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AN EMPIRICAL ANALYSIS OF EFFECT OF PUBLIC DEBT ON ECONOMIC GROWTH IN INDIA IN THE POST-REFORM ERA

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ABSTRACT

The present paper examines the causal nexus between public debt and economic growth for 15 NSC states of India for the period 1991-2015 using Dumitrescu Hurlin causality test. The panel causality test identified the endogeneity issue as it revealed the bidirectional causality between these two variables. Further, we revisited the effect of public debt on economic growth for NSC states for the same period by incorporating other controlled variables in the model. Understanding the potential endogeneity issue, we employed FMOLS which solves the endogeneity as well as serial autocorrelation problem in the model. The results of the present study revealed that public debt, total revenue receipts and total credit have favorable effect on economic growth. As regards policy implications, the government should adopt proper tax reform strategies to minimize tax leakages. Further, it should implement effective credit and risk management practices to improve the asset quality. Lastly, suitable debt management strategy should be adopted to utilize debt in the most effective and proficient way to expand productivity capacity of the economy. This, in turn, will sustain high economic growth in India.

Keywords: Public debt, Economic growth, Indian States, Dumitrescu Hurlin causality, Endogeneity, FMOLS.
JEL Classification: H630, O4, R5, C33.

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Contribution/ Originality

This study contributes to the existing literature by analyzing the causal nexus between debt and growth for 15 NSC States for India over the period 1991-2015 using Dumitrescu Hurlin causality test. We estimated the effect of public debt on economic growth applying FMOLS approach that solves potential endogeneity problem.

1. INTRODUCTION

Whether public debt is a drag on the economic growth of a state or if it lends a vital nudge to economic growth, continues to remain a much mooted over puzzle. Particularly in a country like India where incurring public debt is a

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method to undertake investment in the much desired economic development, the question is of great significance. This makes an analysis, into the relationship between the public debt and economic growth, urgent and imperative.

The persistent increase in government expenditure enlarges the fiscal deficit gap, and necessitates that the government hinge on public debt from both the sources, internal and external. Though the government of India endeavors to contain the fiscal deficit by encouraging an inflow of foreign investment and disinvestment, high subsidies on food and fertilizer pose a serious challenge before sustaining a lower fiscal deficit. High fiscal deficits, resulting in heavy public debt, diminish the prospects of the economic growth of the nation.

It can be observed from these trends that the total debt that include sum of debt and other liabilities of the central government has significantly increased. During 1990-91, total debt as percentage of GDP was 53.7% which rose up to 61.5% during 2004-05. Although in the last few years, total debt has slightly come down, it still amounted to 50% of GDP during the year 2014-15. Public debt (sum of internal debt and external debt) amounted to 42.3% of GDP during 2002-03 from 31% during 1990-91. During 2014-15, Public debt was still high (close to 39%). The average central government debt was 53.1% of GDP during the early reform period from 1992-93 to 2003-04 while in the later reform period (2004-05 to 2014-15) it was 55% (Handbook of Statistics on Indian Economy, 2015). Similarly, the average public debt was 34.4% during the early reforms period which soared up to 39% during the later reforms period. Total internal debt as percentage of GDP was 26% during 1990-91 which rose to 40% during 2003-04. It slightly declined to 37% during the year 2014-15. In the early reform period, the average internal debt as percentage of GDP was 30% which significantly increased to 36% during the later reforms period. In this context, it has become essential to re-examine the effect of public debt on economic growth in Indian context.

Further, in the present paper, the panel causality results from non-special category Indian states revealed the bidirectional causality between public debt and economic growth in India for the period 1992-2015. Realizing the endogeneity issue in the relationship between public debt and economic growth, we employed fully modified OLS. The novelty of the paper is that we examined the effect of public debt on economic growth in Indian context taking into account 15 non-special category states in the post reforms period. No state level panel studies are available in Indian context in the debt-growth literature to the best of our knowledge. Hence, this study will add to the existing debt-growth nexus literature by analyzing the causal nexus between debt and growth and also examining the effect of debt on economic growth.

The rest of the present paper is set out as follows. Section 2 outlines the analytical framework, while Section 3 explains the issues related to data and methodology pertaining to the empirical exercise undertaken in the study. Empirical results examining the causal nexus between the public debt and economic growth; and the effect of public debt on economic growth in India are discussed in Section 4. Finally, Section 5 concludes with policy implications.

2. ANALYTICAL FRAMEWORK

According to debt overhang theory if the debt of a country is more than its repayment capacity, this discrepancy will negatively affect investment and the ability to work and therefore affect the growth of the economy. Pattillo *et al.* (2002) argued that debt has an inverted U-shaped relationship on economic growth.

The growth function can be extended by incorporating the variables namely, total debt (total outstanding liabilities), total revenue receipts, total credit of the scheduled commercial banks and per capita electricity consumption.

The present study estimated the following growth function.

$$Y = f(D, RR, CRDT, ELEC) \quad (1)$$

This study uses the FMOLS (fully modified Ordinary Least Square) technique to establish the output equation for 15 non-special category states of India for the 26-year period, 1991 to 2015.

$$Y_t = A_t D_t^{\alpha} \quad (2)$$

$$Y_t = A_t D_t^{\alpha} RR_t^{\beta} \quad (3)$$

$$Y_t = A_t D_t^{\alpha} RR_t^{\beta} CRDT_t^{\mu} \quad (4)$$

$$Y_t = A_t D_t^{\alpha} RR_t^{\beta} CRDT_t^{\mu} ELEC_t^{\gamma} \quad (5)$$

$$Y_t = A_t D_t^{\alpha} RR_t^{\beta} CRDT_t^{\mu} ELEC_t^{\gamma} \quad (6)$$

Where, α, β, μ,γ are treated as the elasticity coefficients of the total debt (D), total revenue receipts (RR), total credit of all scheduled commercial banks (CRDT) and per capita electricity consumption (ELEC) . Taking the logarithm in both sides of the Eq-(6), we find:

$$\ln Y_t = A_t + \alpha \ln D_t + \beta \ln RR_t + \mu \ln CRDT_t + \gamma \ln ELEC_t \quad (7)$$

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2.1. Debt and Economic Growth

That public debt weighs down on the economic growth has been often stated as a rationale for fiscal austerity measures. That goes on to imply that an expansionary fiscal policy led stimulus to economic growth, in fact results in a lower growth in the long run. By and large, policy makers tend to borrow this faith to argue that a higher public debt eventually will cement into a lower long-run economic growth rate (Schclarek, 2004; Presbitero, 2005).

The traditional view holds that in the long run debt incurred by the government is an impediment to the economic growth. Fuelled by an increased fiscal expenditure, there is increase demand in the short run. This leads to expansion in both output and employment. Consequently, as the marginal propensity to consumption outruns marginal propensity to save, private savings suffer. This eventually will result in a spike in the interest rate. And in the long run, owing to the increase in the interest rate, private investment would be hindered. Furthermore, if the shortage in domestic savings is matched by an increase in borrowings from abroad, it would lead to an increased foreign debt. In the overall picture therefore, in due course of time, output contracts, consumption falls and overall welfare seems to hit a downswing.

Do high levels of public debt reduce economic growth? This is an important policy question. A positive answer would imply that, even if effective in the short-run, expansionary fiscal policies that increase the level of debt may reduce long-run growth, and thus partly (or fully) negate the positive effects of the fiscal stimulus. Most policymakers do seem to think that high public debt reduces long-run economic growth.

In both the overlapping generation models of growth (Modigliani, 1961; Diamond, 1965; Blanchard, 1985) and the endogenous growth models (Barro, 1990; Saint-Paul, 1992) the effect of public debt on economic growth is negative. The negative ramifications of higher public debt on economic outcomes are magnified if it contributes towards escalating uncertainty and also if it tinkers with expectations relating to future financial developments, if it interferes with the productivity of public expenditure (Teles and Mussolini, 2014) and adds to the creation of upsurges in sovereign risk (Codogno *et al.*, 2003) thereby effecting a rise in the real interest rates that eventually translate into lower private investment (Tanzi and Chalk, 2000; Laubach, 2009).

Most of the developing nations are generally characterized by reasonably high levels of indebtedness. Debt can be a boom when it is utilized in an effective and proficient way to realize the macroeconomic goals of the nation.

When a country makes use of its borrowed funds to expand the productive capacity of the economy, debt favors economic growth. In the aggregate model of Modigliani (1961) accumulation of debt can have positive effect on real economic activity if the rise in debt is accompanied by government expenditure on productive public capital formation. Further, a capital scarce country benefits from capital accumulation if the marginal product of capital exceeds the world interest rate (Modigliani, 1961; Diamond, 1965). Moreover, the adverse effect of a recession on private investment can be nullified by the government incurring additional expenditure, and thus debt, to keep up the full-employment rate of capital formation (Moore and Thomas, 2010). Trends in debt (%GSDP) and GSDP growth rate for all NSC states are depicted in appendix (see Fig.2).

2.2. Revenue Receipts and Economic Growth

Revenue Receipts comprises of tax-revenue and non-tax revenue. Tax-revenue consists of taxes and duties levied by the State/Union government such as sales tax, motor vehicle tax, electricity duties, income tax, corporate tax, excise duty, customs duty, service tax, etc., and non-tax comprises of interest payment on loan and advances, profit and dividend from public enterprises, share in central taxes and grants in ad from central to state, etc.

Economic growth is characteristic, of an increased prosperity. It is measured as an increase in the production capacity of goods and services of an economy from one period to the other. Fundamentally, investment in new capital to generate infrastructure and machineries, enactment of new techniques of production, introduction of new products, etc. are the elements of the economic growth.

Revenue Receipts (RR) play a pivotal role in economic growth and development. It not only finances the essential expenditures of the government, but also, helps to reduce recourse of public sector or market borrowing of government. A higher level of RR is instrumental for the government expenses and these expenses if mapped to development sector, lead to heightened economic growth. If RR falls short of the expected expenditure of government, it would bring in more market borrowing that will further lead more interest payments which adversely affect the economy. Trends in Revenue receipts (%GSDP) and GSDP growth rate for all NSC states are depicted in appendix (see Fig.5).

2.3. Bank Credit and Economic Growth

Total bank credit is one of the important catalysts creating demand for goods and services. Increase in bank credit creates demand for goods and services which, in turn, creates employment, raises income levels, and savings. Barring the changes in inflation, availability of bank credit certainly fuels economic growth, at constant or increased supply of goods and services. Thus, growth of an economy is affected by bank credit. Hence, the expected sign of the coefficient of Total Credit is positive.

2.4. Electricity Consumption and Economic Growth

Power sector is an important infrastructure component for growth of an economy. The availability of reliable, quality and affordable power is critical for rapid growth in agriculture, industry and for overall economic development of a nation. An efficient, resilient and financially healthy power sector is an essential requirement for growth of a State and economic empowerment of the common man. We have taken per capita annual electricity consumption as a proxy for physical infrastructure development. Its coefficient is expected to be positive in the model.

3. DATA AND METHODOLOGY

Data on Gross State Domestic Product (GSDP), Outstanding Liabilities (DEBT), Total Revenue Receipts (TRR), Total Credit of all Scheduled Commercial Banks (CRDT) and Per Capita Annual Electricity Consumption (ELEC) for all non-special category states for the period 1992-93 through 2014-15 have been obtained from EPW Research Foundation database. We have considered the non-special category states [(Andhra Pradesh (AP), Bihar (BHR), Goa (GOA), Gujarat (GUJ), Haryana (HARY), Karnataka (KARNT), Kerala (KERLA), Madhya Pradesh (MP), Maharashtra (MH), Odisha (ODI, Punjab (PUN), Rajasthan (RAJ), Tamil Nadu (TN), Uttar Pradesh (UP), West Bengal (WB)] in the present study. All the variables such as GSDP, DEBT, TRR, CRDT and ELEC have been transformed into logarithmic form. GSDP at current prices has been considered in the model. Outstanding liabilities has been taken as debt in the present study. Outstanding liabilities mainly include total internal debt, loans from banks and FIs, loans and advances from centre, provident funds, reserve funds, deposit and advances, contingency funds. Total Revenue Receipts comprise both the tax revenue and non-tax revenue of the tax. Per capita electricity consumption constitutes both utilities and non-utilities.

3.1. Endogeneity Issues

The issues of endogeneity and the assessment of likely direction of the bias can be explained with the help of a bivariate model in which growth (G) is a function of debt (D).

$$G = \alpha + \lambda D + \varepsilon \tag{8}$$

and debt (D) is a function of growth (G)

$$D = \beta + \phi G + \nu \tag{9}$$

The OLS estimator of b is then given by:

$$\hat{\lambda} = \frac{\lambda\sigma_\nu^2 + \phi\sigma_\varepsilon^2}{\sigma_\nu^2 + \phi^2\sigma_\varepsilon^2} \tag{10}$$

and the bias of the OLS estimator is:

$$E(\hat{\lambda}) - \lambda = \frac{\phi(1-\lambda\phi)}{\sigma_\nu^2 / \sigma_\varepsilon^2 + \phi^2} \tag{11}$$

Since stability requires that $\lambda\phi < 1$, Eq. (2) shows that OLS estimations are unbiased if and only if $\phi = 0$. (i.e., if debt is not endogenous). Moreover, if ϕ is negative (as it is likely to be), OLS estimates are negatively biased.

Thus, the asymptotic distribution of the OLS estimator depends on nuisance parameters arising from endogeneity of the regressors and serial correlation in the errors. To solve these problems, FMOLS (fully modified OLS) is implemented in the present analysis.

3.2. Fully Modified Ordinary Least Square (FMOLS) Estimator

Consider the following model:

$$y_t = \mu + \beta' x_t + u_{1t} = \theta' z_t + u_{1t} \tag{12}$$

$$\Delta x_t = u_{2t} \tag{13}$$

for t=1,…..,T,

$$\theta = (\mu, \beta')', z_t = (1, x_t')'$$

For $u_t = (u_{1t}, u_{2t})$, we assume that the functional central limit theorem (FCLT) can be applied as follows:

$$\frac{1}{\sqrt{T}} \sum_{t=1}^{[Tr]} \Rightarrow W(r) = \begin{bmatrix} W_1(r) \\ W_2(r) \end{bmatrix} \quad (14)$$

For $0 \leq r \leq 1$, where W(r) is a Brownian motion on [0,1] with a variance-covariance matrix $\Omega(W(\cdot) \backsim BM(\Omega))$. Note that long-run variance of u_t and its one-sided version can be expressed as:

$$\Omega = \sum_u + \Pi + \Pi'$$

$$\Lambda = \sum_u + \Pi, \text{ with } \sum_u = \lim_{T \to \infty} T^{-1} \Sigma_{t=1}^{T} E(u_t u_t') \text{ and}$$

$$\Pi = \lim_{T \to \infty} T^{-1} \Sigma_{j=1}^{T-1} \Sigma_{t=1}^{T-j} E(u_t u_{t+j}')$$

Ω and Λ can be conformably partitioned with u_t as:

$$\Omega = \begin{bmatrix} \omega_{11} & \omega_{12} \\ \omega_{21} & \Omega_{22} \end{bmatrix}$$

$$\Lambda = \begin{bmatrix} \lambda_{11} & \lambda_{12} \\ \lambda_{21} & \Lambda_{22} \end{bmatrix}$$

It is known that the OLS estimator of θ, denoted by $\hat{\theta}$, is consistent but inefficient in general. The centered OLS estimator with a normalizing matrix $D_T = diag\{\sqrt{T}, \sqrt{Tl_n}\}$ weakly converges to

$$D_T(\hat{\theta} - \theta) \Rightarrow \left(\int_0^1 W_2(r) W_2'(r) dr \right)^{-1} \left(\int_0^1 W_2(r) dW_1(r) + \lambda_{21} \right) \quad (15)$$

and we can observe that this limiting distribution contains the second-order bias from the correlation between $W_1(\cdot)$ and $W_2(\cdot)$ and the non-centrality parameter λ_{21}.

As per the Phillips and Hansen (1990) and Phillips (1995) the former bias comes from the fact that the regression errors are serially correlated. Phillips and Hansen (1990) argued that the second-order biases have no effect on the consistency of the estimators, but result in asymptotic distributions of scaled estimators, such as $T(\hat{\beta} - \beta)$ in (Eq-12), having non-zero means. In order to eliminate the second-order bias, Phillips and Hansen (1990) proposes correcting the single-equation estimates non-parametrically in order to obtain median-unbiased and asymptotically normal estimates.

3.3. Dumitrescu Hurlin Panel Causality Test

The pairwise Dumitrescu Hurlin panel causality test in the present study confirmed the bidirectional causality between public debt and economic growth in India. The existing literature tries to address endogeneity issue by using lagged values of the debt-to-GDP ratio, GMM estimations with internal instruments (Kumar and Woo, 2010) and by

instrumenting the debt-to-GDP ratio with the average debt of the other countries in the sample (Checherita-Westphal and Rother, 2012). Here, we used FMOLS technique in our analysis.

4. EMPIRICAL RESULTS

It is observed from the scatter plot (Fig: 1) that both the debt-to-GSDP ratio and economic growth are positively correlated. The calculated partial correlation coefficient between growth rate and debt-to-GSDP ratio is 0.94 which is statistically significant at 1 percent level.

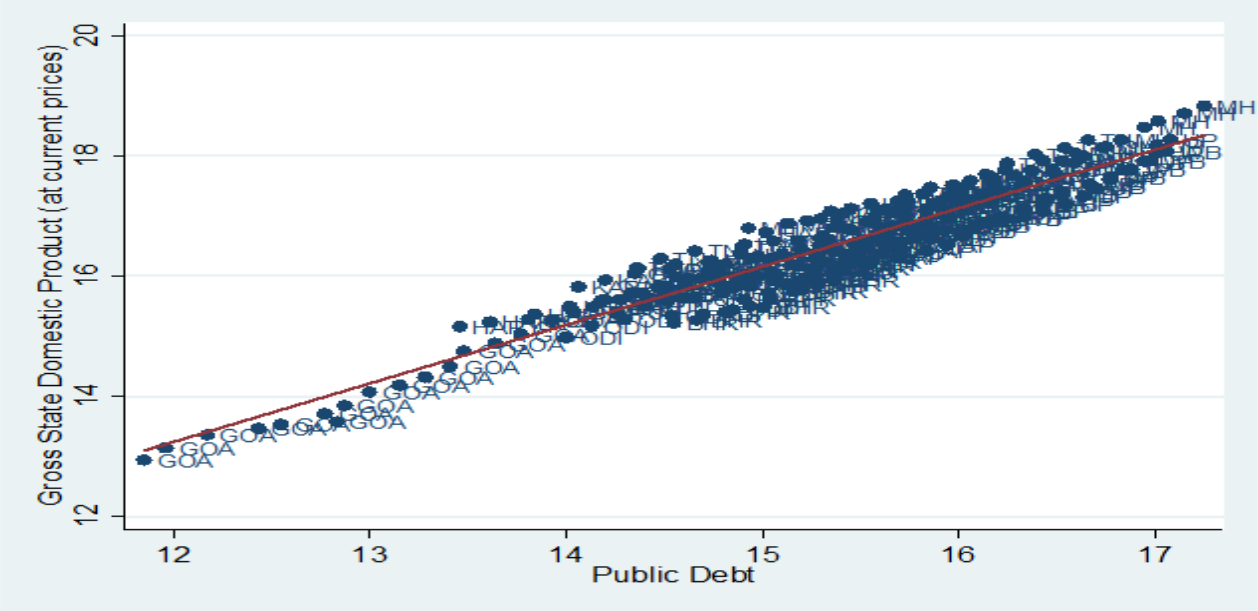

Fig-1. Scatter Plot of Debt-to GSDP Ratio and Economic Growth in non-special category states
(Coeff: 0.94***, p-value: 0.00)

4.1. Descriptive Statistics

Prior to estimation, it is essential to know the basic statistics of the variables considered in the present study (Table 1).

Table-1. Basic Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
GSDP	270	16.51	1.01	12.93	18.83
Debt	270	15.36	0.98	11.85	17.25
RR	270	14.53	0.99	11.30	16.66
CRDT	270	15.30	1.43	11.46	19.02
ELEC	270	6.30	0.79	3.59	7.72

Source: Authors' own calculation

Table 2 presents the trends in Economic Growth Rate, Debt, Revenue Receipts (RR), total credit of all scheduled commercial banks (CRDT) and per capita electricity consumption (ELEC) for all NSC states of India for three periods viz. 1993 to 2000 (classified as post economic reform period), 2001 to 2004 (characterised as pre-FRBM period) and 2005 to 2015 (categorised as post-FRBM period). The trends in Economic Growth indicates that first period (i.e., 1993 to 2000) and third period (i.e., 2005 to 2015) have high growth for all the states compare to second period that has low Economic Growth. The trends in Debt denote higher trend in second period compared to first and third periods for all states (except Bihar that has higher trends in first period as compared to second and third

periods). In addition, the trends in Debt are reduced in post-FRBM period compare to pre-FRBM period for all NSC states. The trends in Revenue Receipts indicate increasing trends in all three periods, respectively, for Andhra Pradesh, Goa, Karnataka, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. However, there are diverse trends in RR in Bihar, Gujarat, Haryana, Kerala, Madhya Pradesh and West Bengal. Total Credit of all Scheduled Commercial Banks (CRDT) has consistently rose up in all states in all periods. Per Capita Electricity Consumption has been consistently rising in the states of HARY, KARNT, MH, TN and WB.

Table-2. Trends in Growth Rate, DEBT, RR, CRDT and ELEC

States	Years	GRGSDP	DEBT	RR	CRDT	ELEC
AP	1993 to 2000	13.31	36.17	20.45	14.42	6.57
	2001 to 2004	9.72	50.21	21.73	15.28	4.58
	2005 to 2015	13.26	46.82	24.34	16.88	9.80
BHR	1993 to 2000	10.50	55.32	21.89	13.29	0.14
	2001 to 2004	6.92	54.65	17.96	13.46	-5.34
	2005 to 2015	15.91	38.14	22.36	14.79	3.05
GOA	1993 to 2000	17.59	38.02	19.56	11.35	-0.14
	2001 to 2004	9.62	40.54	19.96	12.25	1.58
	2005 to 2015	15.45	29.56	14.52	13.42	1.00
GUJ	1993 to 2000	14.77	21.41	11.55	14.14	7.21
	2001 to 2004	10.63	35.64	11.76	14.94	0.35
	2005 to 2015	14.31	28.83	10.64	16.35	1.08
HARY	1993 to 2000	12.76	20.12	14.44	12.98	0.28
	2001 to 2004	11.95	26.09	11.41	13.91	0.61
	2005 to 2015	14.87	20.64	11.13	15.61	1.55
KARNT	1993 to 2000	13.47	17.99	12.75	14.33	0.34
	2001 to 2004	6.44	26.10	13.23	15.29	1.22
	2005 to 2015	14.67	23.46	15.21	16.78	1.38
KERLA	1993 to 2000	13.94	24.82	11.65	13.78	1.82
	2001 to 2004	8.38	35.60	11.12	14.69	-0.50
	2005 to 2015	14.10	32.49	12.12	16.02	1.33
MP	1993 to 2000	12.91	28.37	16.74	13.72	-0.21
	2001 to 2004	6.24	30.57	14.07	14.33	-0.94
	2005 to 2015	14.01	30.27	18.60	15.64	1.66
MH	1993 to 2000	14.58	17.06	9.92	15.75	-0.34
	2001 to 2004	7.95	27.18	10.04	16.85	0.29
	2005 to 2015	13.88	24.05	10.50	18.33	1.15
ODI	1993 to 2000	11.93	36.16	12.91	12.75	0.80
	2001 to 2004	8.75	53.87	14.63	13.68	0.22
	2005 to 2015	14.06	30.21	17.56	15.16	2.00
PUN	1993 to 2000	12.62	34.12	11.21	13.69	0.75
	2001 to 2004	7.34	45.51	12.65	14.61	-0.07
	2005 to 2015	12.32	36.76	12.96	15.95	0.99
RAJ	1993 to 2000	13.54	27.14	12.47	13.37	0.61
	2001 to 2004	7.49	43.55	13.05	14.32	-0.54
	2005 to 2015	14.12	34.18	14.70	15.89	2.02
TN	1993 to 2000	14.06	17.60	11.66	14.86	0.74
	2001 to 2004	6.69	24.81	11.97	15.77	0.91
	2005 to 2015	14.89	21.44	13.00	17.17	1.21
UP	1993 to 2000	11.58	34.69	12.33	14.23	-0.72
	2001 to 2004	6.48	48.09	12.99	14.95	0.35
	2005 to 2015	12.84	40.91	18.29	16.31	1.65
WB	1993 to 2000	13.36	24.77	9.26	14.40	0.30
	2001 to 2004	8.38	43.76	9.23	15.15	0.70
	2005 to 2015	13.15	42.73	10.66	16.50	1.62

Source: Authors' own calculation

4.2. Results of Panel Unit Root Test

Based on various panel unit root tests (see Table 3), it is evident that all the variables under consideration in the model are integrated of order one i.e. I (1).

Table-3. Panel Unit Root Test

	H_0: Unit Root (assumes common unit root process)				**H_0: Unit Root (assumes individual unit root process)**			
Variable	Levin, Lin & Chu (t-stat)		Breitung (t-stat)		Im, Pesaran and Shin (W-stat)		PP- Fisher (Chi-square)	
	(Level)	(1^{st}diff)	(Level)	(1^{st} diff)	(Level)	(1^{st} diff)	(Level)	(1^{st} diff)
GSDP	-0.59 (0.27)	-1.40 (0.08)	1.59 (0.94)	-1.67 (0.04)	2.93 (0.99)	41.34 (0.08)	7.55 (1.00)	80.39 (0.00)
DEBT	-7.56 (0.00)	-	1.37 (0.92)	-6.84 (0.00)	-3.65 (0.00)	-	23.64 (0.79)	90.74 (0.00)
RR	-3.92 (0.00)	-	2.58 (0.99)	-6.30 (0.00)	-1.20 (0.11)	-6.39 (0.00)	47.73 (0.02)	-
CREDIT	-1.28 (0.10)	-3.47 (0.00)	3.20 (0.99)	-0.81 (0.21)	-0.07 (0.47)	-4.16 (0.00)	13.45 (0.99)	64.83 (0.00)
Electricity	1.56 (0.94)	-14.89 (0.00)	-2.29 (0.01)	-	4.54 (1.00)	-10.80 (0.00)	7.71 (1.00)	154.80 (0.00)

Source: Authors' own calculation

Further, to understand the causal nexus between the debt and economic growth we used pairwise Dumitrescu Hurlin Panel causality test (see Table 4). The panel causality test revealed the bidirectional causality between public debt and economic growth for the period 1991-2015 in India. For the robustness of the results, we took different lags and found the bidirectional causality between these two variables for all lags. In our initial analysis, we used Fixed/Random effect techniques. However, realising the endogeneity issue (bidirectional causality between these two variables) and having ensured that all variables are of same order, we further proceed to estimate the effect of public debt on economic growth using FMOLS technique.

Table-4. Pairwise Dumitrescu Hurlin Panel Causality Test

Variables	**Lag**	**W stat**	**Zbar-Stat.**	**P value**	**Decision**
DEBT does not homogeneously cause GSDP	2	4.28	3.08	0.00	DEBT⇔ GSDP
GSDP does not homogeneously cause DEBT		4.63	3.61	0.00	
DEBT does not homogeneously cause GSDP	3	7.64	4.75	0.00	DEBT⇔ GSDP
GSDP does not homogeneously cause DEBT		6.67	3.64	0.00	
DEBT does not homogeneously cause GSDP	4	13.09	7.16	0.00	DEBT⇔ GSDP
GSDP does not homogeneously cause DEBT		7.39	2.23	0.02	
DEBT does not homogeneously cause GSDP	5	12.12	3.50	0.00	DEBT⇔ GSDP
GSDP does not homogeneously cause DEBT		11.19	2.93	0.00	

Source: Authors' own calculation

4.3. Pooled v/s Individual Effects

Panel data consisting of 15 Non-special category Indian states for 18 years, from 1997-2014 has been exercised in the present study. The regression model can assume that there are time and individual state effects present, or these effects are absent in the data. A simple pooled regression would be appropriate, if these effects are missing, for finding parameter estimates. F test, which has null hypothesis that parameters obtained from pooling are more efficient than fixed effects model, has been performed for selecting between pooled and individual fixed effects. It

presents the model selection between pooling regression and fixed effect model. The F test result for no fixed effects is presented in the Table-5.

Table-5. Test Statistics of Pooled versus Fixed Effects

F test for No Fixed Effects				
Models	**Num DF**	**Den DF**	**F-Value**	**Pr > F**
Model 1	1	268	2407.23	0.00
Model 2	1	268	2173.97	0.00
Model 3	2	267	1098.16	0.00
Model 4	3	266	884.60	0.00

Source: Authors' own calculation

For all the three models, the F test supports fixed effect specification over the pooled regression specification.

4.4. Fixed Effect v/s Random Effect

After rejecting the pooled regression specification, the next step is to examine whether we should go for fixed effect or random effect model. The choice between fixed effect and random effect model has been carried out by performing the Hausman test in which the null hypothesis is that random effect estimators are more efficient than fixed effect model. The Hausman test form selecting between fixed effect and random effect model is depicted in the Table-6.

Table-6. Hausman Test for Random Effect

Hausman Test Results			
Models	Chi2 value	Prob > Chi2	Decision
Model 1	0.05	0.82	Go for Random Effect
Model 2	2.45	0.29	Go for Fixed Effect
Model 3	13.98	0.00	Go for Fixed Effect
Model 4	14.19	0.01	Go for Fixed Effect

Source: Authors' own calculation

The Hausman test results support the fixed effect approach for all models except the Model 1. Thus, we performed fixed effect for Model 2, Model 3 and Model 4; and random effect approach for the Model 1. Further, we estimated the FMOLS regression technique for all models to address the potential endogeneity and serial autocorrelation issues. The results of both Fixed/Random effect approach and FMOLS are presented in the Table-7.

Table-7. Regression Estimates

Dependent: GSDP

Variable	**Model 1**		**Model 2**		**Model 3**		**Model 4**	
	Random Effect	FMOLS	Fixed Effect	FMOLS	Fixed Effect	FMOLS	Fixed Effect	FMOLS
C	1.39*** (0.00)		2.66*** (0.00)		4.18*** (0.00)		4.14*** (0.00)	
DEBT	0.98*** (0.00)	1.03*** (0.00)	0.18*** (0.01)	0.17*** (0.00)	0.07* (0.06)	0.43*** (0.00)	0.07** (0.04)	0.09* (0.08)
RR			0.76*** (0.00)	0.79*** (0.00)	0.50*** (0.00)	0.53*** (0.00)	0.50*** (0.00)	0.57*** (0.00)
CRDT					0.26*** (0.00)	0.14*** (0.00)	0.25*** (000)	0.19*** (0.00)
ELEC							0.03 (0.29)	0.05 (0.20)

Note: ***, ** and * denote significance at 1%, 5% and 10% level of significance

The random effect and FMOLS estimates reveal that debt has significant and favorable effect on economic growth in all the models. In the model, we estimated the effect of debt on economic growth in the absence of other controlled variables. The result in the Model 1 suggests that debt has high and significant favorable effect on economic growth. In the Model 2, we introduced total revenue receipts as a controlled variable model. In the model 2, we found that both the debt and total revenue receipts have positive and significant effect on economic growth in both the random effect model as well as FMOLS model. Further, in the Model 3, we included total credit and observed DEBT, RR, CRDT have strong and positive effect on economic growth. We added per capita electricity consumption into the system in the Model 4. As per the Model 4, we observed that all the variables are positive and significant except the per capita electricity consumption in both the random effect model as well as FMOLS model. However, all the variables are as per their theoretical expectations.

5. CONCLUSION

The present study set out its journey examining the causal nexus between public debt and economic growth for 15 non-special category Indian states for the period 1990-91 to 2014-15 using Dumitrescu Hurlin panel causality. The panel causality test confirmed the bidirectional causality between public debt and economic growth. Further, we assessed the effect of public debt on economic growth using both random effect model as well as the FMOLS model in the presence of controlled variables such as total revenue receipts, total credit and per capita electricity consumption. The results of the present study revealed that public debt, total revenue receipts and total credit have positive effect on economic growth. The sign of all the variables in the model are as per their theoretical expectation. Per capita electricity consumption is not significant in the model but its sign is positive.

Total revenue has favorably effect on economic growth in the analysis. Sound infrastructure is highly essential for sustained economic growth of any economy. An economy can achieve this social responsibility only through a good and an efficient tax system. However, the tax leakages in the form of avoidance and tax evasion is widely present in India. Thus, the government should adopt proper tax reform strategies to minimize such tax leakages and enhance its revenue. Ultimately, this will raise more public expenditure which will further enhance income and savings of the household and firms. In turn, this will encourage more economic activities and thus, economic growth.

Since, bank credit has favorable effect on economic growth, the government of India should make policies that favor more credit allocation in the economy. At the same time, banks needs to maintain risk-return trade off across loan portfolios and ensure asset quality for sustainable growth. Improvement in technology and innovation should be applied in credit selection, evaluation, monitoring and controlling the credit risk. Thus, effective credit and risk management practices should be exercised which would improve the asset quality in particular and the economic growth in general.

This empirical result refutes the views of the economists such as Modigliani (1961); Diamond (1965) and Saint-Paul (1992) that the low level of debt favorably affects economic growth and agrees with Pattillo *et al.* (2002) and Patillo *et al.* (2004). Since, debt has favorable and significant impact on economic growth, the government of India should go for more debt, if necessary, to finance its basic social responsibilities in the form of physical and social infrastructure. However, the government should be careful and cautious while utilizing such borrowed funds. The effective and proficient utilization of public debt to expand productivity capacity of the economy can drive economic growth. Hence, it is suggested to implement a suitable debt management strategy in case of India in order to sustain high economic growth.

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Disclaimer

The views and opinions expressed in this paper are those of authors and do not necessarily reflect the official policy or position of the institute.

REFERENCES

Barro, R.J., 1990. Government spending in a simple model of endogenous growth. Journal of Political Economy, 98(1): 103–117.

Blanchard, O., 1985. Debt, deficits, and finite horizons. Journal of Political Economy, 93(2): 223-247.

Checherita-Westphal, C. and P. Rother, 2012. The impact of high government debt on economic growth and its channels: An empirical investigation for the Euro area. European Economic Review, 56(7): 1392-1405.

Codogno, L., C. Favero and A. Missale, 2003. Yield spreads on EMU government bonds. Economic Policy, 18(37): 503-532.

Diamond, P.A., 1965. National debt in a neoclassical growth model. American Economic Review, 55(5): 1126-1150.

Kumar, M. and J. Woo, 2010. Public debt and growth. IMF. WP/10174: 1-47.

Laubach, T., 2009. New evidence on the interest rate effects of budget deficits and debt. Journal of the European Economic Association, 7(4): 858-885.

Modigliani, F., 1961. Long-run implications of alternative fiscal policies and the burden of the national debt. Economic Journal, 71(284): 730-755.

Moore, W. and C. Thomas, 2010. A meta-analysis of the relationship between debt and growth. International Journal of Development Issues, 9(3): 214-225.

Patillo, C., H. Poirson and L. Ricci, 2004. What are the channels through which external debt affects growth? IMF Working Paper No. 04/15.

Pattillo, C.A., H. Poirson and L.A. Ricci, 2002. External debt and growth. International Monetary Fund. No. 2002-2069.

Phillips, P.C., 1995. Fully modified least squares and vector autoregression. Econometrica: Journal of the Econometric Society, 63(5): 1023-1078.

Phillips, P.C.B. and B.E. Hansen, 1990. Statistical inference in instrumental variables regressions with I(1) processes. Review of Economic Studies, 57(1): 99-125.

Presbitero, A., 2005. The debt-growth nexus: A dynamic panel data estimation. Rivista Italiana Degli Economisti, 11(3): 417-462.

Saint-Paul, G., 1992. Fiscal policy in an endogenous growth model. Quarterly Journal of Economics, 107(4): 1243-1259.

Schclarek, A., 2004. Debt and economic growth in developing and industrial countries. Lund University Department of Economics. Working Paper No. 2005, 34.

Tanzi, V. and N. Chalk, 2000. Impact of large public debt on growth in the EU: A discussion of potential channels. European Economy, 2(2000): 23-43.

Teles, V.K. and C.C. Mussolini, 2014. Public debt and the limits of fiscal policy to increase economic growth. European Economic Review, 66: 1-15.

APPENDIX

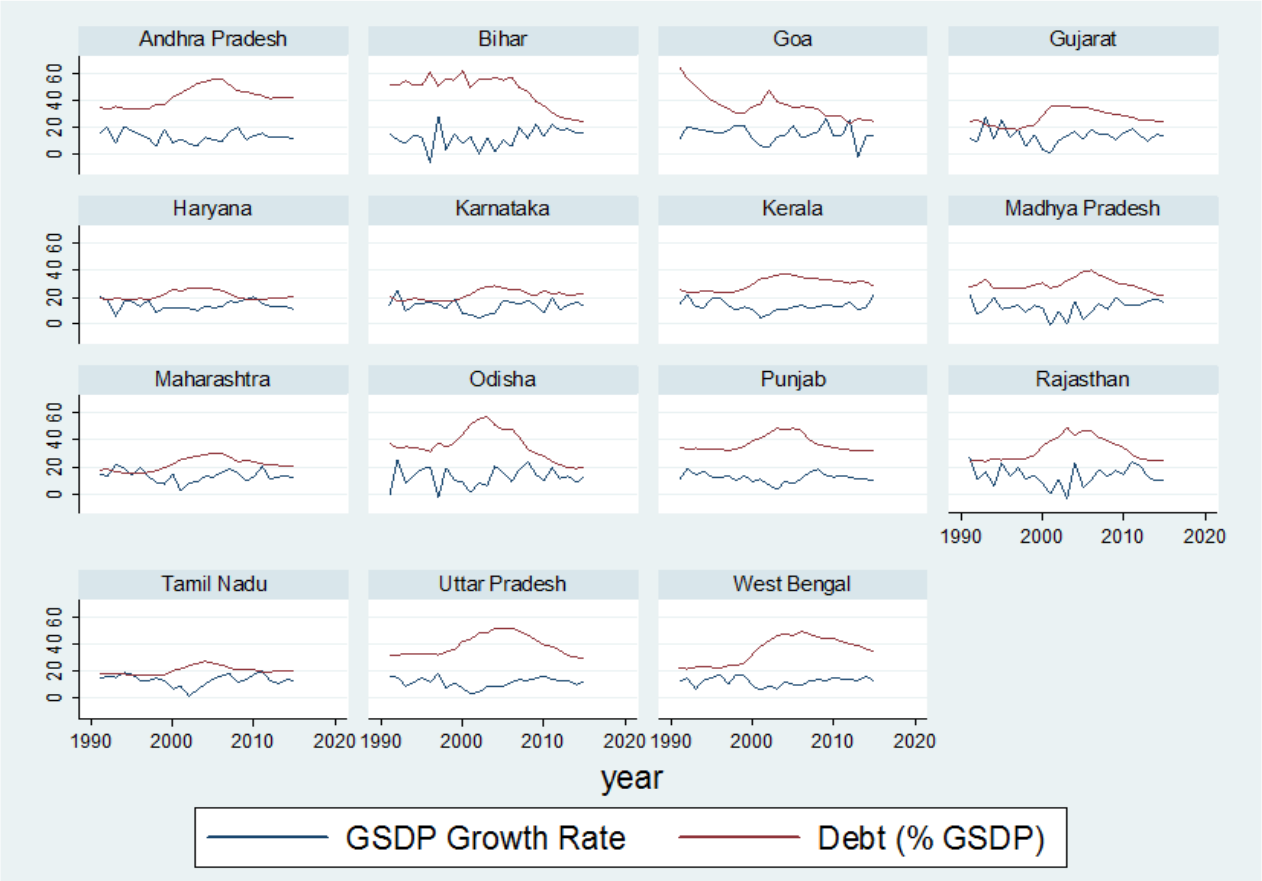

Fig-2. Trends in GSDP Growth Rate and Debt for all Non-special Category States

Source: Authors' own calculation

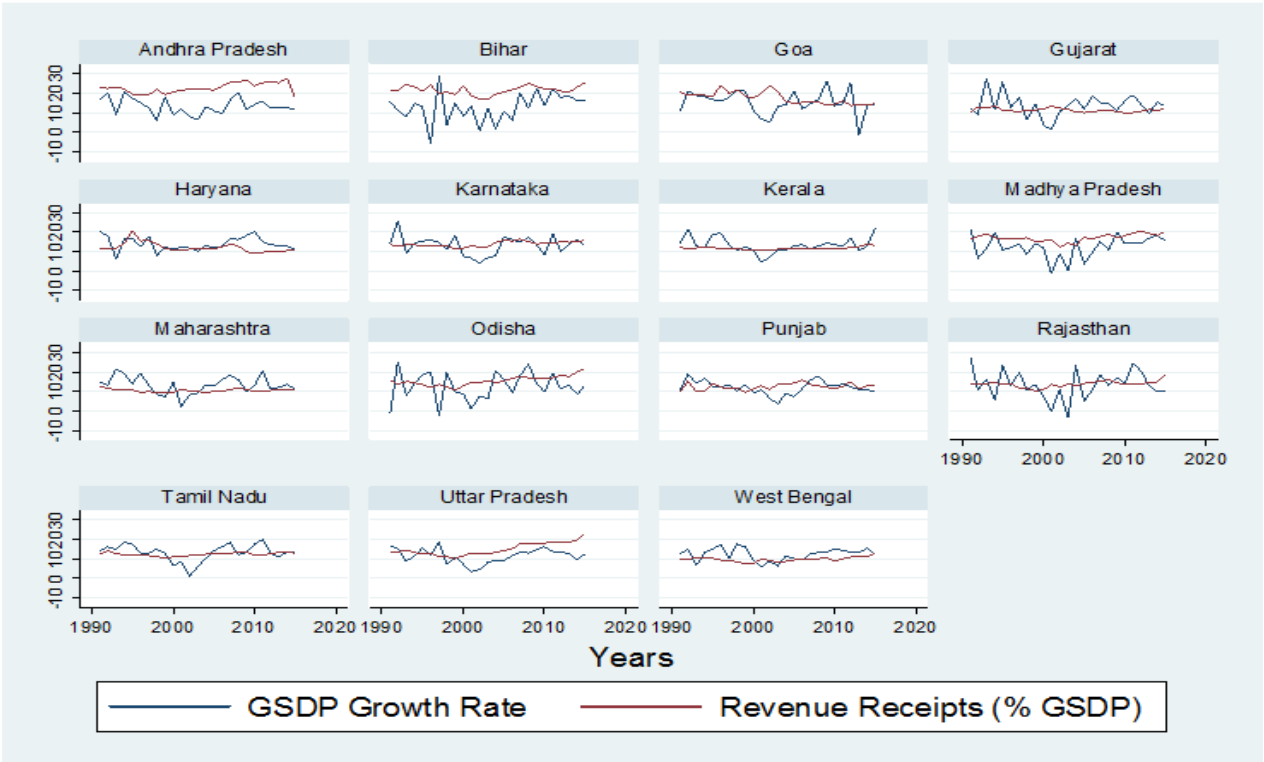

Fig-3. Trends in GSDP Growth Rate and Total Revenue Receipts for all Non-special Category States
Source: Authors' own calculation

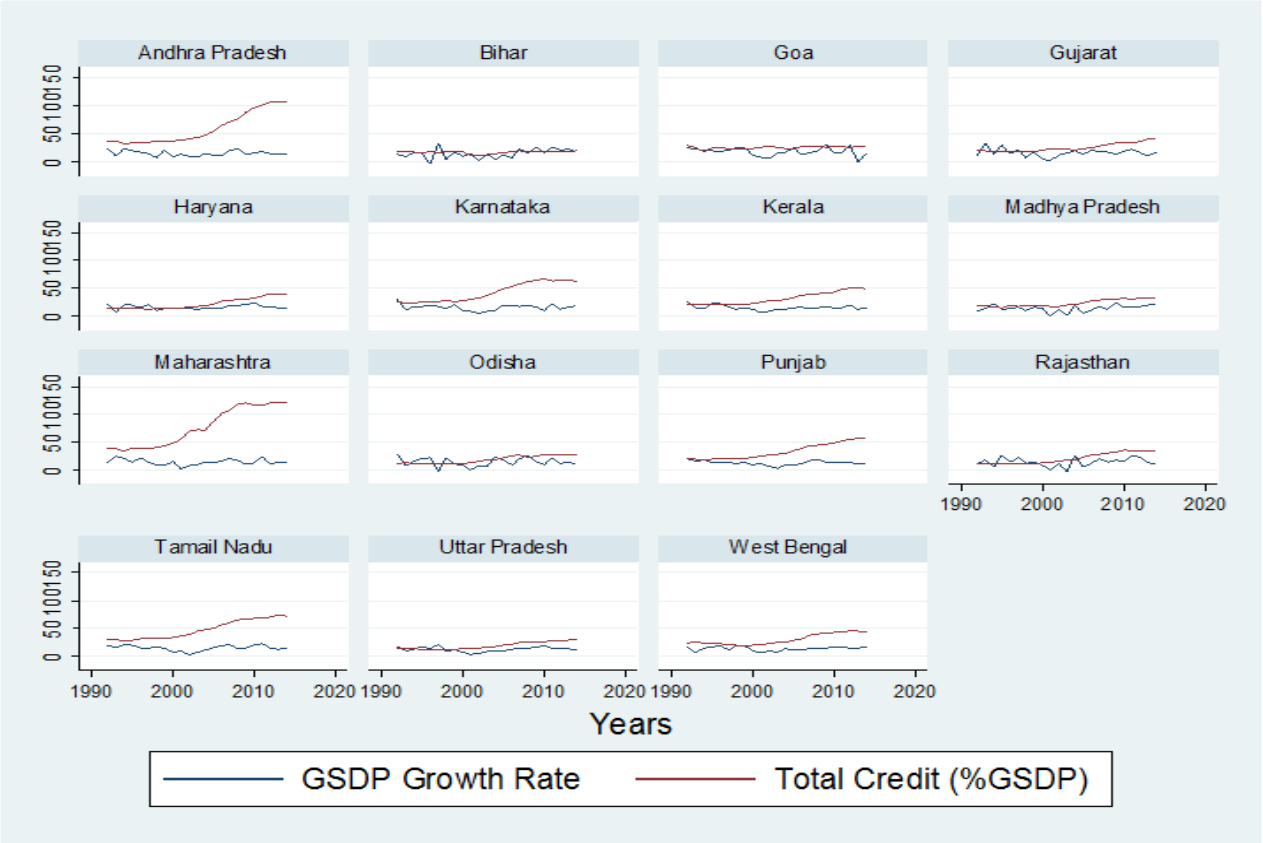

Fig-4. Trends in GSDP Growth Rate and Total Credit for all Non-special Category States
Source: Authors' own calculation

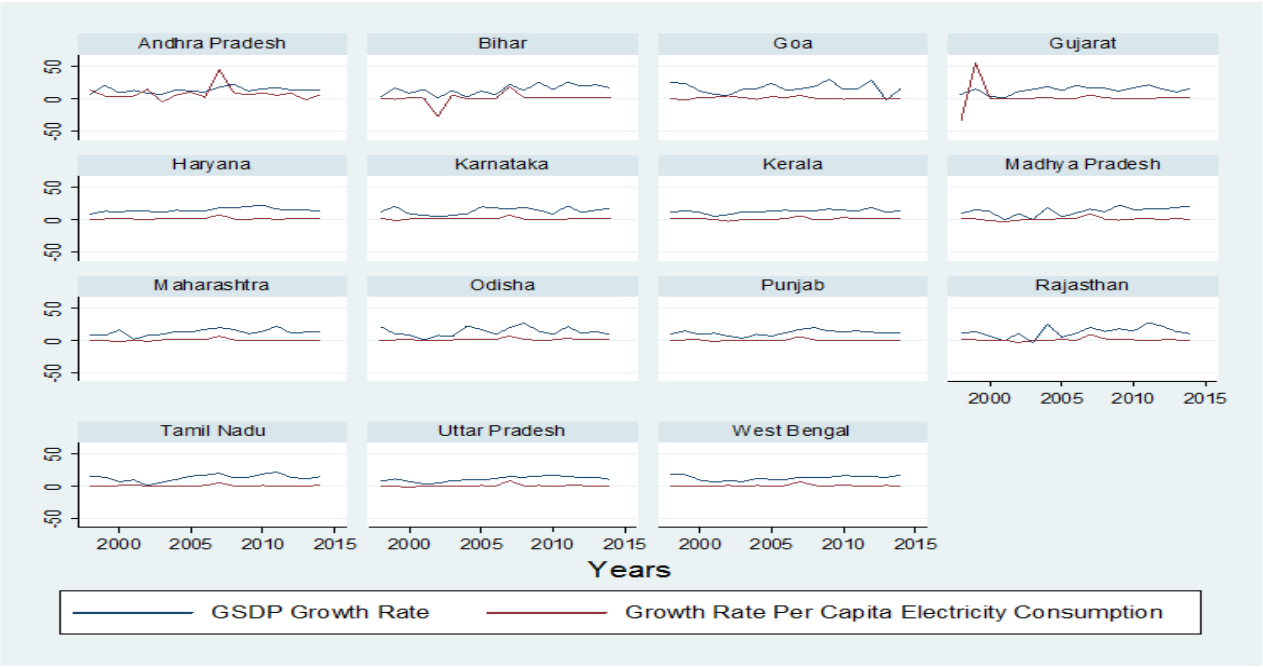

Fig-5. Trends in GSDP Growth Rate and Per Capita Electricity Consumption for all Non-special Category States
Source: Authors' own calculation