Analysis of Competition in Power Generation Sector in India and Argentina

Ms.Vebhav Gupta*
Mr. Yogesh Singla**

Abstract

In 1990's many countries across the world embraced reforms in power sector to improve the performance in this sector. It involved restructuring of the sector - privatization of state owned utilities, vertical and horizontal de-integration, increasing competition in the generation and distribution sector and development of regulatory framework. Although the approaches to reform have varied across countries, the main objective has been to improve the economic efficiency of the sector by introducing private capital, increasing competition and introducing regulatory framework. There is 'No one size fits all' and is tailor made according to the needs, demography, economic, social and political conditions of the country Thus, the impact of competition on the electricity sector may produce different results depending on the design and its implementation

Since India & Argentina both, have carried power reforms, but the methodology has been different. The paper studies the impact of type of competition on power sector in India & Argentina and tries to find out which form of competition has been more powerful in bringing the desired changes

Keywords: Competition, Consumption Per Capita, Electricity Shortages, Distribution Losses

1. Introduction

In 1990's many countries across the world embraced reforms in power sector to improve the performance in this sector. It involved restructuring of the sector - privatization of state owned utilities, vertical and horizontal de-integration, increasing competition in the generation and distribution sector and development of regulatory framework (APERC 2000). Although the approaches to reform have varied across countries, the main objective has been to improve the economic efficiency of the sector by introducing private capital, increasing competition and introducing regulatory framework (Zhang; Kirkpatrick & Parker, 2002).While the restructuring initiatives are ongoing, and there is much to learn from the successes and the problems to date. Most countries are undertaking reforms in some form, though the starting point, pace and scope varies in each country (Briggs, 2007). So there is 'No one size fits all' and is tailor made according to the needs, demography, economic, social and political conditions of the country Thus, the impact of competition on the electricity sector may produce different results depending on the design and its implementation.

The sample countries are India & Argentina. Argentina was chosen as a sample country because the restructuring process of

*Institute of Chartered Accountants of India, India
**National Thermal Power Corporation, India

the electricity sector that started in 1992 fares among the most successful, when compared to other electricity sector reforms in the world. It shares many of the features of developing country's electricity system. Like India, it is a federal state and the provinces retain a large degree of over the regulation of local utilities including the power to privatize local distribution utilities and to set residential prices. Argentina shares the political and macroeconomic instability like of India but is perhaps unusual in its capacity for designing and running sophisticated economic institutions such as those required by a deregulated electricity market. Argentina has GDP growth of 7% as of India which is in the range of 7%-8% and faced the same challenges as being faced by India like power shortages, thefts, transmission, distribution losses, cross-subsidies, political interferences, inefficient use of power and lack of regulatory mechanism for free trade of power. India like Argentina rely on thermal generation which constitutes 65% and 54% of the installed capacity respectively with renewable energies being barely exploited. In view of similarities of the economic and political conditions and the problems encountered by Argentina in its implementation of power sector reforms; the comparative study has been carried out with Argentina which may provide fruitful experiences to be incorporated in the second generation power reforms of India.

Research Problem

In economics, market power is the ability of the firm to alter the market price of good or service (Wikepedia, 2011). In perfectly competitive markets, market participants have no market power. In a competitive market, prices and profit reveal important information about the costs of a firm and efficiency of input use, thus providing the firms with incentive to improve internal efficiency (Hayek, 1945). Competitive markets allow effective oversight on the market players and deliver economic and environmental benefits to consumers. In competitive markets, suppliers compete against each other to provide best possible service at the lowest cost in order to retain and attract the customer. Comparatively in monopoly regulated states, incumbents have no inducement to innovate or lower cost because customers are captive to their monopoly-protected supplier (Compete coalition, 2011).

On the basis of above, it can be said that the widely accepted and recognized view is that in order to sustain in the market; supplier innovates and make the most efficient use of the inputs to provide affordable and reliable services to the customers. But now the question rises does it really hold true for Power sector. When India embarked on its journey to reforms in the power sector there had been unbridled optimism for power reforms. It was expected to act a magic wand that will solve all the problems of power sector. Now twenty years on when the reforms were implemented , the following questions come to mind:

- Does competition brought about technical and productive efficiency?
- If so, which form of competition i.e. competition by restricting the market share or competition by not restricting the market share has been more powerful?
- How should India go ahead with its next generation reforms?

To gauge the impact of reforms the competition will be tested against the following dimensions-net consumption per capita, energy shortages and electricity distribution losses. These parameters have been chosen as the impact of competition will be profound on them and at the same time these variable are measurable and there is availability of data for the same.

Net Consumption Per Capita

The impact of competition on consumption is an important and intriguing issue every where but particularly in the power sector. In monopoly states, protected utilities recover the cost of their investment plus profit from captive rate payers, who bear the risk of investment decisions and little incentive exists to prevent cost over-runs and project delays. In organized competitive markets, utilities are not guaranteed a profit and are dependent upon market returns to recoup their investment (Compete coalition, 2011). Consumers are protected from the risk of poor or failed investment decision. Thus, it is expected that in competitive markets firms will try to reduce their cost and provide better services to consumers in order to retain and attract the customers. This will lead to increase in consumption per capita.

Reduction in Electricity Shortages

Like consumption, competition is expected to have a favourable impact in reducing the electricity shortages. As the competition will increase, barriers to entry will reduce. There will be entrance of new players in the market. This will increase the infrastructure and reduce the electricity shortages. Moreover when there will be competition in the market every player will try to reduce price by increasing the efficiency i.e. he will make better use of existing capital stock and will reduce the technical and other losses. This will increase the generation and will result in reduction of electricity shortages.

Reduction in Electricity Distribution Losses

In a competitive retail electricity markets, customers can choose from a variety of power suppliers who offer various green, sustainable and clean energy sources at cheaper prices. In monopoly protected states, rate payers are locked into power sources and prices chosen by their monopoly utility company. Since in a competitive market a customer can choose among his suppliers, the supplier will always have an incentive to reduce the prices in order to attract and retain the customer. Distribution is one of the major segments of power. Here the supplier can reduce a number of losses in the form of technical, theft and pilferage losses; there by reducing the cost per unit to the end consumer. Thus competition is expected to reduce electricity distribution losses.

Objectives of the Study

The objective of the research paper is to study:

- Impact of competition on power sector in India & Argentina since implementation of reforms in the sector.
- Of the two type of competitions i.e competition by restricting the market share or competition by not restricting the market share; which one has been more effective in bringing the desired changes.

Research Hypothesis

On the basis of above discussion, A set of core hypothesis are developed to examine the behaviour of key variables i.e. consumption per capita, energy shortages and electricity distribution losses.

H1: Competition will stimulate both technical and productive efficiency in the power sector
H2: Competition by not restricting the market share will lead to increase in consumption per capita
H3: Competition by not restricting the market share will lead to decrease in energy shortages
H4: Competition by not restricting the market share will lead to decrease in distribution losses

In India there is no limit to the market share a player can have where as in Argentina the maximum share an electricity firm can have is 10% of the total market thus not allowing dominance of one firm. In this way they don't allow to form market power. Where as in India one market player may acquire any amount of market share which may lead to dominance of a single firm. Thereby allowing him to manipulate prices and enter into collusion. The purpose of the hypothesis is to find out the role of competition in bringing about efficiency and to find out which form of competition is more suitable with respect to the three variables i.e. consumption per capita, energy shortages and distribution losses. One reason for not restricting the market share in India may be that in India there has always been shortage of supply. So every firm that adds to generation is allowed to produce electricity irrespective of the share it has in the market. Where as in Argentina the purpose of the competition has been to provide better services to the customer at cheaper rates.

Research Methodology

Reference Period
Using an original panel dataset for the period 1991-2008, the paper provides the analysis of the effects of competition in power Sector of India & Argentina. The starting year of the study is 1991, as the reforms started in India & Argentina from this year. The final year 2008, represented the last year for which the data were available at the time the research was conducted.

Research Design
Since the study is about describing the state of affairs in the electricity sector as it exists at present and has no control over variables, therefore the researcher has undertaken Ex-Post facto research. Given that, the research involves comparison between India & Argentina Electricity sectors, a Cross-National Policy Sector Approach (NPSA) is used.

Sources of Data
The data base for the present research is secondary which includes published documents of proven authenticity. Data source for the present research is secondary and has been derived from various authentic documents. The indicators consumption per capita was calculated based on data from U.S. Energy Information Administration, Asia Pacific Energy Research Centre (APERC) and World Development Indicators published by the World Bank and from the database of the Ministry of power, Govt. of India & Ministry of power, Govt. of Argentina. Electricity distribution losses and energy shortages were calculated using the database of U.S. Energy Information Administration. Some relevant data have also been taken from the research theses, papers, studies & books for the purpose

Data Analysis Tool
After collecting the data from secondary sources, they have been arranged in tabular form in a sequential and chronological order. To analyse the data, various mathematical and statistical tools have been applied. The mathematical tools are simple average, annual average growth rate (AAGR) and percentage.

The statistical techniques applied in the present study include mean, standard deviation, coefficient of correlation , coefficient of determination and one sample t-test for significance at 5% level.

Since these are parametric tests, to determine normality of the sample tests like descriptive statistics, Stem & Leaf, Box Plots & Histograms have been used. To normalize the data log and Inverse form of transformations have been used.

Data Analysis

Competition has been derived by subtracting %share of the three largest generation company in India from 100. Competition in India in 1991 was 67.62% which increased to 68.54% in 2008. This shows a marginal rise in competition in India.Net consumption per capita in 1991 in India was 277.20 which increased to 527.61 in 2008. Energy shortages in India were 8.62% which increased to 11.07% in 2008.Electricity Distribution losses in India were 21.41% in 1991 which increased to 31.30%. Thereafter they started falling and reached at 26.77% in 2008.

Table 1: Correlation in case of India Correlations

		Competition in electricity market in India	Net Consumption /per capita in India	Energy Shortage (%)	Electricity Distribution losses (%)
Competition in electricity market in India	Pearson Correlation	1	.488*	.715**	-.011
	Sig. (2-tailed)		.040	.001	.966
	N	18	18	18	18
Net Consumption/ per capita in India	Pearson Correlation	.488*	1	.517*	.536*
	Sig. (2-tailed)	.040		.028	.022
	N	18	18	18	18
Energy Shortage (%)	Pearson Correlation	.715**	.517*	1	-.032
	Sig. (2-tailed)	.001	.028		.898
	N	18	18	18	18
Electricity Distribution losses (%)	Pearson Correlation	-.011	.536*	-.032	1
	Sig. (2-tailed)	.966	.022	.898	
	N	18	18	18	18

**Correlation is significant at the 0.05 level (2-tailed).*
***Correlation is significant at the 0.01 level (2-tailed).*

The above analysis shows significant correlation at 0.5 level between competition in electricity market in India and net consumption per capita, r(d.f=16)=.488,p<.05. This means that as the competition increases the net consumption per capita also increases. It also shows a significant correlation at 0.5 level with energy shortage (d.f. =16) =.715, p<.05. This means as competition increases energy shortages also increases which are not good news for India. It has also been found that in actual no significant change has come in competition itself in India. There insignificant correlation at 0.5 level between competition & distribution losses, r (d.f. =16) =-0.11, p>.05 (Table: 1). This means that as competition increases losses decrease. Thus the hypothesis is proved in case of consumption per capita and transmission and distribution losses.

Competition has been derived by subtracting %share of the three largest generation company in Argentina from 100. Since the data of competition was not found normally distributed so a log competition has been used for the purpose of correlation analysis. Competion in Argentina was just 8.49% in 1991 which increased to 54.16% in 2008. It shows a sharp increase in competition in Argentina. Net consumption per capita were 1226.79 in 1991 which increased to 2625.92 in 2008.Energy shortages were .28% which were 0 in 2008. So at present no energy shortages in Argentina. Electricty distribution losses (%) were 19.33 % in 1991 which reduced to 14.39% in 2008.

Table 2: Correlation Results in case of Argentina

		Log (Competition)	Net Consumption/ Capita in Argentina	Energy Shortage (%) in Argentina	Electricity Distribution losses % in Argentina
Log (Competition)	Pearson Correlation	1	-.809**	.872**	.847**
	Sig. (2-tailed)		.000	.000	.000
	N	18	18	18	18
Net Consumption / Capita in Argentina	Pearson Correlation	-.809**	1	-.947**	-.750**
	Sig. (2-tailed)	.000		.000	.000
	N	18	18	18	18
Energy Shortage(%) in Argentina	Pearson Correlation	.872**	-.947**	1	.771**
	Sig. (2-tailed)	.000	.000		.000
	N	18	18	18	18
Electricity Distribution losses % in Argentina	Pearson Correlation	.847**	-.750**	.771**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	18	18	18	18

***Correlation is significant at the 0.05 level (2-tailed).*

The competition has been transformed into log (competition). Therefore it has decreased with the increase in competition and interpretation has been made accordingly. Log (competition) shows a significant correlation with net consumption per capita at 0.5 level, r (d.f. =16) =-.809, p<.05. This means that as the competition increases Net consumption in Argentina also increases. There is a significant correlation at 0.5 level between log (competition) and Energy shortages (%), r (d.f. =16) =-.872, p<.05. This means as the competition increases the energy shortage reduces. Similarly log (competition) have significant relationship at 0.5 level with Electricity distribution losses (%) in Argentina (in actual negative), r (d.f=16) =-.847, p<.05. (Table: 2). It means that as competition increases the distribution losses reduces.

This proves our main hypothesis that competition will bring in technical & productive efficiency

Table 3: Effect of competition on type of competition on net consumption (per capita)

			Net Consumption/per capita	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		22.875	
	Sig.		.000	
t-test for Equality of Means	t		-15.710	-15.710
	df		34	18.064
	Sig. (2-tailed)		.000	.000
	Mean Difference		-1520.97056	-1520.97056
	Std. Error Difference		96.81691	96.81691
	95% Confidence Interval of the Difference	Lower	-1717.72620	-1724.32368
		Upper	-1324.21491	-1317.61743

An independent-samples t-test is conducted to compare consumption per capita in case the market share is not restricted and market share is restricted. There is significant difference in the scores for no restriction on market share (Mean =382.66, S.D. =71.59) and restriction on market share (Mean=1903.6, S.D. =404.47); t (d.f. =34) =15.710, p<.05 (Table: 3).The mean value of consumption is higher where the market share is restricted (Argentina) as compared to where the market share is not restricted (India). This rejects our hypothesis that by not restricting the market share consumption per capita will increase. Thus while increasing the competition; one must resort to restriction of the maximum share that a market player should hold.

Table 4: Effect of Type of Competition on Energy Shortages Independent Samples Test

			Energy Shortage (%)	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		22.902	
	Sig.		.000	
t-test for Equality of Means	T		26.069	26.069
	Df		34	17.139
	Sig. (2-tailed)		.000	.000
	Mean Difference		7.87944	7.87944
	Std. Error Difference		.30225	.30225
	95% Confidence Interval of the Difference	Lower	7.26520	7.24215
		Upper	8.49369	8.51674

An independent -samples t-test is conducted to compare energy shortages in case the market share is not restricted and market share is restricted. There is significant difference in the scores for no restriction on market share (Mean=7.97, S.D. =1.27) and restriction on market share (Mean=.092, S.D. =.082); t (d.f. =34) =26.069, p<.05 (Table: 4). This means that the mean value of energy shortages in case where the market share is not restricted (India) is more than the mean value where the market share is restricted (Argentina). Therefore the shortages in India are much more than the shortages in Argentina.

This rejects our hypothesis that the competition by way of not restricting the market share will lead to reduction of energy shortages. Infact the case of Argentina shows that the competition by restricting the market share has brought down the energy shortages to the level 0.

Table 5: Effect of type of Competition on Distribution Losses Independent Samples Test

			Electricity Distribution losses Percentage	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		22.420	
	Sig.		.000	
t-test for Equality of Means	T		8.188	8.188
	Df		34	22.443
	Sig. (2-tailed)		.000	.000
	Mean Difference		8.99333	8.99333
	Std. Error Difference		1.09842	1.09842
	95% Confidence Interval of the Difference	Lower	6.76109	6.71796
		Upper	11.22558	11.26870

An independent -samples t-test is conducted to compare distribution losses in case the market share is not restricted and market share is restricted. There is significant difference in the scores for no restriction on market share (Mean=25.97, S.D. = 4.31) and restriction on market share (Mean=16.98, S.D. =1.75); t (d.f=34) =8.19, p<.05.The mean value in case where there is no restriction on the market share (India) is more than the mean value where there is restriction on the market share (India). It means that distribution losses in India are more as compared to Argentina (Table:5). In India distribution losses in 1991 were 21.41% which increased in 2001 to 32.10This rejects our hypothesis that the competition by way of not restricting the market share will lead to reduction of distribution losses. Infact the case of Argentina shows that the competition by restricting the market share has brought down the distribution losses to the minimum technical level which cannot be avoided.

Finding of the Study

Consumption Per Capita

The correlation coefficient is significant and positive both incase of India & Argentina. The strong positive correlation between competition and consumption per capita confirms the study by (Hawdon, 1998) that the consumption will improve with the introduction of competition. The rise in consumption may be explained by the fact that in monopoly states, protected utilities recover the cost of their investment plus profit from captive rate payers, who bear the risk of investment decisions and little incentive exists to prevent cost over-runs and project delays. In competitive market, utilities are not guaranteed a profit and are dependent upon market returns to recoup their investments. Consumers are protected from the risk of poor or failed investment decision. Thus in competitive markets firms will try to reduce their cost and provide better services to consumers in order to retain and attract the customers. This will lead to increase in consumption per capita.

Electricity Shortages

The correlation coefficient is significant and positive in case of India. The unexpected positive correlation implies that as the competition increased the electricity shortages also increased in India. The result for electricity shortages is less easy to explain but may indicate the unprecedented growth of Indian economy. Since the installed capacity and generation has increased over a period of time, but there still exists shortages. It means that the increasing vibrancy and flexibility of the Indian economy is not matched by the power sector. In other words, demand for electricity is outpacing its supplies suggesting a need of more investments in the sector.

The correlation coefficient is significant but negative in case of Argentina. It is on the expected lines that as the as the competition will increase, barriers to entry will reduce. There will be entrance of new players in the market. This will increase the investments in the sector and reduce the electricity shortages.

Distribution Losses

The correlation coefficient is insignificant and negative in case of India. It implies that as the competition increased there is a reduction in distribution losses in India but these losses have reduced marginally. This confirms the study by (Ahluwalia, Sanjeev & Gaurav Battani, 2000) that India will have to trim down its distribution losses to international acceptable levels at 15% to make the power sector viable.

The correlation coefficient is significant and negative in case of Argentina. It implies that as the competition increased there is noticeable reduction in distribution losses. In a competitive retail electricity markets, customers can choose from a variety of power suppliers. In monopoly protected states, rate payers are locked into power sources and prices chosen by their monopoly utility company. Since in a competitive market a customer can choose among his suppliers, the supplier will always have an incentive to reduce the prices in order to attract and retain the customer. Distribution is one of the major segments of power. Here the supplier can reduce a number of losses in the form of technical, theft and pilferage losses, there by reducing the cost per unit to the end consumer. Thus competition will reduce electricity distribution losses.

The mean value is higher in case of consumption per capita in Argentina and lower incase of energy shortages & distribution losses. Thus competition by restricting the market share is more successful as compared to not restricting the market share.

Suggestions

The study provides an insight to the efficacy of the competition reforms undertaken. Govt. of India should continue with the competition policy in the power sector as underpinned by the empirical evidences and extensive research. However the caveat is that the government should not continue with competition with unrestricted market share as this will lead to cartel and market power which ultimately defeat the purpose of Competition policy. This unrestricted share should be continued till the time there is shortage of power supply i.e. demand for power is more than the supply. As soon as the supply becomes equal to demand government should switch over to competition with restricted market share.

Thus It is suggested that India should wait to restrict the market share of the firms until the time the competition in the power sector increases and the sector becomes power surplus as in case of Argentina. Till that time Indian power sector cannot afford to restrict the market share of power generating companies as this will amount to limiting generation of power.

Limitations of the Study

1. To begin with, the sample is composed of India & Argentina for which we have obtained data on competition to create our variables. There may be sample bias in the data provided by the sample countries. We have no reason to believe that this should be the case, but cannot of course rule it out.
2. The time period for the study has been taken from 1991-2008, but due to non availability for some years has made limits to the study.
3. Performance indicators like quality of service could not be estimated because of lack of data.
4. The impact of competition on prices charged for electricity generated could not be estimated, as there is lack of sufficient comparable data across our sample of countries to carry out such analysis. Moreover in India, the electricity pricing mechanism is complex in nature as there are different tariff structure is followed for various classes of consumers Viz Houselhold, Agricultural, Industrial & Commercial establishment.
5. The t-test measures the impact of competition by taking mean value into consideration on consumption per capita, Electricity Shortages and Distribution losses. There are other factors like Privatization and Regulation that may have influenced these factors.

Scope for Future Research

Endeavour has been made to produce satisfactory measures of competition; however more work would be valuable at international level.

Similarly a comparative study can be undertaken between India and better performing countries to have a better and wider view of the factors responsible for the differential performances.

Again a focused study can be undertaken on the issues of quality of service after implementation of reforms which are crucial indicators of the performance of the power sector. It includes factors like prices charged for electricity generated, number of blackouts, voltage profile, availability of power to end consumers, intelligent metering and billing, responsiveness and accountability.

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