Public Revenue sources of Odisha over the years with its components: Time series analysis

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ACKNOWLEDGEMENTS

We would like to place on record our deep sense of gratitude towards **Dr. Debasis Patnaik, Dept. of Economics, Birla Institute of Technology and Science, K.K. Birla Goa Campus,** for his able guidance, support and useful suggestions in coming this far and providing us with all the facility that was required.

We would also like to give our thanks to everyone who has indirectly helped us in making this paper. We would also like to extend our sincere thanks to the authors of the books issued in our course by the Instructor in charge.

ABSTRACT:

This report has studied and analysed different sources of public revenue in the state of Odisha. This report also dwells into the statistics of different types of tax and non-tax revenues, their percentage relative to the state's GSDP and possible future trends. It also consolidates the various advancements, steps taken and other speculative reasons that explain any fluctuations in our analysis.

Keywords: Government Revenue; Direct and Indirect Tax; Odisha; Central Transfer; Grants; Non-Tax Revenue; Time Series Analysis; Statistics; Stationarity; Stability; Auto-Regression

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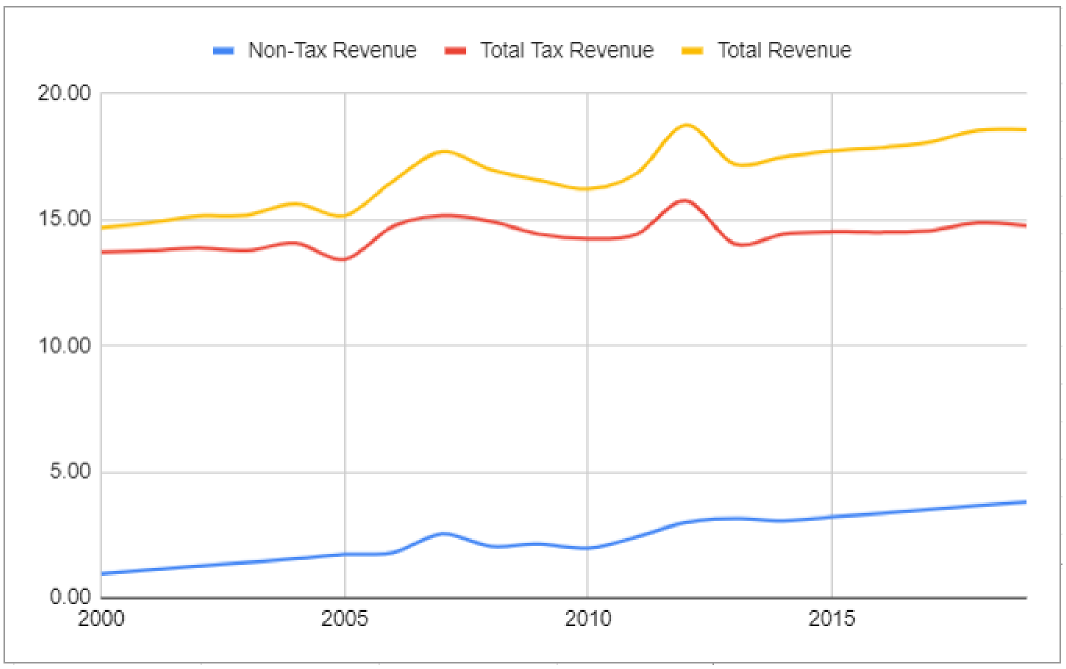
Introduction

The composition of the total revenues of Odisha during the period of the study has undergone countless noteworthy changes. The share of tax revenue in the total revenue has changed from 57.13% to 65.15% and furthermore to 66.50% through the years included in the analysis. Likewise, the share of non-tax revenue has changed from 42.87% to 34.85% and finally to 33.50%. This indicates that over the years the share of tax revenue in the total revenue has increased whereas the share of non-tax revenue has decreased. That is the tax revenue has increased its significance.



SOURCE: COMPUTED FROM THE DATA ACQUIRED FROM FRBM REPORTS ISSUE BY THE STATE

Different components of tax revenue are SOTR and the state's CT. The SOTR as a percentage of tax revenue follows a general incremental trend; going from 47.60%, 47.03% to 49.64% over the span of the study. Similarly, the state's shares in central taxes as a percentage of tax revenue follows an unstable trend; going from 52.40%, 52.97% to 50.36%. It is evident that over the years SOTR has increased its significance marginally as compared to the state's CT. Non-tax revenue is composed of SONTR and grant-in-aid from the centre. State's own non-tax revenue as a percentage of non-tax revenue increased from 32.51% to 35.42%

and further to 35.51%. The share of grant-in-aid in the non-tax revenue increased gradually. It was 67.49% which fell continuously to 64.58% and 64.50% throughout the span of the analysis.

Year	Non-Tax Revenue	Tax Revenue		Total Tax Revenue	Total Revenue
		Direct Tax Revenue	Indirect Tax		
2000	0.96	5.68	8.05	13.73	14.69
2001	1.11	5.67	8.11	13.78	14.89
2002	1.26	5.66	8.23	13.89	15.15
2003	1.41	5.65	8.13	13.78	15.19
2004	1.56	5.64	8.44	14.08	15.64
2005	1.73	5.12	8.31	13.43	15.16
2006	1.80	5.73	9.02	14.75	16.55
2007	2.54	6.11	9.06	15.17	17.71
2008	2.05	6.07	8.87	14.94	16.99
2009	2.14	5.58	8.85	14.43	16.57
2010	1.97	5.23	9.02	14.25	16.22
2011	2.42	5.31	9.12	14.43	16.85
2012	3.00	5.70	10.06	15.76	18.76
2013	3.16	5.47	8.58	14.05	17.21
2014	3.06	5.50	8.93	14.43	17.49
2015	3.21	5.48	9.05	14.52	17.74
2016	3.36	5.56	8.95	14.51	17.87
2017	3.51	5.49	9.08	14.57	18.08
2018	3.66	5.60	9.29	14.89	18.55
2019	3.81	5.54	9.22	14.76	18.57

SOURCE: FRBM REPORTS RANGING FROM 2000 to 2019

Fiscal Profile of Odisha: An Overview

(Percentage of GSDP)

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Revenues	**15.25**	**16.55**	**17.71**	**16.99**	**16.57**	**16.22**	**17.11**	**18.65**
Own Tax Revenues	**5.37**	**5.88**	**5.96**	**5.30**	**5.38**	**5.51**	**5.76**	**6.23**
Sales Tax	3.18	3.54	3.70	3.19	3.23	3.32	3.50	3.80
State Excise Duties	0.39	0.46	0.42	0.41	0.44	0.52	0.56	0.64
Motor Vehicle Tax	0.43	0.48	0.42	0.36	0.35	0.38	0.37	0.36
Goods and Passenger Tax	0.50	0.54	0.56	0.48	0.43	0.50	0.57	0.61
Electricity Duties	0.34	0.41	0.28	0.25	0.25	0.28	0.24	0.26
Other Taxes	0.53	0.45	0.58	0.62	0.68	0.51	0.51	0.56
Own Non-Tax Revenues	**1.73**	**1.80**	**2.54**	**2.05**	**2.14**	**1.97**	**2.46**	**2.98**
Mining Royalties	0.86	0.95	0.92	0.87	0.93	1.24	1.71	2.12
Central Transfers	**8.14**	**8.87**	**9.21**	**9.64**	**9.05**	**8.74**	**8.90**	**9.44**
Tax Devolution	5.12	5.73	6.11	6.07	5.58	5.23	5.40	5.66
Grants	3.02	3.14	3.10	3.57	3.47	3.51	3.50	3.78
Revenue Expenditure	**15.92**	**15.99**	**15.49**	**13.71**	**14.27**	**15.52**	**15.10**	**16.05**
General Services	**8.34**	**8.02**	**7.37**	**5.59**	**4.69**	**5.70**	**5.11**	**5.06**
Social Services	**5.12**	**5.50**	**5.13**	**4.96**	**5.58**	**6.04**	**6.13**	**6.64**
Education	2.51	2.66	2.36	2.45	2.95	3.32	3.23	3.08
Medical and Pub.Health	0.69	0.44	0.47	0.48	0.54	0.61	0.53	0.52
Social Welfare & Nutrition	0.95	1.21	1.23	0.86	1.10	0.94	1.20	1.92
Economic Services	**2.26**	**2.30**	**2.73**	**2.88**	**3.74**	**3.54**	**3.64**	**4.04**
Assignment to LBs	**0.20**	**0.17**	**0.27**	**0.27**	**0.26**	**0.25**	**0.22**	**0.31**
Capital Expenditure	**1.09**	**0.89**	**1.41**	**2.26**	**2.53**	**2.09**	**2.35**	**2.31**
Capital Outlay	1.36	1.22	1.43	2.20	2.55	2.24	2.20	2.08
Net Lending	-0.27	-0.33	-0.01	0.06	-0.02	-0.15	0.14	0.23
Revenue Deficit	**0.67**	**-0.57**	**-2.22**	**-3.28**	**-2.30**	**-0.70**	**-2.01**	**-2.60**
Fiscal Deficit	**1.76**	**0.32**	**-0.81**	**-1.02**	**0.22**	**1.39**	**0.34**	**-0.29**
Primary Deficit	**-2.53**	**-4.02**	**-3.94**	**-3.48**	**-1.72**	**-0.48**	**-1.24**	**-1.48**
Outstanding Debt	**43.81**	**42.84**	**36.58**	**28.09**	**24.53**	**23.15**	**20.13**	**17.87**

Source: Basic data – Finance Accounts of relevant years, GoO

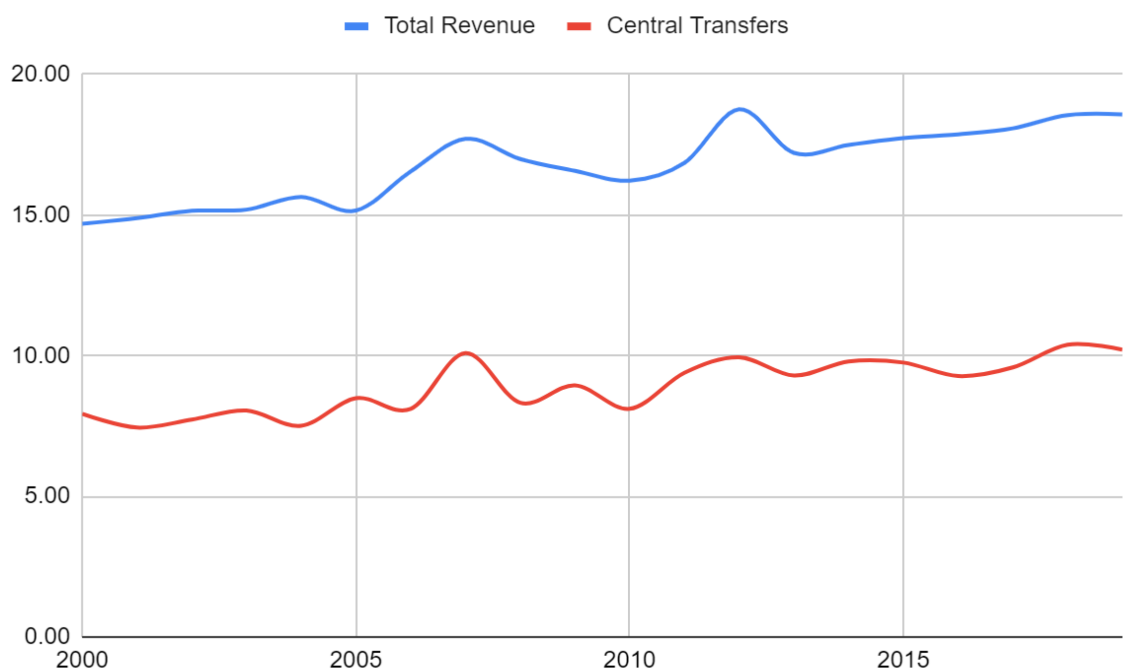
GSDP data used are of 2004-05 series (latest available estimates)

Note: Negative sign for deficit figures indicate surplus

Objective

The study's objective is to analyze the government of Odisha's fiscal situation by looking at the pattern, composition, and growth of various government revenue components. By analyzing various tax and non-tax revenue components using time series data, the study explores how the Government of Odisha has emerged from a persistent revenue and fiscal deficit. The aim of this Act is to determine if the Government of Odisha will minimize deficits and create surpluses in its economic, tax, and primary accounts.

Like most states, Odisha's fiscal situation worsened in the early 1980s, leading to persistent deficits by the mid-1980s. In the years 1999–2000, Odisha's revenue and fiscal deficits hit their peak. The primary deficit has also deteriorated significantly over time (Das, 2011). As a result, the Government of Odisha must review the revenue from existing tax and non-tax sources in terms of the potential available, as well as find new avenues for mobilizing additional capital.



All values mentioned are in Crore Rupees. Data is computed from FRBM reports of years 2000-2019

In this paper, firstly we introduce the components of the total public revenue we have used. The performance of state government revenues is reflected in the **total revenue** (TR). Total revenue is composed of **total tax revenue** (TTR) (which consists of **direct tax revenue** (DTR) and **indirect tax revenue** (ITR)) and **non-tax revenue** (NTR). TTR of the state also consists of the **state's own tax revenue** (SOTR) and share in **central taxes** (CT). Similarly, non-tax revenue consists of the **state's own non-tax revenue** (SONTR) and **grants** from the Centre (GC).

Now proceeding to how we have related public revenue sources and its components of Odisha over the years. We have done a time series analysis and related **Total Revenue** (TR) and share in **Central Taxes** (CT). We used several regression tests to empirically relate TR and CT.

Central Transfers to Odisha

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Central Transfers	12458	13440	14236	17303	20381	20825	23677	29099
Share in Central taxes	7847	8280	8519	10497	12229	13965	15247	16181
Grants-in-Aid	4611	5160	5717	6806	8152	6860	8429	12917
Non-plan grants	1152	1242	1629	2111	2561	1505	2729	1929
State Plan schemes	2232	2633	2777	3279	3853	3484	3429	10886
Grants for CPS	116	119	167	192	109	183	122	102
Grants for CSS	1111	1165	1144	1224	1629	1688	2149	0.08

Firstly, we do **Augmented Dickey-Fuller Test** (ADF) to check the stationarity between our dependent and independent variables. Then we will use the **Johansen Test** to check for cointegration between the variables. Then we go for **Vector autoregression** (VAR) to capture the relationship between multiple quantities as they change over time. And then we are going to do **Wald Causality Test** and **Granger Causality Test** to establish causality between the variables. And then finally, we do the stability tests that are **Jaque-Bera Test** and **LM Test**.

METHODOLOGY

1. VAR Model:

A VAR model is a speculation of the univariate autoregressive model for anticipating a vector of time series.22 It involves one condition for each factor in the framework. The correct hand side of every condition incorporates a consistent and slacks of the entirety of the factors in the framework. To keep it straightforward, we will think about a two-variableVAR with one slack. We compose a 2-dimensional VAR(1)

$y_{1,t}=c_1+\phi_{11,1}y_{1,t-1}+\phi_{12,1}y_{2,t-1}+e_{1,t}$

$y_{2,t}=c_2+\phi_{21,1}y_{1,t-1}+\phi_{22,1}y_{2,t-1}+e_{2,t}$

where $e_{1,t}$ and $e_{2,t}$ are white noise processes that may be contemporaneously correlated. The coefficient $\phi_{ii,\ell}$ captures the influence of the ℓth lag of variable y_i on itself, while the coefficient $\phi_{ij,\ell}$ captures the influence of the ℓth lag of variable y_j on y_i.

An example of a VAR model with 3 variables is shown as:

$$\boldsymbol{lnpdi_t} = \sigma + \sum_{i=1}^{k} \boldsymbol{\beta_i lnpdi_{t-i}} + \sum_{j=1}^{k} \phi_j lnpce_{t-j} + \sum_{m=1}^{k} \varphi_m lngdp_{t-m} + u_{1t}$$

$$\boldsymbol{lnpce_t} = a + \sum_{i=1}^{k} \beta_i lnpdi_{t-i} + \sum_{j=1}^{k} \boldsymbol{\phi_j lnpce_{t-j}} + \sum_{m=1}^{k} \varphi_m lngdp_{t-m} + u_{2t}$$

$$\boldsymbol{lngdp_t} = d + \sum_{i=1}^{k} \beta_i lnpdi_{t-i} + \sum_{j=1}^{k} \phi_j lnpce_{t-j} + \sum_{m=1}^{k} \boldsymbol{\varphi_m lngdp_{t-m}} + u_{3t}$$

Notes:

- $\boldsymbol{k}$ = the optimal lag length
- $\boldsymbol{a}, \sigma, \boldsymbol{d}$ = intercepts
- $\boldsymbol{\beta_i}, \phi_j, \boldsymbol{\varphi_m}$ = short-run dynamic coefficients of the model's adjustment long-run equilibrium
- $\boldsymbol{u_{it}}$ = residuals in the equations

If the arrangements are fixed, we figure them by fitting a VAR to the information straightforwardly (known as a "VAR in levels"). In the series that the arrangements are non-fixed, we take contrasts of the information to make them fixed, at that point fit a VAR model (known as a "VAR in contrasts"). In the two cases, the models are assessed condition by condition utilizing the guideline of least squares. For every condition, the boundaries are assessed by limiting the number of squared $e_{i,t}$ values.

2. CAUSALITY TEST:

The Granger causality test is a factual speculation test for deciding if one Stochastic cycle helps anticipate another, first proposed in 1969 by C. W. J. Granger. Usually, relapses reflect "simple" connections, however, Clive Granger contended that causality in financial matters could be tried for by estimating the capacity to anticipate the future upsides of a period arrangement utilizing earlier upsides of some other time arrangement. Since the subject of "genuine causality" is profoundly philosophical, and due to the post hoc hence proper hoc deception of expecting that one thing going before another can be utilized as a proof of causation, econometricians attest that the Granger test finds just "prescient causality".

The Granger causality is a factual theory test for determining whether a one-time arrangement helps estimate another. A period arrangement X is said to Granger-cause Y if it tends to be shown that those X qualities give measurably critical data about future upsides of Y through a progression of t-tests and F-tests on slacked upsides of X.

Principle

There are two underlying principles:

1. The cause will occur first and then the effect is observed.

2. The cause contains special information about the effect on its future values.

$$P[Y(t+1) \in A|I(t)] \neq P[Y(t+1) \in I-X(t)]\ P[Y(t+1) \in A|I(t)] \neq P[Y(t+1) \in I-X(t)]$$

where P refers to probability, A is an arbitrary non-empty set and I(t) and I−X(t) respectively denote the information available as of time t in the entire universe, and that in the modified universe in which X is executed. If the above hypothesis is accepted, we say that X Granger-causes Y.

Mathematical statement and null hypothesis

Assume y and x to be stationary time series. To test null hypothesis that x does not Granger-cause y, first there is a need to find the proper lagged values of y to inculcate in a univariate auto regression of y:

$$Yt = a0 + a1yt-1 + a2yt-2 + ... + amyt-m + errort$$

next, the auto regression is augmented by including lagged values of x:

$$yt = a0 + a1yt-1 + a2yt-2 + ... + amyt-m + errort + bpxt-p + ... + bqxt-q + errort$$

The null hypothesis which shows that x does not Granger-cause y is not rejected if and only if no lagged values of x stays in the regression.

F-statistic

This test is generally performed in Wald or F -test.

$$F=[(RSS1-RSS2)/(P2-P1)]/[RSS2/n-p2]$$

The null hypothesis (model 2 is not better than model 1) is rejected if the F calculated from the data is greater than the critical value of the F-distribution for some desired false-rejection probability (e.g. 0.05). The F-test is a Wald test.

3. JARQUE-BERA TEST:

Most tests for ordinariness depend either on contrasting the experimental total conveyance and the hypothetical ordinary total appropriation (Kolmogorov-Smirnov, Anderson-Darling, Chi-Square) or exact quantiles with the hypothetical typical quantiles (PPCC, Wilk-Shapiro). Interestingly, the Jarque-Bera test depends on the example skewness and test kurtosis.

The Jarque -Bera test statistic is defined as:

$$\frac{N}{6}\left(S^2 + \frac{(K-3)^2}{4}\right)$$

with *S*, *K*, and *N* denoting the sample skewness, the sample kurtosis, and the sample size, respectively.

For test sizes of 2,000 or bigger, this test measurement is contrasted with a chi-squared appropriation with 2 levels of opportunity (ordinariness is dismissed if the test measurement is more prominent than the chi-squared worth).

The chi-square estimate requires genuinely enormous example sizes to be exact. For test estimates under 2,000, the basic worth is resolved through re-enactment. In particular, 100,000 typical examples with a similar mean and standard deviation as the first information test are produced and the Jarque-Bera test measurement figured to create the reference dispersion.

4. LM TEST:

The Lagrange Multiplier (LM) test has given a standard methods for testing parametric limitations for an assortment of models. Its essential benefit among the trinity of tests (LM, Likelihood Ratio (LR) , Wald) by and large utilized in probability based deduction is that the LM measurement is registered utilizing just the consequences of the invalid, confined model, which is normally easier than the other option, unlimited model. In the event that, under the invalid theory, the boundary being tried lies on the limit of the boundary space, an extra benefit of the LM test is that it will in any case have standard distributional properties, though the LR and Wald tests won't. The arbitrary impacts straight relapse is an unmistakable model; Breusch and Pagan's (1980) LM test for irregular impacts in a direct model depends on pooled OLS residuals, while assessment of the elective model includes summed up least squares either dependent on a two stage methodology or most extreme probability. The LM test can be deciphered as a Wald trial of the separation from zero of the principal subordinate vector of the log probability work (the score vector) of the unhindered model assessed at the limited most extreme probability gauges. A model that will assist with centering thoughts is a probit model with exponential heteroscedasticity:

yi* = b¢xi+ ei , ei ~ N[0, {exp(a¢zi)}2], yi = 1[yi* > 0].

The log likelihood function for the unrestricted model is

logL = Si log F{(2yi - 1)b¢xi / exp(a¢zi)},

where F(t) is the cumulative density function (cdf) of the standard normal distribution. The boost of logL over (b,a) is fairly more confounded than the augmentation over (b,0), which is the standard probit model. Be that as it may, a LM test for the shortfall of heteroscedasticity (a=0) depends on assessments of the last model and is amazingly easy to complete utilizing standard instruments.

ANALYSIS

The report starts off with a general trend overview of the data over a span of 15 years from 2000-01 to 2019-20.

As stated earlier, our choice of variable:

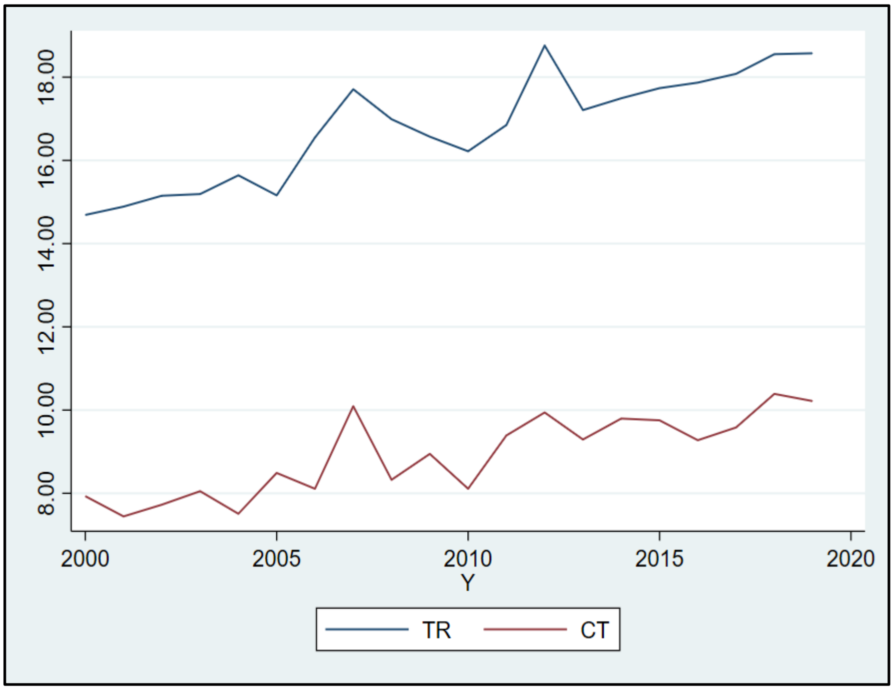
Independent Variable: **Central Transfer** (CT)

Dependent Variable: **Total Revenue** (TR)

It is worth noting that even though the spiked nature of the graphs obtained from the 15-year data set would suggest that the data is unusual however considering the limited number of data points, it is all well within the tolerance limit for the analysis.

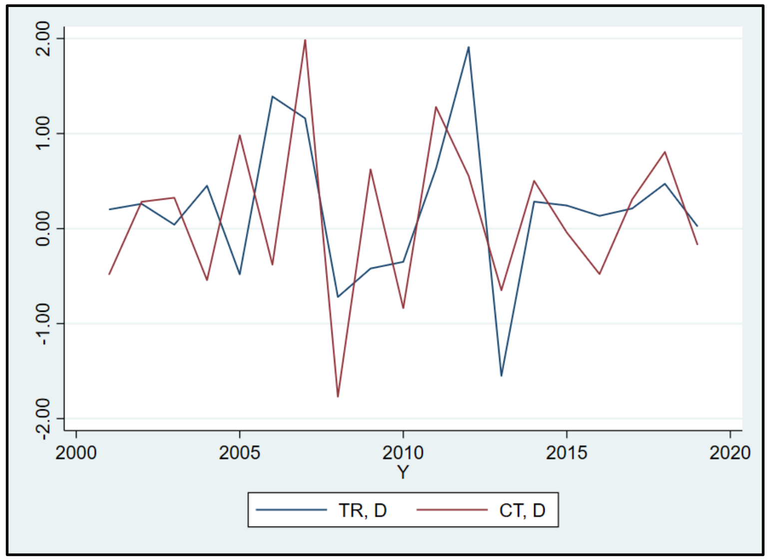
```
. reg CT TR

      Source |       SS           df       MS      Number of obs   =        20
-------------+----------------------------------   F(1, 18)        =     77.85
       Model |  14.4838297         1  14.4838297   Prob > F        =    0.0000
    Residual |  3.34901496        18  .186056387   R-squared       =    0.8122
-------------+----------------------------------   Adj R-squared   =    0.8018
       Total |  17.8328446        19   .93857077   Root MSE        =    .43134

------------------------------------------------------------------------------
          CT |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          TR |   .6611451   .0749337     8.82   0.000     .5037152     .818575
       _cons |  -2.184508   1.262162    -1.73   0.101    -4.836211    .4671947
------------------------------------------------------------------------------
```

SOURCE: Standard Time Series analysis performed on STATA16 using aforementioned datasets



On first observation, one may make the inferences that the data points appear to be generated in natural non-stationary form. However, with this intuition, we perform a series of tests as mentioned in the objective to come across conclusions such as existence and the characteristics of casualty.

Further on we check the line graph of the first difference of the given choice of independent and dependent variable. This graph tells us that first difference of variables chosen yields hints of
Stationarity.



To begin the analysis, the paper draws inferences from a series of analysis and tests and prescribed in the methodology. Firstly, a regression is run between the two primary variables being considered for the detailed analysis; the **Central Transfers**(CT) and **Total Revenue**(TR). Upon running the simple regression we observe that the significance values come out to be about 1% for acquired coefficients.Iit is also worth noting that the P-value comes out to be infinitesimally small which signifies that there is ***considerable level of significance***.

Further, in order to test the stationarity of our data, the **Augmented Dickey-Fuller Test**, also commonly known as the **ADF test** is run on both the Independent and dependent variables.

The Augmented Dickey-Fuller test can be utilized with a sequential relationship. The ADF test can deal with more intricate models than the Dickey-Fuller test, and it is additionally more remarkable. All things considered, it ought to be utilized with alert since—like most unit root tests—it has a generally high Type I error rate. In an Augmented Dickey-Fuller test, greater the magnitude of the negative number, stronger is the rejection of the hypothesis. Stationarity or trend stationarity is used as an alternative hypothesis and presence of a unit root is taken as null hypothesis in the ADF test.

Unit root tests can be utilized to decide whether moving information ought to be first differenced or relapsed on deterministic elements of time to render the information stationery. Additionally, financial and economic hypothesis regularly recommends the presence of long run equilibrium connections among nonstationary time series.

Through the test, the stationarity of the data is determined using the following hypothesis:
Null hypothesis: the Data series is stationary
Alternate hypothesis: Data series is not stationary

. dfuller TR, regress lags(1)

Augmented Dickey-Fuller test for unit root — Number of obs = 18

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.290	-3.750	-3.000	-2.630

MacKinnon approximate p-value for Z(t) = 0.6338

D.TR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
TR						
L1.	-.2087211	.1618116	-1.29	0.217	-.5536143	.1361721
LD.	-.1404379	.2501363	-0.56	0.583	-.6735909	.392715
_cons	3.743984	2.710863	1.38	0.187	-2.034084	9.522052

. dfuller CT, regress lags(1)

Augmented Dickey-Fuller test for unit root — Number of obs = 18

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.931	-3.750	-3.000	-2.630

MacKinnon approximate p-value for Z(t) = 0.7775

D.CT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
CT						
L1.	-.1931092	.2073349	-0.93	0.366	-.6350332	.2488148
LD.	-.5325592	.2218929	-2.40	0.030	-1.005513	-.0596057
_cons	1.945687	1.837142	1.06	0.306	-1.970088	5.861462

For ADF tests on both the variables
As the absolute value of the test stat is ***lower than the 5% critical value***, we cant reject null hyp of unit roots. Therefore the series is ***non stationary***.

Since both the variables CT and TR turn out to be non stationary, the paper moves on to analyse the stationarity of the first difference of the dependent and independent variables. Upon obtaining stationarity after performing the ADF test on the first difference of the given variables we move onto the test and determine the existence of a cointegration relationship. The paper turns to the Johansen Test to achieve that.

```
. dfuller D.TR, regress lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        17

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
                Statistic          Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.443            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0002

------------------------------------------------------------------------------
       D2.TR |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          TR |
         LD. |   -1.72177   .3875319    -4.44   0.001    -2.552943   -.8905966
        LD2. |   .3918145   .2470301     1.59   0.135    -.1380125    .9216414
             |
       _cons |   .3506898   .2060862     1.70   0.111    -.0913212    .7927009
------------------------------------------------------------------------------
```

```
. dfuller D.CT, regress lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        17

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
                Statistic          Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.906            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0020

------------------------------------------------------------------------------
       D2.CT |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          CT |
         LD. |   -1.87071   .4788988    -3.91   0.002    -2.897846   -.8435743
        LD2. |   .1313751   .2643611     0.50   0.627    -.4356231    .6983734
             |
       _cons |   .2872485   .1868797     1.54   0.147    -.1135686    .6880656
------------------------------------------------------------------------------
```

As the absolute value of the test stat is higher than the 5% critical value, we cannot reject the null hypothesis of unit roots. Therefore the series is stationary with first difference. ADF test on the first difference of the given variables reveals that both the series are stationary with first difference. With that, the paper moves onto the test and determines the existence of a cointegration relationship using the Johansen Test.

JOHANSEN TEST

There are two kinds of Johansen test, either with trace or with eigenvalue, and the deductions may be quite different. The null hypothesis for the trace test is that the quantity of cointegration vectors is r = r* < k, versus the elective that r = k. Testing continues consecutively for r* = 1,2, and so on and the primary non-dismissal of the null is taken as an estimate of r. The null hypothesis for the "greatest eigenvalue" test is concerning the follow test however the option is r = r* + 1 and, once more, testing continues successively for r* = 1,2,etc., with the main non-dismissal utilized as an estimator for r.

```
. vecrank CT TR, trend(constant) max

                          Johansen tests for cointegration
Trend: constant                                         Number of obs =      18
Sample:  2002 - 2019                                             Lags =       2
-------------------------------------------------------------------------------
                                                           5%
maximum                                          trace    critical
  rank    parms       LL         eigenvalue  statistic     value
    0       6     -28.544132          .       14.5494*     15.41
    1       9      -22.01377       0.51596     1.4887       3.76
    2      10     -21.269426       0.07938
-------------------------------------------------------------------------------
                                                           5%
maximum                                            max    critical
  rank    parms       LL         eigenvalue  statistic     value
    0       6     -28.544132          .       13.0607      14.07
    1       9      -22.01377       0.51596     1.4887       3.76
    2      10     -21.269426       0.07938
-------------------------------------------------------------------------------
```

The following inferences can be made using the results obtained; a star signal at rank 0 indicates that there is no cointegration between our choice of independent variable and dependent variable.

VAR MODEL ESTIMATION

The above set of results indicate that for the next set of analytical models, the paper shall turn to **Short Run Vector AutoRegressive models**. Some of the main reasons for estimation of the **VAR model** are:

1. Among the variables, there is no cointegration observed in the system.
2. It helps in establishing causal relationships.
3. It can be used for forecasting.(decomposing shocks to the VAR system)
4. To simulate shocks to the system and trace out the effects of shocks on the endogenous variables.

In order to conduct a VAR model estimation, the optimal lag length(k) needs to be determined, Upon performing the test, the optimal lag length is found to be the 5th and 8th lag.

```
Vector autoregression

Sample:   2008 - 2019                          Number of obs     =        12
Log likelihood =   4.293878                    AIC               =  2.284354
FPE            =   .0821195                    HQIC              =  2.015059
Det(Sigma_ml)  =   .0016759                    SBIC              =  3.011714
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
TR	9	.517141	0.8942	101.3995	0.0000
CT	9	.443434	0.8888	95.86591	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TR						
TR						
L5.	-.3446891	.3916871	-0.88	0.379	-1.112382	.4230035
L6.	-1.825644	.7094442	-2.57	0.010	-3.216129	-.4351587
L7.	-2.725459	.8552578	-3.19	0.001	-4.401734	-1.049185
L8.	-.1111041	.3067889	-0.36	0.717	-.7123993	.4901911
CT						
L5.	.7113118	.400507	1.78	0.076	-.0736676	1.496291
L6.	2.797159	1.033618	2.71	0.007	.7713043	4.823013
L7.	3.767475	1.20626	3.12	0.002	1.403249	6.131701
L8.	1.422475	.5836143	2.44	0.015	.2786119	2.566338
_cons	25.20875	6.551606	3.85	0.000	12.36783	38.04966
CT						
TR						
L5.	.1190516	.3358612	0.35	0.723	-.5392242	.7773274
L6.	-1.542175	.6083294	-2.54	0.011	-2.734479	-.3498714
L7.	-2.137414	.7333606	-2.91	0.004	-3.574774	-.7000535
L8.	-.0192791	.2630632	-0.07	0.942	-.5348736	.4963154
CT						
L5.	-.1730614	.343424	-0.50	0.614	-.8461601	.5000373
L6.	2.296215	.8862998	2.59	0.010	.5590991	4.03333
L7.	3.319295	1.034336	3.21	0.001	1.292035	5.346555
L8.	.9498992	.5004336	1.90	0.058	-.0309326	1.930731
_cons	13.49206	5.617826	2.40	0.016	2.481327	24.5028

Observations from estimating the VAR model are as follows:

1. Lagged value for dependent variable and independent variables are presented in the above tables as regressors for both variables are generated.
2. Each section of the table indicates the variable of interest and the respective regressors with their lagged values.
3. For the first half of the analysis, for the dependent variable TR:
    a. **L6(10%) L7(1%)** of TR regressor have a negative impact on the dependent variable with respective levels of significance with average ceteris paribus.
    b. **L6 and L7** of CT regressor have a positive impact with a significance level of **7% and 2%** resp on the dependent variable (TR) with average ceteris paribus
4. For the second half of the analysis, for the dependent variable CT:
    a. L6 and L7 TR regressor have a negative impact on the dependent variable with a significance level of 11% and 4% respectively with average ceteris paribus.
    b. L6 and L7 CT regressor have positive impact with a significance level of 10% and 1% respectively with average ceteris paribus.

All the variables inVAR model are endogenous and no exogenous variables exist. Therefore all variables may be determined inside the system only
The stochastic error terms are often called impulses, or innovations or shocks. All variables in the system have equal lags. VAR must be specified in levels, hence VAR in differences is a mis-specification.

This leads to the determination of a causal relationship, if it exists between the given variables. We perform the following tests for the same:

Granger causality is a way to investigate causality between two variables in a time series. The method is a probabilistic account of causality; it uses empirical data sets to find patterns of correlation.

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
TR	CT	**18.414**	**4**	**0.001**
TR	ALL	**18.414**	**4**	**0.001**
CT	TR	**18.961**	**4**	**0.001**
CT	ALL	**18.961**	**4**	**0.001**

For the causality tests, the following Decision criteria is used:

> *Null hypothesis is rejected if the P value is lower or equal to 0.05*
> *If P value turns out to be higher than 0.05, the null hypothesis of the granger causality can not be rejected.*

From the observations made, it can be concluded that all the null hypotheses will be rejected, at a significance level of 5% each, hence concluding that there exists granger causality between the two variables back and forth.

WALD CAUSALITY TEST

```
( 1)  [TR]L5.CT = 0

           chi2(  1) =    3.15
         Prob > chi2 =    0.0757
```

Chi square results are 3.15 at a **significance level of 10%.**
This tells us that ***CT has a causal effect on TR***.

```
( 1)  [CT]L5.TR = 0

           chi2(  1) =    0.13
         Prob > chi2 =    0.7230
```

Chi square results are 0.13 at an insignificant level.
Therefore we reject the null hypothesis. Furthermore, it can be said that ***TR does not have a causal effect on CT.***

Further on we perform normality tests based on our estimated VAR model to determine the Causal Relationship:

Varnom:
1. Jarque - Bera Test
2. Skewness Test
3. Kurtosis Test

Finally, to test the goodness-of-fit of whether the sample data of the choice of variables have the skewness and kurtosis matching a normal distribution, Stability tests are performed on the variables; namely the Jarque-Bera test, Skewness test and the Kurtosis test.

Jarque-Bera test

Equation	chi2	df	Prob > chi2
TR	**0.891**	**2**	**0.64047**
CT	**0.502**	**2**	**0.77801**
ALL	**1.393**	**4**	**0.84539**

Skewness test

Equation	Skewness	chi2	df	Prob > chi2
TR	**-.62551**	**0.783**	**1**	**0.37637**
CT	**.31971**	**0.204**	**1**	**0.65117**
ALL		**0.987**	**2**	**0.61050**

Kurtosis test

Equation	Kurtosis	chi2	df	Prob > chi2
TR	**2.534**	**0.109**	**1**	**0.74178**
CT	**2.2285**	**0.298**	**1**	**0.58539**
ALL		**0.406**	**2**	**0.81621**

Then we conduct VAR stability tests that are eigenvalue stability conditions.

We see that at least one eigenvalue is at least 1.0 therefore VAR does not satisfy the stability condition.

```
. varstable

   Eigenvalue stability condition
```

Eigenvalue	Modulus
.7368521 + .8554466*i*	1.12904
.7368521 - .8554466*i*	1.12904
-.3142307 + 1.036295*i*	1.08289
-.3142307 - 1.036295*i*	1.08289
1.08152	1.08152
-.7032245 + .7328414*i*	1.01567
-.7032245 - .7328414*i*	1.01567
-1.000273	1.00027
.1251623 + .9826549*i*	.990594
.1251623 - .9826549*i*	.990594
.8187564 + .4109364*i*	.916095
.8187564 - .4109364*i*	.916095
-.8184067 + .2162698*i*	.8465
-.8184067 - .2162698*i*	.8465
.1144681 + .2573877*i*	.281694
.1144681 - .2573877*i*	.281694

```
   At least one eigenvalue is at least 1.0.
   VAR does not satisfy stability condition.
```

CONCLUSION

The following conclusions may be drawn on the basis of the tests done above on our choice of the independent variable and dependent variable

1. Chosen variables are non-stationary but the first difference comes out to be stationary.

2. There exists no cointegration relationship between the Total Revenue and Central Transfers.

3. Optimal lag length for the given data sets in time series analysis comes out to be k = 5,8

4. For the first half of the VAR model estimation analysis, for the dependent variable TR:
    a. **L6(10%), L7(1%)** of TR regressor have a negative impact on the dependent variable with respective levels of significance with average ceteris paribus.
    b. **L6 and L7** of CT regressor have a positive impact with a significance level of **7% and 2%** resp on the dependent variable (TR) with average ceteris paribus

5. For the second half of the VAR model estimation analysis, for the dependent variable CT:
    a. L6 and L7 TR regressor have a negative impact on the dependent variable with a significance level of 11% and 4% respectively with average ceteris paribus.
    b. L6 and L7 CT regressor have a positive impact with a significance level of 10% and 1% respectively with average ceteris paribus.

6. There exists a unidirectional causality from CT to TR.

7. The t-statistic of the explanatory variables indicate the “short-run” causal effects.

8. Chi-square stat from granger and wald tests indicate the “short-run” causal effect.

9. Each of the causality test (checks) can serve as robustness or evidence of validation for one another.

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Appendix

```
. vecrank CT TR, trend(constant) max

                    Johansen tests for cointegration
Trend: constant                                        Number of obs =      18
Sample:  2002 - 2019                                            Lags =       2
-------------------------------------------------------------------------------
                                                         5%
maximum                                       trace    critical
  rank    parms      LL        eigenvalue   statistic    value
    0       6    -28.544132         .        14.5494*    15.41
    1       9     -22.01377     0.51596       1.4887      3.76
    2      10    -21.269426     0.07938
-------------------------------------------------------------------------------
                                                         5%
maximum                                        max     critical
  rank    parms      LL        eigenvalue   statistic    value
    0       6    -28.544132         .        13.0607     14.07
    1       9     -22.01377     0.51596       1.4887      3.76
    2      10    -21.269426     0.07938
-------------------------------------------------------------------------------
```

Growth rate of total revenues of Orissa and its components (1980–1981 to 2010–2011) (in percentage)

Revenues	*Total period (1980–1981 to 2010–2011)*	*Period I (1980–81 to 1990–1991)*	*Period II (1991–92 to 2004–2005)*	*Period III (2005–2006 to 2010–2011)*
State's own tax revenue (SOTR)	15.33*	17.11*	14.50*	15.19
Share in central taxes (SCT)	14.77*	15.48*	12.07*	13.98**
Tax revenue (TR)	15.04*	16.25*	13.21	14.58*
State's own non-tax revenue (SONTR)	12.82*	6.91*	9.81	12.63
Grants from centre (GfC)	12.37*	11.98*	8.85	25.94*
Non-tax revenue (NTR)	12.52*	10.24*	9.12	21.16*
Total revenue (RR)	14.04*	13.52*	11.78**	16.73
Gross domestic product (GDP)	12.40*	11.97*	10.78	17.19*

Note: *Indicates t-statistics of the coefficient is significant at 1 % level of parentheses and **indicates t-statistics of the coefficient is significant at 5% level of parentheses.

Institution-wise Transfer of Resources to PRIs (4th SFC)

(Rs. in Lakhs)

Year	GP/PS/ZP	Devolution	Assignment of Taxes	Grants-in-aid
2015-16 (Actual)	GP	37059.00	3369.57	21708.96
	PS	9963.00	38995.02	2296.00
	ZP	2355.00	1731.21	5000.00
	Total	**49377.00**	**44095.80**	**29004.96**
2016-17 (Actual)	GP	37059.00	4610.11	26818.00
	PS	9963.00	43119.38	2525.00
	ZP	2355.00	1920.98	7500.00
	Total	**49377.00**	**49650.47**	**36843.00**
2017-18 (Actual)	GP	37059.00	4896.05	30234.00
	PS	9963.00	48952.38	2778.00
	ZP	2355.00	2164.01	12500.00
	Total	**49377.00**	**56012.44**	**45512.00**

Source : Budget document, Finance Department

Budget Estimates and Outturns for the year 2011-12

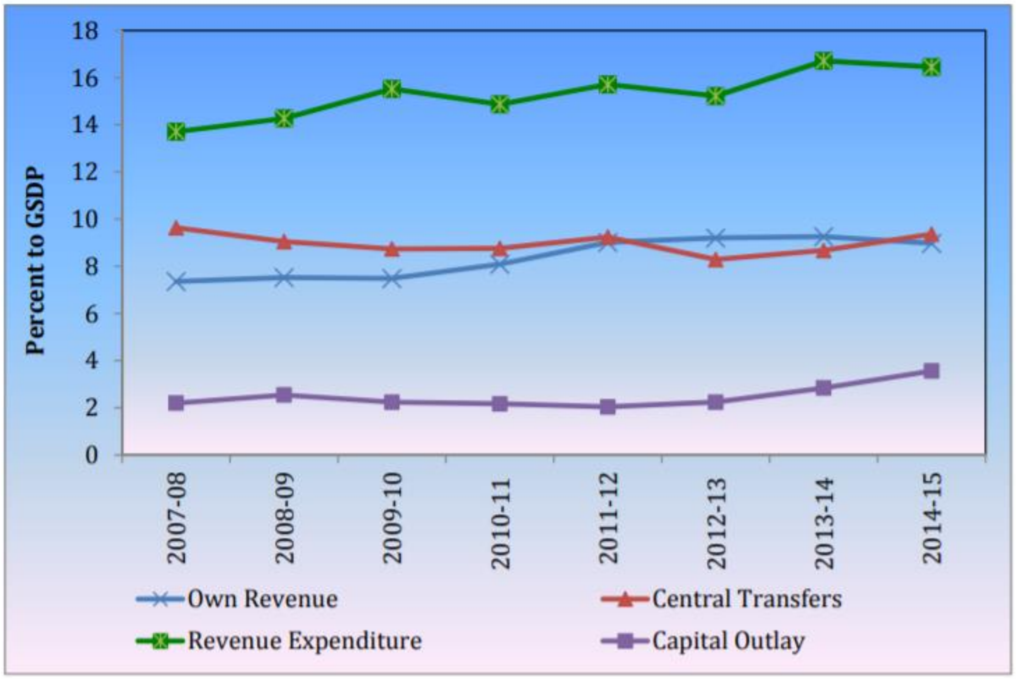
(Percentage of GSDP)

(Percentage of GSDP)	2011-12 (BE)	2011-12 Actual	Changes
Revenues	**16.85**	**18.65**	**1.80**
Own Tax Revenues	5.70	6.23	0.53
Own Non-Tax Revenues	1.76	2.98	1.22
Non-ferrous Mining and Metallurgical Industries	1.41	2.12	0.70
Central Transfers	9.39	9.44	0.05
Tax Devolution	5.29	5.66	0.37
Grants	4.10	3.78	-0.32
Revenue Expenditure	**16.82**	**16.05**	**-0.77**
General Services	6.20	5.06	-1.14
Social Services	6.40	6.64	0.24
Economic Services	3.95	4.04	0.09
Compensation and Assignment to Local Bodies	**0.27**	**0.31**	**0.04**
Capital Expenditure	**2.80**	**2.31**	-0.49
Capital Outlay	2.62	2.08	-0.54
Net Lending	0.18	0.23	0.05
Revenue Surplus	**0.03**	**2.60**	**2.57**
Fiscal Deficit	**2.77**	**-0.29**	**-3.06**
Primary Deficit	**0.90**	**-1.48**	**-2.38**
Outstanding Debt	**21.27**	**17.87**	**-3.40**

Source: Basic data – Finance Accounts and Budget Document for the year 2011-12, GoO
GSDP data used are of 2004-05 series

Note: Negative sign for deficit figures indicate surplus

Broad Fiscal Trends



Own Tax Revenues in Odisha

(% of GSDP)

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Own Tax Receipts	**5.30**	**5.38**	**5.51**	**5.67**	**6.09**	**5.98**	**6.19**	**6.38**
Sales Tax	3.19	3.23	3.32	3.45	3.72	3.86	3.93	3.80
State Excise	0.41	0.44	0.52	0.55	0.63	0.60	0.65	0.65
Motor Vehicle Tax	0.36	0.35	0.38	0.37	0.36	0.30	0.31	0.29
Goods and Passengers	0.48	0.43	0.50	0.56	0.59	0.53	0.59	0.55
Tax on Duties on Electricity	0.25	0.25	0.28	0.23	0.25	0.24	0.25	0.55
Land revenue	0.21	0.23	0.18	0.20	0.24	0.17	0.16	0.21
Stamp Duty	0.31	0.33	0.22	0.21	0.23	0.22	0.22	0.26
Taxes on Profession	0.07	0.08	0.08	0.07	0.06	0.05	0.05	0.05
Other Taxes	0.02	0.03	0.03	0.03	0.03	0.03	0.02	0.01

Source: Finance Accounts of relevant years

Own Sources of Revenue of GPs

(Rs. in lakh)

Year	Vehicle Tax	Water Charges for DW	Lighting Tax	License Fees	Market Fees	Ferry Ghat	Pisci-culture Tank lease	Orchard	Building Plan approval charges	Collection of fees from capital assets	Others (Mobile towers, fees from Mela /fare etc.)	Total receipts of all GPs
1	2	3	4	5	6	7	8	9	10	11	12	13
2015-16	15.23	350.60	260.30	155.40	395.60	28.60	670.54	145.20	12.60	585.30	55.27	2674.64
2016-17	16.45	425.30	262.30	165.40	400.25	35.60	815.60	150.45	25.60	680.45	551.86	3529.26
2017-18	18.45	450.60	275.80	180.25	425.15	25.30	802.30	150.15	35.40	685.20	441.00	3489.60
Total	**50.13**	**1226.50**	**798.40**	**500.33**	**1220.46**	**89.50**	**1288.30**	**445.62**	**73.60**	**1950.50**	**1048.13**	**8691.47**

Source: PR & DW Department

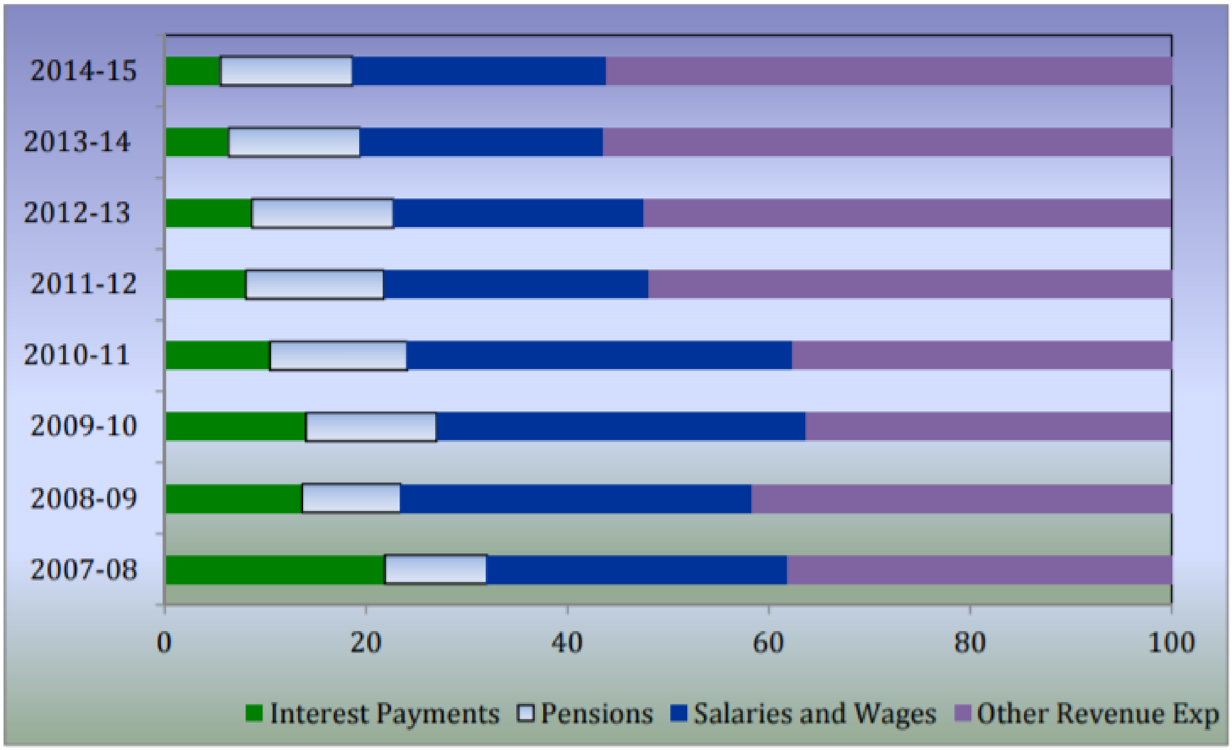
Own Source of Revenue vis-à-vis Funds transferred to ULBs

(Rs. in Crore)

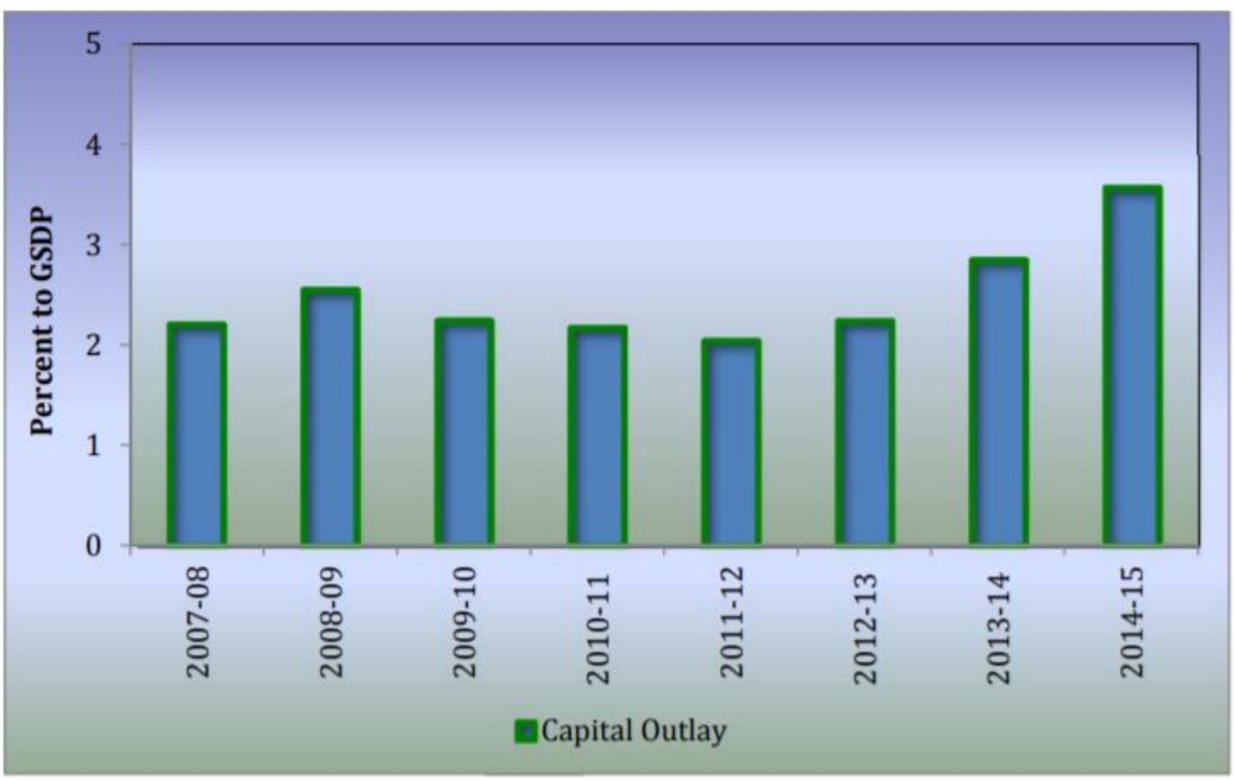
Year	Own Source	Transfer from Government					
		SFC			CFC		Total Govt. transfer
		Devolution	Assignment of Tax	Grants-in-aid	Performance Grant	Basic Grant	
1	2	3	4	5	8	9	11
2015-16	136.32	164.45	640.22	59.51	0.00	162.44	1026.62
2016-17	171.40	164.14	702.24	80.39	68.26	231.25	1246.29
2017-18	185.39	164.61	774.40	178.10	78.67	272.14	1467.91
Total	**493.11**	**493.20**	**2116.86**	**318.00**	**146.93**	**665.83**	**3740.83**

Source: H&UD Department & budget documents

Committed Revenue Expenditure



Capital Outlay



Outstanding Liabilities

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Public Debt	**15.59**	**12.96**	**11.16**	**9.28**	**8.54**	**8.64**
Internal Debt	10.54	9.11	7.86	6.41	5.89	6.35
Market Loans	4.16	3.12	2.32	1.52	1.07	1.47
Special Securities issued to NSSF	4.56	4.28	3.85	3.42	3.29	3.24
Loans from Financial Institutions	1.01	1.10	1.25	1.34	1.44	1.60
Others	0.81	0.10	0.45	0.13	0.08	0.04
Loans and Advances from the Central Government	5.05	3.84	3.30	2.87	2.65	2.29
Loans for Plan Schemes	4.95	3.77	3.26	2.84	2.63	2.28
Other Liabilities	**9.33**	**8.40**	**8.09**	**7.97**	**7.84**	**7.61**
Small Savings, Provident Funds etc.	7.56	6.86	6.33	5.84	5.62	5.28
Reserve Funds	0.01	0.02	0.14	0.08	0.03	0.11
Deposits	1.75	1.53	1.62	2.05	2.19	2.22
Total Public Debt and Other Liabilities	**24.92**	**21.36**	**19.25**	**17.25**	**16.38**	**16.25**

Outstanding Guarantees

Year	Guarantee Outstanding at the end of the year (Rs. Lakh)	Guarantee Outstanding % of Revenue Receipts less Grants for the 2nd Preceding year	Guarantee as % of GSDP
2004-05	3823.25	57.59	4.92
2005-06	3496.19	45.26	4.11
2006-07	2647.55	27.87	2.60
2007-08	2168.43	19.00	1.68
2008-09	1386.4	9.32	0.93
2009-10	1026.94	5.92	0.63
2010-11	2066.25	10.62	1.05
2011-12	2510.43	12.12	1.14
2012-13	2251.23	8.50	0.90
2013-14	1705.27	5.31	0.62
2014-15	1671.77	4.51	0.54

Source: Finance Account, GoO, Relevant Years

Borrowings and Repayments

(Rs. Lakh)

	2013-14	2014-15l
Public Debt Receipts		
Internal Debt	173965.52	711653.00
Loans Advances from Central Government	55059.96	52910.00
Small Savings and Provident Fund	333233.00	347060.00
Debt Repayments		
Internal Debt	177531.61	346149.00
Loans Advances from Central Government	51790.20	64998.00
Small Savings and Provident Fund	264327.00	239781.00
Net Public Debt	68609.67	460695.00

Source: Finance Accounts for the year 2014-15, GoO

YEAR	BUDGET (Rs. in Crore)	EXPENDITURE (Rs. in Crore)	% Expenditure
2009-10	800.6	733.38	91.60
2010-11	1156.33	981.12	84.85
2011-12	1120.00	908.59	81.12
2012-13	1084.26	981.38	90.51
2013-14	1481.06	1426.57	96.32
2014-15	2364.7	2333.49	98.68
2015-16	3807.48	3757.21	98.68

Progressive Quarterly Expenditure (% of BE)

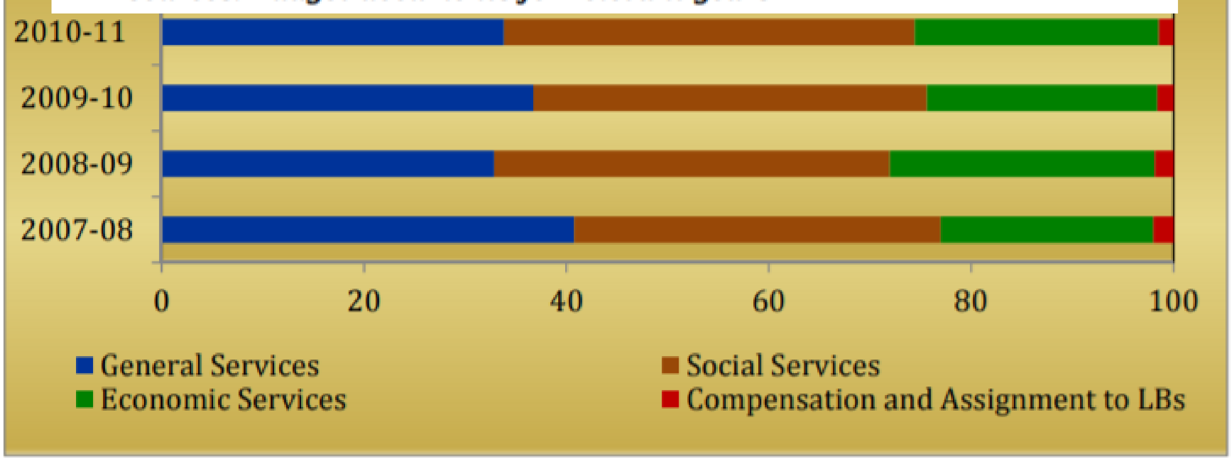
	1st Qr	2nd Qr	3rd Qr	4th Qr
2013-14	14.81%	33.11%	45.71%	83.66%
2014-15	17.10%	28.67%	49.88%	82.35%
2015-16	25.61%	38.19%	65.45%	98.54%

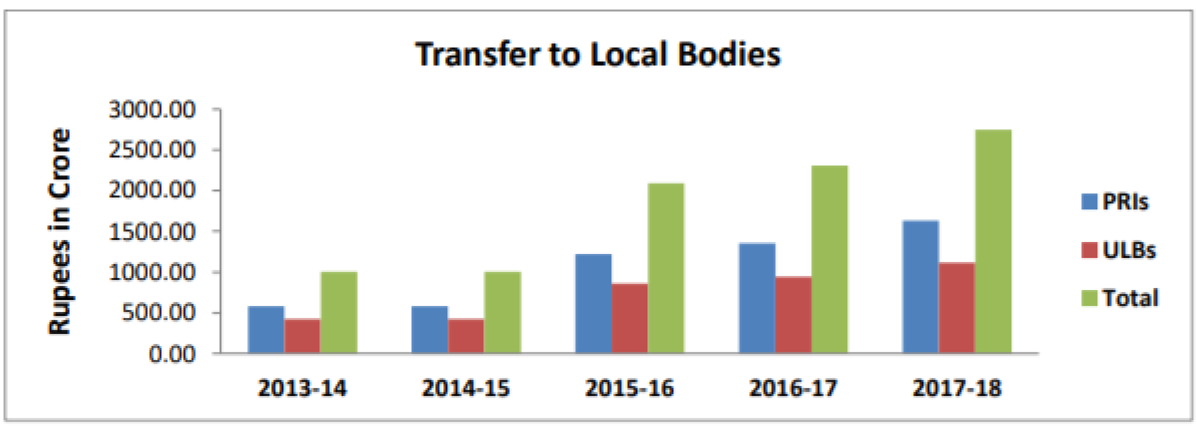
Release of funds by the State Government towards salaries and establishment costs of ULBs.

(Rs.in crore)

Year	Amount of salary
2015-16	399.12
2016-17	448.10
2017-18	492.97

Sources: Budget documents for relevant years





Source: ***Computed***