State Level Power Sector Reforms in India: A Case Study of Odisha

Dr. Asit Ranjan Mohanty[1]

Dr. Suresh Kumar Patra[2]

Abstract

The electricity distribution sector is critical for entire value chain for the electricity sector as it deals with the end consumer and as it provides the vital link between the end consumers and the other segments of the electricity sector. In India, the Transmission & Distribution loss (T&D loss) and aggregate technical & commercial loss (AT&C loss) are still very high. The reform measures envisaged since 2002 through privatization model in India in the distribution sector is yet to be crystallized. In India, Odisha being the first state to kick start the privatization model in 1996 is the worst performer regarding very low billing and collection efficiency. As a result, the AT&C loss is one of the highest in India. This paper empirically establishes that AT&C loss Granger causes revenue realization per unit (RPU). It is also confirmed that lower AT&C loss will raise the RPU. Higher billing and collection efficiency have a positive effect on RPU, though; billing efficiency has more positive impact on RPU as compared to collection efficiency. The empirical evidence suggests that tariff hike for the consumers have a negative correlation with RPU and positive correlation with AT&C loss.

Keywords: AT&C Loss, T&D Loss, Billing Efficiency, Collection efficiency, Random Effects Model, VAR Granger Causality/Block Exogeneity Wald Tests

[1] Professor in Finance, Xavier Institute of Management, Bhubaneswar, E-mail: asit.mohanty@ximb.ac.in.
[2] Research Associate, Centre for Fiscal Policy and Taxation, Xavier Institute of Management, Bhubaneswar, E-mail: suresh@ximb.ac.in.

1. Introduction

India has the fifth largest generation capacity in the world with an installed capacity of which is about 4 percent of global energy production. The top four countries, viz., US, Japan, China, and Russia together consume about 49 percent of the total power generated globally. The installed generation capacity in India has stood at 2, 50, 256 MW at the end of 30th July 2014[3]. The value chain of the electricity sector is entirely dominated by central, state and private sector utilities. The contribution of the State Sector, Central Sector, and Private Sector are 39.37%, 28.73% and 31.88% respectively to the total installed capacity in India[4]. In spite of the massive addition of generation capacity over the last sixty years (1713 MW in 1950), transmission and distribution losses (T&D loss) have grown at an alarming rate. While transmission network and transmission losses are as per the international benchmark, the high losses in the distribution sector have resulted in deficit both regarding load and energy requirements. During the year 2012-13, the country faced an energy deficit of 6% with a peak shortage of 6.3%[5]. Though the per capita electricity consumption has increased from 18.2 units in 1950 to 917 units in 2013, still it is below the per capita consumption of electricity in the world which is reported at 2782 units in 2008 because of high transmission and distribution losses[6]. The T& D losses had increased from 15.20% in 1950-51 to 34% in 2001-02 in India. At 2012-13, the T&D losses are reported at 23.40%[7].

The electricity distribution sector is the last segment in the electricity supply chain and also, a key segment as it provides the vital link between the end consumers and the other sectors of the power sector. The Government of India realizing the problem of inefficiency in the electricity distribution sector passed the Electricity Act (EA) 2003 in June 2003, repealing the Indian Electricity Act 1910. The primary objective of the EA 2003 has been to promote competition to enable the consumers to have the best possible price and quality of supply. The Electricity Act, 2003 was the turning point of the reform process. It led to the unbundling of the former state electricity boards (SEBs) into separate power production, transmission and distribution companies. Though the transmission remained under the control of the state or public sector bodies, the private players were allowed in production and distribution of power in some states

[3] Ministry of Power: http://powermin.nic.in/indian_electricity_scenario/introduction.htm
[4] Ministry of Power, GOI(2013)
[5] Ibid
[6] Ibid
[7] Ibid

with provision for issuing multiple distribution licenses in a given area. Some of the major reforms that have been undertaken in the electricity distribution sector are public and private sector partnership (PPP). Apart from promoting PPP in the distribution sector, the Central Government has come out with various funding programs such as Accelerated Power Development and Reform Program (APDRP). In 2002, the APDRP was created to fund to SEBs /DISCOMs to improve the technical aspects of their distribution network, meter extensively the same, and improve consumer values. The primary objectives of the program are to reduce the Aggregate Technical & Commercial (AT&C) losses to 15%. Consequently, R-APDRP (Restructured-APDRP) in 2008 as part of the XI Plan has been focusing on loss reduction on a sustainable basis and incentivizing the distribution utilities who are maintaining AT&C loss level at 15% level for five years.

Odisha was the first state in India to kick-start the power sector reforms process in the year 1996, it was followed by other states like Haryana (1997), Andhra Pradesh (1998), Uttar Pradesh (1999), Karnataka (1999), Rajasthan (1999), Delhi (2000), Madhya Pradesh (2000) and Gujarat (2003). All these states, after passing their reforms act, unbundled their State Electricity Boards into separate entities of generation, transmission, and distribution. As a result of reforms, Odisha State Electricity Board (OSEB) was unbundled and its successor entities corporatized into GRIDCO (responsible for transmission and distribution of power) and Odisha Hydro Power Corporation (OHPC) (responsible for hydropower generation). The unbundling was followed by the constitution of Odisha Electricity Regulatory Commission (OERC). Subsequently in 1997, GRIDCO divided its distribution functions into four geographical zones and incorporated four wholly owned subsidiaries namely Western Electricity Supply Company of Odisha (WESCO), North Eastern Electricity Supply Company of Odisha (NESCO), Southern Electricity Supply Company of Odisha (SOUTHCO) and Central Electricity Supply Company of Odisha (CESCO) (now known as, Central Electricity Supply Utility of Odisha (CESU) under the Companies Act, 1956. GRIDCO divested 51% of its equity in WESCO, NESCO & SOUTHCO for BSES (now Reliance Energy Limited). BSES took over the management of these three DISCOMs with effect from 01.04.1999. GRIDCO also divested 51% of the equity in CESCO (now CESU) for AES Corporation. AES defaulted in its payment to GRIDCO due to which OERC revoked the license of CESCO and made Central Electricity Supply Utility (CESU) responsible for the operations of CESCO from August 2006. Since 1997, four distribution utilities CESU (formerly known as CESCO), NESCO, SOUTHCO, and WESCO are in operation in the state of Odisha.

In spite of reforming the electricity distribution sector in India, the T&D losses in India is reported at 23.97% and 26.04% respectively in 2010-11 and 201-12[8] as compared to international average T&D losses of 8.75% and 8.94% during the same period. The T&D losses were at 15.20% in 1950; it grew to the level of 23.40% in 2012-13. The aggregate technical and commercial losses (AT&C losses) of India are at 27% level in 2011-12. Both T&D losses and AT&C losses are highest for India in the world[9]. According to a recent report[10], the losses in the power distribution sector were estimated to be 0.9% of GDP for 2010-2011 which accounted for $ 14 Billion. This report also predicted that these losses would become 1.2% of GDP in the year 2013-2014. Because of both high AT& C losses, the aggregate losses (without accounting for subsidy) for all the state utilities increased from Rs. 64,463 Crs. in 2009-10 to Rs.74, 291 Crs. in 2010-11 and to Rs. 92,845 Crs. in 2011-12[11].

Although Odisha is the first state to introduce power sector reforms, it has been experiencing huge transmission and distribution losses. In Odisha, at the end of 2011-12 and 2012-13, the respective T&D losses are reported at 39.45% and 38.48%. The AT&C losses are reported at 44% and 42.83% respectively at the end of 2011-12 and 2012-13.[12] Among the Indian states, Odisha has the highest AT&C loss and T&D loss besides its early journey in the power sector reforms. Hence, we considered Odisha for our study. Understanding high AT&C and T&D losses, this paper discusses the commercial performance of the distribution utilities in Odisha in the context of reform measures. Further, it also establishes the direction of causality between AT&C loss, billing efficiency, and RPU. It also aims to measure and compare the impact of T&D loss and AT&C loss on RPU and to derive which one between T&D and AT&C loss is a comprehensive metric to measure the inefficiency. Finally, it investigates whether the rise in consumer electricity tariff has a positive impact on AT&C loss and RPU or not.

A plethora of literature on the electricity distribution and transmission are available in the energy research. Some authors explained the cause of the inefficiency in the electricity

[8] Central Electrical Authority of India, Executive Summary of Power Sector,2014
[9] Ibid
[10] Avendus India Equity Research Utilities, May 2012

[11] Report on "The Performance of State Power Utilities for the years 2009-10 to 2011-12, Power Finance Corporation, India
[12] Ibid

distribution and some others suggested several procedures to improve efficiency in the electricity distribution sector.

Inadequate capital expenditure, operation and maintenance (O&M) activities and accurate metering adversely affect the effectiveness of the electricity distribution (Ninan, 2012; Kiran Kumar, et al., 2013; Nadal, 2013). The inefficiency in the electricity sector has become pervasive because of outright theft and unmetered supply; skewed LT to HT line ratio for LT lines, poor recoveries, etc. (Rao et al., 1998; Thillai, 2000; Gedam, 2011). System up-gradation, loss reduction, theft control, consumer orientation, tariff rationalization, commercialization and adoption of IT, organizational strengthening, improvement in metering efficiency; continuous energy accounting and auditing and improved billing and collection efficiency are the keys to bring in efficiency in the distribution sector (Katiyar, 2005; Madhav and Mehta, 2010; The CRISIL Risk and Infrastructure Solution Ltd, 2010; Thillai, et al, 2000; Thillai, 2002; Thillai, 2003, Kiran Kumar, et al, 2013; Mohanty and Parida, 2013; Mohanty, et al. 2014; Vinayak, 2014). This, in turn, has created a moral hazard as consumers with legal connections are also becoming free riders by taking more illegal new connections. The supply reliability and quality of power delivered have declined because of inadequate investments in upgrading, improving the R&M in wires, transformers and feeders (Bhattacharya and Patel, 2007). Consumer indexing and energy accounting to overcome the agency problems which in turn will improve the performance of the DISCOMs in India (Ranganathan, 2005). The electricity distribution sector is a leaking bucket wherein the holes are deliberately crafted and the leaks carefully collected as economic rents by various stakeholders that control the system (Parekh, 2002).

Based on this past literature, this paper makes an attempt to fill certain gaps in research. In particular, the paper contributes to the existing literature in four distinct ways with specific reference to the electricity distribution sector of State of Odisha. First, the efficiency of electricity distribution sector is examined by segregating AT&C loss into billing and commercial efficiency. Second, this study has investigated the relationship between AT&C losses and RPU. Third, a comparative performance analysis of DISCOMs of the State of Odisha has been presented. Fourth, the impact of T&D loss and AT&C loss on RPU has been quantified and compared.

With this background, the objective of the paper is to examine the contributing factors to the AT&C losses in India with a particular focus on the State of Odisha. Besides the first introductory section, Section 2 explains the data and methodology. Results and analysis are discussed in Section 3. Finally, section 4 concludes and provides policy prescription and suggestions.

2. Data and Methodology

The latest time series data from 1990-1991 to 2012-13 have been sourced from Odisha Electricity Regulatory Commission (OERC) published data.The data before 1990-1991 is not available. Data relating to Input Energy (MU), Billing Unit (MU), Billed Amount (Rs. Crore), Revenue Collection (Rs.Crore) have been taken for all the four utilities of Odisha from OERC source. The Billing Efficiency, Collection Efficiency, AT&C losses and RPU are computed from the above-published data and compared with the OERC data for validation of these parameters. It is found that there is no difference in the computed data on Billing Efficiency, Collection Efficiency, AT&C losses and RPU and the OERC data. The all India data are sourced from various issues of "Performance of State Power Utilities" published by Power Finance Corporation of India Ltd. The T&D loss data for India is taken from 1990-1991 to 2012-13. The AT&C loss data for India is available from 1999-2000 to 2012-13.

VAR Granger Causality/Block Exogeneity Wald Tests

Granger causality indicates that lagged values of a variable provide statistically significant information to predict another variable. Mostly, Granger causality tests the presence of correlation between the current value of one variable and the lagged values of other variables in the system. Also, Granger causality tests decide about the exogeneity of a variable. However, Causality tests do not indicate the sign of the relations between variables.

To know the direction of causality from AT&C loss and billing efficiency to RPU Granger causality/ Block exogeneity Wald test (Enders, 2003, p. 284) is applied. This test detects whether the lags of block variables can Granger-cause any other variables in the VAR system. The block exogeneity of RPU, billing efficiency and AT&C loss are tested to establish whether or not each endogenous variable could be treated exogenously at significance levels of 5 percent for the sizes of the individual chi-square values. The null hypothesis is that the coefficients are zero, and there is no Granger causality. The null hypothesis assumes that all lags of block variables can be excluded from each equation in the VAR system. This test helps to identify whether or not all lags of AT&C loss and billing efficiency can be eliminated from the equation of RPU or not in the VAR system. Rejection of the null hypothesis implies that if all lags of AT&C loss and billing efficiency cannot be excluded from the RPU equation, then RPU is an endogenous variable, and there is a causality of AT&C loss and billing efficiency on RPU. Therefore, to determine which variables are exogenous in the VAR model of each cross section, the Granger causality/block exogeneity Wald tests are undertaken The VAR Granger Causality/Block exogeneity Wald Tests has been employed to examine the causal relationship AT&C losses, billing efficiency, and RPU. The standard Wald statistic has an asymptotic chi-square distribution under the regularity condition that the covariance matrix of the vector of restrictions is nonsingular under the null hypothesis. Hence, chi-square (Wald) statistics is used to examine the significance of the test.

Since the time span of the individual series is relatively short (1990-91 to 2012-13) for each variable, balanced panel analysis technique is applied. Since the time period in the study is not large enough, the panel unit root test is not relevant. Fixed effects and random effect models are broadly two types of panel approaches used in empirical research. To achieve the objective, both Fixed and Random Effects models have been employed.

Fixed Effects Model

In fixed effects model, the intercept may differ across cross section (here the four DISCOMs), each representative sample's intercept does not vary over time; that is, it is time invariant. But, it is assumed that the slope coefficients are constant across cross sections and over time. The fixed effects model is represented as:

$$y_{it} = \alpha_i + \beta X_{it} + u_{it} \qquad \textbf{(1)}$$

The subscript ‘i' accounts for the cross sections. The subscript 'i' on the intercept term suggests that the intercepts of the cross sections may be different because of their unique features of each cross section. Therefore, α'i' is the individual effect and it is taken to be constant over time but specific to the individual cross-sectional unit (shifting just the intercepts). The fixed effects model assumes that individual specific factors are correlated with the regressors.

Random Effects Model

An alternative to the fixed effects model, the random effects model considers that the individual specific constants are randomly distributed across cross-sectional units. It is represented by

$$y_{it} = \alpha + \beta X_{it} + (u_{it} + \nu_i) \qquad \textbf{(2)}$$

The equation (2) is derived from $y_{it} = \alpha_i + \beta_i X_{it} + u_{it}$. Instead of treating α_i as fixed, we assume that it is a random variable with a mean value of α. The intercept value for an individual Cross section can be expressed as $\alpha_i = \alpha + v_i$ i = 1, 2, ...N. it is error component of the model with zero mean and constant variance. Here, it is assumed that the cross sections have a common average value for the intercept (=α) and the individual differences in the intercept values of each cross section are reflected in the error term εit. By rearranging the equations,

$$y_{it} = \alpha + \beta_i X_{it} + \nu_i + u_{it} \qquad \textbf{(3)}$$

$$y_{it} = \alpha + \beta_i X_{it} + \varepsilon_{it} \qquad \textbf{(4)}$$

Where,

$$\varepsilon_{it} = u_{it} + \nu_i \qquad \textbf{(5)}$$

The composite error term εit consists of two components, u_{it}, which is the cross-section, or individual-specific, error component, and v_i, which is the combined time series and cross-section error component.

The assumptions made in Random effects models are that the individual error components are not correlated with each other and are not auto-correlated across both cross-section and time series units.

Because of the above assumptions,

$$E(\varepsilon_{it}) = 0 \qquad \textbf{(6)}$$

$$\mathrm{var}(\varepsilon_{it}) = \sigma^2{}_v + \sigma^2{}_u \qquad \textbf{(7)}$$

The error term εit is homoscedastic. However, ε_{it} and is (t is not equal to s) are correlated indicating that the error terms of a given cross-sectional unit at two different points in time are correlated. The correlation coefficient is represented as:

$$Correl(\varepsilon_{it}, \varepsilon_{is}) = \sigma^2{}_v \big/ \sigma^2{}_v + \sigma^2{}_u \qquad \textbf{(8)}$$

Here, for any given cross-sectional unit, the value of the correlation between error terms at two different times remains the same irrespective of the distance, and the correlation remains the same for all cross sections. If this correlation structure is not considered, the estimation through OLS will result into inefficient estimators.

Unlike fixed effects model, the intercept term 'α' mean value of all the cross sections intercept and the error component εit represents the (random) deviation of individual intercept from this mean value. εit is not directly observable and is known as an unobservable, or latent, variable. Random effects model assume different intercept terms for each cross section and again these intercepts are constant over time and the relationships between the explanatory and explained variables thought to be the same both cross-sectionally and temporally. There are three well-known variance estimators are used in the random effects model, i.e., Swamy-Arora (SA), Wansbeek-Kaptayn (WK) and Wallace–Hussain (WH) (Mohammadi, 2012). In a small sample, either WK or WH is preferred over SA. In this paper, both these estimators are experimented by using White period robust standard errors. The serial correlation in the residuals has been taken into account by using White period standard errors.

Hausman Test

If vi and the X's are uncorrelated, Random effects model is appropriate, whereas if εi and the X's are correlated, Fixed effects model may be appropriate. Hausman developed a test in 1978. It is a chi-squared test based on the Wald criterion. If computed value is less than the table (chi-square) value for appropriate d.f and level of significance, then the null hypothesis (of individual effects are uncorrelated with other regressors) cannot be rejected (i.e. accepted). In this case, the Random Effect Model is relevant (not the Fixed Effect Model).

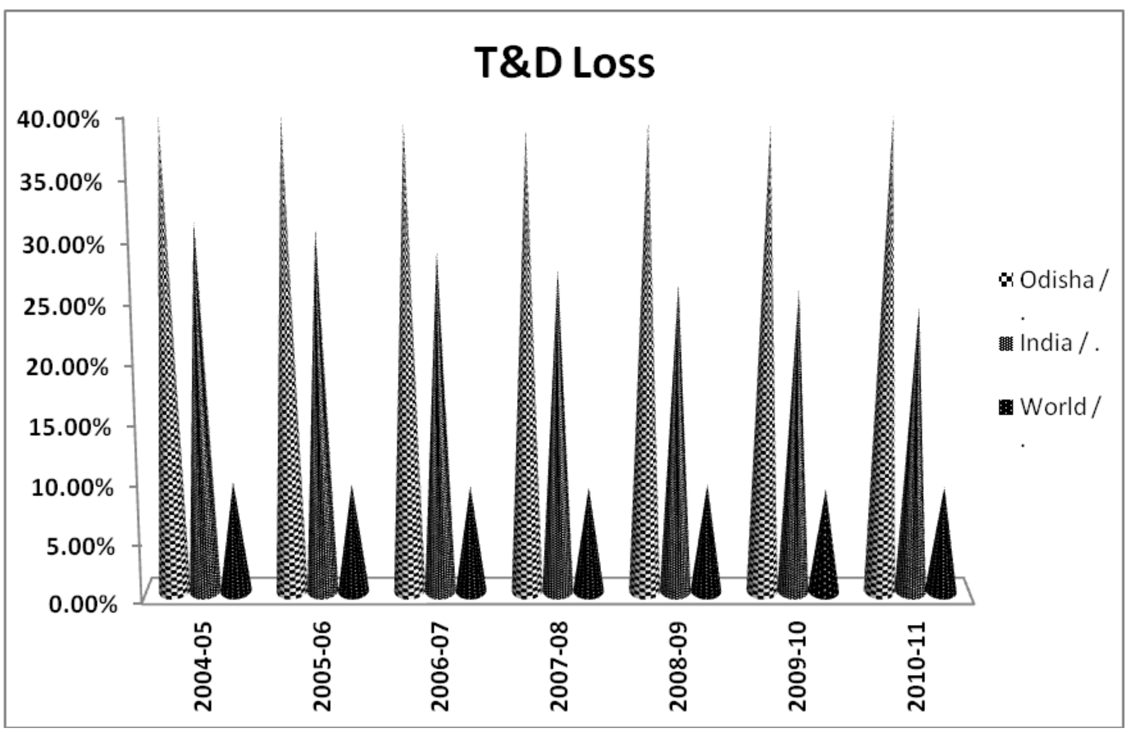
3. Results and Analysis

In this section, we have four empirical sub-sections to achieve the objectives as mentioned above.

Commercial Performance of the Distribution sector

The T&D loss in Odisha in 2010-11 is at 39.55% which is the highest in India. The T&D loss in India is reported at 23.97% in 2010-11 which is much more than the international average of 8.9%[13], and it is one of the five highest countries in the world regarding T&D loss. The lowest T&D loss at 1.8% is witnessed in the case of Luxembourg, and the highest loss is in Paraguay. The comparative picture of T&D loss from 2004-05 to 2010-11 for Odisha, India, and the world is given below (Chart 1).

Chart 1: Comparative Position of T&D Loss (Odisha, India & World)



[13] http://www.wec-indicators.enerdata.eu/world-rate-of-electricity-T-D-losses.html

Though, the state of Odisha was the first state in India to kick-start the power sector reforms process in the year 1996, the yearly average T&D loss from 1996-97 to 2012-13 is reported at 42.20% level which is much higher than the national average of 28.17% during the same period and highest among all states in India (Chart 2).

Chart 2: Comparative Position of T&D Loss (Odisha and India)

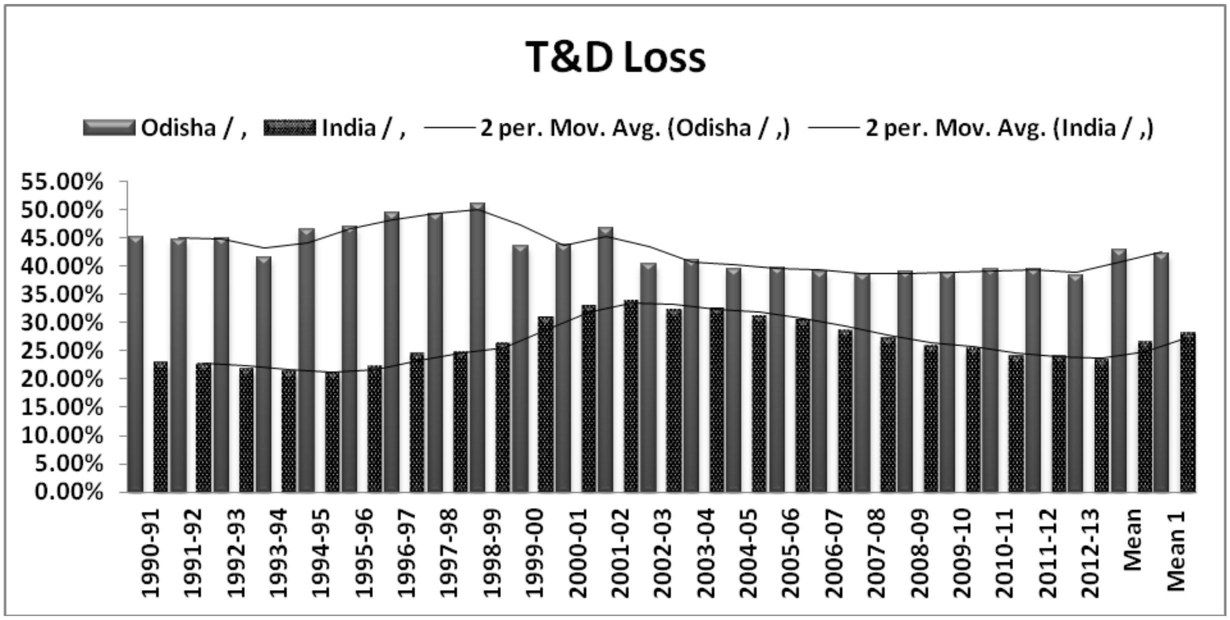
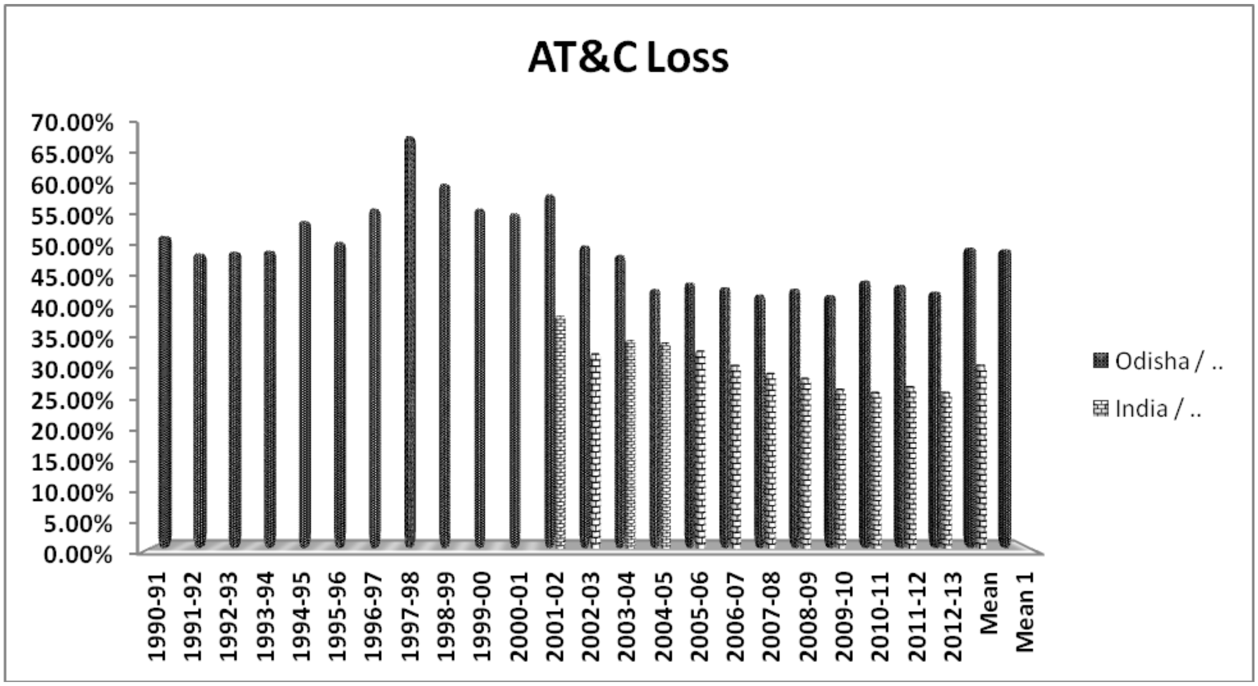


Chart 3: Comparative Position of AT&C Loss (Odisha and India)



Since 1990-91, the T&D loss for Odisha has remained at a much higher level than the all India level both on year on year and two-year moving average basis. The mean T&D loss indicates the average loss during the entire period. The mean 1 is the average T&D loss after the electricity reforms initiated in 1995-96. It is observed and empirically seen that the difference in mean values is not statistically different from zero (Annex – I). The pattern is not changed if the AT&C loss is considered during the same time span[14] (Chart 3).

The mean level of AT&C loss for India is calculated at 30.63% from 2001-02 to 2012-13 which implies the high degree of inefficiency in the electricity distribution sector of India as compared to the world. In India, Odisha is at the top regarding inefficiency; having mean AT&C loss is at 45.75% during the same period. The difference in the mean of AT&C loss during the entire period and the post-reform period is not statistically different from zero (Annex – II).

The objective of APDRP has not managed to reduce AT&C loss level to 15%. Being the pioneer in electricity distribution sector reforms, the state of Odisha has remained as the highest inefficient State in India.

It would be interesting to analyze the performance of the four DISCOMs in Odisha (four cross-sections) which were created after the unbundling of the recent single and monolith distribution sector in 1999. The performance of these four DISCOMs is analyzed in terms Billing Efficiency and Collection Efficiency taking the data from 1999-2000 to 2012-13 (Table 1).

Table 1: Descriptive Statistics BE & CE of DISCOMs in Odisha

	WESCOBE	*NESCOBE*	*SOUTHCOBE*	*CESUBE*	*WESCOCE*	*NESCOCE*	*SOUTHCOCE*	*CESUCE*
Mean	61.25%	61.89%	56.36%	58.28%	89.79%	88.30%	89.85%	86.71%
Std. Dev.	3.60%	5.88%	3.06%	3.20%	5.60%	6.65%	6.34%	7.58%
Skewness	-89.96%	-80.38%	-31.13%	-60.47%	-93.33%	-85.52%	-99.29%	-93.10%
Median	61.71%	62.92%	56.61%	58.51%	91.70%	90.21%	91.58%	90.29%
Minimum	53.56%	49.00%	51.78%	51.19%	79.32%	74.34%	77.34%	72.64%
Maximum	66.45%	68.83%	60.86%	62.96%	96.03%	95.50%	96.59%	95.30%

BE: Billing Efficiency, CE: Collection Efficiency

Both BE and CE are negatively skewed indicating that the mean value of BE and CE have been less than the median value. The CE exhibits more fluctuation than the BE. Besides, the maximum value of BE and CE witnessed by any of the four DISCOMs in Odisha during 1999-2000 to 2012-13 is lower than all India mean value of BE at 71.21% and CE at 96.49%. The average value of billing and collection efficiency in Odisha is calculated at 59.44% and 88.73%

[14] AT&C loss for India is available from 2001-02. However, the AT&C loss for Odisha is computed since 1990-91.

respectively, during this period of analysis which is significantly lower than all India average. CESU has the both lowest BE and CE among the four DISCOMs. Hence, CESU is emerged as the most inefficient DISCOM in Odisha during this period.

Table 2: RPU of DISCOMs in Odisha from 1999-2000 to 2012-13.

	WESCORPU	***NESCORPU***	***SOUTHCORPU***	***CESURPU***
Mean	1.8646	1.7202	1.5544	1.6620
Median	1.7806	1.5719	1.4884	1.5094
Minimum	1.2696	1.0146	1.1484	0.9300
Maximum	2.9871	2.9533	2.3410	3.0098

RPU: Revenue realization per unit of electricity consumed

As a result of very low BE and CE, the average RPU of the four DISCOMs in Odisha is reported at Rs.1.75, Rs.2.08, and Rs.2.54 as against all India RPU of Rs.2.68, Rs.3.03 and Rs.31 respectively in 2009-10, 2010-11 and 2011-12. The descriptive statistics of RPU of all the four DISCOMs in Odisha is reported in Table 2. Among the four DISCOMs, CESU has the lowest average RPU because of very low BE and CE and, highest AT&C loss among all the DISCOMs.

Causality between RPU and AT&C Loss

The Granger-causal relationship has been examined between AT&C loss, billing efficiency and RPU using Granger Causality/Block Exogeneity Wald tests (Appendix – III) under vector auto-regression (VAR) model.

A chi-square test (Wald) statistics of 9.85 and p-value at less than 5% implies that AT&C loss and billing efficiency cause RPU. This indicates RPU is endogenous variable, and AT&C loss and billing efficiency are exogenous variables. The unidirectional causality from AT&C loss and billing efficiency to RPU is established.

The direction and magnitude of impact on RPU of both AT&C loss and BE are captured through modeling framework in the following section.

Impact of AT&C and T&D loss on RPU

To estimate the impact of AT&C loss, the random effects model is taken into account using both WH and WK variance estimators and white period standard errors. Both WH and WK variance estimators give same results; WH variance estimator is used for the analysis (Annex-IV). Then, the Hausman test is applied to find the appropriateness of the Random-effects model.

Random effects model is accepted based on the test summary of Hausman test taking chi-square statistic and p-value into consideration (Annex-V). The model output is given below:

Table 3: Random Effects Model 1

Dependent Variable: RPU

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.818	0.609	6.266	0.0000
AT&C	-0.0427	0.009	-4.361	0.0001

The negative impact of AT&C loss on RPU is established. If the AT&C loss would be reduced by 20% as envisaged in APDRP, RPU will be increased by Rs. 4.67

Table 3: Random Effects Model 2

Dependent Variable: RPU

Variable	**Coefficient**	**Std. Error**	**t-Statistics**	**Prob.**
C	**-2.018**	**0.743**	**-2.713**	**0.00**
T&D Loss	**-0.063**	**0.012**	**-5.014**	**0.00**

The T&D loss has statistically significant negative impact on RPU (Table 3). The T&D loss is one minus billing efficiency. Since the causality runs from billing efficiency to RPU, it is implicit that T&D loss will cause RPU. Therefore, the impact of T&D loss on RPU is estimated. To establish the magnitude of the impact of T&D loss on RPU, Random effects model is carried out, and Hausman test validates the appropriateness of Random effects model (Annex VI & VII). If the T&D loss is reduced by 20%, then RPU will increase by Rs.1.27.

Reduction in both AT& C loss and T&D loss improves the efficiency of the distribution sector which results into higher RPU. Mostly, the reduction in AT&C loss and T&D loss raise the both billing and collection efficiency. If the impact of T&D loss and AT&C loss are compared concerning their impact on RPU, then decline in AT&C loss has more positive impact on RPU for as against the decline of T&D loss by the same magnitude. Therefore, it can be derived that AT&C loss is a comprehensive measure as compared to T&D loss as it capture the impact of collection efficiency and as a result, it impacts on RPU is more.

Tariff Hike, AT&C Loss, and RPU

Often, the DISCOMs suggest the regulator of the electricity hike the tariff applied to the consumers to cushion against higher AT&C loss. The idea behind the higher tariff is to increase the revenue collection from the consumers and to reduce AT& C loss. Since 1990-91, Odisha Electricity Regulatory Commission has raised the consumer tariff eleven times, out of which on two occasions, there has been a downward revision of tariff only (Annex – VII). To find out the correlation between tariff hike, RPU, and AT&C loss, the correlation matrix is prepared by taking into account the percentage change in tariff, the percentage change in RPU and change in AT&C loss from 1990-91 to 2012-13. The correlation Matrix is presented below.

Table 4: Correlation Coefficient Matrix

Variables	*Change in RPU*	*Tariff Hike*	*Change in AT&C loss*
Change in RPU	100%		
Tariff Hike	19.16% (0.87)	100%	
Change in AT&C loss	16.66% (0.75)	30.34% (1.4)	100%

Note: 't' statistics are given in the parentheses.

As inferred from the table 4, the change in tariff has statistically insignificant positive correlation with the percentage change in RPU implying that tariff hike has no impact in raising RPU. Tariff hike and rise in AT&C loss are positively correlated at 10% level of significance, indicating that despite tariff hike, AT&C losses are not reduced, rather it increases. Therefore, tariff hike is not a solution either reducing AT&C loss or increasing RPU in distribution sector of Odisha. It raises the concern that tariff hike could have encouraged the consumers for more unmetered and illegal electricity consumption to avoid paying higher electricity charges.

4. Conclusion

The primary objective of the Electricity Act, 2003 has been to promote competition and to reduce losses that would enable the consumers to have the best possible price and quality of supply by unbundling the unbundling of the state electricity boards (SEBs) into separate power production, transmission, and distribution companies. In 2002, the Accelerated Power Development and Reform Program (APDRP) was created to fund the DISCOMs to improve billing and collection efficiency for bringing down the AT&C loss level to 15% level. Consequently, R-APDRP (Restructured-APDRP) in 2008 was introduced focusing be loss reduction on a sustainable basis and incentivizing the DISCOMs who are maintaining AT&C loss level at 15% level for five years. However, at the end of 2012-13, the T&D loss is at 23.40% level in India. At the end of 2010-11, the average T&D loss an international level is 8.9% as compared to 23.97% T&D which has placed India as one of the five highest countries in the world concerning T&D loss. In 2010-11, the T& D loss for Odisha is reported at 39.55% which is highest in India. Hence, the reform measures envisaged in EA, 2003 to bring in efficiency in electricity distribution sector of India has not been successful. In India, the state of Odisha is one of the worst performers in distribution sector with yearly average T&D loss at 42.20% during 1996-97 to 2012-13 as compared to the national average of 28.17%. The AT& C loss is recorded at 45.75% in Odisha as compared to national average of 30.63% during 2001-02 to 2012-13. The difference in AT& C loss and T&D loss during the 1990-91 to 2012-13 and the post-reform period is proved to be statistically insignificant. Though the state of Odisha was the first state in India to initiate the reforms process in electricity distribution sector by unbundling the state electricity board into four privatized DISCOMs in the year 1996, the inefficiency persists, indicating the failure of privatization model. The mean value of billing and collection efficiency in Odisha is calculated at 59.44% and 88.73% respectively, during 1999-2000 to 2012-13 which is significantly lower than all India average of BE and CE at 71.21% and 96.49% respectively. CESU has the both lowest mean value of BE and CE among the four DISCOMs during this period. Hence, CESU is emerged as the most inefficient DISCOM in Odisha during 1999-2000 to 2012-13. Since the inefficiency in the DISCOMs in Odisha is because of very low billing and collection efficiency, it has resulted in very low the revenue realized per unit of electricity consumed at Rs.1.70 from 1999-2000 to 2012-13. The average RPU of the four DISCOMs in Odisha is reported at Rs.1.75, Rs.2.08, and Rs.2.54 as against all India average RPU of Rs.2.68, Rs.3.03 and Rs.31 respectively in 2009-10, 2010-11 and 2011-12. Among the four DISCOMs in Odisha, CESU has the lowest average RPU during the period 1999-2000 to 2012-13.

It is established that causality runs from AT&C loss and billing efficiency to RPU. From the random effects model, the impact of AT& C loss and T&D loss (one minus billing efficiency is T&D loss) is captured regarding magnitude and direction. It is empirically proved that reduction in both AT&C loss and T&D loss will raise RPU. Since the decline of these losses increases both the billing and collection efficiency which results in system improvement and as a result, RPU improves. However, reduction in AT&C loss has more positive impact on RPU as compared to a reduction of T&D loss by the same magnitude. This is because of AT&C loss captures the impact of collection efficiency besides billing efficiency whereas T&D loss only captures the impact of billing efficiency. Therefore, AT&C loss is a comprehensive measure of efficiency (inefficiency) as compared to T&D loss. It is also established that increase in tariff to the consumers to plug losses in the distribution sector does not reduce the AT&C loss, rather the AT&C loss increases. Besides, the hike in tariff does not have a significant impact in raising RPU.

AT&C loss is a comprehensive and better metric to evaluate the commercial performance of the distribution sector. The AT&C loss may be taken as a policy variable and RPU as target variable to improve the performance of the distribution sector. For minimizing AT&C loss, maximization of both billing efficiency and collection efficiency should be the policy intervention. Relatively, improvement in billing efficiency should get more attention. Billing efficiency has both technical and non-technical components. To improve both the components, capital expenditure regarding investment in infrastructure is essential. DISCOMs should also give importance to operation and maintenance (O&M) expenses to improve part of the non-technical component of billing efficiency and collection efficiency. O&M costs are short term in nature which addresses the consumers' day to day problem immediately. Billing and collection efficiency also aim at optimizing billing coverage ratio15 and collection coverage ratio16. Reducing AT&C loss will augment the revenue realization and, will address the financial losses incurred by the DISCOMs. Tariff hike for the consumers should not be taken as a policy measure as it is counter- productive effect on the system. Therefore, minimization of AT&C loss

[15] Billing Coverage Ratio is defined as numbers of billed consumer about live consumers.
[16] Collection Coverage Ratio is defined as numbers of collected consumer about live consumers.

would raise the revenue realization and, would ensure supply reliability and quality power supply to the consumer, as a result, there will be scope to reduce the consumer tariff further.

References

Bhattacharya, S., and Patel, U.R (2007): "The Power Sector in India: An Inquiry into the Efficacy of the Reform Process". Prepared for Presentation at the Brookings-NCAER India Policy Forum 2007 New Delhi July 17-18, 2007.

Chatterjee, Vinayak (2014): 'Why India needs a 'national power distribution company', *Business Standard*, October 5.
--------------------------(2013): "Mission mode" for PPP in electricity distribution, *Business Standard*, June 18.

CORE International (2002): India Electricity Distribution Reform: Review and Assessment, CORE International, Incorporated, Washington, DC, September 18.

CRISIL Risk and Infrastructure Solutions Ltd (2010), FINAL REPORT ON STUDY ON ANALYSIS OF TARIFF ORDERS & OTHER ORDERS OF STATE ELECTRICITY REGULATORY COMMISSIONS

Dickey, D. A., & Fuller, W. A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. Econometrica, 49, 1057-1072.http://dx.doi.org/10.2307/1912517

Engle, R. and C.W.J. Granger (1987), Cointegration and Error-Correction: Representation, Estimation, and Testing, Econometrica, 55, 251-276.

Gedam,R.(2011): "Towards reducing India's power sector AT&C losses", Electrical Monitor,SPML, http://www.spml.co.in/mediaroom/Electrical Monitor Article.

Government of India, (2006): "Report of the Expert Group on Integrated Energy Policy", Planning Commission.

_________________ (2012): "Report on Working of State Power Utilities & Electricity Departments", Planning Commission.

_______________ (2002): "Report of the Parekh Committee on Structuring of APDRP, Reform Framework and Principles of Financial Restructuring of SEBs", Ministry of Power.

________________(2005): " National Electricity Policy", Ministry of Power.

________________ (2012): "Report of the Working Group on Power for Twelfth Plan (2012-17), Ministry of Power.

_______________ (2012): "Report of 18th Electric Power Survey of India, Central Electricity Authority (CEA), Ministry of Power.

J. A. Hausman, "Specification Tests in Econometrics," Econometrica, vol. 46, 1978, pp. 1251–1271.

Johansen, S. (1991): Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models. Econometrica, Vol. 59, pp. 1551–1580.

Katiyar, Sudhir. (2005). "Political economy of electricity theft in rural areas: A case study from Rajasthan." Economic and Political Weekly, February 12: 644-648.

Kumar,K.. Sairam. K.V., and Santosh, R (2013): Methods to Reduce Aggregate Technical and Commercial (At&C) Losses, International Journal of Engineering Trends and Technology (IJETT) – Volume 4, Issue 5.

Kundu, G. Kumar., and Mishra, B. Bhusan. (2012): "Impact of reform and privatisation on employees a case study of power sector reform in Odisha", India Energy Policy, 45 (2012) 252–262.

Madhav, M. and Mehta, S. (2010): “Case of Reforms in the Indian Power Distribution Sector: A Move Towards Eradicating Energy Poverty”. XXI World Energy Congress Montreal, September 12 to 16, 2010.

Mohammadi, T. (2012), “Relative Performance of Components Variance Estimators in Random Effects Models”, *Iranian Journal of Economic Research*, Vol. 17, No. 50, Spring 2012, pp. 83-98.

Mohanty, A.R., Parida, S. and Mannem, V.N. (2013): “Analysis of Electricity Distribution Efficiency in India”, Odisha Review, September, 2013.

Nandal, Sanjay (2013:. “Analysis of Challenges and Prospects of Power Industry in India”.IJMT, February,Volume 3, Issue 2.

Ninan,K,N(2012): “Electricity Pricing Reforms in Karnataka, India : An Appraisal”, The Journal of Institute of Public Enterprise, Vol. 35, No. 3&4

Power Finance Corporation Ltd. (PFC),REPORT ON "The Performance of State Power Utilities for the years 2008-09 to 2010-11"

________________ (2012): REPORT ON "The Performance of State Power Utilities for the years 2009-10 to 2011-12"

Pierse, R.G., Shell, A.J., 1995. Temporal aggregation and the power of tests for unit root. Journal of Econometrics 65, 335–345.

Ranganathan, V. (2005):“Determining T&D Losses in India: Their Impact on Distribution Privatisation and Regulation.” Economic and Political Weekly, February 12: 644-648.

Rao, M.G., Kalirajan, K., & Shand, R. (1998): “Economics of Electric Supply in India, Macmillan : New Delhi.

Ray, P., 2001. HR Issues in Private Participation in Infrastructure: A Case Study of Odisha Power Reforms, Xavier Labour Relations Institute, Jamshedpur, July, 2001.

The Energy Research Institute (TERI). 2007. "Analysis of tariff orders (distribution) of nine states: A study undertaken for the Ministry of Power."

Thillai Rajan A. & V. Anand Ram (2000). Towards developing a processual understanding of power sector reform: The case of Orissa State Electricity Board. Utilities Policy. 9(3), 93 – 105.

Thillai Rajan A. (2000). Power sector reform in Orissa An ex post analysis of the causal factors. Energy Policy. 28(10): 657 – 669

-------------- (2000). Reforms, Restructuring and Infrastructure Sector: A study of initiatives in Orissa power sector. Vikalpa. 25(4): 11 – 25

--------------(2002). Restructuring state owned power utilities: Qualitative observations from an Indian experience. Global Business Review. 3(1): 77 – 97

-----------------(2003). Principal Players in Utility Restructuring: The case of Orissa. Energy Policy. 31(5): 431 – 441

Annex - I

Test for Equality of Means Between

Method	df	Value	Probability
t-test	38	0.560479	0.5784
Satterthwaite-Welch t-test*	33.08081	0.554008	0.5833
Anova F-test	(1, 38)	0.314136	0.5784
Welch F-test*	(1, 33.0808)	0.306924	0.5833

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	0.000532	0.000532
Within	38	0.064309	0.001692
Total	39	0.064840	0.001663

Category Statistics

Variable	Count	Mean	Std. Dev.	Std. Err. of Mean
MEAN	23	0.429422	0.039794	0.008298
MEAN1	17	0.422047	0.042917	0.010409
All	40	0.426287	0.040775	0.006447

Annex - II

Test for Equality of Means Between Series

Method	df	Value	Probability
t-test	38	0.124531	0.9016
Satterthwaite-Welch t-test*	31.53573	0.121771	0.9039
Anova F-test	(1, 38)	0.015508	0.9016
Welch F-test*	(1, 31.5357)	0.014828	0.9039

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	8.91E-05	8.91E-05
Within	38	0.218298	0.005745
Total	39	0.218387	0.005600

Category Statistics

Variable	Count	Mean	Std. Dev.	Std. Err. of Mean
MEAN	23	0.501813	0.070882	0.014780
MEAN1	17	0.498794	0.082068	0.019904
All	40	0.500530	0.074831	0.011832

Annex - III

VAR Granger Causality/Block Exogeneity Wald Tests

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 2000 2013
Included observations: 48

Dependent variable: RPU

Excluded	Chi-sq	df	Prob.
BE	0.124924	2	0.9394
ATC	4.718305	2	0.0945
All	9.856573	4	0.0429

Dependent variable: BE

Excluded	Chi-sq	df	Prob.
RPU	0.045880	2	0.9773
ATC	0.462227	2	0.7936
All	0.511814	4	0.9723

Dependent variable: ATC

Excluded	Chi-sq	df	Prob.
RPU	0.465743	2	0.7923
BE	0.103987	2	0.9493

All	0.690346	4	0.9525

Annex - IV

Method: Panel EGLS (Cross-section random effects)
Dependent Variable: RPU

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.818350	0.609364	6.266124	0.0000
ATC	-0.042671	0.009784	-4.361496	0.0001

Effects Specification				
			S.D.	Rho
Cross-section random			0.178404	0.1457
Idiosyncratic random			0.432079	0.8543

Weighted Statistics			
R-squared	0.302655	Mean dependent var	0.924046
Adjusted R-squared	0.289741	S.D. dependent var	0.505204
S.E. of regression	0.425770	Sum squared resid	9.789129
F-statistic	23.43654	Durbin-Watson stat	0.244023
Prob(F-statistic)	0.000011		

Unweighted Statistics			
R-squared	0.189997	Mean dependent var	1.700536
Sum squared resid	11.77249	Durbin-Watson stat	0.202912

Annex - V

Correlated Random Effects - Hausman Test

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	1.763219	1	0.1842

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
ATC	-0.053795	-0.048559	0.000016	0.1842

Cross-section random effects test equation:
Dependent Variable: RPU
Method: Panel Least Squares
Date: 10/19/14 Time: 23:59
Sample: 2000 2013
Periods included: 14
Cross-sections included: 4
Total panel (balanced) observations: 56
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.370427	0.653409	6.688649	0.0000
ATC	-0.053795	0.011445	-4.700180	0.0000

Effects Specification
Cross-section fixed (dummy variables)

R-squared	0.398610	Mean dependent var	1.700536
Adjusted R-squared	0.351442	S.D. dependent var	0.514055
S.E. of regression	0.413984	Akaike info criterion	1.159069
Sum squared resid	8.740538	Schwarz criterion	1.339904
Log likelihood	-27.45392	Hannan-Quinn criter.	1.229178
F-statistic	8.450872	Durbin-Watson stat	0.326289
Prob(F-statistic)	0.000026		

Annex - VI

Dependent Variable: RPU
Method: Panel EGLS (Cross-section random effects)

Sample: 2000 2013
Periods included: 14
Cross-sections included: 4
Total panel (balanced) observations: 56
Wallace and Hussain estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.018687	0.743940	-2.713509	0.0089
TD	-0.063638	0.012691	-5.014416	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.431071	1.0000

Weighted Statistics

R-squared	0.321481	Mean dependent var	1.700536
Adjusted R-squared	0.308916	S.D. dependent var	0.514055
S.E. of regression	0.427341	Sum squared resid	9.861513
F-statistic	25.58512	Durbin-Watson stat	0.274106
Prob(F-statistic)	0.000005		

Unweighted Statistics

R-squared	0.321481	Mean dependent var	1.700536
Sum squared resid	9.861513	Durbin-Watson stat	0.274106

Annex – VII

Correlated Random Effects - Hausman Test

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.017402	1	0.8951

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
TD	-0.037281	-0.039197	0.000211	0.8951

Cross-section random effects test equation:
Dependent Variable: RPU
Method: Panel Least Squares

Sample: 2000 2013
Periods included: 14
Cross-sections included: 4
Total panel (unbalanced) observations: 55
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.504573	1.234376	-0.408768	0.6845
TD	-0.037281	0.020493	-1.819219	0.0749

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.162465	Mean dependent var	1.676727
Adjusted R-squared	0.095462	S.D. dependent var	0.486636
S.E. of regression	0.462826	Akaike info criterion	1.383578
Sum squared resid	10.71041	Schwarz criterion	1.566063
Log likelihood	-33.04840	Hannan-Quinn criter.	1.454147
F-statistic	2.424745	Durbin-Watson stat	0.295012
Prob(F-statistic)	0.060168		

Annex – VIII

Year	Change in RPU	Tariff Hike	Change in ATC
1991-92	**-0.64%**	**0.00%**	**-2.93%**
1992-93	**19.40%**	**0.00%**	**0.25%**
1993-94	**15.00%**	**0.00%**	**0.20%**
1994-95	**10.71%**	**0.00%**	**4.96%**
1995-96	**17.95%**	**0.00%**	**-3.49%**
1996-97	**25.21%**	**17.00%**	**5.56%**
1997-98	**7.50%**	**10.33%**	**12.09%**
1998-99	**-7.42%**	**9.30%**	**-7.93%**
1999-00	**4.77%**	**4.50%**	**-4.15%**
2000-01	**6.56%**	**10.23%**	**-0.78%**
2001-02	**0.43%**	**0.00%**	**3.15%**
2002-03	**19.23%**	**0.00%**	**-8.55%**
2003-04	**2.71%**	**0.00%**	**-1.56%**
2004-05	**9.38%**	**0.00%**	**-5.69%**
2005-06	**2.86%**	**-0.37%**	**1.05%**
2006-07	**2.72%**	**0.00%**	**-0.75%**
2007-08	**4.93%**	**0.12%**	**-1.22%**
2008-09	**2.23%**	**-0.64%**	**0.98%**
2009-10	**3.31%**	**2.46%**	**-1.05%**
2010-11	**16.71%**	**7.20%**	**2.39%**
2011-12	**21.34%**	**2.61%**	**-0.72%**
2012-13	**11.07%**	**11.83%**	**-1.13%**

Annex – IX

Panel Data on four DISCOMs in Odisha

Year	Cos	ATC	BE	CE	RPU	TD
1999-00	WESCO	53.46	55.83	83.36	1.30	-54.83
2000-01	WESCO	54.94	56.80	79.32	1.27	-55.80
2001-02	WESCO	57.18	53.56	79.95	1.34	-52.56
2002-03	WESCO	47.30	61.71	85.40	1.57	-60.71
2003-04	WESCO	46.36	60.98	87.96	1.53	-59.98
2004-05	WESCO	41.66	63.62	91.70	1.67	-62.62
2005-06	WESCO	41.75	62.20	93.65	1.78	-61.20
2006-07	WESCO	39.99	63.64	94.29	1.85	-62.64
2007-08	WESCO	40.65	63.87	92.91	1.89	-62.87
2008-09	WESCO	37.63	66.45	93.86	2.02	-65.45
2009-10	WESCO	37.67	64.91	96.03	2.01	-63.91
2010-11	WESCO	44.20	61.11	91.32	2.18	-60.11
2011-12	WESCO	42.30	61.11	94.43	2.72	-60.11
2012-13	WESCO	42.67	61.73	92.88	2.99	-60.73
1999-00	NESCO	55.04	56.65	79.37	1.08	-55.65
2000-01	NESCO	54.38	55.56	82.12	1.14	-54.56
2001-02	NESCO	63.57	49.00	74.34	1.01	-48.00
2002-03	NESCO	52.25	58.62	81.46	1.29	-57.62
2003-04	NESCO	51.85	56.34	85.47	1.28	-55.34
2004-05	NESCO	42.20	60.60	95.39	1.51	-59.60
2005-06	NESCO	43.24	62.92	90.21	1.57	-61.92
2006-07	NESCO	40.60	66.94	88.74	1.63	-65.94
2007-08	NESCO	35.88	68.83	93.16	1.81	-67.83
2008-09	NESCO	39.48	65.43	92.50	1.78	-64.43
2009-10	NESCO	35.56	67.48	95.50	1.89	-66.48
2010-11	NESCO	37.87	67.25	92.38	2.26	-66.25
2011-12	NESCO	38.23	65.72	93.99	2.87	-64.72
2012-13	NESCO	40.38	65.07	91.63	2.95	-64.07

1999-00	SOUTHCO	54.99	58.19	77.34	1.15	-57.19
2000-01	SOUTHCO	52.10	57.48	83.32	1.25	-56.48
2001-02	SOUTHCO	52.80	59.53	79.29	1.35	-58.53
2002-03	SOUTHCO	49.26	60.86	83.37	1.48	-59.86
2003-04	SOUTHCO	48.62	57.55	89.28	1.49	-56.55
2004-05	SOUTHCO	40.22	59.50	100.48	1.64	-58.50
2005-06	SOUTHCO	43.86	58.93	95.26	1.59	-57.93
2006-07	SOUTHCO	46.61	56.61	94.31	1.52	-55.61
2007-08	SOUTHCO	48.73	54.51	94.05	1.49	-53.51
2008-09	SOUTHCO	50.80	52.22	94.21	1.42	-51.22
2009-10	SOUTHCO	51.13	51.97	94.04	1.38	-50.97
2010-11	SOUTHCO	52.69	51.78	91.36	1.65	-50.78
2011-12	SOUTHCO	50.94	53.57	91.58	2.02	-52.57
2012-13	SOUTHCO	47.13	56.32	93.88	2.34	-55.32
1999-00	CESU	61.58	55.11	72.64	0.93	-54.11
2000-01	CESU	61.58	55.11	76.92	1.09	-54.11
2001-02	CESU	64.31	51.19	73.48	1.08	-50.19
2002-03	CESU	60.28	56.97	82.24	1.30	-55.97
2003-04	CESU	58.00	60.24	84.69	1.44	-59.24
2004-05	CESU	59.21	58.51	87.22	1.50	-57.51
2005-06	CESU	60.16	57.15	90.29	1.51	-56.15
2006-07	CESU	60.62	56.48	93.26	1.57	-55.48
2007-08	CESU	59.20	58.52	95.30	1.64	-57.52
2008-09	CESU	58.45	59.59	91.58	1.66	-58.59
2009-10	CESU	57.77	60.57	91.56	1.74	-59.57
2010-11	CESU	56.99	61.70	91.06	2.23	-60.70
2011-12	CESU	56.92	61.80	90.30	2.57	-60.80
2012-13	CESU	56.11	62.96	93.44	3.01	-61.96

Cos: DISCOMs

ATC: AT&C loss (%)

BE: Billing Efficiency (%)

CE : Collection Efficiency (%)

TD: T&D loss (%)

RPU: Revenue Realization Per Unit (in Rs.)