



Special article

Is Disparity of State Domestic Product Stationary in Twenty Indian States?

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As an instrument of economic development, the government has to play inescapable role for providing social overhead capital both for directly promoting economic development and for building up the essential condition for the process of economic development. Also in most of the developing countries at least there is general consensus among economic thinkers and policymakers that economic growth and stability are joint objectives for developing nations to pursue. In various literatures this can be investigated through the stationary process (Nelson and Plosser (1982), Wasserfallen 1986, Ben-David & Papell 1995, Cheung & Chinn 1996, Rapach 2002)³.

Increasing disparity across states is undoubtedly a concern if it abrades political tensions, especially in a diverse federal system (Singh *et al* 2003). The growth rate of an economy accelerate, initially some regions with better resources would grow faster than others⁴. Regional disparity in India is now a matter of serious concern. It is well

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³ Note that a unit root in real output is inconsistent with the notion that business cycles are stationary fluctuations around a deterministic trend; instead, it suggests that shocks to real output have permanent effects on the system (Nelson and Plosser 1982).

⁴ But after sometime, when the law of diminishing marginal returns set in, first growth rates would converge, due to differential marginal productivity of capital (higher in poorer regions and lower in richer regions), and this in turn would bridge the gaps in the levels of income across regions (Barro 1991).

known that in a large economy, different regions with different resource bases and endowments would have a dissimilar growth path over time (Bhattacharya and Sakthivel, 2004).

This paper analyses the stationarity and disparity among twenty major states in India for the period 1980 to 2006⁵. In the recent period, a number of studies (Bhattacharya & Sakthivel 2004, Ahluwalia 2000 & 2002, Nagaraj, Varoudakis & Veganzous 1998 Rao, Shand & Kalirajan 1999 Shand & Bhide 2000) have observed that the regional disparity in India has widened, especially during the 1990s. However, these studies have used pre-revised state domestic product (SDP) data. Further⁶, their analyses do not cover the testing of unit root for the time series data.

The stationarity of the SDP for twenty states from the earlier series therefore cannot be compared with the same from the revised series. A proper comparison of stationarity and equity should be therefore done through a common database. This paper tries to estimate by extending the 1999-2000 SDP series and 1993-94 SDP series backwards to compare the stationarity by using ADF, DFGLS, Phillips Perron and KPSS tests for the State Domestic Product of twenty states for the period 1980-2006 and also measure regional variation across states on a common database⁷. We have also applied the ADF, DFGLS, PP and KPSS tests on various indicators of disparity among states to detect stationarity of these indicators from 1980-81 to 2006-07.

Per capita income is widely used as composite indicator for economic development. Thus in order to assess the economic development of region or state, total and per capita domestic product is extensively used by the scholar, researcher and policymakers. Although this indicator does not through light on distribution of income but these are used for comparing level of development of country/state/region at various point of time. Therefore, a study of per capita income and the income of the state would help in assessing the level of economic development in a state/ region. In

⁵ New series based on 1999-2000 (Handbook of Statistics on Indian Economy, 2009).

⁶ Ahluwalia's study covers the pre- and post-reform periods on the basis of two different sets of SDP data.

⁷ Bhattacharya and Sakthivel in their study covers data for the period up to 1999-2000, compared the pre- and post-reform periods by correcting the data series on the basis of 1993-94 SDP data.

the light of above the paper is organized as follows. The data and econometric methodology is given in Section II. Empirical results are discussed in Section III. Section IV concludes the paper.

II. Data and Econometric Methodology:

For a proper comparison of stationarity and disparity over time, the revised series of SDP should be extended backwards. When we began our analysis the revised series SDP data were available only from 1999 to 2006 on the basis of 1999-2000 base and 1993 to 1999 on the basis of 1993-94 Series. However, data for the SDP is not available for the period 1980 to 2006 on a common series⁸. We first computed the average ratio of 1993-94 series data to 1980-81 series data at current prices for the common period (1993-94 through 1998-99) for which data on both the series are available. In this manner, we extend the 1993-94 SDP current price series backwards up to 1980-81. Dividing the current price series by the computed price deflator (corrected for price changes) we get the computed constant price SDP series for state for the period 1980-81 through 1992-93 that are consistent with the 1993-94 series data. Again, similar exercise applies by using base year 1999-2000 SDP series.

Also, in the present study, stationarity and disparity has been calculated for per capita State Domestic Product (SDP). Moreover, Stationarity and disparity of state domestic product as well as per capita SDP have been examined for Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal (Handbook of Statistics on Indian Economy 2009).

II. Stationarity test:

II.1 Unit Root Test: Augmented Dickey Fuller (ADF test)

In order to detect unit root in a time series data the corresponding equation for Augmented Dickey Fuller test :

⁸ For this purpose, we first computed the price correction factor (defined as the ratio of implicit deflator for 1999-2000 series to the 1993-94 series for the year 1999-2000 similarly for 1993-94 series to 1980-81 series for the year 1994).

$$\Delta Y_t = \delta Y_{t-1} + \sum_{j=2}^q \delta_j \Delta Y_{t-j+1} + \epsilon_t \quad \dots \quad (2.1)$$

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \sum_{j=2}^q \delta_j \Delta Y_{t-j+1} + \epsilon_t \quad \dots \quad (2.2)$$

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{j=2}^q \delta_j \Delta Y_{t-j+1} + \epsilon_t \quad \dots \quad (2.3)$$

In fact, the critical values for DF test, τ statistics still holds for the ADF test and the testing of hypothesis is the existence of unit roots in the time series data Y_t according to the following hypothesis.

$$H_0 : \delta = 0, \text{ for non stationarity if } t_\delta > \tau \quad \dots \quad (2.4)$$

$$H_a : \delta < 0, \text{ for stationarity, if } t_\delta < \tau$$

Where, τ is the critical value as given by Fuller (1976).

In equations 2.1, 2.2, 2.3 the number of additional lagged difference terms will depend on the minimum value of AIC and SIC (Akaike, 1973 and Schwartz, 1989).

II.4 Unit Root Test: Dickey-Fuller Test with GLS Detrending (DFGLS Test)

The test performs a modified DF test for a unit root in which the series has been transformed by a generalized least square regression. This test was proposed by Elliott, Rothenberg and Stock (1996) this test has significantly greater power than the previous versions of the ADF test. Elliott, Rothenberg and Stock (1996) propose a simple modification of the ADF tests in which the data are de-trended so that explanatory variables are "taken out" of the data prior to running the test regression. Elliott et al (1996) define a quasi-difference of Y_t that depends on the value a representing the specific point alternative against which we wish to test the null hypothesis:

$$d(Y_t/a) = \begin{cases} Y_t & \text{if } t = 1 \\ Y_t - aY_{t-1} & \text{if } t > 1 \end{cases} \quad \dots \quad (2.5)$$

Consider an OLS regression of the quasi-differenced data $d(Y_t/a)$ on the quasi-differenced $d(X_t/a)$ as

$$d(Y_t/a) = d(X_t/a)\delta(a) + \eta_t \quad \dots \quad (2.6)$$

Where X_t contains either a constant, or a constant and trend, and let $\hat{\delta}(a)$ be the OLS estimates from this regression. ERS recommend the use of $a = \bar{a}$ where:

$$\bar{a} = \begin{cases} 1 - 7/T & \text{if } X_t = \{1\} \\ 1 - 13.5/T & \text{if } X_t = \{1, t\} \end{cases} \quad \dots \quad (2.7)$$

We now define the GLS detrended data, Y_t^d using the estimates associated with the $\bar{a}$:

$$Y_t^d = Y_t - X_t' \hat{\delta}(\bar{a})$$

Then the DFGLS test involves estimating the standard ADF test equations 2.1, 2.2 and 2.3, after substituting the GLS detrended Y_t^d for the original Y_t :

$$\Delta Y_t^d = \alpha Y_{t-1}^d + \sum_{j=2}^p \beta_j \Delta Y_{t-j+1}^d + \pi_t \quad \dots \quad (2.8)$$

As with the ADF test, we consider the t-ratio for $\hat{\alpha}$ from this test equation.

II.5 Unit Root Test: Phillips Perron Test

Another test for stationarity was suggested by Phillips and Perron (1988). ADF tests use a parametric autoregression to approximate the ARMA structure of the errors in

the test regression but Phillips-Perron (PP) test ignore any serial correlation in the test regression. The test regression equation

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \epsilon_t \quad \dots \quad (2.9)$$

The PP tests correct for any serial correlation and hetroskedasticity in the errors ϵ_t of the test statistics $t_{\delta=0}$ and $T_{\hat{\delta}}$. These modified statistics, denoted Z_t and Z_{δ} , are given by

$$Z_t = \left(\frac{\hat{\sigma}^2}{\hat{\lambda}^2} \right)^{\frac{1}{2}} * t_{\delta=0} - \frac{1}{2} \left(\frac{\hat{\lambda}^2 - \hat{\sigma}^2}{\hat{\lambda}^2} \right) * \left(\frac{T * SE(\hat{\delta})}{\hat{\sigma}^2} \right) \quad \dots \quad (2.10)$$

$$Z_{\delta} = T_{\hat{\delta}} - \frac{1}{2} \frac{T^2 * SE(\hat{\delta})}{\hat{\sigma}^2} (\hat{\lambda}^2 - \hat{\sigma}^2) \quad \dots \quad (2.11)$$

The terms $\hat{\sigma}^2$ and $\hat{\lambda}^2$ are consistent estimates of the variance parameters

$$\sigma^2 = \lim_{T \rightarrow \infty} T^{-1} \sum_{t=1}^T E(\epsilon_t^2) \quad \dots \quad (2.12)$$

$$\lambda^2 = \lim_{T \rightarrow \infty} \sum_{t=1}^T E(T^{-1} S_T^2) \quad \dots \quad (2.13)$$

Where, $S_T^2 = \sum_{t=1}^T \epsilon_t^2$. The sample variance of the least squares residual $\hat{\epsilon}_t$ is a consistent estimate of σ^2 , and the Newey-West long run variance estimate of ϵ_t using $\hat{\epsilon}_t$ is a consistent estimate of λ^2 .

Under the null hypothesis 2.9, the PP test, Z_t and Z_{δ} statistics have the same asymptotic distributions as the ADF test. PP tests are robust to general forms of

heteroskedasticity in the error term u_t and also not to specify a lag length for the test regression. In the present paper, equation 2.14 has been used for both PP and ADF stationarity test.

II.6 Unit Root Test: The Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) Test

The test described that the series Y_t is assumed to be stationary under the null hypothesis (i.e. null hypothesis, $H_0: Y_t \sim I(0)$ against the alternative hypothesis, $H_a: Y_t \sim I(1)$). Kwiatkowski, Phillips, Schmidt, and Shin (1992) have derived a test for the above hypotheses based on the residuals from the OLS regression of Y_t on the exogenous variables X_t .

$$Y_t = X_t + z_t \quad \dots \quad (2.14)$$

Where X_t is random walk, $X_t = X_{t-1} + V_t$, $V_t \sim iid(0, \sigma_v^2)$ and Z_t is a stationary process. In this framework the foregoing pair of hypothesis is equivalent to the pair $H_0: \sigma_v^2 = 0$ versus $H_1: \sigma_v^2 > 0$. If null hypothesis is accepted, Y_t is composed of constant and the stationary z_t ; hence Y_t is also stationary. The Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test is

$$KPSS = \frac{1}{T^2} \sum_{i=0}^T \frac{S_i^2}{\hat{\sigma}_\infty^2} \quad \dots \quad (2.15)$$

Where $S_t = \sum_{j=1}^t \hat{\omega}_j$ with $\hat{\omega}_t = Y_t - \bar{Y}$ and $\hat{\sigma}_\infty^2$ is an estimator of

$$\hat{\sigma}_\infty^2 = \lim_{T \rightarrow \infty} T^{-1} V \left(\sum_{t=1}^T Z_t \right) \quad \dots \quad (2.16)$$

i.e., $\hat{\sigma}_\infty^2$ is an estimator of long run variance of the process Z_t . If Y_t is Stationary process, S_t is $I(1)$ and the quantity in the numerator of the KPSS statistic is an estimator of its variance, which has a stochastic limit.

Kwiatkowski, Phillips, Schmidt, and Shin (1992) proposed a nonparametric estimator of σ_∞^2 based on Bartlett window having, once again, a lag truncation parameter $L_q = q(T/100)^{1/4}$.

$$\hat{\sigma}_{\infty}^2 = \frac{1}{T} \sum_{t=1}^T \hat{\omega}_t^2 + 2 \sum_{j=1}^{L_q} \omega_j \left(\frac{1}{T} \sum_{t=j+1}^T \hat{\omega}_t \hat{\omega}_{t-j} \right) \quad \dots \quad (2.17)$$

Where, $\omega_j = 1 - \frac{j}{L_q + 1}$. We can find the KPSS statistics has a limiting distribution

that does not depend on nuisance parameters under the null hypothesis. If a series is I(0), DF test should reject the null hypothesis, whereas the KPSS test should not reject its null hypothesis.

II.7 Measurement of Disparity:

Alter Kolm (1969), Atkinson (1975), Sen (1974) and others have given the foundations of the modern approach to inequality measurement. To measure disparity in the State Domestic Product and per capita SDP present study uses Range, Range Ratio, Coefficient of Variation, Gini Coefficient and Theils Statistics.

Range:

Range is the one of the easiest method for calculating disparity. Range is difference between maximum and minimum observations of a particular variable

$$\text{Range} = \text{Maximum value} - \text{Minimum value} \quad \dots \quad (2.18)$$

Range Ratio:

The range ratio computed by dividing a value at one predetermined percentile by the value at a lower predetermined percentile. For calculating range ratio we are using 90th and 10th percentiles

$$\text{Range ratio} = 90^{\text{th}} \text{ percentile} / 10^{\text{th}} \text{ percentile} \quad \dots \quad (2.19)$$

The value of range ratio lies between one and infinity. The smaller value shows lower inequality and higher value reflect the more inequality.

Coefficient of Variation:

$$\text{CV} = \text{Standard Deviation of SDP} / \text{Mean of SDP} \quad \dots \quad (2.20)$$

Main drawback of this measure is that, it can take any value between 0 and infinity, and there is no standard that defines a reasonable value of the measure for the particular phenomena.

Gini-coefficient:

Gini-coefficient is used to attach some absolute measures to the degree of inequality or to give some idea whether the inequality is large or small. The Gini-coefficient ranges from 0 to 1, where 0 represents perfect equality and 1 total inequality. Gini-coefficients have been worked out for individual years based on the SDP and per capita SDP. The Gini-coefficient can be as follows.

$$G = \frac{\sum_{i=1}^n (2i - n - 1) X_i'}{n^2 \mu} \quad \dots \quad (2.21)$$

Where, 'i' is the rank of a state SDP or per capita SDP when arranged in ascending order

G = Gini-coefficient

n = number of states;

X_i' = SDP or per capita SDP of State i.

μ = mean of the SDP or per capita SDP of all states for the year.

Theil's Statistics:

Theil's T statistics of income inequality is given by:

$$T = \sum_{i=1}^n \left\{ \left(\frac{1}{n} \right) * \left(\frac{SDP_i}{SDP_{average}} \right) * \ln \left(\frac{SDP_i}{SDP_{average}} \right) \right\} \quad \dots \quad (2.22)$$

Where n= number of the observation, SDP_i =SDP of ith State and $SDP_{average}$ = Average value of SDP. The high value of Theil's t statistics shows the more inequality.

III Empirical Results

III.1 Stationarity Test:

In our present study, we have data relating to state domestic product for the period 1980-81 to 2006-07. In order to perform Augmented Dickey Fuller test regression equation 3.1 and equation 3.2 are used

$$\Delta Y_t^i = \alpha + \beta t + \delta Y_{t-1}^i + \sum_{j=2}^q \delta_j \Delta Y_{t-j+1}^i + \epsilon_t \quad \dots \quad (3.1)$$

$$\Delta \log(Y_t^i) = \alpha + \beta t + \delta \log(Y_{t-1}^i) + \sum_{j=2}^q \delta_j \Delta \log(Y_{t-j+1}^i) + \epsilon_t \quad \dots \quad (3.2)$$

Where, i stand for ith states. Calculated τ values for Augmented Dickey Fuller test of state domestic product relating to equation 3.1 and 3.2 for level and various differences as well as first lag and second lag are presented in Table 1.

Table 1 reveals that for all the states, State Domestic Product and log of SDP has not been stationary at level for first lag & second lag for the period 1980-81 to 2006-07. However, in this connection SDP of five states like Assam, Jammu & Kashmir, Madhya Pradesh, Nagaland and Rajasthan is found stationary at first difference and first lag (at 5 percent level of significance).

So far as SDP of Andhra Pradesh, Bihar and Orissa is found stationary at second difference and first lag (at 1 percent level of significance) (Table 1). States like Haryana, Himanchal Pradesh, Manipur, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal are concerned; it is obvious from Table 1 that at second difference second lag, State Domestic Product is stationary as per ADF test. In case of Gujarat Karnataka and Punjab SDP is not stationary at second difference but it is found stationary in log of SDP.

In order to perform Augmented Dickey Fuller test for per capita SDP⁹ regression equation 3.3 and equation 3.4 are used

⁹ Per capita SDP has been calculated by dividing SDP of states by its population.

$$\Delta p Y_t^i = \alpha + \beta t + \delta p Y_{t-1}^i + \sum_{j=2}^q \delta_j \Delta p Y_{t-j+1}^i + \xi_t \quad \dots \quad (3.3)$$

$$\Delta \log(p Y_t^i) = \alpha + \beta t + \delta \log(p Y_{t-1}^i) + \sum_{j=2}^q \delta_j \Delta \log(p Y_{t-j+1}^i) + \psi_t \quad \dots \quad (3.4)$$

Table 2 presents ADF τ statistics for per capita state domestic product and also log of per capita SDP for the twenty states at levels, first difference, and second difference for first lag and second lag. At level per capita SDP as well as log of per capita SDP for all twenty states (as given in Table 2) under study for the period 1974-75 to 2006-07 are found non-stationary as per ADF test. Based on ADF test, Table 2 also shows that at first difference and first lag per capita SDP for the states like Bihar, Himachal Pradesh, Madhya Pradesh, Nagaland and Orissa, is found stationary at one percent significant level while per capita SDP of Haryana, Manipur and West Bengal is found stationary at five percent significant level. At second difference and second lag log of per capita state domestic product of Andhra Pradesh, Assam, Gujrat, Jammu & Kashmir, Karnataka, Kerala, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal are not having any unit root at one percent level of Significance. The log of per capita SDP of Punjab is found stationary at second difference and second lag at 5 percent significant level.

DFGLS test of stationarity for SDP of twenty states equation 3.5, equation 3.6, equation 3.7 and equation 3.8 are used

$$\Delta Y_t^{id} = \alpha Y_{t-1}^{id} + \sum_{j=2}^p \beta_j \Delta Y_{t-j+1}^{id} + D_t^i \quad \dots \quad (3.5)$$

$$\Delta \log Y_t^{id} = \alpha \log Y_{t-1}^{id} + \sum_{j=2}^p \beta_j \Delta \log Y_{t-j+1}^{id} + \pi_t^i \quad \dots \quad (3.6)$$

$$\Delta p Y_t^{id} = \alpha p Y_{t-1}^{id} + \sum_{j=2}^p \beta_j \Delta p Y_{t-j+1}^{id} + \Omega_t^i \quad \dots \quad (3.7)$$

$$\Delta \log p Y_t^{id} = \alpha \log p Y_{t-1}^{id} + \sum_{j=2}^p \beta_j \Delta \log p Y_{t-j+1}^{id} + h_t^i \quad \dots \quad (3.8)$$

DFGLS test of stationarity for SDP log of SDP, per capita SDP and log of per capita SDP for the twenty states have been presented in Table 3, Table 4, Table 5 and Table 6 respectively. As per DFGLS test of stationarity, results reveals that SDP of only four states, Jammu & Kashmir, Karnataka, Tripura and West Bengal are found stationary at level (Table 3). Table 4 reveals that log of SDP for the states like Haryana, Jammu & Kashmir, Kerla, Maharashtra and Orissa is found no unit root at level. Per capita SDP for the states like Bihar, Karnataka, Punjab, Tripura and West Bengal shows stationarity at level based on DFGLS test (Table 5). When we apply DFGLS test on the per capita SDP in log term states like Bihar, Gujrat, Haryana, Jammu & Kashmir, Kerala, Orissa and West Bengal reveal stationarity at level (Table 6).

For Phillips and Perron test, the test regression equations 3.9, 3.10, 3.11 and 3.12 are utilised

$$\Delta Y_t^i = \alpha + \delta Y_{t-1}^i + \zeta_t^i \quad \dots \quad (3.9)$$

$$\Delta \log Y_t^i = \alpha + \delta \log Y_{t-1}^i + \chi_t^i \quad \dots \quad (3.10)$$

$$\Delta p Y_t^i = \alpha + \delta p Y_{t-1}^i + \varpi_t^i \quad \dots \quad (3.11)$$

$$\Delta \log p Y_t^i = \alpha + \delta \log p Y_{t-1}^i + v_t^i \quad \dots \quad (3.12)$$

Table 7 reveals that on the basis of PP test SDP of twenty states in total, log of SDP, per capita SDP and log of per capita SDP have not been stationary at level for the period 1980-81 to 2006-2007. However, in this connection log of SDP and log of per capita SDP have been stationary for all the twenty states at first difference (Table 7).

Kwiatkowski, Phillips, Schmidt, and Shin (1992) used the following OLS regression equations 3.13, 3.14, 3.15 and 3.16.

$$Y_t^i = X_t^i + z_t^i \quad \dots \quad (3.13)$$

$$\log Y_t^i = X_t^i + z_t^i \quad \dots \quad (3.14)$$

$$pY_t^i = X_t^i + z_t^i \quad \dots \quad (3.15)$$

$$\log pY_t^i = X_t^i + z_t^i \quad \dots \quad (3.16)$$

Results of stationarity for the KPSS test have been presented in the Table 8. Table 8 reveals that SDP of all the states has been stationary at 3rd lag at level. SDP in log and log of per capita for Orissa is found stationary at zero lag and level (Table 8). KPSS

test for log of per capita SDP for the states like; Bihar, Himanchal Pradesh, Jammu & Kashmir and Madhya Pradesh reveals stationary at zero lag and level at one percent significant level for the period 1980-2006.

Disparity among states:

In the present study disparity among state domestic product as well as per capita state domestic product has been measured by using Range, Range ratio, Coefficient of Variation, Gini Coefficient and Theils Index and results are presented in Table 9 and Table 10. The purpose of these indices is to sketch the shape of inter state income inequality among the Indian states. Range for SDP and per capita SDP for the major twenty states reveals increasing trend from the period 1980 to 2006 (Table 9 and Table 10). Similar results have been found for the coefficient of variation. Range ratio in the year 1994 is the highest for SDP (Table 9) and in the year 2000 it is highest for the per capita SDP (Table 10). High values of Gini Coefficients and Theils index show that more disparity among states. Gini coefficient has decline from 1980-81 and reaches minimum during 1983-84 and after that it shown slight rising tendency for SDP among twenty states (Table 9). Similar trend has been found for Theils index for SDP among twenty states in India (Table 9).

In case of per capita SDP for the twenty states Gini coefficient varies from 0.446 to 0.458 and Theils index varies from 0.349 to 0.358 (Table 10). Gini coefficient and Theils index shows that, there is more inequality in term of per capita SDP in comparison with SDP for the twenty states during the study period (from Table 9 and Table 10)

Stationarity of the indicators of Disparity for SDP and per capita SDP for the period 1980-2006:

For ADF test, DFGLS test, PP test and KPSS test of stationarity on various indicators of disparity for SDP and per capita SDP (from the period 1980-81 to 2006-07) following equation have been utilized.

$$\Delta Range_t = \alpha + \delta Range_{t-1} + \sum_{j=2}^q \delta_j Range_{t-j+1} + \epsilon_t \quad \dots \quad (3.17)$$

$$\Delta CV_t = \alpha + \delta CV_{t-1} + \sum_{j=2}^q \delta_j CV_{t-j+1} + \epsilon^{cv}_t \quad \dots \quad (3.18)$$

$$\Delta RangeRatio_t = \alpha + \delta RangeRatio_{t-1} + \sum_{j=2}^q \delta_j RangeRatio_{t-j+1} + \epsilon^{rr}_t, \dots \quad (3.19)$$

$$\Delta Gini_t = \alpha + \delta Gini_{t-1} + \sum_{j=2}^q \delta_j Gini_{t-j+1} + \epsilon^g_t \quad \dots \quad (3.20)$$

$$\Delta Theil_t = \alpha + \delta Theil_{t-1} + \sum_{j=2}^q \delta_j Theil_{t-j+1} + \epsilon^t_t \quad \dots \quad (3.21)$$

$$\Delta Range_t = \alpha Range_{t-1} + \sum_{j=2}^p \beta_j \Delta Range_{t-j+1} + D^r_t \quad \dots \quad (3.21)$$

$$\Delta CV_t = \alpha CV_{t-1} + \sum_{j=2}^p \beta_j \Delta CV_{t-j+1} + D^{cv}_t \quad \dots \quad (3.21)$$

$$\Delta RangeRatio_t = \alpha RangeRatio_{t-1} + \sum_{j=2}^p \beta_j \Delta RangeRatio_{t-j+1} + D^{rr}_t, \dots \quad (3.21)$$

$$\Delta Gini_t = \alpha Gini_{t-1} + \sum_{j=2}^p \beta_j \Delta Gini_{t-j+1} + D^g_t \quad \dots \quad (3.21)$$

$$\Delta Theil_t = \alpha Theil_{t-1} + \sum_{j=2}^p \beta_j \Delta Theil_{t-j+1} + D^t_t \quad \dots \quad (3.21)$$

$$\Delta Range_t = \alpha_r + \delta_r Range_{t-1} + \zeta^r_t \quad \dots \quad (3.27)$$

$$\Delta CV_t = \alpha_c + \delta_c CV_{t-1} + \zeta^{cv}_t \quad \dots \quad (3.28)$$

$$\Delta RangeRatio_t = \alpha_{rr} + \delta_{rr} RangeRatio_{t-1} + \zeta^{rr}_t \quad \dots \quad (3.29)$$

$$\Delta Gini_t = \alpha_g + \delta_g Gini_{t-1} + \zeta^g_t \quad \dots \quad (3.30)$$

$$\Delta Theil_t = \alpha_{th} + \delta_{th} Theil_{t-1} + \zeta^t_t \quad \dots \quad (3.31)$$

$$Range_t = X^r_t + Z^r_t \quad \dots \quad (3.32)$$

$$CV_t = X^{cv}_t + Z^{cv}_t \quad \dots \quad (3.33)$$

$$RangeRatio_t = X^{rr}_t + Z^{rr}_t \quad \dots \quad (3.34)$$

$$Gini_t = X^g_t + Z^g_t \quad \dots \quad (3.35)$$

$$Theil_t = X^t_t + Z^t_t \quad \dots \quad (3.36)$$

Table 1: Stationarity test: Augmented Dickey Fuller Test for SDP and log of SDP (for the period 1980-2006)

State	ADF Test						ADF Test (in log form)				
	At level (1st lag)	At level (2nd lag)	At 1st difference (1st lag)	At 1st difference (2nd lag)	At 2nd difference (1st lag)	At 2nd difference (2nd lag)	At level (1st lag)	At level (2nd lag)	At 1st difference (1st Lag)	At 1st difference (2nd Lag)	At 2nd difference (1st lag)
Andhra Pradesh	2.263	1.973	-2.086	-0.868	-6.118*		-0.739	-1.173	-2.721	-2.078	-5.428*
Assam	1.144	1.984	-4.216**				-1.438	-1.863	-4.029**		
Bihar	1.013	0.898	-3.062	-2.726	-5.272*		-1.520	-1.212	-5.795*		
Gujarat	1.213	0.408	-1.608	-2.163	-3.593	-3.483	-1.541	-2.199	-2.839	-2.732	-4.947*
Haryana	3.811	2.177	1.765	3.486	-3.604**		-1.601	-1.264	-4.315**		
Himachal Pradesh	1.361	1.100	-2.510	-2.603	-4.402**		-1.246	-1.392	-2.601	-1.753	-6.302*
Jammu & Kashmir	-0.034	-0.029	-3.983**				-1.413	-1.637	-3.214	-2.252	-6.091*
Karnataka	0.987	0.780	-1.688	-3.051	-3.384	-3.112	-1.014	-1.236	-3.049	-2.182	-5.498*
Kerala	0.700	0.758	-3.319	-1.613	-6.482*		-1.108	-1.104	-2.764	-1.660	-5.883*
Madhya Pradesh	-1.134	-1.248	-3.794**				-0.076	-0.209	-3.663**		
Maharashtra	1.114	0.830	-2.022	-1.527	-4.959*		-0.884	-1.393	-2.460	-1.900	-4.941*
Manipur	0.746	0.566	-2.394	-2.339	-4.311**		-1.961	-2.070	-3.720**		
Nagaland	-1.321	-1.049	-3.626**				-0.291	0.356	-3.868**		
Orissa	1.815	1.625	-2.497	-1.884	-5.364*		-2.358	-1.814	-5.315*		
Punjab	0.459	0.447	-1.323	-2.820	-2.328	-1.690	-0.334	-1.785	-1.860	-2.306	-4.194**
Rajasthan	-0.796	-0.917	-3.814**				-0.491	-1.151	-2.853	-2.347	-5.339*
Tamil Nadu	-0.327	-0.085	-2.728	-3.038	-3.672**		-0.521	-1.102	-3.195	-2.084	-4.820*
Tripura	0.373	-0.757	-2.124	-2.194	-3.953**		-2.037	-2.853	-2.416	-2.285	-4.435*
Uttar Pradesh	0.654	0.475	-1.454	-1.126	-4.062**		-0.857	-1.331	-2.329	-1.764	-5.413*
West Bengal	0.838	0.561	-2.423	-3.033	-3.759**		-1.405	-1.267	-3.604**		

Note: (i) Data has been taken from Handbook of Statistics on Indian Economy, (ii) * Significant at 1 percent level, (iii) ** Significant at 5 percent level. (iv) Equations 3.1 and 3.2 have been used.

Table 2: Stationarity test: Augmented Dickey Fuller Test for per capita SDP and log of per capita SDP(for the period 1980-2006)

State	ADF Test for per capita SDP						ADF Test for per capita SDP(in log form)				
	At level (1st lag)	At level (2nd lag)	At 1 st difference (1st lag)	At 1 st difference (2nd lag)	At 2 nd difference (1st lag)	At 2 nd difference (2nd lag)	At level (1st lag)	At level (2nd lag)	At 1 st difference (1st lag)	At 1 st difference (2nd lag)	At 2 nd difference (1st lag)
Andhra Pradesh	1.276	1.115	-3.084	-1.846	-6.210 [*]		-1.093	-1.399	-2.857	-2.331	-5.150 [*]
Assam	-0.405	-0.104	-4.524 [*]				-0.980	-1.335	-3.315	-3.234	-4.883 ^{**}
Bihar	0.490	0.486	-3.838 ^{**}				-3.023	-2.674	-5.345 [*]		
Gujarat	0.242	-0.358	-1.947	-2.597	-3.596	-3.652 ^{**}	-1.525	-2.187	-2.808	-2.731	-4.870 [*]
Haryana	2.708	2.201	-0.372	0.866	-4.612 [*]		-1.706	-1.472	-4.009 ^{**}		
Himachal Pradesh	1.263	2.124	-4.988 [*]				-2.696	-2.257	-3.646 [*]		
Jammu & Kashmir	-1.261	-1.354	-3.615 [*]				-1.511	-1.613	-3.457	-2.654	-5.785 ^{**}
Karnataka	0.432	0.277	-2.016	-3.192	-3.543	-3.302	-1.199	-1.341	-3.127	-2.198	-5.563 [*]
Kerala	0.260	0.071	-3.352	-2.073	-5.916 [*]		-1.118	-1.368	-2.629	-1.703	-5.663 [*]
Madhya Pradesh	-0.761	-0.760	-5.091 [*]				-1.684	-1.337	-4.761 [*]		
Maharashtra	-0.359	-0.288	-3.102	-2.026	-5.464 [*]		-1.096	-1.194	-2.879	-2.080	-5.266 [*]
Manipur	1.068	0.642	-2.367	-1.501	-5.122 [*]		-1.952	-2.202	-3.675 ^{**}		
Nagaland	-1.980	-2.132	-4.880 [*]				-0.292	0.008	-4.173 [*]		
Orissa	1.131	1.123	-2.949	-2.288	-5.466 [*]		-2.591	-1.970	-5.294 [*]		
Punjab	-0.609	-0.616	-1.939	-2.938	-2.882	-2.321	-0.654	-1.707	-2.059	-2.617	-3.852 ^{**}
Rajasthan	-1.909	-2.055	-3.275	-2.245	-5.880 [*]		-0.589	-1.218	-2.843	-2.324	-5.283 [*]
Tamil Nadu	-0.827	-0.593	-2.782	-2.848	-3.876 ^{**}		-0.652	-1.129	-3.055	-2.071	-4.898 [*]
Tripura	0.155	-0.430	-2.846	-2.377	-5.284 [*]		-1.742	-2.320	-2.627	-2.537	-4.596 [*]
Uttar Pradesh	-0.086	-0.233	-1.659	-1.401	-3.963 ^{**}		-0.865	-1.323	-2.368	-1.823	-5.280 [*]
West Bengal	0.085	-0.069	-2.760	-3.144	-3.951 ^{**}		-1.828	-1.627	-3.647 ^{**}		

Note: (i) Data has been taken from Handbook of Statistics on Indian Economy, (ii) * Significant at 1 percent level, (iii) ** Significant at 5 percent level. (iv) Equations 3.3 and 3.4 have been used.

Table 3: DFGLS Test for the State Domestic Product (for the period 1980-2006)

State	Level & Differences	1 st Lag	2 nd Lag	3 rd Lag	4 th Lag	5 th Lag	6 th Lag	7 th Lag	8 th Lag
Andhra Pradesh	At level	0.116	-0.417	-1.015	-0.654	-1.133	0.075	1.122	1.163
	At 1st difference	-1.986	-1.193	-1.671	-1.026	-1.108	-1.478	-0.777	-1.023

	At 2nd difference	-4.818 [*]							
Assam	At level	-0.352	-0.525	-0.807	-1.178	-1.554	0.249	0.588	0.635
	At 1st difference	-3.715 [*]							
Bihar	At level	0.195	-0.149	-0.299	-0.826	0.001	-0.597	-1.205	-1.912
	At 1st difference	-3.715 [*]							
Gujarat	At level	-0.492	-1.252	-0.916	-1.074	-0.991	-0.807	-1.422	-1.703
	At 1st difference	-1.428	-1.947	-1.587	-1.843	-2.404	-1.176	-0.956	-0.440
	At 2nd difference	-2.785 ^{***}							
Haryana	At level	-0.144	-0.850	-1.229	-0.207	-0.232	0.157	0.725	1.403
	At 1st difference	-0.353	-0.375	-1.021	-0.995	-1.181	-1.602	-2.018	-1.942
	At 2nd difference	-2.491	-1.044	-1.150	-1.047	-0.837	-0.753	-0.865	-2.754
Himachal Pradesh	At level	-0.617	-1.076	-1.101	-1.447	-0.861	-2.161	-1.894	-1.567
	At 1st difference	-2.105	-2.135	-1.649	-2.199	-1.133	-1.005	-0.865	-0.833
	At 2nd difference	-3.665 ^{**}							
Jammu & Kashmir	At level	-0.608	-0.895	-0.654	-0.718	-0.840	-1.133	-2.751	-8.093 [*]
Karnataka	At level	-0.659	-0.563	-1.352	-0.885	-0.659	-0.989	-3.793 [*]	
Kerala	At level	-0.263	-0.442	-0.753	-0.606	-0.993	-1.043	-1.789	-1.781
	At 1st difference	-2.973 ^{***}							
Madhya Pradesh	At level	-0.469	-0.887	-1.045	-1.062	-0.686	-0.894	-1.460	-1.375
	At 1st difference	-3.224 ^{***}							
Maharashtra	At level	-0.607	-1.050	-0.929	-0.576	-1.047	-1.756	-2.021	-2.694
	At 1st difference	-1.836	-1.523	-1.476	-2.512	-1.947	-1.647	-1.596	-0.496
	At 2nd difference	-4.104 [*]							
Manipur	At level	-0.945	-0.785	-1.130	-1.206	-1.407	-1.499	-2.214	-1.385
	At 1st difference	-2.102	-2.162	-3.332	-1.430	-0.452	-0.164	0.268	0.038
	At 2nd difference	-3.700 ^{**}							
Nagaland	At level	-0.945	-0.785	-1.130	-1.206	-1.407	-1.499	-2.214	-1.385
	At 1st difference	-3.146 ^{***}							
Orissa	At level	-0.010	-0.576	-0.823	-1.036	-0.934	-1.142	-0.446	-0.073
	At 1st difference	-2.227	-1.754	-1.323	-1.511	-1.167	-1.864	-2.245	-0.824
	At 2nd difference	-4.244 [*]							
Punjab	At level	-0.330	-0.493	-0.168	-0.108	-1.490	-2.554	-2.903	-3.365
	At 1st difference	-1.558	-2.644 ^{***}						
Rajasthan	At level	-0.338	-0.492	-1.093	-0.607	-1.147	-1.837	-2.019	-2.923
	At 1st difference	-3.180	-1.835	-2.666	-1.005	-0.273	-0.295	0.210	0.063
	At 2nd difference	-5.094 [*]							
Tamil Nadu	At level	-0.838	-0.738	-0.626	-0.596	-0.757	-2.612	-2.198	-2.051
	At 1st difference	-2.433	-2.704	-2.756	-2.391	-0.841	-1.146	-2.707	-1.739
	At 2nd difference	-3.146 ^{***}							

Tripura	At level	-0.577	-1.891	-1.783	-2.129	-2.013	-1.797	-1.948	-3.906*
Uttar Pradesh	At level	-0.250	-0.466	-0.609	-0.342	-0.221	-0.422	-1.417	-1.824
	At 1st difference	-1.619	-1.440	-2.041	-2.728***				
West Bengal	At level	-0.639	-0.989	-0.794	-1.058	-0.678	-1.330	-1.659	-3.808*

Note: (i) Data has been taken from Handbook of Statistics on Indian Economy, (ii) * Significant at 1 percent level, (iii) ** Significant at 5 percent level, (iv) *** Significant at 10 percent level. (v) Equation 3.5 has been used.

Table 4: DFGLS Test for the State Domestic Product in log term (for the period 1980-2006)

State	Level & Differences	1 st Lag	2 nd Lag	3 rd Lag	4 th Lag	5 th Lag	6 th Lag	7 th Lag	8 th Lag
Andhra Pradesh	At level	-0.545	-0.878	-1.533	-1.402	-2.265	-2.431	-2.456	-2.356
	At 1st difference	-2.907	-2.039	-2.039	-1.256	-1.219	-1.177	-1.413	-2.780
	At 2nd difference	-5.555*							
Assam	At level	-0.525	-0.152	-0.188	-0.376	-0.974	-1.203	-1.464	-1.852
	At 1st difference	-4.928*							
Bihar	At level	-0.871	-0.649	-0.910	-1.510	-1.001	-1.001	-0.856	-1.002
	At 1st difference	-4.928*							
Gujarat	At level	-1.245	-1.927	-1.468	-2.434	-1.944	-2.217	-1.847	-1.024
	At 1st difference	-2.305	-2.663**						
Haryana	At level	-1.171	-1.279	-2.227	-1.141	-1.639	-3.052***		
Himachal Pradesh	At level	-0.732	-0.941	-1.498	-1.933	-1.384	-1.594	-1.893	-1.765
	At 1st difference	-2.364	-1.603	-1.148	-1.855	-1.265	-1.173	-1.181	-0.944
	At 2nd difference	-4.885*							
Jammu & Kashmir	At level	-1.177	-1.399	-1.738	-1.679	-3.924*			
Karnataka	At level	-1.030	-1.430	-1.730	-1.865	-2.015	-1.289	-1.884	-3.076
	At 1st difference	-2.002	-1.920	-1.672	-1.784	-1.308	-1.487	-1.852	-1.733
	At 2nd difference	-4.371*							
Kerala	At level	-1.563	-1.662	-2.284	-3.030***				
Madhya Pradesh	At level	-0.357	-0.625	-1.297	-1.149	-1.442	-2.059	-2.086	-1.856
	At 1st difference	-2.865***							
Maharashtra	At level	-1.042	-1.349	-1.826	-2.564***				
Manipur	At level	-1.744	-1.702	-1.633	-1.158	-1.189	-1.397	-1.103	-1.263
	At 1st difference	-2.837***							
Nagaland	At level	-0.706	-0.576	-0.912	-0.736	-0.759	-0.891	-1.433	-1.344
	At 1st difference	-3.238***							
Orissa	At level	-2.017	-1.629	-1.751	-2.360	-1.570	-2.876***		
Punjab	At level	-0.824	-2.400	-1.825	-1.647	-2.588	-1.341	-1.953	-2.280
	At 1st difference	-1.692	-1.992	-2.078	-1.339	-2.057	-1.343	-1.357	-2.840
	At 2nd difference	-2.930***							
Rajasthan	At level	-0.425	-1.179	-1.468	-1.161	-1.259	-1.378	-2.053	-2.611
	At 1st difference	-2.343	-1.894	-2.235	-1.972	-1.551	-0.855	-0.742	-0.705
	At 2nd difference	-4.390*							

Tamil Nadu	At level	-1.325	-1.555	-1.576	-2.029	-2.069	-2.517	-1.987	-1.176
	At 1st difference	-2.002	-1.920	-1.672	-1.784	-1.308	-1.487	-1.852	-1.733
	At 2nd difference	-2.964***							
Tripura	At level	-1.517	-2.426	-2.539	-2.602	-2.457	-1.842	-1.557	-2.472
	At 1st difference	-1.804	-1.879	-1.853	-1.793	-2.073	-1.703	-0.908	-1.055
	At 2nd difference	-4.169*							
Uttar Pradesh	At level	-0.931	-1.622	-1.961	-1.361	-1.447	-1.981	-1.834	-2.002
	At 1st difference	-1.894	-1.610	-2.116	-1.835	-1.304	-1.364	-1.224	-1.322
	At 2nd difference	-3.343***							
West Bengal	At level	-1.352	-1.665	-1.633	-2.916	-1.455	-1.693	-1.951	-2.552
	At 1st difference	-2.388	-2.192	-1.380	-2.682***				

Note: (i) Data has been taken from Handbook of Statistics on Indian Economy, (ii) * Significant at 1 percent level, (iii) ** Significant at 5 percent level, (iv) *** Significant at 10 percent level. (v) Equation 3.6 has been used.

Table 5: DFGLS Test for the per capita State Domestic Product (for the period 1980-2006)

State	Level & Differences	1 st Lag	2 nd Lag	3 rd Lag	4 th Lag	5 th Lag	6 th Lag	7 th Lag	8 th Lag
Andhra Pradesh	At level	0.191	-0.253	-0.804	-0.515	-1.216	-0.558	0.543	0.495
	At 1st difference	-2.566***							
Assam	At level	-0.447	-0.500	-0.595	-0.837	-0.986	-0.885	-0.988	-1.493
	At 1st difference	-4.283*							
Bihar	At level	-0.001	-0.262	-0.324	-0.727	-1.708	-3.552**		
Gujarat	At level	-0.553	-1.245	-0.840	-1.012	-0.838	-0.650	-1.183	-1.251
	At 1st difference	-1.693	-2.319	-1.737	-2.174	-2.867***			
Haryana	At level	0.153	-0.327	-0.739	-0.702	-0.426	-0.256	0.672	1.090
	At 1st difference	-1.062	-0.832	-1.054	-1.461	-1.303	-1.869	-1.997	-1.852
	At 2nd difference	-3.298**							
Himachal Pradesh	At level	-0.202	-0.518	-1.588	-1.968	-2.084	-1.687	-1.880	-1.292
	At 1st difference	-4.134*							
Jammu & Kashmir	At level	-0.550	-0.745	-0.987	-1.344	-2.507	-2.322	-2.666	-1.804
	At 1st difference	-3.236***							
Karnataka	At level	-0.549	-0.828	-0.588	-0.640	-0.706	-0.870	-2.561	-7.110*
Kerala	At level	-0.557	-0.619	-1.179	-1.074	-0.633	-0.516	-2.679	-2.989
	At 1st difference	-3.045***							

Madhya Pradesh	At level	-0.200	-0.384	-1.036	-1.091	-1.511	-2.024	-1.483	-1.813
	At 1st difference	-4.413*							
Maharashtra	At level	-0.694	-0.680	-0.928	-0.792	-0.595	-0.899	-1.396	-1.077
	At 1st difference	-2.731***							
Manipur	At level	-0.520	-1.217	-1.308	-0.744	-0.802	-1.421	-1.206	-1.458
	At 1st difference	-2.044	-1.595	-2.488***					
Nagaland	At level	-0.814	-0.699	-1.003	-1.058	-0.950	-0.885	-1.546	-0.062
	At 1st difference	-4.319*							
Orissa	At level	-0.098	-0.536	-0.741	-0.902	-0.806	-1.047	-0.517	-0.321
	At 1st difference	-2.566	-2.037	-1.517	-1.709	-1.230	-1.934	-2.395	-0.816
	At 2nd difference	-4.345*							
Punjab	At level	-0.571	-0.617	-0.335	-0.238	-0.765	-3.303**		
Rajasthan	At level	-1.264	-1.326	-1.641	-1.063	-1.262	-1.328	-1.398	-1.848
	At 1st difference	-2.782***							
Tamil Nadu	At level	-0.865	-0.802	-0.682	-0.586	-0.734	-2.301	-2.012	-1.746
	At 1st difference	-2.464	-2.570***						
Tripura	At level	-0.241	-1.014	-1.362	-1.738	-2.026	-3.017***		
Uttar Pradesh	At level	-0.291	-0.441	-0.526	-0.340	-0.250	-0.240	-0.853	-1.179
	At 1st difference	-1.683	-1.547	-1.899	-2.198	-2.392	-1.578	-1.468	-1.613
	At 2nd difference	-3.316***							
West Bengal	At level	-0.639	-0.868	-0.729	-0.896	-0.702	-1.191	-1.610	-4.009*

Note: (i) Data has been taken from Handbook of Statistics on Indian Economy, (ii) * Significant at 1 percent level, (iii) ** Significant at 5 percent level, (iv) *** Significant at 10 percent level. (v) Equation 3.7 has been used.

Table 6: DFGLS Test for the per capita State Domestic Product in log term (for the period 1980-2006)

State	Level & Differences	1 st Lag	2 nd Lag	3 rd Lag	4 th Lag	5 th Lag	6 th Lag	7 th Lag	8 th Lag
Andhra Pradesh	At level	-0.688	-0.926	-1.315	-1.013	-1.982	-2.487	-2.478	-2.392
	At 1st difference	-3.179**							
Assam	At level	-0.742	-0.757	-0.615	-0.838	-0.948	-0.919	-1.061	-1.628
	At 1st difference	-3.803*	-4.194	-3.389	-3.518	-3.981	-3.412	-3.111	-3.035
Bihar	At level	-2.801***							

Gujara	At level	-1.242	-1.939	-1.424	-2.530***				
Haryana	At level	-1.290	-1.411	-2.223	-1.448	-1.713	-2.867***		
Himachal Pradesh	At level	-1.958	-1.647	-1.777	-1.872	-1.410	-1.239	-1.833	-1.352
	At 1st difference	-4.458*							
Jammu & Kashmir	At level	-1.288	-1.443	-1.532	-1.570	-4.058*			
Karnataka	At level	-1.192	-1.518	-1.762	-2.016	-2.163	-1.376	-1.979	-3.006
	At 1st difference	-1.961	-1.867	-1.653	-1.721	-1.299	-1.523	-1.941	-2.059
	At 2nd difference	-4.399*							
Kerala	At level	-1.616	-1.844	-2.293	-3.265**				
Madhya Pradesh	At level	-1.684	-1.425	-1.641	-1.437	-1.163	-1.354	-1.209	-1.378
	At 1st difference	-4.440*							
Maharashtra	At level	-1.174	-1.169	-1.718	-1.983	-2.048	-2.327	-2.379	-1.279
	At 1st difference	-3.022***							
Manipur	At level	-1.730	-1.803	-1.818	-1.484	-1.299	-1.639	-1.425	-1.372
	At 1st difference	-2.693***							
Nagaland	At level	-0.322	-0.481	-0.939	-0.909	-1.004	-1.083	-2.706	-1.384
	At 1st difference	-3.765**							
Orissa	At level	-2.230	-1.804	-1.927	-2.425	-1.613	-3.037***		
Punjab	At level	-1.003	-2.074	-1.413	-1.593	-2.575	-1.690	-1.868	-1.857
	At 1st difference	-1.972	-2.422	-2.029	-1.306	-1.701	-1.403	-1.532	-1.998
	At 2nd difference	-2.857***							
Rajasthan	At level	-0.524	-1.226	-1.469	-1.454	-1.451	-1.345	-1.864	-2.256
	At 1st difference	-2.266	-1.889	-1.942	-1.902	-1.764	-1.044	-0.918	-0.780
	At 2nd difference	-4.224*							
Tamil Nadu	At level	-1.335	-1.625	-1.679	-2.102	-2.172	-2.665	-2.168	-1.230
	At 1st difference	-1.961	-1.867	-1.653	-1.721	-1.299	-1.523	-1.941	-2.059
	At 2nd difference	-3.028***							
Tripura	At level	-1.313	-1.956	-1.855	-1.787	-1.766	-2.046	-1.696	-1.835
	At 1st difference	-2.148	-2.123	-1.987	-1.809	-1.382	-1.630	-1.256	-1.240
	At 2nd difference	-4.205*							
Uttar Pradesh	At level	-0.921	-1.661	-1.796	-1.410	-1.684	-2.094	-1.618	-1.827
	At 1st difference	-1.893	-1.737	-2.020	-1.626	-1.341	-1.601	-1.344	-1.404
	At 2nd difference	-2.918***							
West Bengal	At level	-1.670	-1.904	-1.937	-2.750***				

Note: (i) Data has been taken from Handbook of Statistics on Indian Economy, (ii) * Significant at 1 percent level, (iii) ** Significant at 5 percent level, (iv) *** Significant at 10 percent level. (v) Equation 3.8 has been used.

Table7: Phillips Perron Test for the State Domestic Product (for the period 1980-2006)

State	PP Test			PP Test (in log form)		PP Test in per capita			PP Test per capita SDP (in log form)	
	At level	At 1 st difference	At 2 nd difference	At level	At 1 st difference	At level	At 1 st difference	At 2 nd difference	At level	At 1 st difference
Andhra Pradesh	2.793	0.093	-36.556*	-0.329	-28.369*	2.454	-3.726	-36.699*	-0.276	-29.163
Assam	2.157	-3.682	-26.285*	-0.809	-19.333*	1.582	-10.800	-28.250*	-0.850	-22.439
Bihar	2.472	-35.995*		-0.525	-39.994*	2.432	-27.661*		-0.240	-36.669
Gujarat	3.173	-7.668	-40.582*	-0.292	-36.062*	2.537	-13.046**		-0.349	-35.798
Haryana	3.809	7.669	-33.932*	-0.048	-30.175*	3.148	5.768	-32.318*	-0.026	-28.964
Himachal Pradesh	2.619	0.621	-31.640*	-0.128	-31.721*	2.522	-2.725	-26.758*	0.001	-32.352
Jammu & Kashmir	2.112	-5.928	-29.635*	-0.225	-31.081*	1.276	-17.207*		-0.391	-30.380
Karnataka	2.885	-1.943	-33.658*	-0.286	-24.438*	2.482	-4.762	-34.261*	-0.240	-24.989
Kerala	2.485	-0.091	-20.069*	-0.207	-16.761**	2.227	-1.062	-23.894*	-0.145	-18.940
Madhya Pradesh	1.666	-29.721*		-0.542	-33.924*	1.728	-40.181*		-0.243	-37.813
Maharashtra	2.732	-3.047	-33.828*	-0.267	-19.537*	2.129	-6.895	-26.375*	-0.295	-18.864
Manipur	3.196	-8.377	-32.343*	-0.282	-25.741*	2.941	-12.807**		-0.210	-28.970
Nagaland	1.760	-7.646	-23.105*	-0.768	-14.911**	1.022	-33.056*		-0.969	-25.705
Orissa	3.321	-9.429	-33.792*	-0.039	-33.843*	2.928	-14.756**		0.017	-33.443
Punjab	2.255	-0.299	-33.686*	-0.493	-18.766*	1.740	-5.127	-32.582*	-0.535	-17.442
Rajasthan	1.952	-34.833*		-0.645	-36.081*	1.108	-33.850*		-0.761	-34.525
Tamil Nadu	2.240	-3.104	-25.175*	-0.455	-20.105*	1.929	-4.903	-26.482*	-0.444	-20.690

Tripura	2.425	-3.145	-40.396 [*]	-0.163	-24.302 [*]	2.285	-18.264 [*]		0.077	-30.105 [*]
Uttar Pradesh	2.252	-1.290	-32.168 [*]	-0.406	-20.242 [*]	1.683	-5.282	-33.748 [*]	-0.427	-20.830 [*]
West Bengal	2.494	-3.214	-35.419 [*]	-0.223	-24.152 [*]	2.111	-5.746	-33.564 [*]	-0.184	-23.478 [*]

Note: (i) Data has been taken from Handbook of Statistics on Indian Economy, (ii) * Significant at 1 percent level, (iii) ** Significant at 5 percent level. (iv) Equations 3.9, 3.10, 3.11 and 3.12 have been used.

Table 8: KPSS Test for the State Domestic Product (for the period 1980-2006)

State	State Domestic Product				State Domestic Product (In log)				Per Capita State Domestic Product				Per Capita State Domestic Product (In log)			
	0 lag	1 lag	2 lag	3 lag	0 lag	1 lag	2 lag	3 lag	0 lag	1 lag	2 lag	3 lag	0 lag	1 lag	2 lag	3 lag
Andhra Pradesh	0.620	0.350	0.256	0.210 ⁺	0.460	0.254	0.183 ⁺		0.622	0.352	0.257	0.211 ⁺	0.403	0.227	0.167 ⁺	
Assam	0.624	0.347	0.254	0.208 ⁺	0.509	0.311	0.238	0.202 ⁺	0.613	0.342	0.251	0.206 ⁺	0.498	0.296	0.223	0.188 ⁺
Bihar	0.584	0.352	0.260	0.213 ⁺	0.451	0.300	0.225	0.189 ⁺	0.609	0.351	0.255	0.207 ⁺	0.089 ⁺			
Gujarat	0.540	0.308	0.231	0.195 ⁺	0.263	0.163 ⁺			0.501	0.289	0.219	0.187 ⁺	0.274	0.168 ⁺		
Haryana	0.586	0.337	0.249	0.206 ⁺	0.347	0.208 ⁺			0.575	0.335	0.250	0.208 ⁺	0.330	0.195 ⁺		
Himachal Pradesh	0.653	0.359	0.259	0.210 ⁺	0.295	0.172 ⁺			0.642	0.353	0.255	0.207 ⁺	0.186 ⁺			
Jammu & Kashmir	0.665	0.361	0.259	0.208 ⁺	0.237	0.144 ⁺			0.661	0.356	0.253	0.203 ⁺	0.196 ⁺			
Karnataka	0.590	0.335	0.250	0.208 ⁺	0.456	0.250	0.181 ⁺		0.576	0.329	0.246	0.206 ⁺	0.417	0.230	0.167 ⁺	
Kerala	0.626	0.349	0.255	0.208 ⁺	0.387	0.210 ⁺			0.631	0.350	0.255	0.208 ⁺	0.346	0.189 ⁺		
Madhya Pradesh	0.586	0.338	0.248	0.203 ⁺	0.536	0.302	0.218	0.177 ⁺	0.603	0.349	0.251	0.203 ⁺	0.182 ⁺			
Maharashtra	0.577	0.328	0.244	0.204 ⁺	0.495	0.264	0.187 ⁺		0.534	0.307	0.232	0.197 ⁺	0.484	0.260	0.185 ⁺	
Manipur	0.517	0.301	0.230	0.198 ⁺	0.369	0.221	0.170 ⁺		0.460	0.273	0.211 ⁺		0.329	0.205	0.159 ⁺	
Nagaland	0.642	0.347	0.249	0.202 ⁺	0.526	0.304	0.230	0.193 ⁺	0.536	0.314	0.232	0.191 ⁺	0.579	0.330	0.242	0.198 ⁺
Orissa	0.545	0.317	0.237	0.200 ⁺	0.166 ⁺				0.530	0.311	0.235	0.199 ⁺	0.121 ⁺			
Punjab	0.606	0.345	0.255	0.211 ⁺	0.578	0.308	0.218	0.176 ⁺	0.558	0.322	0.242	0.202 ⁺	0.576	0.306	0.217	0.175 ⁺
Rajasthan	0.548	0.326	0.240	0.199 ⁺	0.479	0.274	0.200 ⁺		0.390	0.240	0.181 ⁺		0.474	0.269	0.195 ⁺	
Tamil Nadu	0.594	0.334	0.248	0.206 ⁺	0.529	0.284	0.202 ⁺		0.578	0.326	0.242	0.202 ⁺	0.507	0.272	0.194 ⁺	
Tripura	0.663	0.358	0.256	0.206 ⁺	0.217	0.127 ⁺			0.636	0.345	0.246	0.199 ⁺	0.413	0.234	0.172 ⁺	
Uttar Pradesh	0.570	0.329	0.247	0.205 ⁺	0.577	0.307	0.218	0.176 ⁺	0.530	0.310	0.235	0.197 ⁺	0.589	0.313	0.222	0.179 ⁺
West Bengal	0.640	0.354	0.257	0.210 ⁺	0.263	0.154 ⁺			0.639	0.353	0.257	0.209 ⁺	0.206	0.122 ⁺		

Note: (i) Data has been taken from Handbook of Statistics on Indian Economy, (ii) * Significant at 1 percent level. (iii) Equations 3.13, 3.14, 3.15 and 3.16 have been used.

Table 9: Disparity in the State Domestic Product among twenty states of India from 1980 to 2006

Year	Range	Coefficient of Variation	Range Ratio	Gini Coefficient	Theil Index
1980	15594.190	0.805	43.946	0.427	0.321
1981	17458.720	0.781	40.056	0.420	0.310
1982	19173.370	0.783	41.346	0.417	0.309
1983	21702.910	0.767	41.966	0.413	0.304
1984	23466.740	0.771	42.197	0.416	0.306
1985	27145.150	0.779	43.048	0.416	0.307
1986	29645.110	0.775	41.812	0.415	0.306
1987	34579.100	0.792	40.766	0.424	0.316
1988	41434.140	0.780	38.496	0.420	0.310
1989	51394.350	0.805	40.682	0.428	0.322
1990	59558.570	0.808	42.690	0.431	0.326
1991	67370.390	0.800	42.760	0.427	0.321
1992	84091.360	0.822	43.000	0.435	0.333
1993	102105.100	0.834	42.368	0.440	0.338
1994	116996.300	0.825	45.354	0.439	0.337
1995	141398.700	0.847	43.319	0.446	0.347
1996	159360.200	0.844	43.750	0.446	0.347
1997	173166.000	0.835	40.983	0.444	0.342
1998	187090.400	0.813	41.089	0.439	0.333
1999	217748.000	0.826	37.737	0.440	0.335
2000	218295.000	0.810	34.904	0.434	0.326
2001	236418.000	0.810	31.959	0.434	0.325
2002	262148.000	0.819	31.679	0.435	0.327
2003	297012.000	0.817	31.924	0.436	0.328
2004	333713.000	0.823	31.950	0.436	0.329
2005	381121.000	0.837	33.395	0.441	0.338

2006	421771.000	0.829	34.541	0.438	0.335
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Note: (i) Data has been taken from Handbook of Statistics on Indian Economy. Disparity has been calculated on the basis of equations 2.31 to 2.35

Table 10: Disparity in the per capita State Domestic Product among twenty states of India from 1980 to 2006

Year	Range	Coefficient of Variation	Range Ratio	Gini Coefficient	Theil Index
1980	22.403	0.288	1.982	0.448	0.353
1981	26.186	0.290	2.092	0.448	0.353
1982	28.105	0.290	2.056	0.448	0.353
1983	30.203	0.270	1.994	0.448	0.352
1984	33.305	0.278	2.066	0.448	0.352
1985	37.538	0.285	2.065	0.447	0.352
1986	40.030	0.282	2.070	0.447	0.351
1987	47.932	0.283	1.948	0.448	0.352
1988	53.984	0.286	2.064	0.448	0.352
1989	67.234	0.308	2.160	0.448	0.352
1990	72.892	0.311	2.248	0.448	0.352
1991	86.623	0.317	2.253	0.453	0.358
1992	100.328	0.338	2.333	0.454	0.358
1993	117.589	0.349	2.376	0.454	0.358
1994	130.727	0.357	2.441	0.454	0.358
1995	150.710	0.360	2.535	0.454	0.358
1996	158.066	0.365	2.612	0.453	0.357
1997	174.485	0.355	2.551	0.453	0.357
1998	198.622	0.351	2.507	0.454	0.357
1999	214.568	0.352	2.603	0.454	0.357

2000	235.417	0.370	2.783	0.455	0.358
2001	228.271	0.340	2.506	0.446	0.349
2002	235.814	0.349	2.525	0.446	0.350
2003	272.088	0.344	2.396	0.447	0.350
2004	305.081	0.349	2.534	0.447	0.351
2005	345.839	0.365	2.631	0.448	0.352
2006	404.926	0.374	2.654	0.448	0.353

Note: (i) Data has been taken from Handbook of Statistics on Indian Economy. Disparity has been calculated on the basis of equations 2.31 to 2.35

Table 11: Stationarity Test: Indicators of Disparity for SDP and Per Capita SDP

Indicator of Disparity		SDP					Per capita SDP				
		Range	Coefficient of Variation	Range Ratio	Gini Coefficient	Theil Index	Range	Coefficient of Variation	Range Ratio	Gini Coefficient	Theil Index
ADF Test (at level)	1 st Lag	3.546	-1.006	-0.755	-1.020	-1.132	2.540	-0.525	-0.709	-1.723	-1.686
	2 nd Lag	2.392	-1.153	-1.542	-1.417	-1.431	2.209	-0.624	-0.757	-1.634	-1.756
DFGLS Test	1 st Lag	-0.450	-1.787	-1.491	-1.408	-1.548	-0.392	-1.772	-2.093	-1.482	-1.526
	2 nd Lag	-0.867	-1.699	-2.332	-1.533	-1.678	-0.528	-2.013	-2.058	-1.433	-1.610
	3 rd Lag	-1.043	-2.479	-1.882	-2.585	-2.994	-0.692	-2.340	-1.486	-1.377	-1.604
	4 th Lag	-1.074	-2.235	-1.578	-2.268	-2.142	-1.196	-2.635	-3.431**	-2.380	-2.059
	5 th Lag	-0.678	-3.406**	-2.643	-2.680***	-3.199**	-0.573	-2.818		-1.359	-1.674
	6 th Lag	-0.876		3.163**			-0.625	-2.883		-1.610	-1.650
	7 th Lag	-1.492					-1.150	-2.471		-1.598	-1.763
	8 th Lag	-1.362					-0.739	-2.498		-1.928	-1.983
PP test	At Level	2.730	-3.442	-2.974	-2.308	-2.907	2.823	-0.978	-1.882	-6.245	-7.159
KPSS test	At Level	0.578	0.286	0.448	0.361	0.362	0.493	0.325	0.247	0.427	0.395
	1 st Lag	0.328	0.180 [*]	0.245	0.211 [*]	0.208 [*]	0.297	0.186 [*]	0.155 [*]	0.243	0.228
	2 nd Lag	0.244		0.178 [*]			0.230			0.181 [*]	0.169 [*]
	3 rd Lag	0.204 [*]					0.199 [*]				

Note: Data for the stationarity test has been taken from Table 9 and Table 10. , (ii) * Significant at 1 percent level, (iii) ** Significant at 5 percent level, (iv) *** Significant at 10 percent level. (v) Equations 3.17-3.36 have been used.

Based on different indicators of disparity for State Domestic Product and per capita SDP and equations 17-36, unit root tests have been estimated and the results are presented in the Table 11. In the present study, ADF test for all the measure of disparity for the period 1980-2006 shows that there is presence of unit root in the series. DFGLS test for Gini coefficient and Theil index for the per capita SDP reveal non stationarity. Also Phillips Perron test reveals the presence of unit root for all the measures of disparity for the twenty states under the period of study. Similarly no indicator reveals the stationarity at level for SDP and per capita SDP in case of the KPSS test.

IV Conclusion:

The main aim of this paper is to test the stationarity of SDP as well as per capita SDP for the twenty states in Indian federal system using an extended dataset and unit root test. We apply the test like ADF, DFGLS, PP and KPSS. Data has been utilized from the Handbook of Statistics on Indian Economy for the period 1980-81 to 2006-07 for the twenty states like; Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

The results based on ADF test reveals that State Domestic Product and per capita SDP on the basis of new series among twenty states are nonstationarity at level and first & second lag. Similar result has been found with Philips and Perron (1988) test of stationarity i.e. SDP and per capita SDP for the twenty states are nonstationarity at level. The results here are not consistent with DFGLS (1996) who used detrend time series –based unit root tests and determined that the SDP and per capita SDP for is stationary for the states like Jammu & Kashmir, Karnataka, Tripura and West Bengal. Our results are consistent with KPSS (1999) test, which support the notion of stationarity in SDP for all the twenty states for the period 1980-81 to 2006-07.

Disparity in term of SDP and per capita SDP for the twenty states under the study period, Gini coefficient and Theils index reveal higher values for per capita SDP. And also stationarity of all the measures of disparity presence of unit root at level and zero lag.

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