Regional Disparity and Convergence of the Growth of Output, Employment and Productivity of Labour of Indian Pharmaceutical Industry

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Abstract

This paper tries to find out the nature of the growth process of output, employment and productivity of labour of Pharmaceutical Industry in the 17 major selected states, tests whether the series of the growth of output, employment and productivity of labour are converging towards a stationary process having deterministic trend and estimates the break point of these three variables for the period 1983-84 to 2007-08 employing endogenous structural break analysis of Sen (2003). The distinguishing feature of this method is that the break point is not dependent on the prior belief of the researcher; rather it is endogenously determined depending on time series properties of the series. The results of estimation suggest that for most of the states, the endogenously determined break point turned out to be the years after 1995, the year when the first version of product patent was implemented and The Drug and Cosmetic Act was also amended to infuse competition in this sector. Thus important policy changes pertaining to this sector have taken place in the year 1995. An interstate and regional variation of the growth of output, employment and productivity of labour is strongly evident. The growth of output of sixteen among the seventeen selected states converges towards a deterministic trend, it is fourteen for productivity of labour whereas for employment, all the states shows convergence toward stationary process having constant variability over time. The study clearly identifies the regions and the states whose performance are satisfactory and others showing relatively poor performance and hence needs special attention.

Key words: Indian Pharmaceutical Industry, Regional Variation, Convergence, Structural Break, Unit Root
JEL Code: L65, R11, O41, C22

1. Introduction

Indian pharmaceutical industry (IPI) has made phenomenal progress making its presence felt in the international market. It ranked third in volume and fourteenth in value in the global pharmaceutical market (Kalani, 2011).

From the beginning of the Indian plan period, planners have taken care to ensure equal development across different states, such that the weaker sections of the population benefit from the progress. Growth analysis at the state level will be

useful for identifying states whose growth performance is not satisfactory and hence proper measure can be taken for those backward states.
Majority of the growth analysis relied upon the assumption of deterministic trend and hence they are devoid of testing for difference or trend stationarity using unit root of modern time series approach. But those assumptions are not always valid as the series may be non stationary in nature as pointed out by researchers over the last three decades or so. Thus for getting a valid result, stationary properties of the series are to be checked.

Given the high growth of this industry the following questions can be raised:

- What is the nature of growth of output (Y), employment (L) and productivity of labour (Y/L) of Pharmaceutical industry in major selected states of India?
- Whether the above mentioned three variables are converging towards a stationary process having deterministic trend?
- Is there any structural break in the series of these variables?
- Is there any interstate and regional variation in Pharmaceutical industry in major selected states of India in terms of Y, L and Y/L?

The literature survey revealed that not much attempt has been made to analyze the behaviour of IPI quantitatively. Mention may be made of few studies like Singh (1989), Nagarajan and Barthwal (1990), Majumder (1994), Madanmohan (1997), Kumar (2001), Chaudhuri (2005), Chaudhuri and Das (2006), Ghose and Chakraborty (2008), Mazumdar and Rajeev (2009), Mazumdar, Rajeev and Ray (2009), Saranga and Banker (2010), Chakraborty and Ghose (2011, 2010), Ghose and Chakraborty (2012) among others. Moreover state or region level analysis of variation in the growth of output, employment and productivity of labour in IPI are lacking in the literature.
The present paper contributes to the literature from the above perspective by finding out the nature of growth process of Y, L and Y/L, tests whether the three variables are converging towards a stationary process having deterministic trend, also tests for endogenous structural break in the series of Y, L and Y/L and analyses the variation in the growth of Y, L and Y/L in IPI at state and region level over the period 1983-84 to 2007-08.

The format of the present study is as follows: Section 2 gives the methodology and data source. Section 3 presents the result of analysis. Section 4 summarizes the conclusion of the study.

2. Methodology and Data Source

2.1 Methodology

Perron (1989) in his path breaking work has shown that the standard unit root test is inconsistent against trend stationarity in the presence of structural break and has suggested a procedure appropriate for testing unit root in presence of one time structural break in the series which is assumed to be exogenously determined from consideration of visual examination of the plots of the data. But Zivot and Andrews (1992) argued that Perron's procedure for finding out the break point is not an appropriate method and argued that the break point should be endogenously determined and can be evaluated considering the following models:

Model A: $Y_t = a_1 + b_1\, DU_t + c_1\, t + d_1\, Y_{t-1} + e_1\, \Sigma\Delta\, Y_{t-1} + e_t$

Model B: $Y_t = a_2 + g_2\, DT_t + c_2\, t + d_2\, Y_{t-1} + e_2\, \Sigma\, \Delta\, Y_{t-1} + e_t$

Model C: $Y_t = a_3 + b_3\, DU_t + c_3\, t + g_3\, DT_t + d_3\, Y_{t-1} + e_3\, \Sigma\, \Delta\, Y_{t-1} + e_t$

$DU_t = 1$ if $t > T\gamma$

$= 0$ otherwise

$DT_t = t - T\gamma$ if $t > T\gamma$

$= 0$ otherwise

Model A allows an endogenous break in the level of the series, Model B permits an endogenous break in the rate of growth and Model C admits both changes in the level as well as rate of growth. If DT_t is positive and significant, then there has been acceleration in the growth. Here $\gamma = T_B/T$ is the break fraction and ranges from 2/T to T-1/T where T_B is the break point and T stands for total time period. The parameters of the i^{th} regression are denoted by a_i, b_i, c_i, d_i, e_i, g_i. The above three regressions can be estimated by ordinary least square method and with the break fraction γ ranging from 2/T to T-1/T. Regarding the choice of the lag value, Perron suggested that one should start with a reasonably high value of k, and 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 the present paper uses visual descriptions of the series and in particular the figures of the correlogram. It suggests that the series is AR(1) type with the autocorrelations dying out and only the first partial correlation coefficient being significant, for all the major states of India over the entire sample period.

Zivot and Andrews (1992) proved that among the overall T-2 regressions one can choose that year as break-point year which gives us the minimum value of 't' statistics corresponding to the coefficient of Y_{t-1}. That model is chosen as the best-fitted model which gives us the minimum't' value of the coefficient Y_{t-1}. The estimated results are to be compared with the critical values given by Zivot and Andrews (1992) to determine the nature of the series. Sen (2003) argued that Zivot and Andrews (1992) procedure can be improved by considering maximum 'F' statistic instead of minimum 't' statistic and also suggested that Model C has a higher power than Model A or Model B. His test is based on F statistic having the following form:

$$F^{Max} = Max_{T_b \in \{[\lambda_0 T],[\lambda_0 T]+1,....,T-[\lambda_0 T]\}} F_b(T_b)$$

The test procedure is as under:
Among the overall T-2 regressions choose that year as break-point year which gives us the maximum value of the 'F' statistics corresponding to the coefficient of Y_{t-1}. After finding out the break-point one can compare the results with the critical values provided by Sen (2003) to determine the nature of the series.
The present study used logarithm of output, employment and productivity of labour as regressands.

2.2. Data Source

The paper uses data on gross value added and number of workers for 17 major selected states of India obtained from various issues of "Annual Survey of Industries, Summary Results for the Factory Sector". Wholesale Price Index published by the Central Statistical Organisation, Government of India is used to deflate the output series. The states are Andhra Pradesh (AP), Assam (AS), Bihar (BI), Gujarat (GU), Haryana (HA), Himachal Pradesh (HP), Jammu & Kashmir (JK), Karnataka (KA), Kerala (KE), Maharashtra (MH), Madhya Pradesh (MP), Orissa (OR), Punjab (PU), Rajasthan (RA), Tamilnadu (TN), Uttar Pradesh (UP) and West Bengal (WB).

The sample states are classified in regions as below:

(A) Eastern: AS, BI, WB and OR

(B) Northern: HA, HP, JK, PU and UP

(C) Southern: KA, KE, AP and TN.

(D)Western: GU, MH, MP and RA.

3. Results of estimation

3.1 Results of test on convergence and break points

The nature of the series i.e. whether the growth process converges to a path having trend preserving properties for Y, L and Y/L are determined as well as their break points are found and the results are presented in **Table 1** to **Table 3**. The summary information showing whether the series follows TSP or DSP for each of the variables are presented in **Table 4.**

It is found that most of the states follow TSP and only few follow DSP i.e. for Y only BI, for Y/L only BI, GU and OR whereas for L none of the states shows DSP. As DSP possesses stochastic trend, so no definite conclusion can be drawn from the series. Hence for appropriate conjecture about the growth process only states following TSP are considered.

One interesting observation is that for L, the break points for all the 17 states are after 1995[1]. But for Y and Y/L, the break-point are after 1995 for majority of the states excepting PU and WB for Y and HA, JK, RA, OR, PU and WB for Y/L.

3.2 Results of growth pattern

Depending on the growth performance of Y, L and Y/L following TSP, states are classified into different groups: (i) A (Good performer), (ii) B (Satisfactory performer), (iii) C (Moderate performer) and (iv) D (Bad performer). The criterion for belonging to different groups are defined in **Table 5** and the classification of states is presented in **Table 6.**

There is wide variation in growth pattern among the variables which is as follows: The estimated results suggest that none of the states are good performer. The performance is **satisfactory** for **(i)** Output for HP, KA and PU, (ii) Employment for HP and OR and (iii) Productivity of Labour for PU only. The performance is **moderate** for (i) Output in case of AS, GU, HA, KE, MH, OR, JK and UP, (ii) Employment in case of AS, TN, WB, KA, MH, MP and JK and (iii) Productivity of Labour for KA, AS, HP, RA, TN, JK and MH. The performance is **bad** for (i) Output for AP, MP, RA, TN and WB, (ii) Employment in case of AP, BI, GU, HA, KE, PU, RA and UP and (iii) Productivity of Labour in case of HA, KE, MP, UP, WB and AP.

[1] In 1995 the first version of product patent was implemented. The Drug and Cosmetic Act was also amended in 1995 to infuse competition in this sector. Important policy changes pertaining to this sector have taken place for this year. (Mazumdar, Rajeev &Ray (2010)).

3.3 An Interstate Analysis

An interstate comparison reveals that there is wide variation in growth performance among the states. The states are classified on the basis of the performance of the variables (The criterion of the classifications are specified in Table 5).

AP shows bad performance for Y, Y/L and L. For AS, the performance is moderate for all the variables. BI shows bad performance for L. In case of GU, the performance is moderate for Y and bad for L. For HA, the performance is moderate for Y and bad for Y/L and L. HP performed satisfactorily for Y and L but moderately for Y/L. JK shows moderate performance for all variables. For KA, the performance is found to be moderate for Y/L and L but for Y it performed satisfactorily. KE performed moderately for Y and badly for Y/L and L. MH shows moderate performance for all the variables. Bad performance is found for all the variables in MP except L which performed moderately. OR performed moderately for Y and satisfactorily for L. In case of PU, the performance is satisfactory for Y and Y/L except L which is a bad performer. RA performed badly for Y and L and moderately for Y/L. TN performed moderately for Y/L and L and badly for Y. The performance for UP is bad for Y/L and L and moderately for Y. WB shows moderate performance for L and bad for Y and Y/L.

3.4 Regional Analysis

Interstate analysis as discussed above, gives some idea regarding the regional behaviour.

Eastern Region: For **Output,** all the states follow TSP except BI. AS and OR belongs to Group-C and WB in Group-D. For **employment,** all the 17 states follow TSP. AS and WB belongs to Group-C and BI in Group-D whereas OR belongs to B. In case of **productivity of labour,** all the states follow TSP except BI and OR**.** AS belongs to Group-C and WB belongs to Group-D. Hence in eastern region, AS performed moderately w.r.t. the three variables.

Western Region: For **output** all the states are TSP. GU and MH belongs to Group-C. MP and RA corresponds to Group-D. For **employment,** all the states are TSP. MH and MP belongs to Group-C whereas GU and RA in Group-D. For **productivity of labour,** all the states follow TSP except GU**.** MH and RA belong to Group-C and MP in Group-D. Hence MH performed moderately w.r.t. the three variables.

Northern Region: For **output** all the states shows TSP. HP and PU belong to Group-B and JK, HA and UP in Group-C. For **employment** all the states are TSP. HP belongs to Group-B and JK under Group-C. The other three states, PU, UP

and HA belongs to Group-D. For **productivity of labour,** all the states follow TSP**.** PU belongs to Group-B and HP and JK in Group-C. But HA and UP falls under Group-D. Thus in this region, HP performed satisfactorily in case of output and employment and moderately for Y/L. JK performed moderately for all the three variables.

Southern Region: For **output** all the states shows TSP. KA and KE falls under Group-B and Group-C respectively. AP and TN corresponds to Group-D. For **employment,** all the states are TSP. KA and TN belongs to Group-C whereas AP and KE belong to Group-D. For **productivity of labour,** all the states follow TSP**.** KA and TN belongs to Group-C and KE and AP belongs to Group-D. The performance of KA is well for all the three variables.

4. Conclusion

The present paper analyses the growth performance of output, employment and productivity of labour, examines whether they are converging towards a stationary series having deterministic trend and also checks for endogenous structural break in the series. State level data of Indian Pharmaceutical Industry have been used and modern time series technique of Sen (2003) is employed over the period 1983-84 to 2007-08.

The states are classified into different regions- Eastern, Western, Northern and Southern. The following conclusions emerge from the analysis:

- The growth of **output** of sixteen among the seventeen selected states converges towards a deterministic trend, it is fourteen for **Productivity of Labour** whereas for **Employment**, all the states shows convergence towards stationary process having constant variability over time.
- For **output**, all the sixteen states showing TS process, the break point occurred after 1995 except PU and WB. For **L** the break points for all the 17 states are after the year 1995. In case of **Y/L**, for all the fourteen states showing TS process the break point occurred after 1995 except HA, JK, RA, OR, PU and WB.

An interstate and regional variation of the growth of output, employment and productivity of labour is strongly evident. Among the eastern states, AS performed moderately w.r.t. the three variables. The western state, MH performed moderately w.r.t. the three variables. HP among the northern states performed satisfactorily in case of output and employment and moderately for Y/L. Also JK performed moderately for all the three variables. The performance of the southern state, KA is moderate for all the three variables.

The study on growth of output, employment and productivity of labour of Indian Pharmaceutical Industry by using modern time series technique clearly identifies

the states whose performance are better and other states showing relatively poor performance and hence needs special attention.

Bibliography

Central Statistical Organisation, Government of India, *Annual Survey of Industries, Summary Results for the Factory Sector,* various issues.

Chaudhuri, S.(2005): " The WTO and India's Pharmaceutical Industry", *Oxford University Press.*

Chaudhuri,K. and Das,S.(2006): "WTO, the TRIPS and Indian Pharmaceutical Industry", *Journal of Quantitative Economics*, Vol. 4 (1), pp. 97-110.

Chakraborty, C. and Ghose, A. (2010): "Growth Performance of Indian Pharmaceutucal Industry: Evidence from Structural Break Unit Root Test", *Vidyasagar University Journal Of Economics*, vol. xv, 2010, pp-115-124.

Chakraborty, C. and Ghose, A. (2011): "Interstate Variation of the Growth Process of Indian Pharmaceutical Industry: Evidence from Structural Break Unit Root Test", *Vidyasagar University Journal Of Economics*, vol. xvi, 2011.

Dickey,D.A.(1976): "Estimation and Hypothesis Testing in Non Stationary Time Series", Unpublished Doctoral Dissertation, *IOWA State University*, AMES, IA.

Dicky,D.A. and Fuller, W.A.(1979): "Distribution of the Estimators for Autoregressive Time Series with a Unit Root", *Journal of American Statistical Association,*74,427-431.

Dicky D.A. and Fuller, W. A.(1981): " Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root, *Econometrica*, 49,1057-1072

Ghose, A. and Chakraborty, C. (2008): "The Effect of Trade Liberalisation on the Growth Process of Indian Pharmaceutical Industry", *Vaanijya, Oct.2008, pp-15-21.*

Ghose, A. and Chakraborty, C. (2012): "Total Factor Productivity Growth in Pharmaceutical Industry: A Look Using Modern Time Series Approach with Indian Data", *Journal of Industrial Statistics*, Volume 1, Number 2, pp 250-268.

Kalani, S. (2011): "Emerging role of IT in Indian Pharmaceutical Industry and its Implications for the Education System", *Pharmaceutical Times*, Vol. 43 - No. 05 - May 2011.

Kumar, N. (2001): "WTO Regime, Host Country Policies And Global Patterns Of MNE Activity: Recent Quantitative Studies And India's Strategic Response", *Economic and Political Weekly*, Vol. 36, no.1, Jan.

MacKinnon, J.G., (1990): "Critical Values for Co-integration Tests", *UC San Diego Discusion Paper*, 90-4.

Madanmohan, T. R. (1997): "Exit Strategies: Experience Of Indian Pharmaceutical Firms", *Economic and Political Weekly*, Vol. 32, No.48, 29 Nov.

Majumdar (1994): "Assessing Firms Capabilities-Theory and Measurement - A Study of Indian Pharmaceutical-Industry", *Economic and Political Weekly*, Vol. 29(22), pp. M 83-M 89.

Majumdar, M and Rajeev, M ((2009): "Comparing the Efficiency and Productivity of Indian Pharmaceutical Firms: A Malmquist-Meta-Frontier Approach", *International Journal of Business and Economics*, 2009, Vol.8, no. 2, 159-181.

Majumdar, M, Rajeev, M and Ray, S.C. (2009): "Output and Input Efficiency of Manufacturing Firms in India: A Case of the Indian Pharmaceutical Sector", *Institute for Social and Economic Change*, Bangalore, Working Paper, 219.

Nagarajan, M and Barthwal R. R. (1990): "Profitability And Structure: A Firm Level Study Of The Indian Pharmaceutical Industry", *Indian Economic Journal*, vol 38, (2) pp70-81, Oct-Dec1990.

Nelson,C.R. and Plosser,C.I.(1982): Trends and Random Walks in Macroeconomic Time Series Some Evidence and Implications", *Journal of Monetary Economics*, 10 (I 982) 139-162.

Perron,P.(1989): "The Great Crash, The Oil Price Shock and The Unit Root Hypothesis", *Econometrica*,vol.57,6, pp1361 to 1401.

Saranga,H. and Banker,R.(2010): "Productivity and technical changes in the Indian pharmaceutical industry", *Journal of the Operational Research Society*, 61, 1777 –1788.

Sen, A (2003): "On unit root test when the alternative is a trend-break stationary process", *Journal of Business and Economics Statistics*, 21, 174-84.

Zivot, E and Andrews, D.W.K. (1992): "Further Evidence On the Great Crash, the Oil Price Shock and the Unit Root Hypothesis", *Journal of Business and Economic Statistics*,10, 251-287.

Table 1: Endogenous Structural Break Analysis for Output (Y) of IPI by Sen (2003) Approach

Place	**Constant**	**DU_t**	**T**	**DT_t**	**Y_{t-1}**	**ΔY_{t-1}**	**F-Value**	**Break Point**	**Series**
AP	0.263 (0.561)	-0.806*** (2.636)	0.004 (0.038)	0.078 (0.811)	0.010 (0.028)	0.557*** (3.253)	19.557***	1997-98	**TS**

AS	-0.418 (0.653)	-1.678*** (2.776)	0.065** (1.924)	0.127 (1.451)	-0.162 (0.603)	0.497*** (4.381)	16.318***	1997-98	**TS**
BI	-1.936 (1.235)	1.753*** (2.221)	0.071 (0.760)	-0.145 (1.455)	-0.431 (1.460)	0.344*** (2.112)	6.235	1995-96	**DS**
GU	-0.027 (0.033)	-1.512*** (4.596)	0.085** (1.925)	0.031 (0.416)	-0.097 (0.402)	0.463*** (3.705)	13.826***	1997-98	**TS**
HA	-0.247 (0.619)	-1.448*** (3.499)	0.081** (1.935)	0.071 (1.098)	-0.143 (0.546)	0.453*** (3.388)	11.643***	1997-98	**TS**
HP	-1.833 (1.473)	-4.651*** (2.308)	0.355** (1.983)	0.625** (1.999)	-1.284** (1.962)	0.064 (0.281)	13.786***	1997-98	**TS**
JK	-0.186 (0.192)	-2.633*** (2.432)	0.036 (0.415)	0.394*** (2.696)	-0.153 (0.745)	0.452*** (4.693)	14.288***	1997-98	**TS**
KA	2.465*** (2.947)	1.023*** (3.892)	-0.054*** (2.025)	0.087** (1.896)	-0.609*** (2.367)	0.247** (2.001)	14.101***	1995-96	**TS**
KE	-0.071 (0.252)	-1.517*** (4.622)	0.065** (1.930)	0.048 (0.645)	-0.094 (0.542)	0.466*** (5.343)	19.135***	1997-98	**TS**
MH	0.077 (0.088)	-1.116*** (5.658)	0.058** (1.958)	0.028 (0.611)	-0.073 (0.394)	0.461*** (3.968)	15.523***	1997-98	**TS**
MP	-0.048 (0.196)	-0.989*** (4.615)	0.018 (0.232)	0.060 (0.687)	0.061 (0.211)	0.543*** (4.183)	15.465***	1997-98	**TS**
OR	-0.876 (1.348)	-2.385*** (3.944)	0.124** (1.821)	0.072 (0.522)	-0.002 (0.007)	0.489*** (3.383)	11.921***	1997-98	**TS**
PU	2.171* (1.776)	2.774*** (4.243)	-0.519*** (2.036)	0.526** (1.988)	-0.492*** (2.582)	0.288*** (2.651)	14.005***	1988-89	**TS**

RA	-0.329 (0.605)	-2.498*** (3.836)	0.051 (0.701)	0.122 (0.979)	0.292 (1.285)	0.619*** (5.568)	14.226***	1997-98	**TS**
TN	-0.504 (0.911)	-1.428*** (3.798)	0.031 (0.546)	0.079 (0.944)	0.156 (0.157)	0.566*** (4.172)	12.213***	1997-98	**TS**
UP	-1.260*** (2.344)	-1.824*** (5.395)	0.033 (0.943)	0.155* (1.890)	0.308* (1.721)	0.656*** (5.772)	15.482***	1997-98	**TS**
WB	-1.493* (1.668)	-1.487*** (2.569)	0.052 (0.827)	0.041 (0.401)	0.413 (1.320)	0.669*** (5.425)	17.397***	1994-95	**TS**

*****, ** and *significant at 1%, 5% and 10% level of significance respectively**

Table 2: Endogenous Structural Break Analysis for Employment (Y=L) of IPI by Sen (2003) Approach

Place	**Constant**	**DU_t**	**T**	**DT_t**	**Y_{t-1}**	**ΔY_{t-1}**	**F-Value**	**Break Point**	**Series**
AP	-0.111 (0.066)	-0.581*** (3.667)	0.028 (1.160)	0.026 (0.969)	-0.001 (0.007)	0.516*** (3.814)	8.754*	1997-98	**TS**
AS	-0.081 (0.076)	-1.884*** (4.451)	0.101*** (2.463)	0.071 (1.002)	-0.115 (0.554)	0.481*** (4.465)	17.027***	1997-98	**TS**
BI	-0.729 (0.305)	0.553 (0.897)	-0.001 (0.108)	0.153 (0.365)	0.103 (0.316)	0.539*** (4.638)	31.098***	2005-06	**TS**
GU	-0.913 (0.471)	-1.117*** (4.892)	0.045 (1.402)	0.044 (0.881)	0.070 (0.317)	0.513*** (5.095)	19.691***	1997-98	**TS**
HA	-0.744 (0.382)	-0.987*** (3.665)	0.038 (1.277)	0.061 (1.334)	0.072 (0.255)	0.525*** (3.291)	9.311*	1997-98	**TS**
HP	1.625 (1.554)	-0.944**	0.026* (1.698)	0.158***	-0.265* (1.647)	0.370***	19.465***	1997-98	**TS**

		* (4.266)		(3.974)		(3.781)			
JK	-0.701 (0.533)	3.129*** (2.498)	0.008 (0.314)	-1.741*** (3.314)	0.135 (0.482)	0.582*** (4.891)	15.826***	2004-05	**TS**
KA	-3.813*** (2.351)	-0.865*** (4.962)	-0.034 (1.151)	0.091*** (2.374)	0.531*** (2.312)	0.773*** (5.268)	12.613***	1997-98	**TS**
KE	-3.266 (1.509)	-1.381*** (3.751)	0.027 (0.725)	0.076 (1.158)	0.421 (1.351)	0.699*** (3.908)	9.039*	1997-98	**TS**
MH	-0.059 (0.023)	-1.846*** (3.469)	-0.002 (0.221)	0.945*** (4.324)	0.011 (0.042)	0.502*** (4.683)	20.118***	2004-05	**TS**
MP	-6.054*** (2.288)	0.517* (1.832)	-0.147*** (2.557)	0.119 (1.358)	0.914*** (2.391)	0.969*** (5.839)	15.508***	1999-00	**TS**
OR	-1.736* (1.801)	-2.101*** (5.957)	0.068** (1.943)	0.147* (1.868)	0.218 (1.223)	0.587*** (6.049)	20.379***	1997-98	**TS**
PU	-0.231 (0.170)	-1.171*** (4.245)	0.066 (1.441)	0.031 (0.591)	-0.021 (0.091)	0.472*** (3.778)	13.202***	1997-98	**TS**
RA	-2.658 (1.252)	-1.189*** (2.669)	0.032 (0.666)	0.032 (0.404)	0.371 (1.064)	0.731*** (4.256)	9.792*	1997-98	**TS**
TN	-1.862 (1.151)	-1.894*** (4.923)	0.073* (1.696)	0.083 (1.095)	0.167 (0.788)	0.568*** (4.921)	15.179***	1997-98	**TS**
UP	-3.276 (1.396)	-0.859*** (3.056)	0.012 (0.404)	0.083 (1.120)	0.362 (1.303)	0.861*** (6.417)	18.193***	1997-98	**TS**
WB	-0.314 (0.141)	-0.648*** (3.799)	0.027 (1.632)	0.017 (0.385)	0.015 (0.059)	0.509*** (4.662)	16.685***	1997-98	**TS**

*****, ** and *significant at 1%, 5% and 10% level of significance respectively**

Table 3: Endogenous Structural Break Analysis for Productivity of Labour (Y=Y/L) of IPI by Sen (2003) Approach

Place	Constant	DU_t	T	DT_t	Y_{t-1}	ΔY_{t-1}	F-Value	Break Point	Series
AP	2.031 (1.142)	0.354 (1.631)	-0.101* (1.765)	0.082 (1.444)	0.185 (0.782)	0.595*** (4.866)	10.769***	1995-96	**TS**
AS	-2.722* (1.871)	0.715*** (2.766)	-0.021 (1.509)	0.007 (0.122)	-0.489*** (2.128)	0.393*** (4.658)	23.452***	2000-01	**TS**
BI	-3.952 (1.183)	1.796*** (2.389)	0.068 (0.769)	-0.191*** (2.083)	-0.339 (1.238)	0.378*** (2.304)	6.995	1995-96	**DS**
GU	-1.311 (0.845)	-0.456*** (2.633)	0.029 (1.265)	0.007 (0.214)	-0.231 (0.816)	0.422*** (2.881)	7.326	1997-98	**DS**
HA	0.733 (0.545)	-0.447*** (2.346)	0.047 (1.558)	-0.029 (0.906)	0.182 (0.797)	0.615*** (6.028)	18.029***	1993-94	**TS**
HP	-0.312 (0.106)	2.768*** (2.409)	-0.046 (0.567)	-0.294 (1.443)	-0.116 (0.285)	0.514*** (3.533)	14.873***	1999-2000	**TS**
JK	4.543*** (2.282)	0.996 (1.393)	-0.283*** (2.576)	0.342*** (2.727)	0.391* (1.722)	0.638*** (6.205)	13.259***	1994-95	**TS**
KA	0.683 (1.138)	-1.472*** (2.852)	0.007 (0.948)	0.598** (1.950)	0.152 (1.241)	0.635*** (7.004)	12.929***	2005-06	**TS**
KE	0.641 (0.465)	-0.998*** (3.358)	0.031 (0.795)	0.038 (0.611)	0.121 (0.568)	0.595*** (5.627)	14.143***	1995-96	**TS**
MH	0.451 (0.703)	1.983*** (11.445)	-0.008 (1.248)	-0.952*** (12.729)	0.073 (0.555)	0.511*** (11.041)	177.279***	2004-05	**TS**

MP	-0.659 (0.367)	-0.478*** (2.835)	0.025 (0.693)	0.025 (0.641)	-0.106 (0.370)	0.475*** (3.506)	9.879**	1998-99	**TS**
OR	-1.686 (0.671)	0.834* (1.881)	-0.243 (0.760)	0.235 (0.729)	-0.359 (0.812)	0.372** (1.913)	7.569	1987-88	**DS**
PU	-1.717 (1.493)	2.267*** (4.691)	-0.450*** (2.429)	0.421*** (2.241)	-0.591*** (2.985)	0.256*** (2.141)	13.312***	1988-89	**TS**
RA	-0.076 (0.057)	1.114*** (2.684)	-0.083 (1.290)	0.012 (0.162)	-0.106 (0.587)	0.435*** (5.272)	18.688***	1993-94	**TS**
TN	-0.587 (0.349)	0.385*** (2.274)	-0.028 (1.607)	0.010 (0.375)	-0.163 (0.561)	0.421*** (3.661)	9.827**	1997-98	**TS**
UP	0.482 (0.413)	-1.022*** (4.391)	0.027 (1.127)	0.079 (1.433)	0.120 (0.623)	0.507*** (5.656)	18.879***	1998-99	**TS**
WB	1.532 (0.872)	-1.075*** (3.025)	0.048 (0.999)	0.007 (0.119)	0.295 (1.113)	0.621*** (6.069)	20.326***	1994-95	**TS**

*****, ** and *significant at 1%, 5% and 10% level of significance respectively**

Table 4: Summary Information about the Nature of the Series

Variables	TS States	DS States
Y	AP, AS, GU, HA, HP, JK, KA, KE, MH, MP, OR, PU, RA, TN, UP & WB	BI
Y/L	AP, AS, HA, HP, JK, KA, KE, MH, MP, PU, RA, TN, UP & WB	BI, GU, OR
L	AP, AS, BI, GU, HA, HP, JK, KA, KE, MH, MP, OR, PU, RA, TN, UP & WB	None

Table 5: Classification criterion of Different Groups

Group	Features	Performance
A	$t > 0$, $DU_t > 0$, $DT_t > 0$ and Significant - The growth rate is positive for Sample Period and increases after Break Period. - There is a rise in the level at Break Period.	**Good**
B	t Insignificant, $DU_t > 0$, $DT_t > 0$ - No conclusion can be made about the growth rate for Sample Period and it increases after Break Period. - There is a rise in the level at Break Period.	**Satisfactory**
	$t > 0$, $DT_t > 0$ and $DU_t < 0$ - The growth rate is positive for Sample Period and increases after Break Period - There is a fall in the level at Break Period.	
	$t < 0$, $DT_t > 0$ and $DU_t > 0$ - There occurs a negative growth rate for Sample Period and after Break Period the growth rate increases. - The level increases at Break Period.	
C	t Insignificant, $DT_t > 0$ and $DU_t < 0$ - No conclusion about growth rate for Sample Period. - But after Break Period, the growth rate increases and there is a fall in the level at Break Period.	**Moderate**
	t and DT_t Insignificant, $DU_t > 0$ - No conclusion about the trend for Sample Period and change in growth rate after Break Period. - But there is a rise in the level at Break Period.	
	$t < 0$, $DT_t > 0$ and DU_t Insignificant - There occurs a negative trend for Sample Period and growth rate increases after Break Period. - But no conclusion about the level at Break Period.	
	$t < 0$, D_t Insignificant, $DT_t > 0$ - There is a negative trend for Sample Period but no conclusion about the change in growth rate after Break Period. - Also there occurs a rise in the level at Break Period	
	t Insignificant, $DT_t < 0$, $DU_t > 0$ - No conclusion about the trend for Sample Period. - But after Break Period, the growth rate decreases and there is a rise in the level at Break Period.	
	$t < 0$, $D_t < 0$ and $DU_t > 0$ - There is a negative trend for Sample Period. - After Break Period, the growth rate decreases and there is a rise in the level at Break Period.	
	$t > 0$, DT_t Insignificant and $DU_t < 0$ - There is positive growth rate for Sample Period but no conclusion about the change in growth rate after Break Period. - Also there occurs a fall in the level at the Break Period.	
D	t Insignificant, DT_t Insignificant and $DU_t < 0$ - No conclusion about growth rate for Sample Period and change	**Bad**

Group	Features	Performance
	in growth rate after Break Period. - But there is a fall in the level at Break Period.	
	$t < 0$, DT_t and DU_t Insignificant - There occurs a negative trend for Sample Period but no conclusion about the change in growth rate after Break Period and also level at Break Period.	
	t, DU_t and DT_t Insignificant - No conclusion about the trend for Sample Period and also about the change in growth rate after Break Period and level at Break Period.	

Table 6: Performance of States

Group	Performance	Variables		
		Y	**Y/L**	**L**
B	**Satisfactory**	HP, KA & PU	PU	HP , OR
C	**Moderate**	AS, GU, HA, KE, MH,OR, JK, UP	KA,AS, HP,RA, TN,JK, MH	AS, TN, WB, KA, MH, MP, JK
D	**Bad**	AP,MP, RA, TN, WB	HA, KE, MP, UP, WB , AP	AP, GU, HA, KE, PU, RA, UP, BI