ANALYSIS OF IMPACT OF ELECTRICITY PRODUCTION ON ECONOMIC DEVELOPMENT OF THE STATE OF CHHATTISGARH

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Abstract: *Generation of electricity is important in the economic development of state of Chhattisgarh. The GSDP of the Chhattisgarh state is in double digits and there is a constant rise in the percapita income of the residents of the state. In this research paper the factors affecting the production of electricity in the state and its consequent effect on the states GSDP has been examined. The examination of the factors affecting the production of electricity has been performed so as to determine the extent of contribution of these factors in either generation of electricity in surplus or deficit condition. From the analysis it is clear that GSDP of the state is having a significant relationship with per capita income of the state, T&D (Transmission and Distribution) losses incurred by the distribution agencies and coal production in the state. The details of the analysis is presented in the paper.*

Keywords: *GSDP, T&D losses, coal production and electricity generation*

1. INTRODUCTION

Power production in the state of Chhattisgarh has now become an important foundation of the state's economic development, on this foundation stands the industrial hubs and production center that is not only driving the economy of the state but also economy of the nation towards positive growth [1]. The uninterrupted power supply in the state has set an example for other states as well and now is benefiting the farmers, industrial sectors and residents that are below poverty line [2]. Due to easy and uninterrupted availability of power in agriculture sector and industrial hubs, the industrial output from the state as well as the agricultural production in the state has increased many folds when compared to the production of the same when the state was undivided and was a part of the central India's biggest state – Madhya Pradesh [3][7]. The growth in agriculture sector in state of Chhattisgarh is above the average agricultural growth of the nation. Due to tremendous growth in every sector

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in state of Chhattisgarh, the state has now become a major investment hotspot for the private agencies, which is leading to the generation of new sources of employment.

The uninterrupted power supply in the state has not only affected the agricultural and industrial output in the state but has also improved the living standard of the people in the state [8]. The state of Chhattisgarh is self-dependent in terms of power supply to the residents of the state. The state is also the one of the states in India to have a zero power cut in 5 years. Time to time due to wide availability of high quality of coal the state is adding to the power production capacity continuously, by inviting industrial giants such as Adani and GMR groups to establish thermal power plants in the state. The state policies also promote use of non-conventional energy resources for the production of electricity such as animal manure, agricultural by products such as hay and energy from natural resources such as solar and hydel electricity [7]. But still the power production from the nonconventional power sources cannot be compared to the production of electricity from thermal resources hence our present study will only to be focused upon the generation of thermal power and subsequent factor affecting its production and the combined effect of electricity generation over states GSDP.

Many researchers such Babu 2008, have stated that GSDP is the direct indicator of states economic development and if the generation of electricity and its subsequent effect on GSDP has to been analyzed, Grangers Causality Test is recommended [4].

2. GRANGERS CAUSALITY TEST FAILURE AND LIMITATIONS

The first limitation of the study is that the state of Chhattisgarh is a newly formed state and the state came into existence in late 2000 (1st of November). The data available for GSDP of the state and electricity production is available only after that, specifically for Chhattisgarh. Before that the data is affected by the biases that include data for the parent state Madhya Pradesh. Hence the number of data points available for analysis is less than 15. The researcher tried to apply Grangers Causality Test on the data point but encountered the fact that the Economic Growth indicator GSDP is not a stationary series. Hence the process of difference was used to differentiate the series and to convert it to stationary process [4]. The process of converting GSDP to stationary process led to reduction of the data point and the series only become stationary after two differentiation process. Hence reducing the data points to 13. A series with data points lesser than 15 will give an erroneous Causality Test [5][6]. Hence to analyze the variable Multivariable Regression Analysis will be used (Linear). From figure 1 it is visible that the GSDP of the state is a non-stationary process. Hence differentiation of the time series is necessary. A single stage differentiation of the time series results in one point less than the previous number of data points in the process, similarly second stage differentiation process will result in two data points less than the starting non stationary data time series.

Figure 1: GSDP vs Year time graph depicting the exponential growth and non-stationary behavior of the series
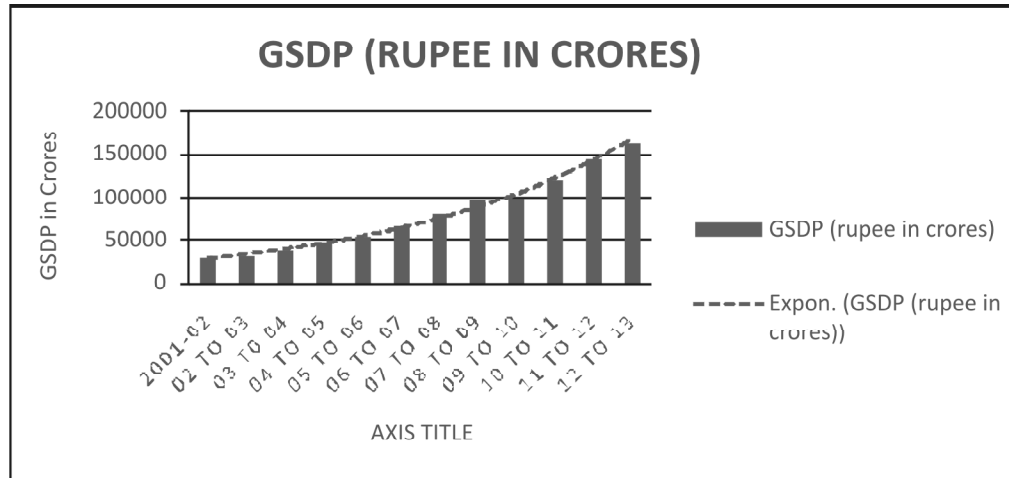
The failure of Granger's causality test for our case is due to the fact the Granger's Test primarily assumes that the both the time series are stationary in nature.

The study has a second limitation that the thermal power plants considered in this research only belongs to the public sector, private sector has been excluded from the analysis as the boom in the private electricity generation in the state came only after 2005. Hence to maintain the consistency in the data only public power generation units has been included.

3. OBJECTIVE OF THE STUDY

The objective of the present study is to:

1. To analyze the present situation of power production and distribution in the state of Chhattisgarh

2. To analyze and see the effects of the factors that affect the power production in the state and its subsequent effects on the states economic development that will be measured using the direct indicator, gross state domestic product (GSDP).

4. HYPOTHESIS OF THE STUDY

1. There is a significant relationship between the GSDP of the state and per capita income of the state.

2. Transmission and distribution losses (T&D loss) incurred by the state's distribution and generation agencies has a significant relationship with the GSDP of the state.

3. The coal production in the state has a significant relationship with the GSDP of the state

4. The GSDP of the state has a significant relationship with the plant load factor.

The hypothesis framed above is based on the fact that the economy of the state is entirely dependent on two factors.First is the power generation in the state and its distribution to industries and other states. Secondly the economy is driven by excavation of mineral in majority coal from the states coal mines. Hence the factors such as T&D losses, plant load factor and coal productions relation with the GSDP will be tested. Percapita income will also be tested for significant relationship as it is widely accepted fact that percapita income has a significant relationship with the economic development of any state or country.

5. METHODOLOGY ADOPTED

The methodology adopted in this research works include collection of the secondary data from authentic resources. The collection of the secondary data depicting factor under consideration was collected from the following mentioned resources.

1. PerCaptia Income of the state and GSDP– Report of Planning Commission of India (Now Known as Niti Ayog) of different years 2000-2013

2. T & D losses in the state – Load Generation and Balance Report (LGBR) of different years 2000-2013

3. Coal Production in the state – Environment and sustainability report of different years, Ministry of Environment

4. Plant load factor and Installed capacity in state– Load Generation and Balance Report (LGBR) of different years 2000-2013

Once the data is obtained for the factors under consideration, the effect of these factors on the state's GSDP will be determined using multivariable regression analysis. Where GSDP of the state will be dependent variable and the factors other than GSDP will be independent variable, whose contribution on states GSDP is to be analyzed.

The multivariable regression analysis is given by the following equation (1).

$$Y = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + \mu \tag{1}$$

Where Y is the dependent variable

a is the intercept

$b_{1\,to}\,b_{5\,is}$ the coefficients for terms x_1 to x_5

μ is the error compensation term

The goodness of fit of the model presented by the above equation will test using F test and if significance F is less than 0.01 (1%) the model will be accepted otherwise the model will be rejected.

6. TIMELINE AND STUDY AREA OF RESEARCH WORK

The present research work focuses upon the situation of power production in the state of Chhattisgarh and its subsequent effect on the state's economy from 2000 to 2013, after the state became and separate state, separating out of than Madhya Pradesh. Due to technical constraint it is not feasible to include details of the same before 2000 as the data will contain the scenario of the Madhya Pradesh region as well.

7. ANALYSIS

Table 1 shows the GSDP (dependent factor) of the state of Chhattisgarh, the sources of the time series for different variables that will be used in the analysis is already mentioned in the Methodology section of this research work.

Table 1
GSDP of the state of Chhattisgarh (Source: Reports of Planning Commission of India)

Year	GSDP (rupee in crores)
2001-02	29539
2002 - 03	32493
2003- 04	38802
2004- 05	47862
2005- 06	53381
2006- 07	66875
2007- 08	80255
2008- 09	96972
2009- 10	99364
2010- 11	119420
2011- 12	144382
2012- 13	163461

From the table 1 it is evident that the GSDP of the state is constantly rising since its formation on 2000. The analysis of the series for GSDP reveals the fact that the GSDP time series is an exponential time series with non-stationary characteristics hence Grangers Causality test is not applicable.

Table 2 shows the data table for independent factors considered in the analysis.

Table 2
Independent factors of analysis (Source: Different Reports from different government agencies of India)

Year	Installed Capacity (MW)	Percapita income	PLANT LOAD FACTOR (%)	T&D Loss	Coal Production in Million Tonnes
2001-02	1400	12443	71.3	30	53.6
02 to 03	1400	13145	69.9	31	56.8
03 t0 04	1400	16098	69.9	27	61.5

contd. table 2

Year	Installed Capacity (MW)	Percapita income	PLANT LOAD FACTOR (%)	T&D Loss	Coal Production in Million Tonnes
04 to 05	1400	18068	72.9	32	69.3
05 to 06	1411	20151	79.7	37	76.4
06 to 07	1668	24556	82.29	32	83
07 to 08	1918.1	29776	80.75	31	90.2
08 to 09	2058	34483	85.91	28.6	101.9
09 to 10	2199	35121	85.25	38.7	110
10 to 11	2199.1	41167	85.31	34.7	113.8
11 to 12	2280	45929	86	32	115
12 to 13	2780	50691	86.1	33.3	116.3

Table 3 shows the output of the regression analysis, computed using the data presented in table 2 and table 3. From the analysis it is clear that Intercept is insignificant (P>0.05). Installed Capacity in Megawatts in state of Chhattisgarh is not significantly contributing in the states GSDP in any way (P>0.05, P=0.92). Percapita Income is significantly contributing in the state GSDP wih P-value less than 0.05 (5% significance level). Plant load factor is not contributing to GSDP of the state while, T&D loss is contributing significantly to states GSDP P-value less than 0.05, and an interesting fact unearthed from the analysis is that the T&D loss is contributing positively in states GSDP increase. While coal production is contributing negatively to states GSDP. F value obtained for the model is 6.5257E-09 which is less than 0.01. Hence the model is significant.

Table 3
Output of Regression analysis (Source: Computed)

	Coefficients	Standard Error	t Stat	P-value
Intercept	-11042.97592	17009.26582	-0.649232955	0.540228814
Installed Capacity(MW)	-0.491696	5.358405365	-0.091761628	0.92987442
Percapita income	4.367826468	0.325169298	13.43246884	1.05453E-05
PLANT LOAD FACTOR (%)	62.85504162	288.4047868	0.217940355	0.834698627
T&D Loss	570.4796619	217.4322006	2.623712865	0.03938983
Coal Production in Million Tonnes	-634.7680477	171.3407832	-3.704710786	0.01003223
R Square	0.999001499			

8. RESULT

From the analysis presented in the section above it can be seen that the Hypothesis that there is a significant relationship between GSDP of the state and Percapita income is true. Similarly GSDP has significant relationship with Transmission and Distribution loss (T&D Loss) and Coal production in the state hence the hypothesis for these factors also holds to be true.

9. CONCLUSION

From the following research work it can be concluded that

1. The GSDP time series obtained from different records and reports is a exponential process, hence it can be said that GSDP of Chhattisgarh State is increasing exponentially.

2. The Granger's Causality Test cannot be applied to the data to test for the causality of the variables as the number of data points is less than 13 after removing the non-stationary feature from the GSDP time series.

3. The factors such as T&D loss, coal production and Percapita income has a significant relationship with GSDP growth.

4. From the table 2, it can be easily observed that even though the installed capacity in the state is increased with plant load factor being increasing with the same, indicating increase in power generation, the T&D losses in the state is nearly stationary with average of approximately 30%, stating that the new technology is needed to minimize the T&D losses in the state. Minimization of T&D losses can result in maximization of Profit for the generation and distribution bodies which can in return result in better services to the people of the state and nation.

5. Due to limitation of unable to apply causality test on the time series it is proposed that after few years the same research can be conducted again to test for causality between GSDP and electricity production in state since the number of data points available for the analysis will be sufficient enough to carry out the test.

6. It can be seen from the analysis that the Installed capacity do not have a significant relationship with the installed capacity of power generation in the state hence it can be said that at present with following available data, the electricity production in the state is not having a significant relationship the economic development of the state. Investigation of the fact will only be possible after application of Granger's Causality Test when the sufficient time series data is available.

References

Anantaram, R. (2010), The Development of the Power Sector in India: Issues and Prospects (ARI). New Delhi: Indian Council for Research on International Economic Relations.

Ankur Omer, S. G. (2013), Indian Power System: Issues and Opportunities. *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, 2 (3), 1089-1094.

Babu, M. G. (2010), An Overview on Power Scenario and the Need of Nuclear Power in India. New Delhi: Kudankulam Nuclear Power Plant.

Bank, T. W. (2008), Residential Consumption of Electricity in India. New Delhi: The World Bank.

Cea. (2013), National Electricity Plan.New Delhi: Cea.

Dr. C. K. Chanda, A. G. (2013), Assessment of Distributed Generation in a Deregulated Power Market Scenario in India. *International Journal of Emerging Technology and Advanced Engineering*, 3 (3), 1-6.

FICCI. (2013), Power Transmission. New Delhi: FICCI.

G. Pollitt, W. Y. (2009), Does Liberalisation Cause More Electricity Blackouts? Evidence from A Global Study of Newspaper Reports.Cambridge: ESRC.