Vidyasagar University Journal of Economics, Vol. XVI, 2011-12 ISSN – 0975-8003

Interstate Variation of the Growth Process of Indian Pharmaceutical Industry: Evidence from Structural Break Unit Root Test

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Abstract

This paper identifies whether there has been a change in the level or growth or both in the level as well as growth of output of 17 major states of India and in the All India level in Pharmaceutical Industry in the post liberalization period since 1991-92 using recent advancement of structural break analysis of modern time series econometrics by using the data on gross value added for the period 1983-84 to 2007-08 and tested for exogenous structural break in the level, growth and both in the series of output of Pharmaceutical industry in the 17 major states as well as in All India level. This paper concludes that for the states like Andhra Pradesh, Gujarat, Haryana, Maharashtra and Rajasthan the underlying process is TS for the Model A and Model B supporting the evidence of deterministic trend but no statistical evidence of one time structural break is found. In case of Karnataka, there exists onetime exogenous structural break in Model B only. For Madhya Pradesh, there exists one time exogenous structural break in Model A only. For the states like Assam, Punjab, Tamilnadu and West Bengal, all the three models are TS supporting the evidence of deterministic trend. In case of West Bengal only, there is statistical evidence of structural change after 1991-92 and also the evidence of one time structural break in the level, growth and both in the level and growth of the series of output of Pharmaceutical industry.

Introduction

Since independence the Indian Pharmaceutical industry (IPI) has gone through several phases in it's growth process. Particularly in the 1980's large scale production of bulk drugs was started by the indigenous sector with the change in the patent law in 1972, and after 1990s significant changes occurred in Pharmaceutical sector with the introduction of trade liberalization measures like signing of TRIPS agreement in 1994 and delicensing of the drugs which led to manifold increase in the competition among the domestic firms and foreign companies in 1990s and hence there was sharp and steady increase of production.

The literature survey revealed that very little attempt has been made to analyze the behaviour of growth process of IPI quantitatively and the econometric studies are not too much. Mention may be made of the few studies like Ghose and Chakraborty (2010), Mazumdar & Rajeev(2009), Ghose and Chakraborty (2008) and Nagarajan and Barthwal (1990), Chaudhuri (2005).

Chaudhuri (2005) in his study along with the other characteristics discussed the rise and growth of the Pharmaceutical Industry in India and also the growth and prospects of generic Pharmaceutical exports from India. Nagarajan and Barthwal (1990) examined how the profitability of the firm and the growth rate are affected for 38 pharmaceutical firms by the firm specific

variables like the size of the diversification, vertical integration and advertising intensities given the market structure and external constraints over the period 1970-82. Ghose and Chakraborty (2008) analyzed the growth performance of IPI by estimating the growth rates of output using data on gross value added and net value added and also estimated the growth rate of employment and capital labour ratio and also of productivity of labour, capital and total factor productivity. However this study did not use the testing based on recent rigourous time series econometrics. Mazumdar & Rajeev (2009) using firm level data, examined some characteristics of IPI like the technical efficiency, technological gap ratio and productivity change of IPI, which has to do something with the growth process, across different groups which are formed on the basis of size, strategies and product varieties and concludes that vertically integrated firms that produce both bulk drug and formulation exhibit higher technological innovation and efficiency and also concluded that increased export earnings do not necessarily lead to higher efficiency. Ghose and Chakraborty (2010), although used the recent rigourous time series econometrics tested for both exogenous and endogenous structural break at the All India level for the period 1973-74 to 2007-08. They concluded that there is break only in the level of the output series of IPI and at the year 1991-92. There is also the evidence of positive and significant structural change after 1991-92 in both the cases of endogenous and exogenous structural break.

The perusal of the literature suggests most of the studies are concerned with all India level and there is dearth in the study to analyse the growth process of Indian Pharmaceutical industry using state level data specifically using modern econometric time series approach. The present paper contributes to the literature from the above perspective and test for exogenous structural break in the series of output of IPI for 17 major states of India for the period 1983-84 to 2007-08 taking 1991-92 as the break point. The reason for taking 1991-92 as the break point is that most of the liberalization process in the Indian economy takes place since 1991-92 and it will be interesting to see whether the growth process of IPI had changed since 1991-92.

The format of the present paper is as follows:

Section 2 gives the methodology and data sources. Section 3 presents the result of analysis. Section 4 summarizes the conclusion of this study.

2. Test for Exogenous Structural Break

2.1 Methodology

In the early eighties a major debate was going on about the nature of the macroeconomic data due to Nelson and Plosser (1982) and they found that most of the macroeconomic data follows Difference Stationary (DS) rather than Trend Stationary (TS). A TS process implies that the effect of random shock is temporary around a trend and the variance of the series is independent of time whereas DS process implies that this random shock has a permanent effect and the variance of series is not constant but time dependent. The unit root test is performed to understand whether the series is DS or TS which is as under:

$\Delta Y_t = \delta_0 + \delta_1 t + \gamma Y_{t-1} + U_t$ where $U_t = \alpha U_{t-1} + \varepsilon_t$

Failure of rejection of null hypothesis, $H_0: \gamma = 0$, implies that the underlying series is DS. The problem that the coefficient of Y_{t-1} does not follow the standard t distribution was solved by Fuller, who obtained limiting distribution of this coefficient. These distributions were approximated empirically by Dicky(1976). McKinnon (1990) has derived critical values from a much larger set of replications.

In his path breaking work Perron (1989) concluded that in the presence of structural break the standard unit root test is not consistent against trend stationarity and suggested a procedure which

is appropriate for testing unit root in presence of one time structural break in the series. The structural break is assumed to be exogenously determined from consideration of visual examination of the plots of the data. In the presence of exogenous structural break the method is based on the following models:

$\Delta Y_t = \lambda^A + \beta^A DU_t + \eta^A t + \mu^A D(TB)_t + (\varphi^A - 1)Y_{t-1} + \sum \delta_i \Delta Y_{t-1} + \xi_i$ ….Model A

$\Delta Y_t = \lambda^B + \beta^B DU_t + \eta^B t + \pi^B D(TS)_t + (\varphi^B - 1)Y_{t-1} + \sum \delta_i \Delta Y_{t-1} + \xi_i$ …..Model B

$\Delta Y_t = \lambda^C + \beta^C DU_t + \eta^C t + \pi^C DT_t + \mu^C D(TB)_t + (\varphi^C - 1)Y_{t-1} + \sum \delta_i \Delta Y_{t-1} + \xi_i$ ….Model C

Where $\xi_i \sim$ iid $(0,\sigma^2)$

An exogenous break in the level only is permitted in **Model A**, an exogenous break in the growth only is permitted in **Model B** and **Model C** permits exogenous break in both the level and growth.

The variables DU_t, $D(TB)_t$, $D(TS)_t$ and DT_t can be defined as follows:

DU_t is the post break dummy

$DU_t = 1$ if $t > T_B$

$= 0$ otherwise.

$T_B (1 < T_B < T)$ refers to the time break, T being the total time period.

$D(TB)_t$ is the dummy for the structural break if exogenous structural break only in the level of the series is considered (Model A) and

$D(TB)_t = 1$ if $t = T_B + 1$

$= 0$ otherwise,

$D(TS)_t$ is the dummy for the exogenous structural break only in the growth of the series (Model B) and

$D(TS)_t = t - T_B$ if $t > T_B$

$= 0$ otherwise

DT_t is the dummy for the exogenous structural break both in the level as well as in the growth of the series (Model C) and

$DT_t = t$ if $t > T_B$

$= 0$ otherwise

The break point T_B is taken as 1991-92 in this paper because in India since 1991 major industrial and trade liberalization policies were introduced. The existence of exogenous structural break after 1991-92 is tested separately for Model A, Model B and Model C. In the above regression equations the error term is a white noise term. Now this model is appropriately nested in the testing framework under the null hypothesis of unit root, the alternative being trend stationarity. The null and alternative hypothesis is specified as follows:

$H_0^A : \varphi^A - 1 = 0, \eta^A = 0, \beta^A = 0$ and $H_1^A : \varphi^A - 1 \neq 0, \eta^A \neq 0, \beta^A \neq 0$

$H_0^B : \varphi^B - 1 = 0, \eta^B = 0, \pi^B = 0$ and $H_1^B : \varphi^B - 1 \neq 0, \eta^A \neq 0, \pi^B \neq 0$

$H_0^C : \varphi^C - 1 = 0, \eta^C = 0, \pi^C = 0$ and $H_1^C : \varphi^C - 1 \neq 0, \eta^C \neq 0, \pi^C \neq 0$

The different coefficients of Model A, Model B and Model C can be interpreted as follows:

- Statistically significant coefficient of Y_{t-1} implies that the underlying series is TS and has deterministic trend and if the coefficient of time is also statistically significant and positive (negative) it suggests that the underlying process is TS around a deterministic positive (negative) trend. Also if the coefficient of DU_t is statistically significant then it can be inferred that there exists significant structural change after the break point. The constant term if found significant then it can be concluded that there exists a drift parameter.

But if the coefficient of Y_{t-1} is insignificant and the coefficient of time is statistically significant and positive (negative) it implies that the degree of instability increases (decreases) over time.

- If the coefficient of $D(TB)_t$, $D(TS)_t$ and DT_t are statistically significant and the series is of TS type then it can be inferred that there exist a significant structural break in the level, growth and both in the level and growth of the series of output respectively in IPI for that period.

In this paper Ordinary Least Square Estimation method has been used but the coefficient of Y_{t-1} cannot be tested by the standard percentiles, as originally provided by Fuller (1976). So the coefficient of Y_{t-1} has been tested using Perron's table which can be found in his paper (Table-IV, page-1376). Although Perron has suggested a method for choosing appropriate lag length i.e. to start with a reasonably high value of k, k being the lag length and to choose that particular k, say k*, such that the value of the statistic for k* is greater than 1.64 in absolute value and for all other is less than 1.64 but in this paper Perron's procedure has not been followed because it is sensitive to a particular value of "t" statistic around 10% level of significance. Rather this paper follows a different method of finding out the proper lag length i.e. first the correlogram is plotted and then by studying the partial autocorrelation function (PACF) the appropriate lag length is chosen. The PACF of each of the 17 major states of India suggests that the series are of AR (1) type with the autocorrelations dying out and only the first partial correlation coefficient being significant for all the states excepting 4 states such as Assam, Jammu & Kashmir, Orissa and West Bengal.

2.2. Data Sources

The present paper uses the data on gross value added (Y) for 17 major selected states of India namely Andhra Pradesh, Assam, Bihar , Gujarat , Haryana , Himachal Pradesh , Jammu & Kashmir, Karnataka , Kerala, Mahasashtra, Madhya Pradesh, Orissa, Punjab , Rajasthan, Tamilnadu, Uttar Pradesh and West Bengal as well as for All India level for the period 1983-84 to 2007-08 obtained from the various issues of "Annual Survey of Industries, Summary Results for the Factory Sector" published by Central Statistical Organisation, Government of India.

3. The empirical findings:

The results of the present paper can be discussed under the following heads:

3.1 Exogenous Structural Break in the Level of the series (Test for Model A)

Table 1 reveals that for the states like Andhra Pradesh, Assam, Gujarat, Haryana, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and West Bengal the underlying series is of TS type. For Andhra Pradesh only, the coefficient of time is positive and statistically significant and so there is an upward positive deterministic trend. For the states like Gujarat, Maharashtra, Punjab, Rajasthan and Tamil Nadu the coefficient of DUt are positive and statistically significant suggesting a positive structural change after 1991-92. There is statistical evidence of one time structural break in the level of the series for Madhya Pradesh and West Bengal. In case of West Bengal as the coefficient of time and the coefficient of DUt are found to be negative and positive respectively and both are statistically significant, it can be said that there occurred a positive structural change after 1991-92 but over the entire period of study there exists a negative deterministic trend.

For the states like Bihar, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Orissa and Uttar Pradesh as well as for All India the underlying series is of DS type. Only for Himachal

Pradesh, Jammu & Kashmir and Karnataka, the coefficient of time are positive and statistically significant implying that the variance of the stochastic trend increases over time for these states.

3.2 Exogenous Structural Break in the growth of the series (Test for Model B)

The figures of Table 2 concludes that in case of the states like Andhra Pradesh, Assam, Gujarat, Haryana, Karnataka, Maharashtra, Punjab, Rajasthan, Tamilnadu and West Bengal, the underlying series is of TS type. The coefficient of time is not significant for any of the above states. Only for Karnataka and West Bengal, the coefficients of DT_s are significant and are positive and negative respectively and hence there is one time positive and negative structural break respectively for these states in the growth of the series. Also in case of West Bengal the coefficient of DUt is positive and significant and so there occurred a positive structural change after 1991-92 in the growth of the series.

For the states like Bihar, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Orissa and Uttar Pradesh and also for All India the underlying series is of DS type. In case of only All India there is the evidence of negative trend suggesting that variance of stochastic trend decreases over time.

3.3 Exogenous Structural Break in the Level and growth of the series (Test for Model C)

From Table 3 it can be said that in case of the states like Assam, Punjab, Tamilnadu and West Bengal, the underlying series is of TS type. The coefficient of time is not significant for any of the above states. Statistical support of one time negative structural break and also of positive structural change in the level and growth of the series of output in case of West Bengal are found as the coefficient of DTt and DUt are negative and positive respectively and are both statistically significant. The coefficient of DUt is found to be positive and statistically significant and so there lies the statistical evidence of structural change after 1991-92 in case of Punjab and Tamilnadu.

For the states like Andhra Pradesh, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan and Uttar Pradesh the underlying series is of DS type. The coefficient of time is not found to be statistically significant for any of the above states.

The summary of the above results can be visualized from Table 4.

4. Conclusion

This paper attempts to test whether there has been a change in the level, growth or both in the level as well as growth of the series of output of Pharmaceutical industry in the 17 major states of India as well as in the All India level in the post liberalization period since 1991-92. The study uses the data on gross value added for the period 1983-84 to 2007-08 and tested for exogenous structural break in the series. Three alternative specifications of the model is tested for: Structural break in the level (Model-A), Structural break in the growth (Model-B) and Structural break in both the level as well as growth of the series (Model-C). The major conclusion of this paper are as follows:

- In case of the states like All India, Bihar, Himachal Pradesh, Jammu & Kashmir, Kerala, Orissa and Uttar Pradesh the underlying process is of DS for all the three models implying the presence of stochastic trend and there does not exist any onetime exogenous structural break in the level or growth or both in the level and growth of the series of output of Pharmaceutical industry for these states.
- For the states like Andhra Pradesh, Gujarat, Haryana, Maharashtra and Rajasthan the underlying series is of TS for Model A and Model B. For all these states Model C is DS supporting the evidence of stochastic trend. Thus a meaningful interpretation of the

situations of all these states must be based on Model A and Model B. For all these states, there is no evidence of one time structural break in the level or growth of the series of output. In case of Andhra Pradesh, for Model A, the coefficient of time is positive and statistically significant suggesting that there exists a positive upward deterministic trend but for Model B although the coefficient of time is positive but is statistically insignificant. For Gujarat, Maharashtra and Rajasthan, in case of Model A, the coefficient of DUt is positive and significant and so there exists the statistical support of positive structural change after 1991-92. For Haryana, neither Model A nor B shows any evidence of structural break.

- For Karnataka and Madhya Pradesh, the result is different. In case of Karnataka, Model B is TS supporting deterministic trend and Model A and Model C are DS supporting stochastic trend. Thus a meaningful interpretation of the situation of this state must be based on Model B. From Model B, one can conclude that there exist positive significant structural break in the growth of the series for that period. Whereas for Madhya Pradesh, Model A is TS and so has deterministic trend but Model B and Model C are DS and hence has stochastic trend. Thus a meaningful interpretation of the situation of this state must be based on Model A. From Model A, it can be inferred that there exists significant negative structural break in the level of the series.
- For the states like Assam, Punjab, Tamilnadu and West Bengal, all the three models are of TS and so have deterministic trend. In case of Assam, there exists no statistical support of structural break in the level or growth or both in the level and growth of the series of output of Pharmaceutical industry. For Punjab and Tamilnadu there exists the evidence of positive structural change after 1991-92. For West Bengal, the coefficient of time is negative and significant in case of Model A which shows that there exists a negative deterministic trend in the series. The coefficient of structural break dummy is negative and coefficient of post break dummy is positive and both are statistically significant for all the three models suggesting a negative crash in the series and a significant positive structural change in the level, growth and both in the level and growth of the series of output of Pharmaceutical industry after 1991-92.

On the whole the analysis reveals that considering the series of output of Indian Pharmaceutical industry, one can find that there was a (i) change in the level of the series for the states like Gujarat, Maharashtra, Punjab, Rajasthan, Tamilnadu and West Bengal (ii) change in the rate of growth of the series for the states like Karnataka and West Bengal and (iii) change in the level as well as rate of growth of the series for the state West Bengal only after 1991-92, the year when the liberalization process started taking place in the Indian economy.

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Table 1
Analysis of Exogenous Structural Break in the level (Model A)

Places	Constant	DU_t	T	$D(TB)_t$	Y_{t-1}	ΔY_{t-1}
All India	17.044 (0.22)	-131.873 (.906)	15.391 (.639)	100.899 (.499)	-0.002 (.009)	-0.144 (.410)
AndhraPradesh	-49.554 (1.038)	45.501 (.506)	14.662 (2.168)**	-47.139 (.383)	-1.211 (3.548)#	0.373 (1.319)*
Assam	-0.371 (.335)	0.013 (.006)	.169 (1.167)	-0.576 (.202)	-1.172 (5.162)###	
Bihar	-0.091 (0.455)	0.193 (.536)	0.024 (.888)	-0.115 (.234)	--0.474 (1.978)	-0.212 (.925)
Gujarat	166.67 (0.881)	561.52 (1.48)*	-17.521 (.736)	-423.88 (.854)	-0.88 (3.81)##	0.391 (1.89)*
Haryana	3.456 (0.503)	12.59 (.938)	0.366 (.421)	-9.331 (.517)	-1.009 (3.74)#	0.396 (1.68)*
Himachal Pradesh	-29.282 (1.061)	-50.701 (.987)	5.862 (1.441)*	20.788 (.325)	0.366 (1.461)	-0.961 (4.034)***
Jammu & Kashmir	-3.431 (1.209)	-6.513 (1.156)	0.699 (1.75)**	3.209 (.439)	0.004 (.014)	
Karnataka	-31.358 (1.216)	-61.332 (1.221)	11.468 (2.296)**	3.566 (0.061)	-0.99 (2.883)	-0.04 (.204)
Kerala	14.874 (1.079)	48.345 (1.735)**	-2.217 (1.274)	-30.174 (.834)	-0.755 (3.262)	0.231 (1.089)
Madhya Pradesh	-3.325 (.156)	56.852 (1.289)	2.544 (.925)	-48.21 (1.837)**	-0.923 (3.513)#	0.326 (1.458)*
Maharashtra	224.707 (1.247)	577.105 (1.622)*	-15.89 (.722)	-349.95 (.761)	-0.786 (3.653)#	0.394 (1.935)**
Orissa	2.529 (0.87)	7.315 (1.281)	-0.394 (1.072)	-5.387 (.711)	-0.647 (3.182)	
Punjab	3.738 (0.279)	45.079 (1.652)*	0.537 (.314)	-40.461 (1.141)	-1.034 (3.888)##	0.294 (1.382)*
Rajasthan	14.748 (0.692)	63.227 (1.491)*	-2.607 (.965)	-50.885 (.907)	-0.828 (3.684)#	0.372 (1.799)**
Tamil Nadu	29.332 (0.727)	128.601 (1.594)*	-3.284 (.647)	-94.714 (.886)	-0.903 (3.817)##	0.359 (1.737)**
Uttar Pradesh	58.86 (1.096)	179.52 (1.673)*	-8.431 (1.245)	-119.722 (.858)	-0.627 (3.439)	0.432 (2.186)**
West Bengal	97.763 (3.35)***	265.013 (4.36)***	-14.509 (3.85)***	-200.83(-2.744)**	-1.306 (6.914)###	

- Figures in the parenthesis shows the 't' values
- *: significant at 10% level of significance
- **: significant at 5% level of significance
- ***: significant at 1% level of significance
- ###: Significant at 1% according to Perron's Table
- ##: Significant at 5% according to Perron's Table
- #: Significant at 10% according to Perron's Table

Table 2
Analysis of Exogenous Structural Break in the growth (Model B)

Places	Constant	DU_t	TIME	$D(TS)_t$	Y_{t-1}	ΔY_{t-1}
All India	149.207 (1.189)	-42.332 (.309)	-3.905 (1.385)*	30.561 (1.228)	-0.101 (.374)	-0.096 (.291)
Andhra Pradesh	-8.002 (.104)	54.858 (.631)	6.398 (.463)	11.014 (.728)	-1.224 (3.654)#	.369 (1.336)*
Assam	0.009 (.005)	0.057 (.027)	0.094 (0.286)	0.103 (0.288)	-1.177 (5.172)###	
Bihar	-0.023 (.074)	0.2002 (.562)	0.011 (.2001)	0.019 (.304)	-0.487 (1.971)	-0.204 (.875)
Gujarat	19.96 (0.06)	371.08 (1.009)	11.423 (.201)	-24.59 (.396)	-0.845 (3.68)#	0.374 (1.801)**
Haryana	4.071 (.351)	10.396 (.794)	0.22 (.108)	0.361 (.161)	-0.986 (3.688)#	0.380 (1.608)*
Himachal Pradesh	0.521 (0.012)	-34.461 (.734)	-0.083 (0.011)	7.396 (.886)	.295 (1.131)	-0.933 (3.95)***
Jammu & Kashmir	0.761 (.164)	-3.601 (.667)	-0.143 (.171)	.910 (1.02)	0.021 (.065)	
Karnataka	14.606 (.422)	-50.095 (1.175)	3.292 (.521)	12.769 (1.758)**	-1.231 (3.577)#	0.058 (.259)
Kerala	1.774 (.077)	33.21 (1.257)	0.369 (0.09)	-2.339 (.525)	-0.721 (3.161)	0.222 (1.039)
Madhya Pradesh	-3.658 (.099)	41.88 (.977)	25.35 (.388)	0.878 (.123)	-0.867 (3.354)	0.299 (1.328)*
Maharashtra	22.578 (0.077)	382.449 (1.135)	23.979 (0.458)	-39.09 (.688)	-0.771 (3.621)#	0.390 (1.912)**
Orissa	0.761 (.155)	4.976 (.897)	-0.045 (.051)	-0.287 (.304)	-0.626 (3.088)	
Punjab	-4.857 (.208)	28.979 (1.067)	2.213 (.532)	-1.175 (0.261)	-0.978 (3.62)#	0.266 (1.217)
Rajasthan	-0.867 (0.023)	41.383 (.997)	0.506 (0.078)	-2.511 (0.357)	-0.796 (3.57)#	0.358 (1.706)*
Tamil Nadu	4.521 (0.065)	89.439 (1.135)	1.575 (0.128)	-3.667 (0.275)	-0.861 (3.652)#	0.342 (1.632)*
Uttar Pradesh	4.658 (0.052)	119.093 (1.61)*	2.273 (0.143)	-9.809 (0.567)	-0.603 (3.337)	0.426 (2.133)**
West Bengal	10.831 (0.216)	159.815 (2.643)***	2.496 (0.281)	-14.76 (1.498)*	-1.204 (5.913)###	

- Figures in the parenthesis shows the 't' values
- *: significant at 10% level of significance
- **: significant at 5% level of significance
- ***: significant at 1% level of significance
- ###: Significant at 1% according to Perron's Table
- ##: Significant at 5% according to Perron's Table
- #: Significant at 10% according to Perron's Table

Table 3
Analysis of Exogenous Structural Break in the level as well as growth of the series (Model C)

States	Constant	DU_t	T	$D(TB)_t$	DT_t	Y_{t-1}	ΔY_{t-1}
All India	152.854 (1.203)	-386.951 (1.619)*	-6.382 (.222)	149.702 (.743)	34.032 (1.33)*	-0.068 (.247)	-0.159 (.462)
Andhra Pradesh	-8.178 (0.103)	-29.044 (.2003)	6.482 (.458)	-34.584 (.273)	10.368 (.661)	-1.242 (3.553)	.383 (1.331)*
Assam	0.009 (0.005)	-0.669 (0.192)	0.094 (0.279)	-0.445 (.150)	0.093 (.250)	-1.177 (5.04)###	
Bihar	-0.023 (.072)	0.066 (0.109)	0.011 (.195)	-0.097 (.189)	0.017 (.267)	-0.492 (1.929)	-0.201 (.838)
Gujarat	20.34 (.063)	831.375 (1.357)*	11.927 (.208)	-480.06 (.932)	-35.96 (.567)	-0.88 (3.78)	0.395 (1.88)**
Haryana	4.105 (.346)	11.431 (.520)	0.236 (.111)	-9.102 (.483)	.158 (.068)	-1.008 (3.643)	0.394 (1.623)*
Himachal Pradesh	0.526 (0.012)	-122.816 (1.369)*	-0.077 (.011)	36.730 (.556)	8.598 (.981)	0.262 (.962)	-0.921 (3.81)***
Jammu & Kashmir	.725 (.154)	-14.02 (1.59)*	-0.129 (.153)	4.66 (.631)	1.013 (1.105)	-0.004 (.013)	
Karnataka	14.554 (.413)	-184.964 (2.22)**	3.509 (.543)	30.533 (.535)	13.847 (1.805)*	-1.27 (3.532)	0.084 (.358)
Kerala	1.748 (0.076)	73.652 (1.631)*	0.436 (.106)	-35.963 (.958)	-3.281 (.717)	-0.783 (3.29)	0.240 (1.113)
Madhya Pradesh	-3.728 (.101)	57.563 (.827)	2.624 (.398)	-48.345 (.805)	-0.098 (.013)	-0.923 (3.412)	0.326 (1.418)*
Maharashtra	25.180 (0.085)	963.41 (1.679)*	25.128 (.478)	-435.059 (.918)	-50.28 (.861)	-0.817 (3.721)	0.405 (1.973)**
Orissa	0.776 (.157)	10.547 (1.132)	-0.04 (.048)	-6.06 (.769)	-0.431 (.445)	-0.657 (3.147)	
Punjab	-4.959 (0.214)	60.601 (1.398)*	2.279 (.553)	-43.484 (1.182)	-2.118 (.467)	-1.035 (3.869)#	0.289 (1.331)*
Rajasthan	-0.888 (0.024)	91.672 (1.336)*	0.523 (.081)	-56.715 (.974)	-3.823 (.533)	-0.838 (3.644)	0.373 (1.77)**
Tamil Nadu	4.643 (0.067)	173.289 (1.33)*	1.67 (.136)	-103.861 (.935)	-6.026 (0.443)	-0.909 (3.866)#	0.361 (1.707)*
Uttar Pradesh	5.187 (0.058)	281.608 (1.627)*	2.415 (0.152)	-142.123 (.985)	-13.38 (0.757)	-0.647 (3.473)	0.437 (2.182)**
West Bengal	12.841 (0.334)	456.909 (5.45)***	3.009 (.441)	-250.985 (3.876)*	-22.85 (2.91)***	-1.449 (8.60)###	

- Figures in the parenthesis shows the 't' values
- *: significant at 10% level of significance
- **: significant at 5% level of significance
- ***: significant at 1% level of significance
- ###: Significant at 1% according to Perron's Table
- ##: Significant at 5% according to Perron's Table
- #: Significant at 10% according to Perron's Table

Table 4
Summary Results of Exogenous Structural Break Analysis

States	Structural change
Gujarat	Level of the series
Maharashtra	Level of the series
Punjab	Level of the series
Rajasthan	Level of the series
Tamilnadu	Level of the series
Karnataka	Rate of growth of the series
West Bengal	Level as well as rate of growth of the series