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Does Bihar Faces Breaks in Its Economic Growth?

KEYWORDS: Economic Growth, Time Series, Structural Breaks, Stationarity.

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ABSTRACT *The present study aims to apply the structural breaks in the series of economic growth in terms of state domestic production and per capita state domestic production of Bihar states in India. Data has been utilized from the Handbook of Statistics on Indian Economy for the period 1980-81 to 2011-12 for Bihar. There are four break points i.e. 1985, 1998, 2003 and 2007 in the series of SDP and two break points i.e. 1999 and 2007 in the series of per capita SDP of Bihar in 32 years. The average annual growth rate for the period 1980-85, 2004-07 and 2007-11 in SDP of Bihar experiences higher average annual growth rate for the period under study i.e. 1980-11. Per capita SDP of Bihar experiences lower per capita growth for the period 1980-99 (i.e. 0.20) than overall study period i.e. 1980-11 (i.e. 0.79).*

I. Introduction:

Bihar, comprising 37 districts and about 94,163 sq. km area with population 82,878,796 as per census of 2001 is third largest state in the country in terms of population after Uttar Pradesh and Maharashtra. Total area of the state was 174000 sq km as per census of 1991 but it is reduced now due to division of the state in 2000. A new state, Jharkhand has been formed on 15th Nov. 2000. Bihar finds mention in the Vedas, Purans, epics, etc. and was the main scene of activities of Buddha, and 24 Jain Thirthankars. Great rulers of the state before the Christian era were Bimbisar, Udayian who founded the city of Pataliputra, Chandragupta, Maurya and Emperor Ashoka and Maurya dynasty, were the prominent rurlers of the state in past. Muslim rulers made in-roads into the territory during the medieval period. The first conqueror of Bihar was Mohammed-bin-Bakhtiar Khalji. The Tughlugs and then the Mugals followed the Khilgis. One of the major states of the Indian Union, Bihar is bounded on the north by Nepal, on the east by West Bengal, on the west by Uttar Pradesh and on the south by Jharkhand. The river Ganga, which is most important river of the state, runs through the entire length of Bihar from west to east. The other rivers are Ghaghara, Gandak, Kosi, Durgawati, Karmnasa, Falgu, Poonpoon, Son etc.

To assess the economic growth of region or state, total and per capita State Domestic Product (SDP) is extensively used by the scholars, researcher and policy makers. Although this indicator does not throw light on the distribution of income but they are used for comparing level of development of a state/region at various point of time. The presence of breaks in series leads to changes in the estimates of the parameters which has serious implications on intercept, changes in correlation and volatility of the series. These breaks are due to structural adjustment programmes, policy implication, shocks, or any other reason. The structural change means that at least one of the estimates of parameters has changed at some point. Bai and Perron (1998, 2003) consider the problem of estimation and inference in a linear regression model allowing for multiple shifts and developed some useful tests for endogenously determining multiple structural breaks.

The identification of structural breaks in the series is very important for analysing the changes and evaluating impact of shifts due to change in policies in the economy. Shannon and Moazzami (2014), used Bai and Perron's method for detecting multiple, unknown structural breaks to estimate natural rates of unemployment for 19 OECD countries from 1955-2011. Noriega and Ramirez-lamora (1999) presented the evidence of multiple structural break under the via global and sequential search method in Mexico's Real and per capita real GDP.

Researcher like Nagraj (1990, 1991, 2006, 2009), Dholakia (1994 2007), Panagaria (2004), Wallack (2004), Sinha and Tejani (2004), Nayyar (2006), Balakrishnan and Permeshwaran (2007, 2007a) and Dholakia and Sapre (2011) examine breaks in growth of aggregate series and sector level series of the Indian economy.

Srivastava and Shanmugam (2012) in their working paper employed Bai Perron procedure to identify the presence of structural breaks and their timings in four study variables, namely aggregate GDP, GDP agriculture, GDP industry and GDP services during 1950-51 to 2011-12. They found that the GDP has three break points, the GDP agriculture contains one while the GDP industry and the GDP services contain each four breaks, and all variables are trends stationary with multiple structural breaks.

Choudhury and Biswajit (2014) estimated multiple structural breaks in the components of subsector of services GDP and GDP at constant prices (at 2004-05 prices) at factor cost for the period 1950-51 to 2009-2010. They found three break points in the GDP series i.e. 1978-79, 1990-91, 2001-02 and they also found that the growth rates are highest mainly the third and fourth regime at the sectoral level and at the aggregate level.

These are the highlights of the survey on literature on structural break of economic growth in India. As stated earlier, macroeconomists in India have generally not taken into account structural breaks in various time series including all aggregate macro variables. However, for some important series like growth in real GDP, there has been a discussion regarding the timing of the structural break. One contention is that there was a structural break in 1980-81 in the case of India" s aggregate real GDP. A number of studies (Bhattacharya and Sakthivel 2004, Ahluwalia 2000 and 2002, Rao, Shand and Kalirajan 1999, Shand and

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Bhide 2000, Pandey and Dixit 2010 and Jaman and Kadamtala 2014) have used pre-revised state domestic product (SDP) data to analyse the performance of state wise domestic product. Bhattacharya and Sakthivel in their study covered data for the period up to 1999-2000 and compared the pre- and post-reform periods by correcting the data series on the basis of 1993-94 SDP data. Pandey and Dixit (2010) in their paper detected unit root in SDP and per capita SDP for the major twenty Indian states for the period 1980-81 to 2006-07. Further this study does not focus on the structural breaks in the SDP series of Indian federal system. Jaman and Kadamtala (2014) adopted estimation and testing of multiple structural breaks in linear growth model to identify the phases of economic growth in Mizoram since 1980. It is evident from the estimation that most of the breakdates lie mainly in 1984-85, 1992-93, and 1998-99.

In the light of above the present paper is organized as follows. Section II deals with Data and Methodology. Empirical Findings of the study are discussed in Section III. Section IV concludes the paper.

II. Data and Methodology

For a proper comparison of stationarity over time and breaks, the revised series of SDP should be extended backwards. Data for the study has been utilized from the Handbook of Statistics on Indian Economy (20013-14). However, data for the SDP is not available for the period 1980 to 2011 on a common series.

II.1 Test for stationarity:

The traditional approach relating to test of stationarity is based on autocorrelation function, Box-Pierce Q statistics and Ljung Box (LB). An alternative test of stationarity that has become popular now a day is known as Unit Root test. This test was popularized by Dickey and Fuller (1979) for detecting unit root test in time series data. The test performs a modified DF test for a unit root in which the series has been transformed by a generalized least square regression. Another test for stationarity was suggested by Phillips and Perron (1988). ADF tests use a parametric auto-regression to approximate the ARMA structure of the errors in the test regression but Phillips-Perron (PP) test ignores any serial correlation in the test regression. The PP tests correct for any serial correlation and hetroskedasticity in the errors.

II.2 Test for detecting structural breaks:

The problem of testing structural breaks large number of contribution witnessed econometric literature. Andrews (1993, 1993b), Andrews and Ploberger (1994), Hansen (1997), Bai and Perron (1998, 2003) and Zeileis and etal (2003, 2015) contributed in the literature. For detecting structural breaks in the series Bai and Perron (1998, 2003) provides a comprehensive treatment of various issues in the context of multiple structural changes in a single equation. Zeileis and etal (2015) developed a programme 'strucchange' for detecting multiple breaks. The package 'strucchange' can be downloaded from the comprehensive R Archive Network (CRAN).

The methodology on structural break may be found in Bai and Perron (1998). Consider the model:

$$Y_t = X_t^I\beta + Z_t^I\delta_j + u_t \qquad (t = T_{j-1}+1, \dots\dots, T_j)$$

Y_t is the observed independent variable, $X_t\ (p\times 1)$ $X_t\ (p\times 1)$ and $Z_t\ (q\times 1) z_t\ (q\times 1)$ are vectors of covariats and β and $\delta_j (j = 1, \dots\dots, m+1) \delta_j (j = 1, \dots\dots, m+1)$ are the corresponding vectors of coefficients, u_t is the disturbance. The purpose is to estimate the unknown regression coefficients together with the break when observations on variables are available. When p=0 this model becomes pure structural change model. The method of least square principal has been applied. The method of estimation is based on CLRM principal.

The relationship subject to m breaks up to time T,

$$Y_t = Z_t^I\delta_1 + \hat{u}_t \qquad (t = 1, 2, T_1)$$

$$Y_t = Z_t^I\delta_2 + \hat{u}_t \qquad (t = T_1+1, \dots., T_2)$$

..

$$Y_t = Z_t^I\delta_m + \hat{u}_t \qquad (t = T_m+1,\ T)$$

For each partitioned, the CLRM estimates of are obtained by minimizing the sum of square of residuals i.e.

$$\sum_{i=1}^{m+1}\sum_{t=T_{i-1}+1}^{T_i}(u_t)^2 = \sum_{i=1}^{m+1}\sum_{t=T_{i-1}+1}^{T_i}\left[Y_t - Z_t^I\delta_j\right]^2$$

Substituting value of estimates in the objective function, the estimated break points

$$(\hat{T_1}, \hat{T_2}, \dots..\hat{T_m}) = argmin_{(T_1, T_2, \dots..T_m)} S_T(T_1, T_2, \dots..T_m)$$

Where, the minimization is considered for over all partitions. The break points are discrete parameters and can only take a finite number of values. These break points can be estimated by a grid search. Many hierarchical algorithms have been proposed by Bai (1997) and others.

A common procedure to select the dimension of a model is to take in to account Bayesian Information Criterion (BIC) (Yao1988).

$$BIC(m) = ln\sigma^2(m) + p^*\ln(T)/T$$

Where $p^* = (m+1)q + m + p$ and $\sigma^2(m) = T^{-1}S_T(T_1, T_2, \dots..T_m)$.

A dynamic programming algorithm for structural change models in CLRM context was developed by Bai and Perron (2003). Zeileis, Kleiber, Kramer and Hornik (2003) developed a much easier process for detecting breaks in the series using Bai and Perron (2003) procedure.

Also in the present study average annual growth rate has been calculated by using dummy variable approach (Boyce method 1986). For this purpose, the technique of slope dummy and intercept dummy has been employed.

$$\ln Y_t = \alpha_0 + \alpha_1 t + \alpha_2 d_1 + \alpha_3 d_1 t + \alpha_4 d_2 + \alpha_5 d_2 t + \alpha_6 d_3 + \dots\dots\dots\dots + \alpha_{j-1} d_m + \alpha_j d_m t + u_t$$

Where, t is time trend. Dummy d takes value zero for the

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first break period and 1 for remaining period and so on. The growth rates are calculated for the break period under pure structural change in the series.

III.1 Findings of the study: State Income and Per Capita Income of Bihar

The SDP of Bihar moved up from Rs. 291.6 billion in 1980-81 to Rs. 470.91 billion in 1990-91 and further Rs. 627.01 billion in 1999-2000 to Rs. 1302.81 billion in 2011-12. It reveals approximately 4.46 fold increase over 1980-81. This indicates that rate of increase in state income of Bihar is lower than the national income. Per capita income of Bihar continues to be far behind the per capita income of the country. The per capita state income was Rs. 6051 as against Rs. 11120 for the country in 1980-81. Approximately after three decades, per capita income of Bihar was Rs. 13226 against national per capita income that was Rs. 44118 in 2011-12. Thus, during the span of about thirty years, per capita national income has increased by 2.34 times while the state's per capita income has risen by only 3.97 times.

The forgoing analysis shows that although total as well as per capita income of Bihar has risen but its relative contribution in national income and per capita income has been declining over the period 1980-81 to 2011-12. It shows that the rate of economic growth of Bihar has been far behind than the growth of the national economy.

III.2 Stationarity of SDP and Per capita SDP:

Augmented Dickey Fuller and Phillip Perron test for SDP and per capita SDP and log of SDP and per capita SDP has applied and the results are presented in table 1. DF/ADF test suggests that log of SDP and per capita SDP of Bihar is having one unit root at the level. The SDP series is I(1) in the logarithm of SDP and per capita SDP.

Table 1: Stationarity Test (Dickey Fuller and Phillip Perron) for SDP and Per capita SDP of Bihar

States/Test		Statistics *	Difference	Statistics	Difference
Bihar (1980-2011)					
DF/ADF					
SDP	tau "	-8.023	first difference	-10.516	first difference
Per capita SDP	tau "	-8.798	first difference	-10.357	first difference
PP test					
SDP	Z(rho)	-51.217	first difference	-51.387	first difference
	Z(t)	-7.521		-9.723	
Per capita SDP	Z(rho)	-51.828	first difference	-51.864	first difference
	Z(t)	-8.092		-9.476	

Note: * Log series; all the values are significant at 1% Critical values; Data has been taken from Handbook of statistics on Indian Economy, calculated with the help of STATA11.0

Table reveals that PP test for SDP, log of SDP, per capita SDP and log of per capita SDP for the Bihar has not been stationary at level for. PP test shows similar results for the presence of unit root in the series of SDP and per capita SDP of Bihar.

III.3 Structural Breaks in SDP and Per capita SDP:

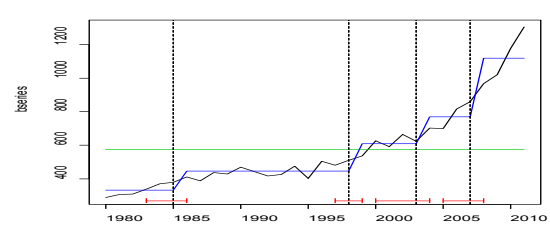
The structural breaks and their dates in the series Bai and Perron (2003) methodology has been adopted. Strucchange package (in R framework) developed by Zeileis and etal (2013) used to test for structural breaks and break dates without imposing any external information for the series of SDP and per capita SDP of the Bihar (1980-2011) and the result are presented in table 2. For choosing number of breaks minimum BIC criterion has been used. BIC test suggest that there are four break points i.e. 1985, 1998, 2003 and 2007 in the series of SDP of Bihar in 32 years. Test also suggests two break points i.e. 1999 and 2007 in the series of per capita SDP of Bihar. BIC and RSS plots are also presented in the table for SDP and per capita SDP for the state Bihar. Graph 1 and 2 represents in the shift in series, structural break dates and their confidence intervals in SDP and per capita SDP of Bihar for the period 1980-2011.

In this table average annual growth rate is also presented. Average annual growth rate for these periods i.e. 1980-85, 1985-98, 1998-2003, 2003-07 and 2007-11 are 2.48, 0.66, 1.53, 3.31 and 4.50 in terms of SDP respectively. Average annual growth rate for these periods i.e. 1980-99, 1999-2007, and 2007-11 are 0.20, 1.34, and 3.89 in terms of per capita SDP respectively. The average annual growth rate for the period 1980-2011 is 1.74 in terms of SDP and 0.79 in terms of per capita SDP. The average annual growth rate for the period 1980-85, 2004-07 and 2007-11 in SDP of Bihar experiences higher average annual growth rate for the period under study i.e. 1980-2011. While in terms of per capita SDP of Bihar experiences lower per capita growth for the period 1980-1999 (i.e. 0.20) than overall study period i.e. 1980-2011 (i.e. 0.79). The analysis reveals the fact that structural breaks are observed when there is change of power of the political parties and political stability in the states. One of the main reasons behind shift in the growth rate of SDP and per capita SDP is change in the policies of government at central and state level. Based on the location and geographical condition there is huge potential in the states to achieve growth rate in SDP more than 7 percent. The state is not able to utilise its huge human resources and the advantage of location. If this state focused on the skill development and small business there is possibility to achieve rapid economic growth.

Table 2: Breakpoint, RSS, BIC, Break dates and Average Annual Growth rate of SDP and per capita SDP of Bihar

Breakpoints	0	1	2	3	4	5
SDP						
RSS	2014743.366	529635.648	225641.188	165620.684	124660.2	107205.3
BIC	451.35	415.53	395.16	392.19	389.88	392.14
Break dates		1985	1998	2003	2007	
Break Periods	1980-85	1985-98	1998-2003	2003-07	2007-11	1980-2011
Growth rate	2.48	0.66	1.53	3.31	4.50	1.74
Per Capita SDP						
RSS	1.02E+08	2.45E+07	1.46E+07	1.21E+07		
BIC	577.1	538.3	528.5	529.5		
Break dates		1999	2007			
Break Periods	1980-99	1999-2007	2007-2011			1980-2011
Growth rate	0.20	1.34	3.89			0.79

Note: calculated with the strucchange package in R, Data has been taken from Handbook of statistics on Indian Economy. Average Annual growth rate has been calculated with dummy variables.



Graph 1: Breaks in SDP of Bihar

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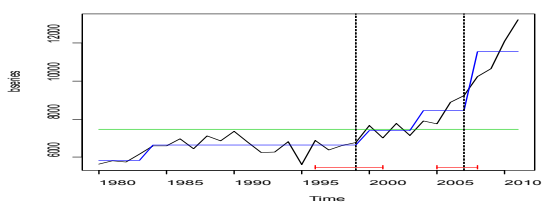

Graph 2: Breaks in Per Capita SDP of Bihar

IV. Conclusion and Policy Suggestions

The main aim of this paper is to test the stationarity of State Domestic Product as well as per capita State Domestic Product for the Bihar using an extended dataset and unit root test. Data has been utilized from the Handbook of Statistics on Indian Economy for the period 1980-81 to 2011-12 for Bihar. The results based on ADF test reveals that State Domestic Product and per capita SDP on the basis of new series for the states are non stationary at level. Similar results have been found with Philips and Perron test of stationarity i.e. SDP and per capita SDP for the states are non stationary at level. In the present study also an attempt has been made to detect on the structural breaks in State Domestic Product as well as per capita State Domestic Product. There are four break points i.e. 1985, 1998, 2003 and 2007 in the series of SDP and two break points i.e. 1999 and 2007 in the series of per capita SDP of Bihar in 32 years. The analysis reveals the fact that structural breaks are observed when there is change of power of the political parties and political stability in the states. One of the main reasons behind shift in the growth rate of SDP and per capita SDP is change in the policies of government at central and state level. Based on the location and geographical condition there is huge potential in the states to achieve two digit growth rates. The state is not able to utilise its huge human resources and the advantage of location. If the policy maker and politician of this state focused on the skill development and small business there is possibility to achieve rapid economic growth of more than 10 percent in the state.

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