its Union budgets in respectively
Revenue and Capital accounts, the basic rationale being the necessity of indicating
the potential asset\liability implications of any budgetary transaction. A balance on
the combined revenue and capital accounts, the “budget deficit” was always
reported, and the balance on the revenue account shown separately. A plausible
explanation for the practice may be found in an early Planning Commission (1968)
comment on the attention given by Indian Policy makers to the potentially inflationary
implications of budgetary actions (S.B. Gupta, 1981)\ii.

Notwithstanding slight definitional problems, the soundness of having a distinction
between these two types of accounts becomes evident when we look at budgetary
data through the 1970s onwards. Going by the trend in finances, India conventionally
focused on the so-called “Principle of Good Budgeting”-- that is, attempting to
maintain a revenue account surplus that can be used to finance the capital budget.
Prior to 1979, India appears to have conventionally focused on the so-called
“Principle of Good Budgeting”-- that is, attempting to maintain a revenue account
surplus that can be used to finance the capital budget. However, since 1979-80 the typically surplus revenue account in the Central Budget (barring one or two outliers in the particularly ‘bad’ years of 1971-72 and 1973-74), turned into a persistent deficit that was to grow subsequently at a phenomenal rate. The deficit in States’ revenue account was to emerge rather later. The consequences of a widening revenue account deficit have been discussed at length in the literature.

Budgetary magnitudes are simultaneously presented into alternative categories like Plan vs. Non-Plan, or “Development” vs. “Non-Development”. Commentators sometimes also refer to “Productive” as against “Non-Productive” resource use, although definitions are relatively hazy. Finally, since not all government transactions fall within the purview of the Budget, additional comprehensive information is obtained from the National Accounts Statistics brought out by the Central Statistical Organization.

NAS also yields additional information on government current account vs. capital account transactions, and government consumption expenditure vis-a-vis. capital formation.

**RESOURCE USE: ALTERNATIVE CLASSIFICATION: A NOTE**

An early work on Indian Public Finances by the British author John Toye (1981) suggested that the only economically meaningful way of looking at expenditure was whether the resource use in question is “exhaustive” as against “non-exhaustive”.
That is, whether it involves final resource use: (examples being Final Consumption or Capital Formation), or whether it amounts to transfer of purchasing power from one sector to another (transfer payments that may be capital / current in nature).

Such a classification was deemed to be economically significant and hence more useful than accounting distinctions like the revenue (current) account vs. capital account.

Using the available NAS data, as also data from the Ministry of Finance (Economic Surveys, various years and the Economic Classification of Central Government Budgets, various years) to derive the economic categorization of Central Government Budget, we were able to follow to some extent the detailed guideline provided by Toye (1981) into identifying and reclassifying data into “exhaustive” or “non-exhaustive” categories from the budgetary magnitudes.

BUDGETARY CLASSIFICATIONS: FUNCTIONAL VS. ECONOMIC HEADS: THEIR RESPECTIVE SIGNIFICANCES:

Functional Classification relates to purpose-specific heads, e.g., Social Services, General Administration, Defense, Interest Payments and so on. The same expenditure item may usually comprise both revenue account and capital account components.

The functional categorization is the basis of customary budgetary classifications like Developmental and Non-Developmental or Plan-Non-Plan, which are all relating to specific purpose categories.
Functional classification helps us to understand the government’s policy stance in terms of expenditure commitments to a specific purpose. However, they tell us little about the economic impact of such expenditure on the rest of the economy, for which one has to turn to the **Economic Classification**.

Economic Classification of budgetary items indicates the economic nature of a particular transaction. Transactions may fall in the category of final transactions or Transfers. Due to some ambiguities in definitions, the customary revenue-capital distinction made in Indian budgets is not exactly analogous to the current-capital distinction. For an insight into the economic implication a reconciliation between the two sets of accounts is found in the **Economic-cum-Functional Classification** of Union Budgets.

Expenditure items as presented into alternative categories like Plan vs. Non-Plan, or “Development” vs. “Non-Development” basically indicate the government’s commitment or policy stance towards specific purposes. Commentators sometimes also refer to “Productive” as against “Non-Productive” resource use, although definitions are relatively hazy. Finally, since not all government transactions fall within the purview of the Budget, additional comprehensive information is obtained from the National Accounts Statistics brought out by the Central Statistical Organization.
So far as the functional aspect is concerned, we have adopted the Indian Public Finance Statistics brought out by the Ministry of Finance as this series was found to be relatively complete, consistent and comprehensive for our purpose, although this too needed substantial effort on our part to reclassify and interpret the variously grouped data for deriving meaningful and comparative time-series database.

Regarding economic classification, the data published by the CSO (National Accounts Statistics, current and constant price) was employed. The constant price data available at various base years were all suitably transformed and converted into 2004-05, the latest available series up to date, by this researcher.

DATA SOURCE

Analyzing long-term (secular) change in public sector activity requires continuous and comparable data on public expenditure and revenue. Budgetary definitions in India, as also classification of items, have changed from year to year, and the main sources that we found useful at the time were:

a) CSO - NAS documents

b) Indian Public Finance Statistics made available by the Ministry of Finance, Government of India—various years being carefully compiled for consistent, continuous and comparable database suitable for the purpose of this researcher.

c) RBI Reports on Currency and Finance for various years, and Ministry of Finance Publications.
3.3 Measuring Real Government Expenditure: The Issue of Deflators

While on the issue of converting nominal expenditure values to real, reference must be made to the classification of government expenditure in budgets, as done along i) Economic lines, and ii) along functional lines.

Economic classification can indicate the economic impact of the government expenditure various components has on the macro-economy. Here the typical classification is, first between government final expenditure on one hand, and transfers on the other. The former comprises government consumption expenditure, in its turn distinguished into a wages and salary component, and a final expenditure on goods and services component. Then there is gross capital formation by the government. Transfer payments in turn comprise of various capital and current transfers that represent, not final expenditure on goods and services, but a transfer of purchasing power from the government to the rest of the economy.

So far as Functional classification is concerned, here we have basically the specific functions/ purposes behind the expenditure. The fundamental revenue and capital distinction account being there, the respective categories are then subdivided as shown in Table 1.

Why is this detailed note necessary? This is because, when we are seeking to look at real expenditure growth and trends, we have to look at data that has been
corrected for inflation/ price change effects. However, government expenditure data is typically presented in current price figures, not constant price, so that a set of suitable deflators has to be applied to render them into real values.

Obviously then, we have to tackle the issue of deflating expenditure separately when the functional categories are concerned.

So far as empirical work goes, a number of works may be cited for their adoption of the practice of deflation. Chronologically, the first work that we can mention is by Reddy, Sarma and Singh (NIPFP 1984) who have adopted the following detailed method. Expenditure is distinguished into the following components:

1. Expenditure on Wages and salaries
2. Government final purchase of consumption goods and services
3. Gross capital formation by government
4. Current transfers, e.g. interest payments
5. Capital transfers, e.g. grants given to assist capital formation
6. Net financial investments and loans to the rest of the economy

Having distinguished these categories, then, the authors apply the following deflators to each category as follows (on next page):
<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>Deflator Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure on Wages and salaries</td>
<td>Deflator for Compensation of employees of government administration (CSO data)</td>
</tr>
<tr>
<td>Expenditure on goods and services</td>
<td>Index constructed by the Directorate General of Supplies and Disposals (DGSD)</td>
</tr>
<tr>
<td>Gross Capital Formation</td>
<td>Implicit price deflator for GFCF in public sector derived from CSO estimates</td>
</tr>
<tr>
<td>Current Transfers</td>
<td>Implicit GDP deflator</td>
</tr>
<tr>
<td>Capital Transfers</td>
<td>Index applied to capital formation as above</td>
</tr>
<tr>
<td>Financial investments and loans to</td>
<td>Implicit GDP deflator</td>
</tr>
<tr>
<td>The rest of the economy</td>
<td></td>
</tr>
</tbody>
</table>

(Based on: Reddy et al. (1984) pp 12-13)

Similar practice has been followed by Joshi (1994) among others, who for her study spanning 1950-51 to 1989-90, has more or less adopted Reddy et al.'s set of deflators.

Sarma and Bhanoji Rao (1992) have studied in detail the trends in government expenditure over, adopting the deflators that are more or less along the same lines as Reddy et al (1984) above.
In the international context, Gemmell (1999) has used separate deflator for Government Consumption Expenditure and Gross Capital Formation, while for transfers, the author has argued for using the Consumer Price Index as it is essentially a transfer to the household sector.

Clearly, in all of this, the focus is on the economic classification of expenditure. However, the problem becomes more complex when we turn to the functional classification of expenditure, where similar data on constant price series is rarely available (unlike the Australian government finances database, for example, where government expenditure data is presented in terms of both current and constant prices).

What, then, has been the practice in the case of functional categories? Although Reddy et al (1984) have used a constant price series for functional categories as well, we could not find explicit documentation of the source, or method, of deriving the constant price data they report. A similar problem is encountered in Sarma and Rao’s 1992 study which, while clearly delineating the choice of deflators in the context of economic expenditure categories, does not make explicit mention of the method of deflating functional ones. Joshi (1994) unequivocally states the absence of constant price series so far as functional data is concerned, and goes on to analyze expenditure trends in case of the latter in nominal terms.
Finally, Rao et al (1995), in their analysis of the uneven pattern of government expenditure in India, have applied the WPI in deriving real expenditure values. They explain that the choice of the deflator is very much dependent on the nature of the query itself. Thus, if the object is to investigate the size then WPI is suitable, while in case of an analysis of the growth of government the CPI will be the preferred deflator (Rao 1995 pp).

In view of the various considerations noted above, the present study has treated the problem of deriving real series respectively for economic and functional categories, in two separate parts.

So far as the economic category is concerned, the following practice has been adopted:

<table>
<thead>
<tr>
<th>Series</th>
<th>Deflator based on</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Consumption Expenditure</td>
<td>constant price data by the NAS</td>
</tr>
<tr>
<td>Gross Capital Formation by Government</td>
<td>Deflator applied to public sector capital formation</td>
</tr>
<tr>
<td>Transfer Payments:</td>
<td></td>
</tr>
<tr>
<td>Current Transfers</td>
<td>Consumer Price Index</td>
</tr>
<tr>
<td>Capital Transfers</td>
<td>Deflator applied to public sector capital formation</td>
</tr>
<tr>
<td>Loans and Advances</td>
<td>Deflator applied to public sector capital formation as these loans are</td>
</tr>
</tbody>
</table>
generally mostly given for capital formation purposes.

The above, to recapitulate, is the detailed account of deflation procedure adopted for the economic categories of government expenditure.

What about functional categories? For reasons that have been already discussed above, the Wholesale Price Index (WPI) has been applied as deflator for functional categories of expenditure following Rao et al (1995).

3.4 Analyzing Time Series Macro Data: Some Methodological Considerations

The final issue that is relevant to our discussion on methodological concerns is that of explicitly recognizing and analyzing the time dimension involved in our analysis. Time series data on Government expenditure, like almost all other macro economic variables, involve characteristics that demand explicit time-series considerations for a valid and complete analysis. By now too well-known to merit discussion at elaborate length, these aspects however require us to devote some attention, albeit very briefly, to issues in Time-Series Econometrics, specifically, the problems of Non-stationarity and “Spurious Regression”, and analytical concepts such as Unit Roots and Cointegration techniques.

The relevant conceptual and methodological issues are first discussed below, followed by explicit incorporation of the above issues in the analysis where relevant. The approach adopted here is an intuitive one rather than overtly technical.

As has become common knowledge for over the last 30 years in econometric analysis, most macro-economic time series data like GDP, income, interest rates, consumption and investment expenditures, including government revenue and expenditure variables, are non-stationary in nature. The first concept involved here is
that of "Non-stationarity" and the resulting violation of the fundamental assumptions on which the Classical Linear Regression Model (CLRM) analysis is based, including constancy of mean, absence of heteroscedasticity, absence of serial correlation between errors, to mention only some of the assumptions that are violated when data are no longer stationary. Application of the CLRM in such cases would therefore be prone to yield misleading results, a problem famously termed by Clive Granger as "Spurious Regression" (Granger and Newbold 1979) in their treatise on time series.

We follow an intuitive approach here to discuss the issues involved.

**Fig 3.2: Interest rate (Quarterly)**

![Random walk model graph]

*Source: Adapted from Gujarati (1995)*

**Fig 3.3: GDP Data (1965-2005)**

![Random walk with drift model graph]

*Source: Adapted from Gujarati (1995)*
Figures 3.2 and 3.3, represent, respectively, the quarterly interest rates and the annual GDP series over specified periods of time. Both the series presented above expectedly show fluctuations over time. We also present a third time series, showing similarly noticeable fluctuations over time.

**Fig 3.4: A “Stationary Time Series”**

Source: Based on RBI (2012) Data on Monthly and Annual Averages of BSE National Index (Base : 1983-84 = 100)

What is the essential difference between the first two series, and the third series presented above showing the monthly and annual averages of the BSE National Index between the years 1992-93 and 2002-03? Notably, the series in Fig 3.4, while having continual fluctuations, appears to do so around a mean value that is not varying over time. In other words, this particular series is varying over time around a time-invariant mean.

However, such is not the case with our first set of series on interest rates and GDP. Figs 3.2 and 3.3, both, in contrast to Fig. 3.4, show that the mean of each series is definitely shifting over time, that is, the mean itself (and, as we shall discuss later, the variance also) is not time-invariant, thus violating a very basic assumption of CLRm.
This qualitative and visually obvious difference between the two sets of series above brings us to the first intuitive definition of “(Non)-Stationarity”, a conceptual issue that is going to be of crucial significance to us in the subsequent phase of our analysis, where we are interested in capturing, and to a plausible extent, formalize, the observed behaviour of government expenditure over time in terms of the plausible economic and institutional factors operating in the economy.

Methods of addressing the problem of Non-stationarity are exemplified in Nelson and Plosser’s seminal 1981 work on US GDP series. The usual practice, prior to the famous “Unit Roots” revolution of early 1990s, had been to de-trend time-series data, a practice that was later realized to result in loss of valuable information (Bhaskara Rao 1995, Maddala and Kim 1998).

A related concern, where time trend was agreed to be present, was realized to be of vital importance, viz., the necessity to distinguish between trend that is deterministic vis-à-vis stochastic. If the time trend is deterministic, usual practices of de-trending would be sufficient. However, in case trend was stochastic, ordinary practices would not be adequate enough.

Determining whether trend is deterministic or random, is a separate technical issue in its own right. For our present purposes, as Perron (1989), Nelsson and Plosser (1981), Clive Granger and others have elaborated, most macroeconomic data in fact display stochastic trends, so that explicit consideration of time-series nature are mandatory.

A non-stationary series needs to be checked for stationarity in order to apply the methods of linear regression—as otherwise it might give spurious regression (Clive Granger 1992). Spurious regression means there is in fact no relationship between the variables but both appear to move together simply because of the presence of
the time factor. If that is the case, then the time factor must be suitably treated in
order to uncover the genuine relationship, or absence thereof, between the two (or
more) variables in question. In other words, non-stationary data must be rendered
into stationary, as a first step.

The most frequently employed check for determining whether data is stationary or
not is the Unit Roots test\textsuperscript{iii}, so-called since the information is contained in the value of
unity of $\rho$ in the autoregressive process:

$$
Y_t = \rho Y_{t-1} + \epsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad 1
$$

If $\rho = 1$, any disturbance to the series gets transmitted and does not die down but
persists. This is when we say that $Y_t$ has a unit root, and we say that the series $Y$ is
non-stationary. Unfortunately, the usual $t$-statistic for testing the unity of value of $\rho$
under the violated CLRM assumptions, does not follow the usual $t$-distribution. It is
now the $\tau$, also called the Dickey-Fuller Test following Dickey and Fuller who
computed the values of the $t$-statistics under these special circumstances.

Note that for sufficiently large distributions, $\tau$ asymptotically approaches the $t$-
distribution and hence when the sample is sufficiently large the DF test can be
approximated by the usual $t$-distribution.

To recapitulate, then, the test for Stationarity, also called the Unit Root Test, is also
goes by the name Dickey-Fuller (DF) Test. Note that in more advanced contexts, the
efficacy of the DF and the ADF tests as adequate tests of Unit Roots/ Stationarity
has been extensively contested and the power of the test found to be low. Alternative
tests have been suggested (Maddala and Kim, 1998). For the present context
however, we restrict ourselves to the DF test for Unit Roots noting its popularity, universality and ease of interpretation.

Augmented Dickey-Fuller (ADF) Test:

A closely related test is the ADF, usually employed more frequently, when there is presence of serial autocorrelation. The change from the DF is the presence of an extra term in the denominator. The presence of serial autocorrelation can be detected by looking at the DW Durbin-Watson d-statistic which as standard practice is reported in DF tests.

**NON-STATIONARITY, UNIT ROOTS AND COINTEGRATION: THE PROBLEM OF SPURIOUS REGRESSION:**

In economics, our concern is with establishing/ exploring relationships between economic variables. Explaining one variable with another with regression is done and certain assumptions like linearity etc. maintained.

When two or more economic series are ncn-stationary, however, we have what Clive Granger (1992) termed as the problem of spurious regression. How to establish or ascertain the genuineness of the estimated regression when the various variables involved are non-stationary?

Cointegration allows us the way to establish relationships between non-stationary variables. To understand this, we define cointegration first.
**Definition:**

**Integrated Series/ Order of Integration:**

Suppose $X_t$ is a non-stationary time-series which becomes stationary on differencing once. We then say $X_t$ is “Integrated of order 1”.

In general, if a stochastic process becomes stationary on being differenced "d" times, we say that it is integrated of order $d$. In notational terms,

$$X_t \sim I(d)$$

**Cointegrated Time Series:**

If for two non-stationary time-series $X_t \sim I(d)$ and $Y_t \sim I(d)$, a vector can be found such that the linear combination $Z_t$ of $X_t$ and $Y_t$ is stationary (in other words, $Z_t \sim I(0)$), then $X_t$ and $Y_t$ are said to be cointegrated.

In notational terms, if, for two time series

$$X_t \sim I(d), \text{and } Y_t \sim I(d), \text{non-zero constants } \beta_1, \beta_2 \text{ can be found such that}$$

$$\beta_1 X_t + \beta_2 Y_t = Z_t \sim I(0), \quad \beta_1, \beta_2 \neq 0,$$

then $X_t$ and $Y_t$ are cointegrated.

It can be shown that for any two unique cointegrated time series $X_t$ and $Y_t$, the cointegrating vector is unique (Perron 1991, Maddala and Kim 1998).
Most applications of cointegration methods treat the case where both series are I(1).

The general definition of co-integration (for the I(1) case) is as follows:

**Definition:** A vector of I(1) variables $y_t$ is said to be cointegrated if there exist at vector $\beta_i$ such that $\beta_i'y_t$ is trend stationary. If there exist $r$ such linearly independent vectors $\beta_i$, $i = 1, \ldots, r$, then $y_t$ is said to be cointegrated with cointegrating rank $r$. The matrix $B = (\beta_1, \beta_2, \ldots, \beta_r)$ is called the cointegrating matrix.

Note that $\beta'y_t$ is an $r$-dimensional vector of trend-stationary variables.

**Economic Implication of Cointegration**

Why is the issue of cointegration important? This is because, it allows us to conceptualise a long-run relationship between economic variables even when they are not allowing the usual Classical regression methods. Presence of cointegration ensures that even when variables/series are appearing to diverge away from each other over time, they are, in fact, moving together which is not simply generated because of the time factor.

While essentially a statistical concept, cointegration does have economic implications which have been amply elaborated by, among others, B. Bhaskara Rao (1995), Maddala and Kim (1998) and others who have discussed at length the economic interpretation of cointegrating vectors.
Relevance to Present Study

Having discussed very briefly some of the fundamental methodological issues at stake, it is now time to relate these to the analysis at hand. Our analysis of central government expenditure not only seeks to study the pattern, changing composition and underlying trends of government expenditure and its variously distinguished components, but also envisages the interrelationship between government expenditure and its various dimensions on one hand, with national income magnitudes and other significant economic (structural) and institutional variables of the economy on the other.

The above discussion of some essential points, it is hoped, should help towards an appreciation of the rationale behind the successive analytical steps that need to be undertaken for carrying out our study.
ENDNOTES

1 As per the IMF (2009), there are at least four alternative ways in which (de)-centralization can be measured, including the Centre’s share in total revenues, and the Centre’s share in total expenditure—all the indicators thus defined not necessarily implying identical results. In our present context, we have decided to use the indicator of the share of Central Expenditure in the Total as more relevant.

2 To provide a necessary elaboration, in the initial definition of the budget deficit, it had been customary to associate the deficit with an increase in money supply, and hence, inflation. Subsequent modifications and improvements in the various concepts of deficits led to the concept of the “monetized deficit” i.e., the addition to net RBI credit to the government which is in actual fact a better measure (though still an approximation), of the monetary impact. For illuminating discussions on these issues refer to Suraj B. Gupta (1981), Monetary Planning for India, Oxford and RBI (1985), Report on the Working of the Monetary System in India.

3 Stationarity checks and Unit Root tests are quite frequently used synonymously in most empirical work. However, more powerful and satisfactory tests exist for Stationarity checks. For an extensive discussion on the various checks for Stationarity, Unit Root tests and their limitations, as well as the alternative proposed tests, see Maddala and Kim (1998).
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