CHAPTER IV

FISCAL SUSTAINABILITY: AN EMPIRICAL ANALYSIS

4.0 Introduction

In recent years, many developed as well as developing countries have pursued such fiscal policies, which led to considerable amounts of public debt. The accumulation of external/public debts combined with overspending that characterizes the behavior of these governments constitutes a threat to future generations. It not only jeopardizes the macroeconomic stability of an economy, but also curtails the ability of the government to undertake basic developmental activities and disrupt delivery of government services. The need to put a responsible fiscal policy and keep government debt under control have made sustainability of fiscal policy one of the most widely discussed problem in recent years. In the present chapter an attempt is made to empirically test for fiscal sustainability in India by adopting the analytical framework given by Quintos (1995).

4.1 Fiscal Scenario in India

Public debt in India has accelerated over the period 1991 – 2003. It grew more rapidly than did the overall economy. In fact, the public debt in India has accumulated since the 1991 crisis. With the implementation of rapid economic reforms, growth in government expenditure also remarkably improved leading to increased government borrowing during the nineties. This posed a challenge to the government in terms of servicing the debt obligations and also to contain it at sustainable levels. In recent years public debt grew rapidly because of a high volume of public spending, especially in the non-
productive areas: the high prices of imported oil and petroleum, subsidies and salaries and pensions of the civil service. With the onset of increasing public debt/GDP ratio in India, the sustainability of public debt came under scrutiny.

Although the concept of sustainability of public debt/finances has been in vogue for more than two centuries, its importance was recognized only with the seminal work by Domar (1944), and Harrod (1948). There is however, no generally agreed definition of debt sustainability. Literally speaking, it may be interpreted as preventing bankruptcy of the economy. The classical economists like Hume, Smith, and Ricardo were the first to analyze the sustainability of fiscal policy. The focus of their analyses was the on the composition between tax and deficit financing of public expenditure, assuming that the latter is an exogenous variable. Ricardo was the first to discuss the government debt neutrality and intertemporal budget constraint. He assumed that the current value of debt should be equal to the discounted sum of the future surpluses. In this context, the sustainability of fiscal policy is said to be achieved if the discounted value of debt converges to zero. This concept was later developed by Barro(1974) and called it the “Ricardian Equivalence theorem”.

The IMF (2001) defines debt sustainability of a country as its ability and willingness to meet the current and future debt service obligation without recourse to debt rescheduling or accumulation of previous debt and without compromising growth. According to De Mole (1990), “if a country has serviced debt of a certain level (defined as percentage of exports, GDP or fiscal revenues) and this level does not increase, it will be willing (otherwise it would have already repaid it) to continue servicing the debt”. In simple
words, sustainability can be seen as the capacity to keep balance between costs of additional borrowing with returns from such borrowing, which could be in the form of higher growth that results in higher government revenues that can be used for servicing the additional borrowing. Thus, we may infer that debt sustainability is essentially an intertemporal issue and needs to be tested empirically. In the light of this observation, an analytical framework is necessary to examine the issue of debt sustainability.

4.2 Analytical Background: Domar’s Canonical Model

One of the earliest analyses of the dynamics of debt accumulation was given by Domar (1994), in which both interest rate and growth rate are taken as exogenous. Based on this assumption, the analytical framework is derived as follow:

Let, \( b_t \) be debt-GDP ratio in period \( t \); \( g_t \) be nominal growth rate in period \( t \); \( i_t \) be nominal interest rate in period \( t \); and \( p_t \) be primary deficit relative to GDP in period \( t \).

The standard equation for debt accumulation is given by

\[
b_t = p_t + b_{t-1} \left[ (1+i_t) / (1+g_t) \right]
\]

Equation (4.1) can be written as

\[
b_t = p_t + x_t b_{t-1} \quad \text{Where} \quad x_t = (1+i_t) / (1+g_t)
\]

If \( b_0 = p_0 \), we have, \( b_1 = p_1 + x_1 p_0 \)

Then, \( b_2 = p_2 + x_2 p_1 + x_2 x_1 p_0 \)

Generalizing, we can write

\[2 \text{ Adapted from the Rangarajan and Srivastava (2005)}\]
\[ b_t = p_t + x_t p_{t-1} + x_{t-1} p_{t-2} + \ldots + (x_{t-1} \ldots x_1) p_0 \]  \hspace{1cm} (4.3)

If it is assumed that \( x_t \) is constant, implying \( g \) and \( i \) are constants for all \( t \), we can write

\[ b_t = p_t + x p_{t-1} + x^2 p_{t-2} + \ldots + x^{t-1} p_{t-1} + x^t p_0 \]  \hspace{1cm} (4.4)

The canonical model (Domar, 1944) requires the additional assumption that \( p \)'s are also constant for all \( t \). Since \( x_t = (1 + i_t) / (1 + g_t) = x \) for all \( t \), three cases namely (i) when \( g = i \), (ii) when \( g > i \), and (iii) when \( g < i \), might arise.

In the first case, we can write

\[ b_t = \sum_{i=0}^{t-1} p_i = (t + 1) p \]  \hspace{1cm} (4.5)

This implies that if \( g=i \), the debt-GDP ratio is the cumulated sum of the primary deficits in all the previous periods. In the second case, when \( g > i \),

\[ b_t = p(1 + x + x^2 + \ldots + x^{t-1} + x^t) \]  \hspace{1cm} (4.6)

The term within parenthesis is a geometric series with common ratio \( x \leq 1 \). As \( t \) tends to infinity, this sum tends to \( x^t / (1-x) \). Then the long run (as \( t \to \infty \)) value of the debt-GDP ratio can be written as

\[ b_t = p / (1-x) \]

\[ b_t = p(1 + g) / (g - i) \text{ as } t \to \infty \]  \hspace{1cm} (4.7)

In the third case, when \( g < i \), \( x > 1 \), \( b_t \) will grow indefinitely.
Thus, a value of $p > 0$, will eventually become unsustainable for both cases when $g = i$ and when $g < i$. In the case, when $g = i$, the debt-GDP ratio grows linearly by the size of the primary deficit, and when $g < i$, the debt-GDP ratio grows explosively if the primary deficit-GDP ratio is positive.

We will now focus on the case where $g > i$. From equation (4.7), the long run equilibrium value of $b = b^*$ is given by

$$b^* = p(1 + g)/(g - i)$$  \hspace{1cm} (4.8)

The fiscal deficit to GDP ratio ($f^*$) corresponding to a stable debt-GDP ratio ($b^*$) will be:

$$f^* = p.g / (g - i)$$  \hspace{1cm} (4.9)

Equations (4.8) and (4.9) provide a system of two equations in three unknowns, viz., $b$, $f$, and $p$, assuming values of $g$ and $i$ are given ($g > i$), and consistent with the a stable debt-GDP ratio$^3$. It is indicated that high values of $p$ will be associated with high levels of $b$ and $f$. However, these equations do not provide a unique solution as the unknowns are more than the number of the equations.

Using equations (4.8) and (4.9) together, the relationship between $b^*$ and $f^*$ can be written as

$$b^* = f^*(1 + g)/g$$  \hspace{1cm} (4.10)

The pair $(b^*, f^*)$ gives that level of fiscal deficit-GDP ratio at which the debt-GDP ratio remains unchanged at $b^*$. As shown in Figure 4.1, equation (4.10) gives a family of straight lines rising to the right, showing combinations of fiscal deficit-GDP ratio and corresponding stable debt-GDP ratio, for a given growth rate. This line shifts upward as

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$^3$ The effect of an increase in the growth rate, given the interest rate and holding other variables unchanged, is to lower the equilibrium levels of fiscal deficit and debt
growth rates are lowered. In the figure below (figure 4.1) the vertical axis represents debt-GDP ratio and horizontal one fiscal deficit-GDP ratio. For lower growth rates, the line is closer to the vertical axis; as growth rates are higher, for the same fiscal deficit ratio, debt-GDP ratios are lower.

**Figure-4.1 Stable Combinations of Debt- and Fiscal Deficit to GDP Ratios for Different Growth Rates**

Alternatively, the stabilization conditions can be expressed in an equivalent way in terms of the ratio of interest payments to GDP.

Defining interest payments to GDP ratio as \((ip_y)\), we have

\[
IP_t = i.B_{t-1} \quad \text{or} \quad (ip_y)_t = ib_{t-1} / (1 + g) \quad (4.11)
\]

As debt is stabilized \(b_t = b_{t-1} = b^*\) and \((ip_y)_t = (ip_y^*)_t\)

from equation (4.11) it follows that,
The corresponding level of fiscal deficit to GDP ratio is given by

\[ f^* = \frac{\mathbb{L}(g_p)}{i} \]  

(4.13)

Equations (4.12) and (4.13) provide a set of two equations in terms of three unknowns, \((b, f, \text{ and } ip_g)\). Again, the system can determine unique values of any two of the three unknowns, provided one of the unknown is pre-specified. Clearly, additional information is needed to solve the system described by either equations (4.8) and (4.9) or equations (4.12) and (4.13). The critical question is whether, when \(g > i\), sustainability is implied for any value \(p > 0\). To address this question, it is useful to recognize that \(g_t\) and \(i_t\) are neither constant nor independent of the level of \(p\). In particular, both \(g_t\) and \(i_t\) should be taken as stochastic processes and dependent on the levels of debt and fiscal deficit relative to GDP. At any time \(t\), the debt-GDP ratio \(b_t\) will be higher than its previous year’s level \(b_{t-1}\), as long as the primary deficit to GDP ratio in the current period \(p_t\) satisfies the following condition:

\[ p_t = b_{t-1} \left\{ \left( \frac{g_t - i_t}{1 + g_t} \right) \right\} = p_t^s \]  

(4.14)

Here, \(i_t\) is the average interest rate and \(p_t^s\) is called the debt-stabilizing primary deficit to GDP ratio. As long as \(p_t\) in any given year is equal to or less than \(p_t^s\) for that year, debt-GDP ratio will not rise in that year compared to its level in the previous year. Since \(p_t^s\)
depends on the difference between $g$, and $i$, it is important to consider how should $p$ be determined in any year since it may affect $g$ and $i$ in that year.

4.2.1 Implications of the Canonical Model

The following points emerge from the canonical model:

- The debt-GDP ratio will rise continuously for positive values of the primary deficit relative to GDP, if the growth rate is equal to or less than the interest rate.
- If growth rate is higher than the interest rate, and both of these are unaffected by the levels of fiscal deficit and debt levels relative to GDP, the debt-GDP ratio and the fiscal deficit to GDP ratio will eventually stabilize.
- The level of fiscal deficit relative to GDP that keeps the debt-GDP ratio stable can be specified as dependent on the growth rate only.
- The system of equations implicit in the canonical model can define combinations of stable debt-GDP ratio and fiscal deficit to GDP ratio but does not determine their best or most desirable values.
- In deciding a suitable fiscal stance for the medium to long run, it is best to consider the debt-GDP ratio and fiscal deficit to GDP ratio together rather than only one of them.
- The long term fiscal stance requires additional information on the impact of debt and deficit levels on growth, and the assumption of constancy of growth and interest rates should be given up. In this case, the ratio of debt to GDP will rise progressively, even if the growth rate is higher than the interest rate, if primary
deficit to GDP ratio is above a threshold level given by $p_\delta$, which can be specified as dependent on previous year’s debt-GDP ratio, growth rate and interest rate.

The canonical framework indicates permissible levels of primary deficits for a given combinations of growth and interest rates, at different levels of debt-GDP ratio. It does not indicate whether a higher or lower debt-GDP ratio may also be sustainable. It also does not indicate as to what may be the optimal ratio at which the debt-GDP ratio should be stabilized.

4.3 **Empirical Tests of Debt Sustainability**

Debt sustainability is essentially an intertemporal issue. Hence studies have been conducted on intertemporal budget constraint. Hamilton and Flavin (1986) proposed an empirical framework for testing the “limits” of public borrowing, using the postwar U.S. data. They concluded that sustainability requires stationarity of the government debt. Trehan and Walsh (1991), Bohn (1991, 1995), Jha and Sharma (2004), Martin (2001) and Quintos (1995), among others, have investigated the issue of fiscal sustainability by testing for the time series properties of public debt and budget deficits by using unit roots and cointegration analysis.

Several tests are suggested to test sustainability of fiscal policy. In some tests, the question of sustainability relies on the stationarity of the debt, deficit, and other main variables. Other tests are based on the cointegration analysis that seeks for the presence of cointegration relationships between revenues and expenditures. For instance, Hamilton
and Flavin (1986) assumed that the sustainability resides in the stationarity of the debt. Wilcox (1989) indicated that the discounted debt process follows a process integrated of order zero, \( I(0) \) without drift. The later studies developed alternative conditions for debt sustainability which imply that total public revenue and expenditure are first order integrated processes and the two series are cointegrated [see Hakkio and Rush (1991), Haug (1991), Afonso (2005)]. Later, Quintos (1995) expanded this approach by introducing the concept of “strong” and “weak” fiscal sustainability.

The concept of strong sustainability differs largely from weak sustainability in the sense that the former assumes a situation in which no future problems are expected in the behavior of deficits and consequently there is no need to change fiscal policy. In the latter, the governments may face future problems in marketing their debt that is accompanied by considerable risk of an increase in interest rates which may have adverse implications on the economic growth and public budget. In this situation, governments are urged to make fiscal reforms or at least should bring about a consolidated effort to address the situation.

Trehan and Walsh (1988) applied the stationarity test under the assumption of a constant real interest rate and demonstrated that it is equivalent to the test for cointegration between government expenditures inclusive of interest payments and revenues. Wilcox (1989) extended Hamilton- Flavin analysis by allowing for a non-constant real interest rate in the study. Hakkio and Rush (1991), tested the cointegrating vector under the assumption that the real interest rate is stationary. Quintos (1995) expanded on Hakkio and Rush (1991) and introduced “strong” and “weak” conditions for fiscal sustainability.
4.3.1 The Model:

The analytical framework of this study has been guided by the work of Quintos (1995). The government’s one period budget constraint following the dynamic budget constraint by Hakkio and Rush (1991) may be written as,

$$\Delta D_t = E'_t - R_t$$  \hspace{1cm} (4.15)

where $D_t$ the market value of debt of the central government, $E'_t = E_t + r_t E_{t-1}$ is government expenditure inclusive of interest payments, and $R_t$ is revenues. The interest rate, $r_t$ is assumed to be stationary around the mean $r$ and (equation 4.15) can be written as,

$$D_t - (1 + r)D_{t-1} = e_t - R_t$$  \hspace{1cm} (4.16)

where $e_t = E_t + (r_t - r)D_{t-1}$ is $E'_t$ with interest rates taken around a zero mean. Because (4.16) holds for every period, forward substitution yields,

$$D_t = \sum_{j=0}^{\infty} \lambda^{j+1} (R_{t+j} - e_{t+j}) + \lim_{j \to \infty} \lambda^{j+1} D_{t+j}$$  \hspace{1cm} (4.17)

where $\lambda = (1 + r)^{-1}$. The representation of (Equation 4.17) in terms of the difference $\Delta D_t$ is written as,

$$E'_t - R_t = \sum_{j=0}^{\infty} \lambda^{j-1} (\Delta R_{t+j} - \Delta e_{t+j}) + \lim_{j \to \infty} \lambda^{j+1} \Delta D_{t+j}$$  \hspace{1cm} (4.18)
where equation (4.18) is derived by applying the difference operator $\Delta$ in equations (4.17) and using (4.15). In equations (4.17) or (4.18) to impose a constraint analogous to the inter temporal budget constraint faced by an individual, it must hold that

$$\lim_{j \to \infty} \lambda^{j+1} \Delta D_{t+j} = 0$$

(4.19)

If (4.19) is satisfied, then inter temporal budget balance or deficit sustainability holds because this would require that the government run future surplus equal, in expected present-value terms, to its current market value of debt.

To test the condition given in equation (4.19), the procedure in the literature has been to test for the stationarity of $\Delta D_t$, or alternatively to test for the stationarity of $E_t - R_t$ [if they are each I(1)] with cointegrating vector $(1, -1)$ imposed. An equivalent procedure is to test for cointegration in the regression equation,

$$R_t = \mu + b E_t + \epsilon_t$$

(4.20)

and test that $b = 1$.

Hakkio and Rush (1991) relaxed this condition by showing that cointegration and $0 < b \leq 1$ are necessary conditions for a strict interpretation of deficit sustainability [i.e., equation (4.19) holds]. But Quintos (1995) argued that the condition $0 < b \leq 1$ is a necessary and sufficient condition for deficit sustainability and that cointegration is only a sufficient condition. He further suggested that, although $0 < b < 1$ is sufficient for the deficit to be sustainable, it is inconsistent with the government’s ability to market its debt in the long run. In other words, the condition $0 < b < 1$ has serious
policy implications because a government that continues to spend more than it earns has a high risk of default and would have to offer higher interest rates to service its debt.

On the basis of the value of the coefficient $b$ in the regression of equation (4.20), Quintos (1995) suggested two kinds of debt sustainability namely, ‘strong’ and ‘weak’ sustainability. He argues that if $0 < b < 1$ and Revenues ($R_t$) and Government expenditure ($E_t^r$) are $I(1)$, debt is sustainable in its weak form, no matter whether $\varepsilon_t$ is $I(0)$ or $I(1)$. Thus, cointegration between the two variables plays no role in this case. Whereas if $b = 1$ and cointegration between these two variables holds, i.e. both variables are $I(1)$ and $\varepsilon_t$ are $I(0)$, then debt is said to be strongly sustainable. Further, if $b = 1$ and the cointegration between these two variables does not hold but they are $I(1)$, in this case debt will be sustainable in its weak form. On other hand if $b = 0$ and both variables are $I(1)$, then debt is unsustainable and cointegration does not have any affect. All the above mentioned possibilities by Quintos may be put in the following tabular form.


<table>
<thead>
<tr>
<th>Value of $b$</th>
<th>Cointegration in (6)</th>
<th>Order of integration of $E_t^r$ and $R_t$</th>
<th>Conclusion for Sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b = 1$</td>
<td>Holds</td>
<td>$I(1)$</td>
<td>Strong sustainability</td>
</tr>
<tr>
<td>$b = 1$</td>
<td>Does not hold</td>
<td>$I(1)$</td>
<td>Weak Sustainability</td>
</tr>
<tr>
<td>$0 &lt; b &lt; 1$</td>
<td>Has no role</td>
<td>$I(1)$</td>
<td>Weak Sustainability</td>
</tr>
<tr>
<td>$b = 0$</td>
<td>Has no role</td>
<td>$I(1)$</td>
<td>Unsustainable</td>
</tr>
</tbody>
</table>
4.3.2 Empirical Results:

To assess the debt sustainability in Indian case over the period 1989-90 -2009-10, we have adopted the previously presented model of Quintos (1995). The relation presented in equation (4.21) is used in real variables,

\[ RR_t = \mu + bRE_t' + \epsilon_t \]  

where RR and RE denote real revenues and real government expenditures inclusive of interest paid on debt, respectively. Annual data over the period 1989-90 to 2009-10 is used; data for central government revenues and expenditure are extracted from the *Hand Book of Statistics on Indian Economy*, Reserve Bank of India. Real variables are constructed by deflating nominal variables using Gross Domestic (GDP) deflator.

4.3.2.1 Stationarity Tests:

Figure 4.2 plots the real government revenues (RR) and real government expenditures (RE) series.

![Figure 4.2]
The above graph indicates more or less a consistent growth in both government revenues and expenditures till the year 1997 and thereafter exhibits widening gap as government expenditures have markedly increased on account of pay revision, subsidies and growth in non-plan expenditure. This situation was somewhat corrected by 2004-05, as the economy started to grow at 9 per cent with revenue buoyancy increasing and with falling real interest rates and most importantly fiscal restructuring and consolidation through the enactment of FRBM Act 2003 and the introduction of subsequent fiscal rules. However, with increasing demands on non-plan as well plan expenditures owing to infrastructure bottlenecks, expenditures have swayed widely after 2007 and again the gap between revenues and expenditures widened considerably as shown above.

As a test for stationarity of the data, conventional unit root tests such as ADF and Phillips Perron (PP) have been performed. But it is well known that the ADF test has low power with short time spans of data, and hence we use the other tests namely, KPSS test developed by Kwiatkowski et al. (1992) and DF-GLS test. Unlike the ADF test, the KPSS test has stationarity as the null and a unit root as the alternative hypothesis. The results of Augmented Dickey fuller (ADF), Phillips Perron (PP), Dickey-Fuller with GLS de-trending (DF-GLS), and KPSS tests for revenue and expenditure are reported in Table 4.2. The optimal lag length has been chosen using SBC information criterion.
Table 4.2

Unit Root Test Statistics at Level (with intercept and trend)

<table>
<thead>
<tr>
<th>Variables</th>
<th>RE</th>
<th>RR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>lags</td>
</tr>
<tr>
<td>ADF</td>
<td>-1.6818</td>
<td>4</td>
</tr>
<tr>
<td>DF-GLS</td>
<td>-1.8410</td>
<td>1</td>
</tr>
<tr>
<td>PP</td>
<td>0.0378</td>
<td>-</td>
</tr>
<tr>
<td>KPSS</td>
<td>0.1893**</td>
<td>-</td>
</tr>
</tbody>
</table>

Unit Root Test Statistics at 1st Difference (with intercept and trend)

<table>
<thead>
<tr>
<th>Tests</th>
<th>RE</th>
<th>RR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>lags</td>
</tr>
<tr>
<td>ADF</td>
<td>-3.3450***</td>
<td>3</td>
</tr>
<tr>
<td>DF-GLS</td>
<td>-3.1320***</td>
<td>0</td>
</tr>
<tr>
<td>PP</td>
<td>-3.0341</td>
<td>-</td>
</tr>
<tr>
<td>KPSS</td>
<td>0.0962</td>
<td>-</td>
</tr>
</tbody>
</table>

*, **, *** denotes rejection of null at 1%, 5%, and 10% levels of significance respectively.

Based on the above tests performed for the stationarity of the data we can infer that all the variables are integrated of order one [I(1)].
4.3.2.2 Tests for the Debt Sustainability

To test for deficit sustainability, the conventional practice has been to first test for cointegration between revenues and expenditures. However, as shown by Quintos (1995), the necessary condition to be tested is whether $0 < b < 1$ [See Equation (4.20)]. The test for cointegration is important only if $b = 1$. If $b = 1$ and revenues and expenditure are cointegrated, then the strong form of deficit sustainability is satisfied. Otherwise, the lack of cointegration with $b = 1$ indicates that the weaker condition holds.

Therefore following Quintos (1995), we have performed the fully modified regression (FMOLS) of Phillips and Hansen (1990) on [equation (4.21)]. We use a test on $b$ which follows Chi-Squared distribution. First we tested the null condition that $b = 0$ against the alternative that $b \neq 0$. If the null condition is rejected, we then again tested for the null condition that $b = 1$ against the alternative that $b \neq 1$. If the null condition is again rejected, then $0 < b < 1$, which implies that the deficit could be sustainable.

The results clearly reject the nulls of $b = 0$ and $b = 1$. Since the value of $b$ is positive and significant, we may conclude that $b$ lies between 0 and 1 ($0 < b < 1$). This implies that the deficit is sustainable in the full sample although not in the "strong" sense.

Further, for the parameter stability of equation (4.21) has been tested over the sample period, using the CUSUM and CUSUM squares recursive residual tests (due to Brown, Durbin, and Evans, 1975). The recursive residual plots are presented in figures 4.3 and 4.4.
Table 4.3

Results of FOMLS Estimation

Regression: Revenue on Expenditure

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coeff.</th>
<th>Std Error</th>
<th>T-Stat</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-32120.926</td>
<td>18360.223</td>
<td>-1.749</td>
<td>0.080</td>
</tr>
<tr>
<td>Expenditure</td>
<td>0.709</td>
<td>0.051</td>
<td>13.950</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Tests on the parameter \( b \) with \( \chi^2(1) \)

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Null</th>
<th>Alternate</th>
<th>Test statistics</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>( b=0 )</td>
<td>( b\neq0 )</td>
<td>194.604</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>( b=1 )</td>
<td>( b\neq1 )</td>
<td>32.8697</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.3

Plot of Cumulative Sum of Squares of Recursive Residuals

The straight lines represent critical bounds at 5% significance level
The plots of CUSUM statistics, presented in figure 4.4 lies within the 95 percent critical bounds, but the CUSUMSQ statistics lie outside the 95 percent critical bounds (See figure 4.3). Whereas the CUSUM statistics take account only the stability of the parameters, CUSUMSQ statistic also takes into account the variability of the variances.

**Inference from the Plots**

The plot of CUSUM statistics suggest that both government revenue and government expenditure appear to be moving steadily indicating broad stability. Further, the plot of CUSUMSQ explains variability of variances in both the parameters and the variances seem to be non-significant as indicated in Figure 4.4. Based on the plots and the results obtained it is clearly established that the parameters during the study period are stable.
4.4 Concluding Remarks

In the context of assessing debt sustainability, the behavior of some of the macroeconomic variables such as interest rate on the debt, growth rate of the economy, government expenditure, revenues and debt ratio are tested. There are several sustainability indicators closely reflecting their relationships to the intertemporal budget constraint whether they take account of the future evolution of the key variable of sustainability or not. In other approaches, a target value of debt is set. One of the most widely used indicators for assessing debt sustainability is the primary gap indicator, which measures the difference between the actual primary deficit and the primary balance required to stabilize the debt-to-GDP ratio.

Based on the data for the period 1991-2010, the sustainability of debt has been analyzed with respect to the sensitivity of government expenditures and revenues as well as other key fiscal parameters such as fiscal deficit and interest payments. The results suggested that the recent path of public debt followed in India appear to be weakly sustainable. For the debts to remain sustainable in future, substantial fiscal reforms are needed and policies should be oriented towards maintaining an increasing growth-interest rate differential.

An appropriate approach to analyze the growth effects of public debt in India would therefore seem to consist in studying the effect within the well-established framework of econometric growth model. Unit root test (test of stationary), co-integration analysis are used with a view to estimating the short run and the long-run dynamics of public domestic debt on government expenditure and revenues. Unsustainable debt would have
an impact on fiscal sustainability parameters such as primary deficit, fiscal deficit, interest payments and economic growth, in the sense that an unsustainable path would lead deterioration of these key macroeconomic parameters in the long-run.

Given the current trend of economic growth and fiscal deficit of around 6 per cent of GDP and debt to GDP ratio of 68 per cent, the co-integration results show moderate level of sustainability which can be further strengthened provided the future debt path gets regulated by the goals set by the FRBM Act 2003 and the rules set forth for the medium term fiscal stability.