The impact of unbundling of DISCOs on electricity prices in Pakistan.

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THESIS ACCEPTANCE CERTIFICATE

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Dedication

First, thanks Almighty Allah for His blessing that he bestowed upon me. After that I would like to thank my parents who continued to support me throughout this journey and without their efforts and prayers, I would not have achieved this milestone. I dedicate my research and efforts to my research supervisor Assist. Prof. Dr. Warda Ajaz for guiding me throughout this research. I feel privileged to have worked under his kind Supervision. Special thanks to Assist. Prof. Dr. Kafait Ullah (GEC member) who gave me this topic for research and for this guidance from first day to last. Besides them, I owe sincere gratitude to the members of my GEC committee, Dr. Nadia Shahzad, and Dr. Muhammad Hassan who honored my committee's presence.

Abstract

Pakistan started power sector reforms in the late 1980s by introducing structural, institutional, and policy reforms. These reforms aimed to restructure the vertically integrated structure, formation of an independent power regulator, and attracting private investment to the power generation sector. This paper analyses the impact of unbundling of distribution companies from the vertically integrated system on electricity prices. We have used Economic and Financial Analysis on electricity prices as an indicator between 2008-2018. Based on the results of the analysis, we can see that even though the power purchase price of electricity is reduced by 52.11%, the average consumer tariff of all PEPCO-based distribution companies has increased by 15%. On the other hand, KESC only private utility has increased consumer tariff by 19%. Also, cost reflectivity shows that most of the time, price change has transferred from generation to consumers, but still, due to high distribution charges, consumers end up paying higher rates. The study concludes with different reasons that contribute to high cost and suggests the need to increase the competition in the distribution sector through privatization and establishing wholesale and retail electricity market, which is part of the liberalization process initiated in1980s.

Keywords

Electricity prices, Power distribution, Pakistan, Economic Analysis, Restructuring

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Abbreviations & Acronyms

IPP	Independent Power Producer
KESC	Karachi Electric Supply Company
KEL	K-Electric Limited
GoP	Government of Pakistan
DISCOs	Distribution companies
GENCOs	Generation companies
PPP	Power purchase price
GWh	Giga-watt hours
PKR	Pakistani Rupee
kWh	Kilo-watt hours
PPIB	Private power infrastructure board
ADB	Asian development bank
IMF	International Monetary Fund
CPPA-G	Central Power Purchasing Agency (Guarantee) Limited
LESCO	LESCO Electric Supply Company
MEPCO	Multan Electric Power Company
NEPRA	National Electric Power Regulatory Authority
NTDC	National Transmission and Despatch Company
PEPCO	Pakistan Electric Power Company
PESCO	Peshawar Electric Supply Company
QESCO	Quetta Electric Supply Company
SEPCO	Sukkur Electric Supply Company
TESCO	Tribal Electric Supply Company
WAPDA	Water and Power Development Authority

Chapter 1: Introduction

1.1 Overview

The electricity sector experienced enormous number of reforms in 1980s throughout the world. These reforms include structural transformations, institutional development, and policy reforms to tackle the problems faced by countries then and keeping in view the future demands of the sector. These reforms encompassed the whole power sector from power generation to transmission and power distribution sector as well. These various areas of power sector require proper management and monitoring so that every step is properly optimized to give the best possible performance while ensuring the maximum consumer welfare.

It was mainly due to unsatisfactory performance of vertically integrated structure of power sector which was dominant in many countries led to the introduction of power sector reforms [1]–[3]. The main reason behind introduction of reforms was government-owned vertically integrated companies faced severe financial burden and poor operating efficiency [4], [5].

Many developed and developing economies embarked on reform journey to counter problems faced and resulting in formation of an efficient system meeting power sector demand and fulfilling sustainable development agenda [5]. Similarly, on suggestion of international organizations like World Bank and International Monetary Fund different developing countries started implementing reform framework without proper analyses. Pakistan too on suggestion of its international donors started power sector reforms in late 1980s to tackle the problems of inefficient production, rising demand-supply gap and to bring the transparency in the power sector.

1.2 Global Reforms and their Objectives

As defined previously, both developed and developing economies-initiated power sector reforms to tackle problems faced. However, the problems faced were different in case of both developed and developing economies.

The problems faced by developed countries were surplus capacity, high electricity prices and inefficient production while the problems faced by developing countries were electricity shortages, inefficient production, and governance problems due to presence of subsidies in power sector [1], [6], [7].

The basic step followed by both types of economies were unbundling of integrated structure of power supply and followed by inviting the private investor in power generation and distribution in electricity market [1]. In addition to that formation of an independent power regulator and liberalization of power distribution market through formation of wholesale and retail market were on agenda as well.

The reforms introduced differed on basis of its motives. So, different countries have opted for different regulatory reforms worldwide [4]. This is one of the reasons why the results of these reforms varied from country to country [8]. The pre-reform structure also played a crucial role in success or failure of a certain reforms. The same framework found to be compatible with one country proved a failure for another country.

1.3 Research Problem

Pakistan started its power sector reforms in late 1980s to address the existing issues at that time while keeping in view the future demands of power sector. As a result, several structural, institutional and policy developments took place. One such structural development was the unbundling of vertically integrated Water and Power Development Authority (WAPDA) to separate power generation, transmission and distribution.

This was done to bring the efficiency in each part of power sector. This study presented here focuses on the impact of unbundling on electricity prices and its comparison with the only privately-owned distribution company Karachi Electric Supply company (KESC). We will investigate whether the electricity prices increased or decreased with the passage of time using Economic and Financial

Analysis as a technique and Real and nominal electricity prices as an indicator along-with distribution margin to quantify the impact of unbundling.

1.4 Justification of topic

The power sector reforms are crucial to analyse after their implementation in order to improve the quality of future reforms while keeping in mind the pros and cons of policies in the past. Many studies are available in literature for both developed and developing countries which quantified the impact of these reforms. These power sector reforms can be analysed through various dimensions. In case of Pakistan, there are studies available that focuses on performance or efficiency of power sector. However, analysing power distribution sector through the dimension of electricity price using Economic and Financial analysis as tool is not conducted before. So, this will be first study that analyse the impact of unbundling of distribution companies on electricity prices in Pakistan. So, this is the major reason behind choosing this research topic.

1.5 Objectives of study

The key objectives of this study are given below:

- We will analyse both Real and Nominal average electricity consumer tariff for both state-owned unbundled, and privately-owned bundled electricity distribution companies and analyse the difference between them.
- We will also analyse Power purchase price (PPP) for both state-owned and privately-owned distribution companies and analyse the difference.
- Finally, we will analyse the Distribution margin and determine if the social welfare in terms of price change of Power purchase price (PPP) reflect in the change of average consumer tariff or not.

To achieve the objectives above, we have used Economic and Financial Analysis as technique while using average power purchase price and average consumer tariff as indicators to analyse the impact of unbundling on electricity prices. To our knowledge, this is the first study that evaluate the impact of unbundling on electricity prices using mentioned technique based on power sector reforms of Pakistan.

1.6 Significance of Results

Through our research we are adding a new dimension to analyse power sector reforms. The results presented not only focus on the prices of unbundled state-owned power distribution companies but also, we have analysed the only bundled privately-owned distribution company as well. This will help us compare both scenarios and help policymakers to adopt to better policy framework in future by taking into account the current status of distribution companies. Similarly, policymakers in Pakistan are considering privatization of distribution companies and developing wholesale market, this study can provide an insight to the current performance of state and private owned distribution companies.

1.7 Organization of Thesis

The rest of the thesis is composed as given below:

- Chapter 2 presents a bird-eye view of power sector of Pakistan focusing on reforms and its objectives, old and current power structure as well.
- Chapter 3 provides and insight to global and local literature that focuses on the impact of power sector reforms on electricity prices.
- Chapter 4 discusses the methodology used in this study and the different data utilised during this study.
- Chapter 5 presents the results of the research and discusses them as well.
- Chapter 6 presents the conclusion and policy recommendations.

Summary

Power sector of any country plays a major role in functioning of other sectors of economy. So, to bring out the best, the power sector must be optimized to maximum efficiency. In 1980s, power sector reforms rolled out by many developed and developing countries to counter the problems faced by each country. Developed countries faced problems of surplus capacity, high electricity prices, and inefficient production while developing countries faced problems of inefficiency, shortage of generation capacity and poor infrastructure. These problems led many countries to adopt to power sector reforms. Like many developing countries, Pakistan too faced many problems in late 1980s and started to restructure its power sector. This study endeavours to examine the impact of unbundling of distribution sector on electricity prices in Pakistan. Unbundling of vertically integrated power structure was the part of wide range of power sector reform proposed in early 1990s. We have analysed, average power purchase price, average consumer tariff and distribution margin for all set of consumers. This study has employed Economic and Financial analysis to adjust inflation and determined the price of electricity in Real terms. This will help us to determine if the prices of electricity have been increased or decreased over the specified time after unbundling or not. Similarly, we have also included in our study the only bundled utility Karachi electric supply company (KESC) to compare with unbundled distribution utilities. Finally, this study will provide an insight to the previous reforms in power sector and will be useful for policymakers who are working on the untouched power sector reforms like formation of wholesale market, and privatization of distribution companies.

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Chapter 2: Power sector of Pakistan: A bird-eye view

2.1 Objectives of power sector reforms

In 1980s, Pakistan faced many problems like many other developing countries. These problems are listed below [1] :

- Due to growing electricity demand, the gap between demand-supply of electricity widened and public sector was unable to tackle this situation.
- The state-owned companies were inefficient as transmission and distribution losses were increasing.
- Poor management of vertically integrated power sector led to financial losses and consumer dissatisfaction.

These were the few major reasons that led Pakistan to initiate its power sector reforms in 1990s. Government of Pakistan adopted the reform framework which was brought up by Chile, UK and US on the suggestion of its International Development Partner "World Bank" [2]–[5]. The reforms introduced can be categorized into 3 categories namely, Structural reforms, Institutional reforms and Policy advancements [6].

The main objectives of the reforms were:

- Reducing demand-supply gap of electricity to overcome the shortfalls.
- Improving the power sector performance in terms of efficiency and opening the market to private participation.
- Ensuring the transparency and accountability will improve the quality of structural reforms and better understanding with stakeholders and thus will make reforms sustainable.
- Finally reducing subsidies and improving tariff policies to boost consumer welfare by reducing electricity prices.

2.2 Template of Reforms

As mentioned earlier, to achieve the goals of reforms, Pakistan on suggestion of its international partners adopted the reforms which were executed by Chile and UK. The template started with shifting from vertically integrated system to horizontal integrated system to remove the cross-subsidization from the power sector. The presence of an autonomous regulator would monitor the whole power sector unbiasedly. Policy reforms would bring liberalization and privatization which will attract the private investors to invest in power generation and thereby increasing the competition through privatization and introduction to wholesale and retail market to bring the social welfare by increasing quality of supply and reduced electricity prices. The current status of reforms followed by Pakistan are summarized in (Figure 2.1).

In case of Pakistan, we have only achieved in, formation of independent Regulator (NEPRA), attracting IPPs and unbundling from vertically integrated system to horizontally integrated system, development of single buyer market and then corporatization of distribution companies and privatization of only one distribution company KESC. Since this paper analyse the unbundling impacts on electricity prices, we will focus more on structural reforms in proceeding paragraphs.

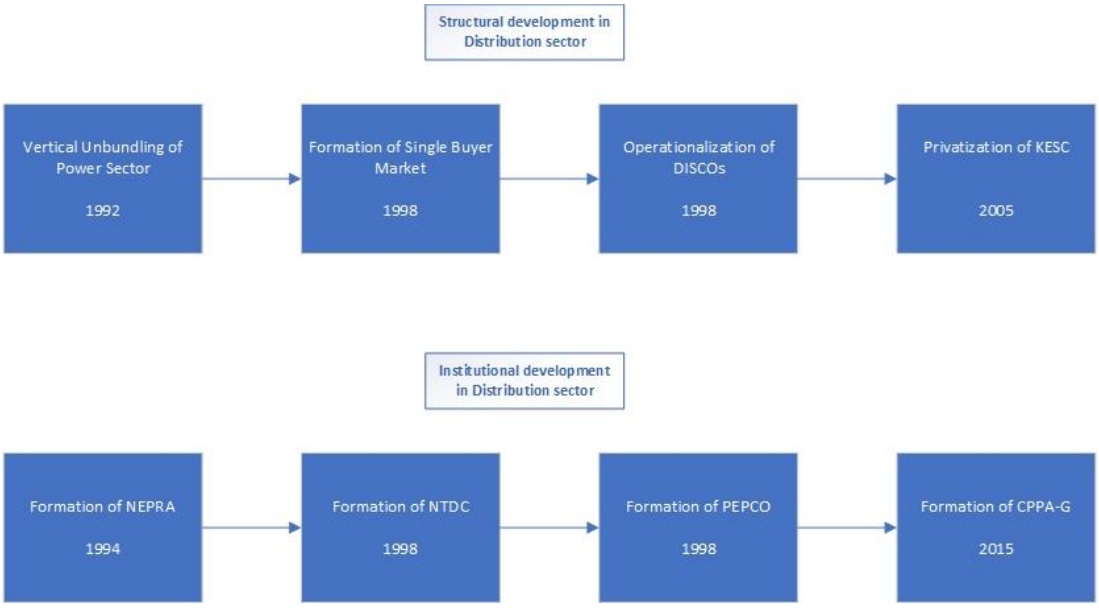

Figure 2.1: Timeline of Structural and Institutional development in Pakistan (Source: NEPRA, 2015)

2.3 Power policies in Pakistan

Several power policies were introduced since the beginning of power sector reforms during last 3 decades. These policies aimed to improve the existing power structure, while keeping in view the future demands of the power sector. All the power policies have been briefly discussed below under their respective headings.

2.3.1 Power Policy 1994

Following are the salient feature of this power policy:

- The entrance of IPPs was encouraged through simplified procedure.
- Corporate income tax exemptions for IPPs in generation sector along-with the exemption of custom duties on import of machineries.
- Capacity payments agreement were finalized, irrespective of power generated by power plants.
- Foreign exchange guarantee and Fuel supply agreements were finalized.
- Power purchase agreements.
- A Bulk Tariff of US cents 6.5/kWh to be charged to WAPDA, a state entity, for the sale of electricity.
- A premium of US cents 0.25/kWh based on energy sold during the first 10 years for projects above 100 MW and be commissioned by the end of 1997.

2.3.2 Hydropower policy 1995

The salient feature of this power policy is listed below:

- The fiscal incentives of previous power policy of 1994 Energy Policy, Model Implementation (Concessions) Agreement and Power Purchase Agreement were extended for private hydropower projects.
- A Bulk Tariff of US cents 6.1/unit of electricity to be charged to WAPDA and KESC, a state entity, for the sale of electricity.
- The ownership of the hydropower project will be transferred to the GOP after 25 years, free of cost.

- Protection against the changes in certain taxes and duties would not hamper the previous projects.
- Guaranteed foreign exchange conversion facility was finalized.

2.3.3 Power policy for new IPPs entrance 1998

Following are the salient features of this power policy

- Open bids were introduced for tariff from private investors and denominated in Pakistani Rupee (PKR).
- Bidders were supposed to bid their tariffs based on 2 different parts which are Capacity Purchase Price (CPP) and Energy Purchase Price (EPP) and they were allowed to conduct feasibility studies of desired project before bidding for their on convenience.
- Protection was provided against any change in tax and duties for projects.

2.3.4 Power generation policy 2002

Following are the salient features of this power policy

- For smooth operation, one-window operation for IPPs was introduced to prevent delays in projects implementation.
- Bulk tariff which was previously introduced was eliminated and competitive bidding was introduced comprised of CPP and EPP.
- Income tax was imposed on oil-based power plants.
- Custom duties that was previously exempted was re-imposed on import of machinery.
- Power policy was extended to public, private-public, and private sector projects.

2.3.5 Renewable Energy Policy 2006

Following are the salient features of this power policy

- Renewable energy projects were exempted from custom duties of imported machineries and sales tax as well.
- Parties were permitted to raise local and foreign finance especially for RETs.

- Non-residents and non-Muslims dividends were declared exempted from zakat payment

2.3.6 National Power Policy 2013

Following are the salient features of this power policy

- Upfront tariff was introduced along-with competitive bidding to lower the cost of electricity.
- Subsidies were minimized.
- Shift to cheaper fuels (i.e., indigenous coal and hydro projects).
- Gradual shifting of fuel supply to IPPs.
- Improved efficiency and better control of loss/theft of electricity.

2.3.7 Power generation policy 2015

The salient features of this power policy are given below

- Being cheaper and environment friendly, hydropower sites were identified for power generation.
- Efficiency improvement in generation sector was promoted.
- Taking all stakeholder on board, for win-win scenarios.
- Attractive IRR/ROE allowed in tariff
- Non-residents and non-Muslims dividends were declared exempted from zakat payment.
- Free repatriation of equity with dividends

So, these are all power policies that has been introduced between 1994-2015.

2.4 Structural transformations of Power sector

The power sector of Pakistan has undergone major structural transformation during last 30 years. The restructuring of power sector began in 1992, followed by introduction of IPPs. The power sector of Pakistan prior to reforms in 1990s was controlled by two vertically integrated public utilities namely, Water and Power Development Authority (WAPDA) and Karachi Electricity Supply Company

(KESC). Each company was responsible of power generation, transmission, and power distribution. WAPDA controlled all territory of Pakistan except Karachi, which were controlled by KESC.

The first structural transformation began in 1992 and completed in 1998 when WAPDA was unbundled vertically [1]. After unbundling WAPDA was split into separate generation, transmission and distribution sector administratively, and Pakistan shifted from monopoly model to single buyer model [6]. The generation sector of WAPDA consisted of 2 public sectors companies, WAPDA (Hydro) and generation companies (GENCOs) which were responsible for Thermal based generation plants. Both pre and post unbundling structure are shown in (Figure 2.2), and (Figure 2.3) respectively**.**

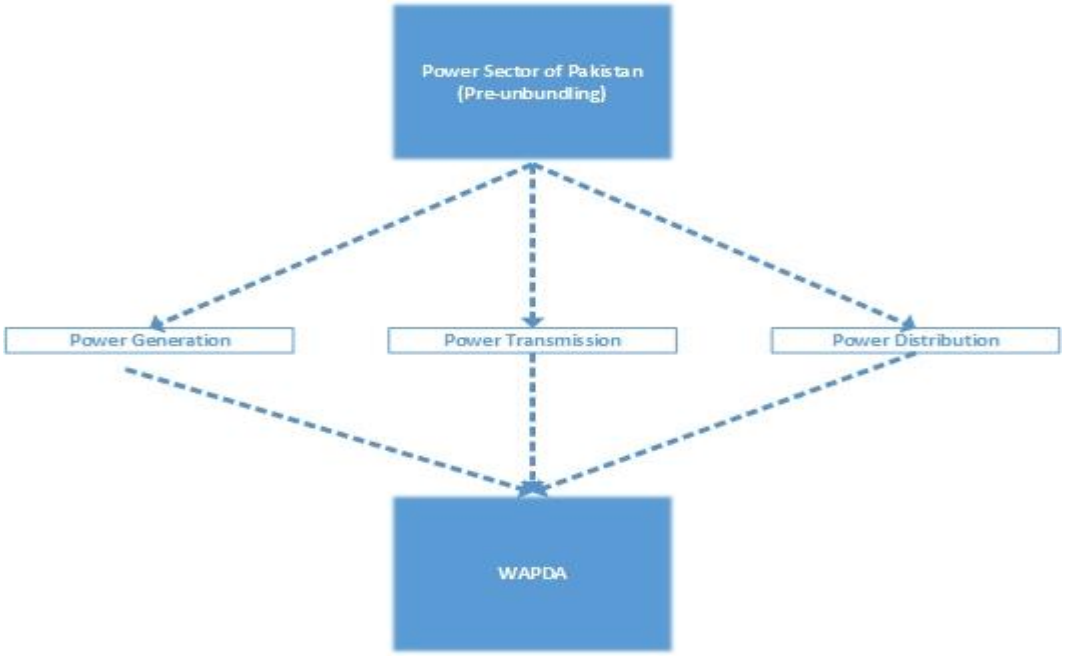

Figure 2.2: Pre-Reform Power Sector Structure of Pakistan (Source: NEPRA, 2015)

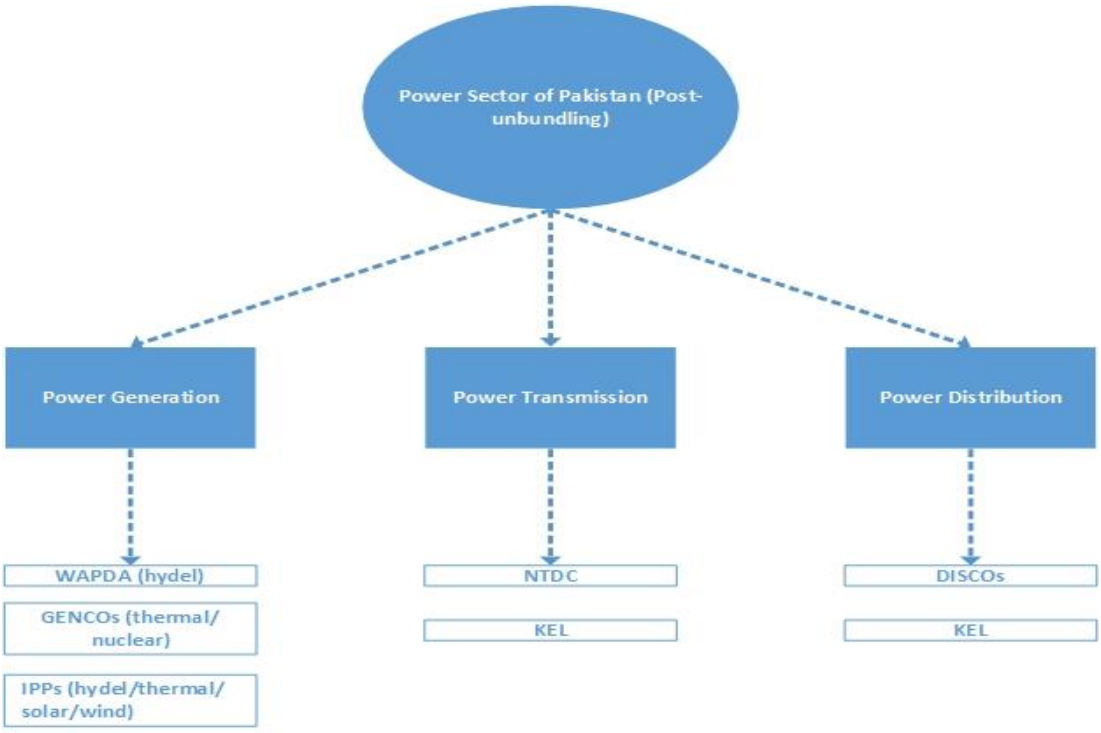

Figure 2.3: Post-Reform Power Sector Structure of Pakistan (Source: SOI Report, 2010)

The introduction of IPPs based of 1994 Power policy led to development of single buyer market. National electricity power regulatory authority (NEPRA) was formed in 1997 as independent body that will regulate power sector to achieve smooth operation.

The next structural transformation took place in 1998 with the creation of Pakistan Electric Power Company (PEPCO) for implementation of the strategic plan of Privatization of Power wing of WAPDA, approved by the Council of Common Interest (CCI) in 1993. PEPCO established and registered 14 companies. This included 4 generating companies (GENCOs), one National transmission and distribution company (NTDC) and 9 distribution companies. The corporatization process was completed in 2001 and these companies received their licenses from NEPRA between 2001 and 2002.

The last structural transformation took place in 2005 when the only vertically integrated company of Pakistan KESC was privatized. The efforts to sell 51% stake in KESC started in 1996 but succeeded only 2005. The other distribution companies were also bound to be privatized in future, but nothing has been done so far. All three significant structural transformation are summarized in (Figure 2.4).

The policymakers had further planned to privatize other distribution companies as well in 2013. From which in first phase Islamabad Electricity Supply Company (IESCO), Faisalabad Electricity Supply Company (FESCO) and Lahore Electricity Supply Company (LESCO) would be privatized. However, the plan didn't implement due to some political issues and past experience of privatizing KESC which didn't produced the desired results as consumers of Karachi faced multiple issues [1].

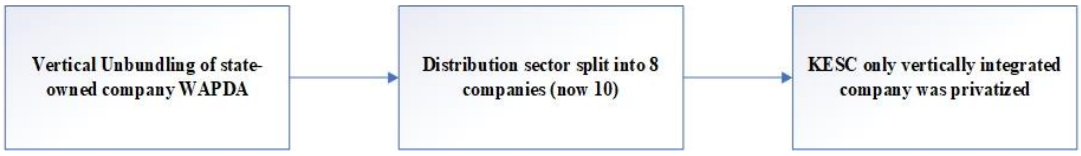

Figure 2.4: Structural Transformation of Power distribution sector of Pakistan (Source: SOI Report, 2017)

2.5 Distribution sector of Pakistan

After undergoing series of structural reforms, the distribution sector was split in 8 distribution companies (now currently 10). These were all public utilities and operating within their specified regions. Market restructuring and privatization efforts progressed quite slowly as well. To facilitate NTDC, another institution CPPA-G was formed that facilitate the electricity sales between Power generators and Power distributors in the country.

In electricity distribution sector there are currently 10 public distribution companies along-with 1 private utility. The 10 public distribution companies, MEPCO, PESCO, FESCO, LESCO, QESCO, TESCO, IESCO, GEPCO, SEPCO and HESCO serve in region of Multan, Peshawar, Faisalabad, Lahore, Quetta, Tribal, Islamabad, Gujranwala, Sukkur, and Hyderabad respectively. (Figure 2.5), also show the summary of public owned distribution companies in Pakistan. The only private distribution utility is KESC which serve the area of Karachi. All distribution companies except KESC, are directly supervised by PEPCO for the monitoring of their performance. These distribution companies serve electricity to consumers of 6

different categories which includes, residential, commercial, industrial, agriculture, public lighting, and bulk supply consumers.

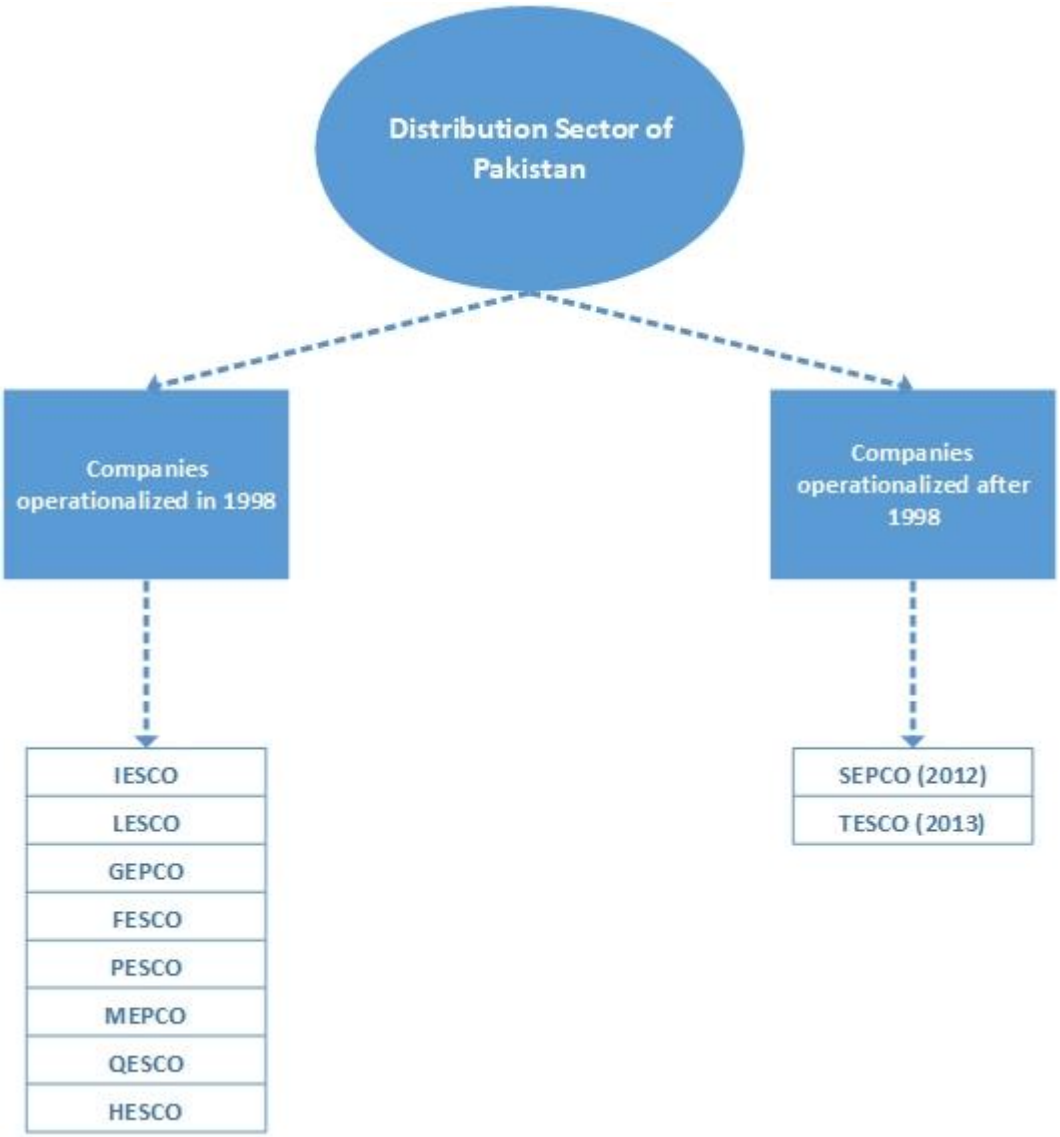

Figure 2.5:Distribution companies in Pakistan (Source: SOI Report, 2015)

Summary

In 1980s, the power sector of Pakistan was controlled by two public utilities WAPDA and KESC. Due to their poor performance, Pakistan faced problems of inefficiency, rising demand-supply gap, and several managerial problems. Owing to these issues and pressure of international partners like IMF, and World Bank, Pakistan embarked on journey of power sector reforms. As a result, government of Pakistan adopted the framework of power sector reform adopted by Chile, and UK. The reform template was composed of formation of an independent power regulator, vertically unbundling of power sector to separate generation, transmission, and distribution companies, followed by introduction of IPPs to boost the investment in the power sector, and finally formation of wholesale and retail market along-with privatization of distribution companies to increase the competition and reaping the rewards in terms of increasing consumer welfare. However, after almost 30 years, we have only been successful in adopting half of the reforms. If we focus on the distribution sector of Pakistan, the only substantial structural transformation occurred in 1998 and the other one in 2005. In 1998, WAPDA was unbundled into generation, transmission, and distribution companies. As a result, eight regional distribution companies were formed (now 10), and one company KESC remained bundled that served the area of Karachi. In other structural transformation in 2005, KESC was privatized while all other remained public entity. This chapter further discusses the objectives, reform template, structural, and institutional transformations that occurred in distribution sector in detail.

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Chapter 3: Literature Review

Several countries adopted different framework to restructure the power sector. This led to deregulation, liberalization, and privatization of power sector. There are many studies conducted to study the impact of these reforms.

3.1 Global and Regional studies

A study conducted on OCED countries with the help of Econometric approach showed that, on dismantling the vertically integrated structure and privatising the resultant companies decreased the performance of power sector. So, the objectives failed considerably [1]. Similarly, another study that used same Econometric approach to analyse the privatization of distribution companies of Turkey showed that the expected decline in electricity prices were not achieved, and the outcome of the power sector reforms were not achieved as expected [2].

A study used the data of 83 countries that were from Latin America, former Soviet Union, and Eastern Europe between 1985-2002. This study concluded that unbundling of generation, transmission and distribution, entrance of IPPs, formation of regulatory body and introduction of wholesale market and competition affect the electricity prices in different ways [3].

The reforms of electrical industry began in UK started in 1980s. Based on these reforms, a study was conducted that included 12 distribution companies, performing distribution and supply of electricity in England and Wales. The social cost and benefit analysis technique was used, and the study concluded that the liberalization benefitted more to the local government but the social welfare in terms of electricity prices were not significant [4].

Another study was conducted on Australia electricity markets. In their study, they concluded the introduction of reforms and wholesale electricity market did bring the gains but with the growing trend of investment in energy infrastructure the retail

prices are increasing to unsustainable level. In order to tackle is problem they should bring the last piece of reforms which were smart metering and dynamic electricity pricing [5].

A study based on the electricity reforms in US, concluded that even after removing the costly entry price and regulation which affected all the energy sector directly and indirectly, the reforms were not that successful in last four decades [6] (Joskow, 2008). Based on the reforms of 19 OCED countries focusing the industrial and residential sectors a study was conducted. The empirical analysis concluded that due to unbundling, expansion of system to third party access (TPA) and introduction to electricity markets, the ratio of industrial to residential electricity prices were reduced. However, the study also concluded that the high private ownership along with liberalization and privatization result in increase of end user price [7].

A case study based on the reforms of 10 Latin American countries and a total of 116 electric utilities used mean and median to test significance of the reforms along with the economic model to test the reforms. The study concluded that post transition period of reforms the average electricity prices was increased. So, the social welfare of reforms in terms of electricity prices were not achieved [8]. Similarly, another study used the panel data of 78 developed, developing and transition countries between 1985-2003, finds that liberalization of electricity market does not necessarily lead to reduction in electricity prices [9].

A case study that determined the social welfare of restructuring and privatization for 2 major state-owned distribution companies of Peru that account for 64% of total distribution network was conducted. The study concluded that the social welfare was achieved in terms of expansion of electricity coverage, reduction of losses and improve quality of service. However, it also showed that government and producers gained the most and customer suffered due to increase in price [10]. Chile despite being the prime example of successful market-based electricity reforms have faced several problems in last decade. Similarly, in Norway the success of electricity reforms is characterized by local and regional government ownership, and it shows that privatization is not necessary for reforms to be successful (Anaya, 2010).

A study conducted for Poland, Czech Republic, Slovakia, and Hungary analysed the privatization of power sector using Frontier Analysis as tool. As a result, the study showed that due to reforms, technical efficiency of the sector improved vastly [11].

A study was conducted based on the selected Asian countries, Pakistan, India, Japan, South Korea, Turkey between year 1970-2017 and for Industrial and domestic user. The analysis concluded the inconsistent behaviour of reforms. Different type of regulatory reform has different impact on prices in given sector. Unbundling impact is only significant for domestic user while moving towards competition and deregulation leads to price decrease. Lastly the access of TPA and regulator is either insignificant or positive and significant [12]. Similarly, another study analysed qualitatively the reforms in five South Asian countries namely, Pakistan, India, Bangladesh, Nepal, and Sri Lanka. It concluded that the political instability has greatly affected the power sector reforms in region and this led to adverse impact on Investment and performance of the sector [13]. The goals of the reforms must be cleared before privatization because the private companies may charge than public companies [14]. Market-based reforms truly failed in case of Indian state Orissa, but the same reforms were successful for Indian state New Delhi [15].

The restructuring of WAPDA was a decision taken by government of Pakistan on recommendation of lending agency IMF was a forced one as there was no proper framework made prior to restructuring. However, they also concluded that the unbundling was beneficial but still the targets were not achieved [16]. The Institutional determinants of power sector reforms concluded that poor governance, country and sector endowments, inefficient regulator and political instability are the major reasons for reforms to be unsuccessful [17]. Fixed effects stochastic frontier analysis to analyze the post reform progress of distribution companies between 2006-2013. The study concluded that the technical efficiency of the companies increased by 4.3% while the total factor productivity has negative growth about 11% [18].

Power sector reforms were analysed using stochastic frontier analysis on 8 distribution companies between 2003-2013. The study concluded that the distribution companies are only cost effective to about 72.5%. This led to high prices being charged to end user consumers [19]. Electricity theft lead to power outages and high tariff rates being charged to consumers [20].

So, these are the few studies that showed the impact of power sector reforms on the performance of sector and electricity prices.

Summary

This chapter explored various studies that are available in global literature which analysed the impacts of power sector reforms on the output of the sector. We have included studies for both developed and developing countries. The template of reforms followed by almost all countries was same that involved restructuring, deregulation, liberalization, and privatization of the power sector. However, the results of these reforms varied from country to country. The same set of reforms proved to be success for developed country, but unsuccessful for the developing country. The reason behind this outcome is the pre-reform structure of the countries varied. The developed countries had better infrastructure, governance system, and were more transparent to accountability, while the developing countries were dominated by poor governance, lack of transparency, and political instability that led to the partial success or failure of those power sector reforms. Similarly, various studies based on Pakistan were explored as well. Many showed that power sector of Pakistan even though undergoing some sort of reforms is facing many problems due to poor efficiency, lack of infrastructure, political instability, and lack of long-term vision or planning.

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Chapter 4: Data and Methodology

This chapter is divided into two parts. First part explains the data which is collected from various sources and how secondary data is generated from the primary data. Second part of this section describes the methodology which is Economic and Financial Analysis and how our data set described in first section is utilized to perform this analysis. Now we shall move towards the data section first

4.1 Data

The data used in this study is divided into two categories i.e. Primary data and Secondary data. The classification is introduced because the secondary data is derived from the Primary dataset.

The actual unbundling of distribution company occurred as a part of power sector reforms. Since, we are looking here the impact of unbundling of DISCOs the data is obtained for all 10 Distribution companies and KEL although which is still vertically integrated company in Pakistan[1] (SOI Report NEPRA, 2015). However, the data which we obtained were from year 2008 onwards. Data before 2008 was not publicly available so this was a bit of limitation. Also limited data is available for SEPCO and TESCO because they were formed in 2012 and 2013 respectively.

The primary data obtained are the Total Units billed (GWh) in each fiscal year from FY 09 to FY 18 by each of 10 distribution companies and Total Amount Billed (in Millions) from fiscal year FY 09 to FY 18 across total units billed. These variables data are obtained from NEPRA State of Industry Reports (2006-2018).

Another key variable in Primary data is Power Purchase Price (PPP) which is paid to Central Power Purchasing Agency (CPPA) by DISCOs as it purchases electricity from generation side. So, we can say that CPPA in the link between Power generators and Power distributors. PPP is made up of two different prices which are Fuel charges/kWh and Variable operation and maintenance charges/kWh (shown in

[1] State of Industry Report 2015, NEPRA, Islamabad.

Equation 1 below). This price data is obtained from report released by NEPRA[2] (Monthly Fuel Adjustment NEPRA). In case of PPP, we have determined the average yearly value by using monthly reports from FY 08 to FY 18. This PPP is nominal value and include the effect of Inflation.

$$\boldsymbol{Power\ Purchase\ Price(PPP) = Fuel\ Charges/kWh + Variabke\ Charges/kWh} \ (\mathbf{1})$$

Now moving towards the secondary dataset, it is mainly derived from Primary dataset (variables described above). Nominal Consumer Tariff is secondary data variable.

The secondary data variable is Nominal Consumer Tariff, it is computed by using the two indicators explained in primary data. This nominal consumer tariff is obtained by dividing Total Amount Billed (Million PKR) with Total Units Billed (GWh) during that year from each fiscal year (See equation 2 below). As a result, we will get an average electricity tariff which is without any subsidies given by government and irrespective of any sector (Residential, commercial etc.) served by distribution company, so in this way these effects are removed, and we get actual Electricity Consumer Tariff.

$$\boldsymbol{Nominal\ consumer\ price} = \frac{\boldsymbol{Total\ amount\ billed\ by\ each\ DISCO}}{\boldsymbol{Total\ units\ billed\ by\ each\ DISCOs\ yearly}} \ (\mathbf{2})$$

These are the few data variables that we will use in our study. The next section will explain the methodology which we will use in this research and how the above-mentioned data will be utilized to obtain the results required.

4.2 Methodology

Based on the literature that is available the reforms in electricity sector in the form of unbundling, liberalization and privatization are analysed using various methodologies. The methodologies used in empirical studies are categorized into 4

[2] Monthly Fuel Adjustment Report, NEPRA, Islamabad

categories as stated in paper by [1]. The first category is Frontier Analysis used by [2], [3] in his study. Second category is Financial and Economic Analysis used by [4], [5]. Third category involves studies like [6], [7] which uses Efficiency measure or Total factor productivity. Finally, we have category involve studies like[8], [9] that use social cost and benefit analysis to study the social welfare of reform in electricity sector.

All set of methodologies are summarized in Figure 4.1 below.

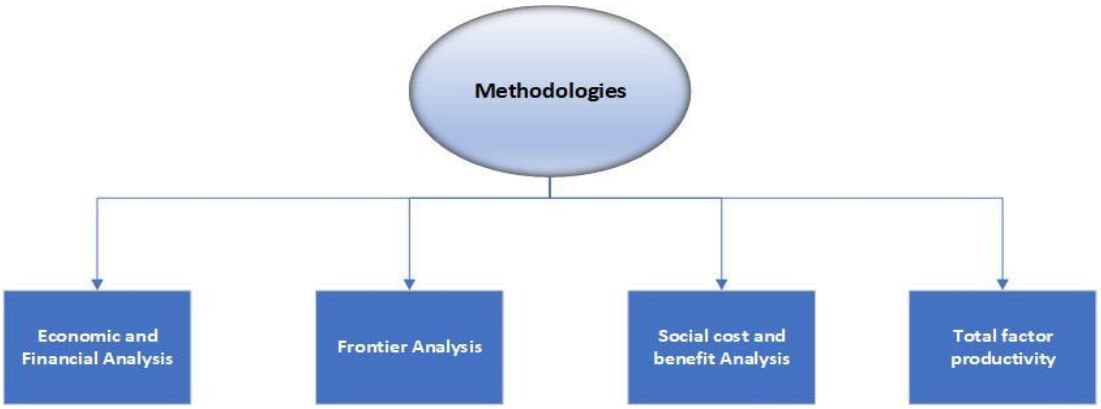

Figure 4.1: Types of Methodologies

The above data set contains monetary values like Power purchase price and Nominal Consumer Tariff so the methodology we used is "Economic and Financial Analysis". In this technique we will look at both Nominal PPP and Nominal Consumer Tariff and then we will use time series analysis to compute the results. The timespan of our study is from Fiscal Year 2008 to Fiscal Year 2018. All the prices data used is for this timespan given.

Since, we are talking about the Economic Analysis we will also look at the Real Power Purchase Prices and Real Consumer Tariff by taking into consideration of Consumer Price Index (CPI). The value of this CPI is obtained through World Bank from year 2008 to year 2018. For the reference value of CPI is 100 points in year 2010. According to this reference value of CPI we have developed an index. This index is shown below in Table 4.1. Further we will use CPI index to calculate the Real Power Purchase Price and Real Value of Consumer Tariff. The equation used to

calculate the Real PPP is shown in equation 3 and the formula to calculate Real Consumer Tariff is shown by equation 4 below.

Table 4.1: Consumer Price Index (Base Year=2010) (Source: World Bank)

Year	Inflation/CPI (%)	CPI (2010=100)	Index with base year 2010
FY 08	20.286	77.266	0.77266
FY 09	13.648	87.811	0.87811
FY 10	13.881	100	1
FY 11	11.917	111.917	1.11917
FY 12	9.682	122.753	1.22753
FY 13	7.692	132.195	1.32195
FY 14	7.189	141.699	1.41699
FY 15	2.529	145.283	1.45283
FY 16	3.765	150.753	1.50753
FY 17	4.085	156.912	1.56912
FY 18	5.078	164.88	1.6488

$$\boldsymbol{Real\ PPP = \frac{Nominal\ PPP}{CPI\ index(base\ year = 2010)} = PKR/kWh} \quad (3)$$

$$\boldsymbol{Real\ Consumer\ Tariff = \frac{Nominal\ consumer\ tariff}{CPI\ index(base\ year = 2010)} = PKR/kWh} \quad (4)$$

Another parameter that we will use is to compute Distribution Margin. This is the portion of Consumer Tariff that is retained by Distribution companies. We will compute this distribution margin in both Nominal and Real terms first by using Nominal PPP and Consumer Tariff and then by using Real PPP and Consumer Tariff computed through CPI respectively. This Distribution Margin is computed for all 10 unbundled Distribution companies. Mathematically, formula to compute Real Distribution Margin in given by Equation 5 below.

$$\textbf{\textit{Real Distribution Margin} = \textit{Real Consumer Tariff} - \textit{Real PPP} = PKR/kWh} \quad (5)$$

Last parameter which we will use to analyse the impact on prices due to unbundling of DISCOs is by using the Cost transfer Index. This index is the ratio of absolute price change of consumer tariff to absolute price change of PPP. In this way we would be able to know if the certain DISCO is how effectively transferring the change in price at the generation end to the consumer end. Ideally, this value of index should be 1 which means that the price change in PPP is totally reflected in Consumer tariff. If this value of index is less than 1 this means that prices change at PPP is not successfully transferred to consumer end and lastly if this index has value of more than 1 than additional benefit is given to consumer for its welfare. Mathematically, this index is calculated by the formula below in equation 6.

$$\textbf{\textit{Cost transfer index}} = \frac{\textbf{\textit{Absolute price change in CT}}}{\textbf{\textit{Absolute price change in PPP}}} \quad (6)$$

Up till, now we are familiar with all the variables both primary and secondary and with the Economic Analysis which is used to compute the Real Prices of Electricity, we shall move towards the time series analysis of all the results obtained.

We will use the time series analysis to obtain trends of following from Fiscal Year 2008 to Fiscal Year 2018 to analyse to Price changes:

1. Nominal and Real PPP.
2. Nominal and Real Consumer Tariff.
3. Real Distribution Margin(average).
4. Percentage of DM in Real consumer tariff.
5. Cost transfer index.

All set of data variables are summarized in Figure4.2**.** These all-mentioned trends above are obtained for each DISCO separately and explained in next section of this paper.

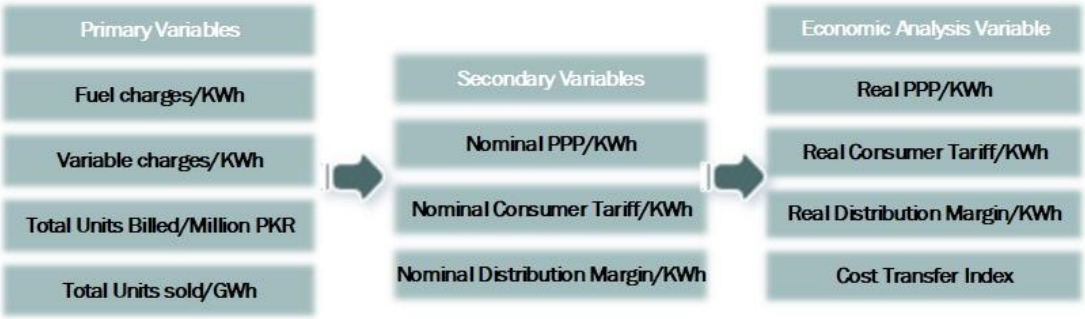

Figure 4.2: Complete set of data variables

Summary

In this study, we have used Economic and Financial Analysis to study the impact of unbundling on electricity prices. The unbundling was completed in 1998, and corporatization of distribution companies was completed in 2002. This study covers the time frame between 2008 to 2018. Data prior to 2008 was not publicly available. The data is divided into two parts, primary and secondary. Primary set of variable includes Total yearly consumption of electricity units in terms of GWh and total amount billed by distribution company in terms of Millions. Data for these parameters were obtained from NEPRA State of Industry Reports between 2008-2018. We have used these to compute secondary variables, average consumer tariff and distribution margin. These average consumer tariff consist of all consumer type (Residential, Commercial, etc), and for each ten state-owned unbundled, and one privately-owned bundled distribution companies. Power purchase price data was obtained from NEPRA fuel adjustment reports between 2008-2018. We have assumed power purchase price of privately-owned distribution company is same as of state-owned companies. We have also computed distribution margin kept by distribution companies and, also developed an indicator of cost transfer index which tells us how effectively price change at generator end is reflected into consumer tariff. Finally, using the economic analysis to compute, Real power purchase price, and real consumer tariff by adjusting for Inflation. CPI data for inflation-adjustment was obtained between year 2008 and 2018 through World Bank.

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Chapter 5: Results and Discussions

This section of research paper discusses two things. First, it explains the results which were obtained through Economic Analysis followed by Time series Analysis on the data collected in previous section of the paper. Secondly, it discusses the major findings on the impacts of electricity prices due to unbundling of DISCOs. Further, we can compare the results of all DISCOs with the results obtained of KESC which is the sole bundled utility operating in Pakistan. Also, assuming that the Power Purchase Price (PPP) of KESC is same as of other unbundled utilities. Now we shall move towards first part of this section which contain Results.

5.1 Results

We have already described in the previous section the different trends through which we can analyse the impacts on electricity prices. These trends include comparison between Nominal or Real PPP and Consumer Tariff, comparison between Real Distribution Margin, comparison between percentage of DM Real Consumer Tariff and lastly the comparison between cost transfer index of all DISCOs. Each of these comparison in explained under its specified heading. One thing that should before analysing the result is for SEPCO and TESCO data is limited because they were formed in 2012 and 2013 respectively. So, they have some missing values in results.

5.1.1 Nominal and Real PPP

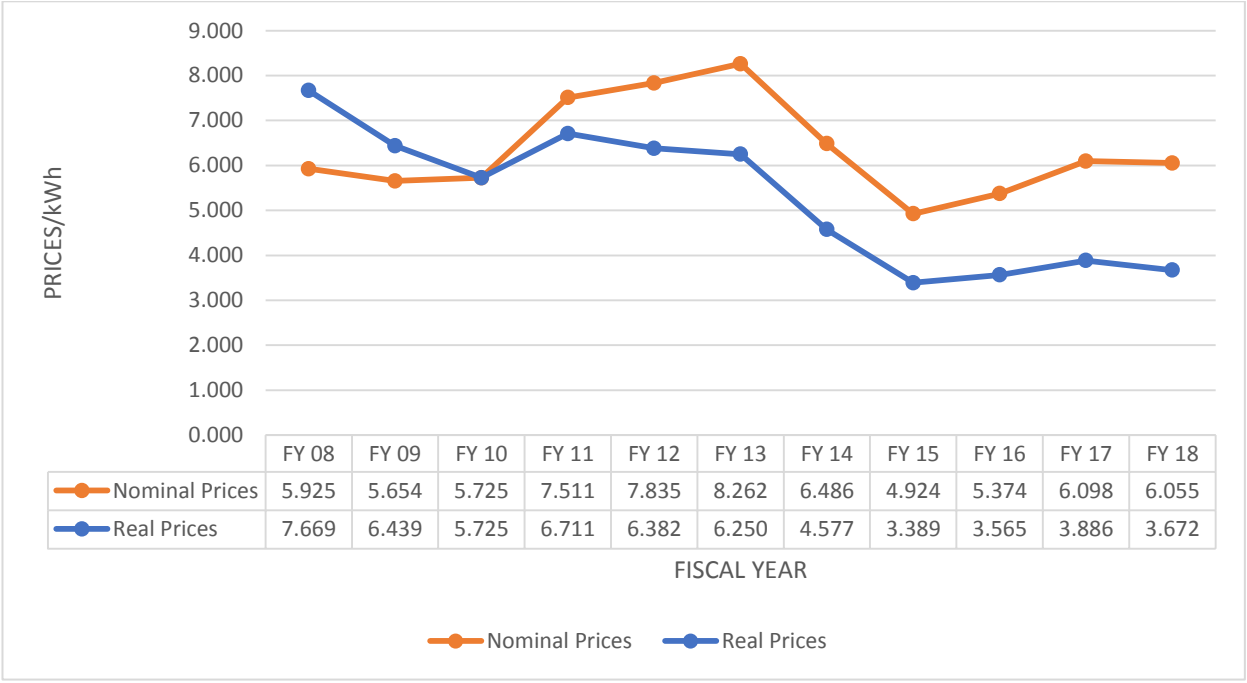
Power purchase price trends were simpler as compared to Consumer tariff because here we were looking at the price that DISCOs pay to CPPA to acquire electricity on behalf of DISCOs. This price is same for all distribution companies or we can say that the price that all distribution buy electricity at same price[3] (Monthly Fuel Adjustment NEPRA).

The trends of both types of PPP are shown in Figure 5.1 below. To summarize the results for FY 08 to FY 18, we can say that the average Nominal PPP is about PKR

[3] Monthly Fuel Adjustment Reports, NEPRA

6.530/kWh while the average Real PPP was PKR 5.297. Highest nominal PPP was recorded was PKR 8.262/kWh in FY 13 while the lowest recorded were PKR 4.924/kWh. On the other hand, in case Real PPP the highest PPP was recorded was PKR 6.722 in FY 11 while the lowest was recorded was PKR 3.389/kWh in FY 15. If we look closely at the graph in Figure , we can notice the graph has almost similar increasing or decreasing trend with exception in few years. Following are the few exceptions in trends:

1. Between FY 09 and FY 10, the increasing trend was noticed in Nominal PPP which was from PKR 5.654/kWh to PKR 5.725/kWh but there was decreasing trend in Real Prices as PPP was reduced from PKR 6.439/kWh to PKR 5.725/kWh.
2. Between FY 11 and FY 13, the increasing trend was noticed in Nominal PPP which was from PKR 7.511/kWh to PKR 8.262/kWh but there was decreasing trend in Real Prices as PPP was reduced from PKR 6.711/kWh to PKR 6.250/kWh.



	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18
Nominal Prices	5.925	5.654	5.725	7.511	7.835	8.262	6.486	4.924	5.374	6.098	6.055
Real Prices	7.669	6.439	5.725	6.711	6.382	6.250	4.577	3.389	3.565	3.886	3.672

Figure 5.1: Real and Nominal PPP/kWh

5.1.2 Real and Nominal Consumer Tariff

These both tariffs are computed for all distribution companies. The trends are shown in Figure 5.1 below. In order to draw comparison between companies we have determined the Average Real and Nominal Consumer Tariff. The results are shown in Table 5.1 and Table 5.2.

From the Table 5.1 we can see that; in terms of Nominal Consumer Tariff it ranges between PKR 9.6/kWh to PKR 13.321/kWh. The lowest recorded is of MEPCO which is PKR 9.605/kWh and the highest being PKR 13.321/kWh of SEPCO. PESCO has slightly higher tariff than MEPCO which is PKR 9.668/kWh. The bar chart in Figure 4 shows the summary of Average Nominal Consumer Tariff. The trend below shows the sequence of Average Nominal Consumer Tariff, which the leftmost has the lowest value.

MEPCO<PESCO<QESCO<GEPCO<HESCO<FESCO<IESCO<LESCO<TESCO<SEPCO

KESC has the second highest value which is PKR 12.711/kWh.

Table 5.1: Average Nominal Consumer Tariff/kWh

Average Nominal Consumer Tariff/kWh											
Year	**IESCO**	**LESCO**	**PESCO**	**FESCO**	**GEPCO**	**MEPCO**	**HESCO**	**QESCO**	**SEPCO**	**TESCO**	**KESC**
FY 08	5.31	5.59	5.02	5.21	5.24	5.01	5.90	4.00			
FY 09	6.61	6.99	6.01	6.43	6.41	6.01	7.24	4.83			6.18
FY 10	7.98	8.45	6.84	7.64	7.74	7.28	8.52	5.87			7.12
FY 11	8.73	9.4	7.93	8.64	8.71	8.31	9.17	7.72			10.63
FY 12	9.95	10.86	9.33	9.97	9.97	9.78	9.48	8.33	13.22		11.12
FY 13	10.84	11.47	10.02	11.14	10.76	10.89	9.63	9.45	12.11	11.61	12.98
FY 14	13.44	14.17	11.1	12.88	12.6	12.12	10.91	12.01	12.32	11.54	15.18
FY 15	13.5	13.91	13.94	12.81	12.88	11.84	11.37	16.32	13.69	14.22	15.25
FY 16	12.94	13.46	11.78	12.46	11.92	11.48	13.11	13.11	14.95	4.56	16.30
FY 17	12.89	13.13	11.67	12.14	12.05	11.14	13.00	14.36	12.70	11.98	16.33
FY 18	13.58	13.82	12.71	12.58	12.72	11.81	13.31	14.54	14.24	12.69	16.03
Avg	10.525	11.023	9.668	10.173	10.091	9.605	10.149	10.048	13.321	11.100	12.711

Table 5.2: Average Real Consumer Tariff/kWh

Average Real Consumer Tariff/kWh											
Year	IESCO	LESCO	PESCO	FESCO	GEPCO	MEPCO	HESCO	QESCO	SEPCO	TESCO	KEL
FY 08	6.87	7.23	6.50	6.74	6.78	6.48	7.64	5.18			
FY 09	7.53	7.96	6.84	7.32	7.30	6.84	8.25	5.49			7.04
FY 10	7.98	8.45	6.84	7.64	7.74	7.28	8.52	5.87			7.12
FY 11	7.80	8.40	7.09	7.72	7.78	7.42	8.19	6.90			9.49
FY 12	8.11	8.85	7.60	8.12	8.12	7.97	7.72	6.78	10.77		9.06
FY 13	8.20	8.68	7.58	8.43	8.14	8.24	7.29	7.15	9.16	8.78	9.82
FY 14	9.48	10.00	7.83	9.09	8.89	8.55	7.70	8.47	8.70	8.14	10.71
FY 15	9.29	9.57	9.60	8.82	8.87	8.15	7.83	11.23	9.42	9.79	10.49
FY 16	8.58	8.93	7.81	8.27	7.91	7.62	8.69	8.70	9.92	3.03	10.81
FY 17	8.21	8.37	7.44	7.74	7.68	7.10	8.29	9.15	8.10	7.63	10.41
FY 18	8.24	8.38	7.71	7.63	7.71	7.16	8.07	8.82	8.64	7.70	9.72
Average	8.209	8.620	7.531	7.956	7.902	7.528	8.016	7.613	9.244	7.512	9.468
Real price change	1.37	1.15	1.21	0.89	0.93	0.68	0.43	3.64	-2.13	-1.08	2.68
Real % change	19.9%	15.9%	18.6%	13.2%	13.7%	10.5%	5.6%	70.2%	-19.7%	-12.3%	38.1 %

Now if we look at the trend of Real Average consumer tariff it ranges between PKR 7.528/kWh to PKR 9.468/kWh as shown in Table 5.2. Here the lowest belongs to TESCO (PKR 7.512) followed by MEPCO and PESCO which are PKR 7.528 and PKR 7.531/kWh. The highest value is of SEPCO which is PKR 9.244/kWh among unbundled entities. However, KEL has the highest Average Real Consumer Tariff which is about PKR 9.468/kWh. For detail data these values are shown in bar chart in Figure .

Lastly, if we look at the Real change of prices in Table 5.2, we can find that among the unbundled utilities HESCO and MEPCO record the lowest price change between specified years i.e., 5.6% and 10.5% respectively. However, from the table we can also see that SEPCO, and TESCO prices have decreased but these were formed after gap of few years. Although the average increase in Real consumer tariff of all unbundled DISCOs is about 36.4%. This value is high only because of QESCO

whose percentage change is about 70.2%. However, the only unbundled utility KEL has second highest rise in price which is about 38.1%.

The trend below shows the sequence of Average Nominal Consumer Tariff, which the leftmost has the lowest value.

TESCO<MEPCO<PESCO<QESCO<GEPCO<FESCO<HESCO<IESCO<LESCO<SEPCO

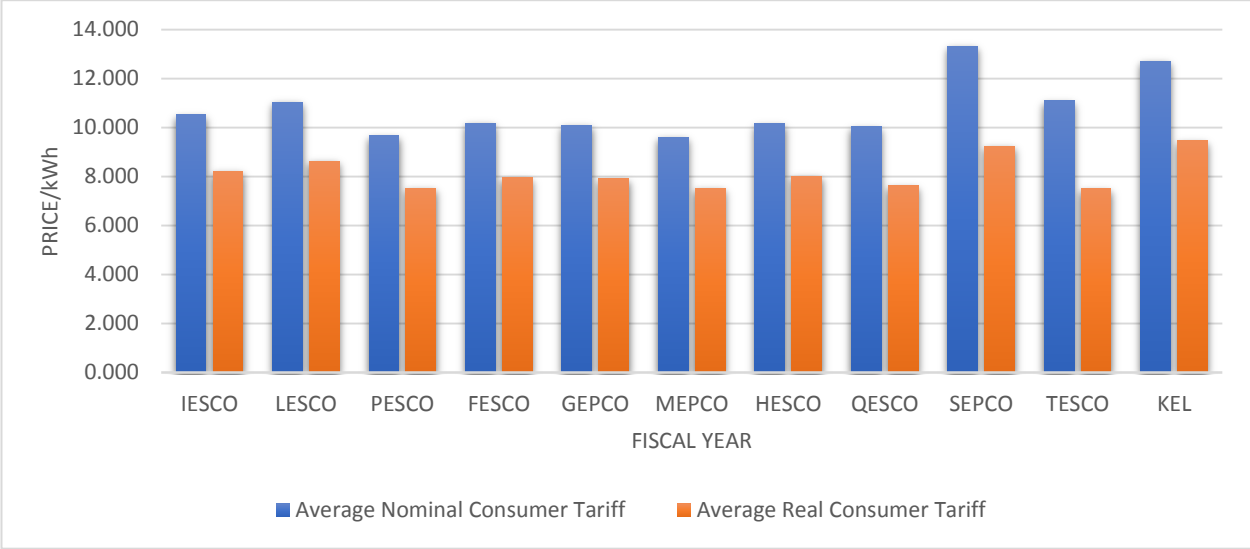


Figure 5.2: Average Real and Nominal Consumer Tariff 2008-2018

So, these are the trends related to Average Nominal and Real Consumer Tariff.

5.1.3 Real Distribution Margin

Distribution margin is the difference between, Consumer Tariff and Power Purchase Price. Mathematically, Equation 4 and 5 represent its calculation. We have computed Real DM for FY 08 to FY 18 (11 years) then average out its value for each DISCO over the span of 11 years.

Figure, which is the bar chart shows the average Real DM of all DISCOs. From the chart we can clearly see that MEPCO has recorded the lowest average Real DM of all DISCOs which is PKR 2.230 while PESCO has slightly higher average Real DM which is PKR 2.233. QESCO, has 3rd lowest margin which is PKR 2.316. SEPCO

has recorded the highest average margin which is PKR 4.712. LESCO and TESCO are the only DISCO which has average Real DM between 3 and 4 and specifically PKR 3.323 and PKR 3.288 respectively. While all other distribution companies i.e., IESCO, FESCO, GEPCO, HESCO have Average real DM in range of PKR 2.6-2.9 and to be exactly, PKR 2.912, PKR 2.659, PKR 2.605 and PKR 2.719 respectively. Lastly, if we compare all these values with KEL which is only vertically integrated utility it has average Real DM of PKR 4.41, which is the second highest among all DISCOs.

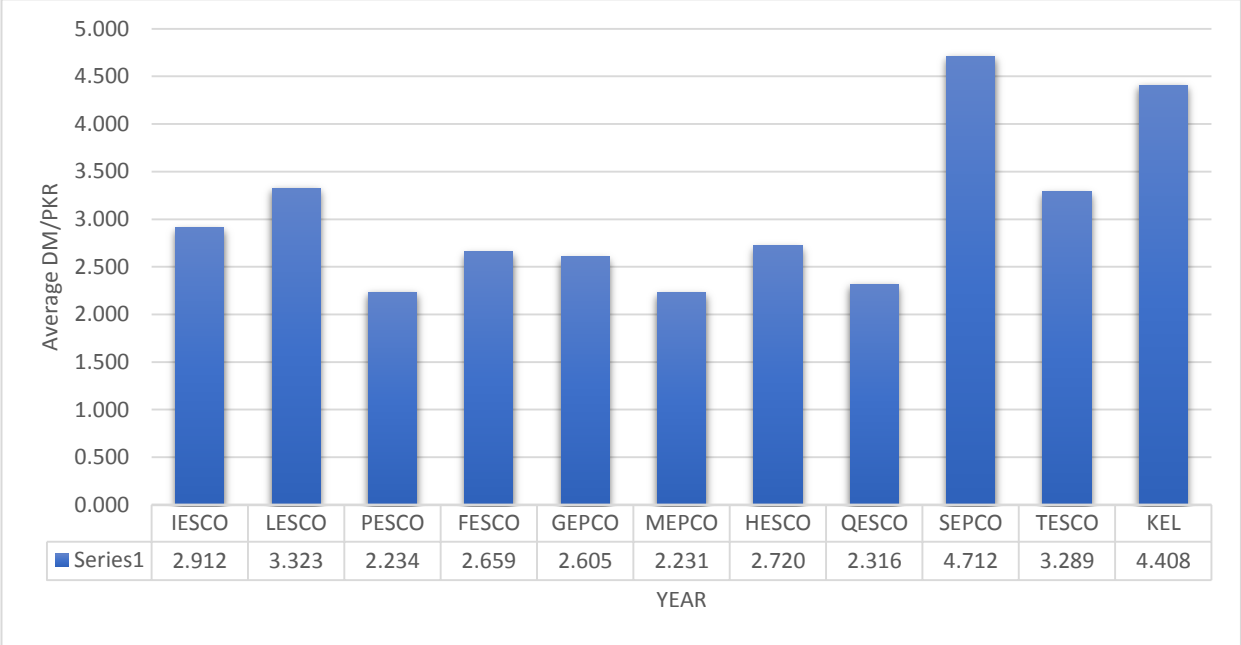


Figure 5.3: Average Real Distribution Margin/kWh 2008-2018

5.1.4 Percentage of Real DM in end user consumer tariff

In this part we have used, DM used is in Real terms because it is computed through Real PPP and Real Consumer Tariff. Percentage share of DM in end user consumer is calculated and results obtained are explained in following paragraph.

Figure shows the graph of how percentage distribution margin of all 10 DISCOs and KESC changes over the span of 11 years from FY 08 to FY 18. If we look at the

trends more closely in Figure 5.4, we can see that almost all the distribution companies follow same increasing or decreasing trend with some variations in percentage share of DM. Following same trend means, either all companies have either increasing percentage share of DM at the same time or at the same time this share falls in all distribution companies.

If we look at the trends, we can see that QESCO recorded the lowest share in distribution margin from FY 08 to FY 13 among all DISCOs starting from -47.8% in FY08 which means PPP was higher than consumer price (in real terms) so it might heavily rely on government subsidies. After that there is steepest rise among all DISCOs from 12.52% in FY 13 to 45.98% in FY 14. Lastly, QESCO also recorded the highest percentage share of DM in consumer tariff in FY 15 which was 69.8% of consumer tariff.

However, QESCO, HESCO and SEPCO have few data points that do not follow the mentioned trend and these exceptions are listed below.

1. In QESCO, from FY 10 to FY 11, percentage share of DM increases from 2.39% to 2.71% while in all other DISCO this share has decreased.
2. In HESCO, from FY 11 to FY 13, percentage share of DM has fell from 18.08% to 17.36% in FY 12 and to 14.22% in FY 13 but during that time this percentage share has increased in all other distribution company. Similarly, in FY 15 to FY 16 when every distribution company has percentage share of DM was decreasing except SEPCO, here the percentage share has increased from i.e. 56% to 59%.
3. In SEPCO, formed in 2012, from FY 12 to FY 13 the percentage share of DM has decreased from 40.75% to 28.83% as opposed to trend in which this share was increasing in all other distribution companies. Similarly, in FY 15 to FY 16 the percentage share almost remained same from 64.02% to 64.06% as opposed to the decreasing trend in all other DISCOs except HESCO (increasing trend).

So, these are the few trends of percentage share of DM in consumer tariff.

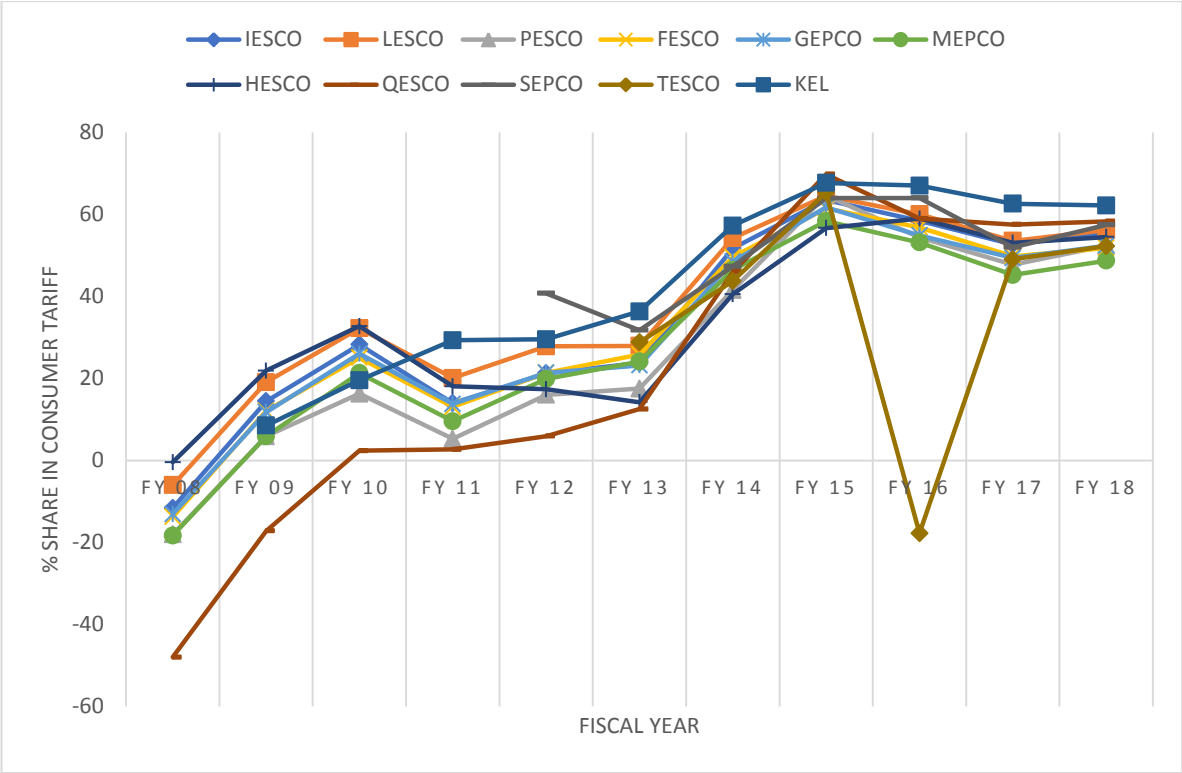


Figure 5.4: Percentage of DM in End user Tariff

5.1.5 Cost transfer index

Cost transfer index is absolute ratio of change in Average Real Consumer tariff to change in Real PPP. Its formula is given in Equation 6. By using this formula, we have computed this index for all DISCOs. The higher the value of this index it shows that most of the price change is transferred towards the consumer tariff.

In order to analyse this parameter, we have made a frequency chart ranging from 0 to 100% and above. This ratio is expressed in terms of percentage for easy understanding. Each interval is of width 10 and last interval open after 100. The index value has been computed from FY 09 to FY 18, except for SEPCO and TESCO because they were formed in 2012 and 2013 respectively. The frequency table is given below Table 4.

From the Table 5.3 and Figure, we can see that IESCO and LESCO on 3 occasions out of 10 have failed to transfer even 50% of price change towards consumers. QESCO is the only distribution company that has failed only 2 times out of 10 to transfer price more than 50% change in price towards consumers. Similarly,

MEPCO, FESCO and PESCO have failed on 5 occasions to transfer more than 50% price changes towards consumers. GEPCO is the only company that has failed on 6 occasions out of 10 while HESCO has failed 4 times. TESCO has failed 2 times out of 10 and SEPCO has failed Only 1 time to transfer price change more than 50%. KEL only featured in this range 2 times out of all.

If we change this index range between 50% to 79%, we can find out that IESCO represented in this range 4 times, LESCO 3 times, FESCO/MEPCO/HESCO/SEPCO recorded only 1 time in this range. PESCO and TESCO did not feature in this range at all. Lastly, KEL featured in this range only once.

Changing the range between 80-90%, we notice that no distribution company featured at all in this range.

Lastly, if we change the range from 90% to above, we find that QESCO has feature in this range most which is 6 times, HESCO and PESCO feature 5 times, MEPCO, FESCO LESCO and SEPCO has feature 4 times, IESCO and TESCO feature 3 times and GEPCO only feature in this range 2 times. Lastly, KEL has featured in this list most as well which is 6 times.

Table 5.3: Cost Transfer Index Frequency

Range	IESCO	LESCO	PESCO	FESCO	GEPCO	MEPCO	HESCO	QESCO	SEPCO	TESCO	KEL
0-9%		2	1	1	2						1
10-19%	3		2		2	2	1				1
20-29%			2	1		2	1	1	1		
30-39%		1				1	2	1		2	
40-49%				3	2						
50-59%	1	1		1			1	1			1
60-69%	1	1			1	1			1		
70-79%	2	1			1			1			
80-89%											
90-above	3	4	5	4	2	4	5	6	4	3	6

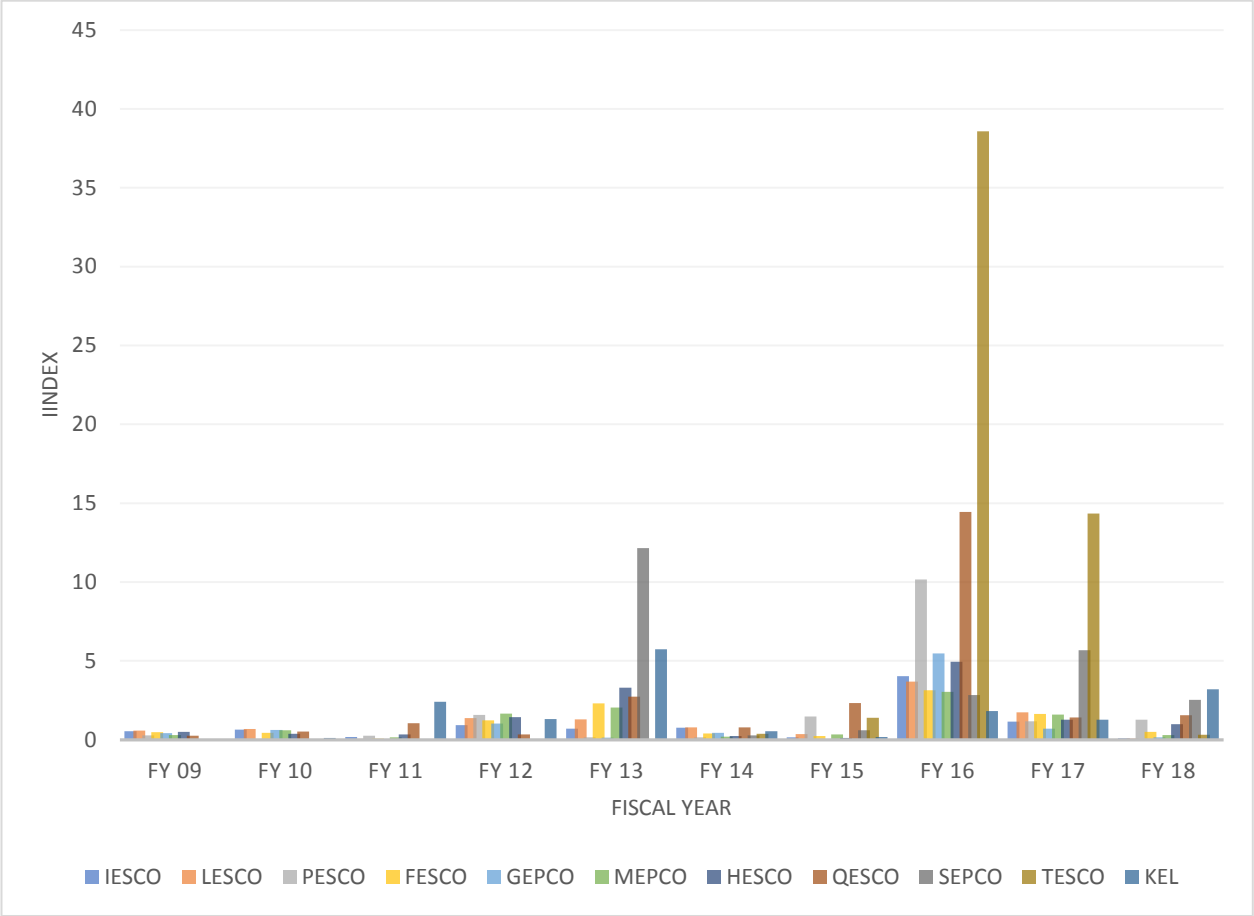


Figure 5.5: Cost Transfer Index yearly

5.2 Discussion

Based on our results, major findings are listed below:

1. Our first indicator, which deals with nominal price, shows that both the power purchase price and consumer tariff of PEPCO companies and KESC have increased. The increase is much greater in consumer tariff compared to purchase price.
2. The second indicator, which analysed inflation-adjusted prices, concludes that the Power purchase price has decreased over the years, but the Consumer tariff of PEPCO companies and KESC has increased. So, we can say that changes in purchase prices have not been reflected in consumer tariffs.
3. The third indicator extends the analysis from the previous one by analysing the extent to which change in real purchase price has reflected in consumer

end tariff. As a result, PEPCO-based companies fared poorly as only 3 times more than 80 % price change is reflected in consumer tariff in the last 11 years. However, the KESC fared much better, as more than 6 times have they transferred more than 80 % price change towards consumers.

4. The final indicator examines the distribution fee that companies charge by determining the portion of the purchase price in the final consumer tariff. In this regard, both PEPCO and KESC have seen a sharp increase in distribution fees over the years as purchase price share has declined over the years. Since FY 14, the portion of the purchase price is below 50 % in end-user tariff.

Consequently, based on the findings above for all four indicators, we have seen that there is no decline in consumer per-unit prices even after all these years of unbundling. This is mostly due to increased distribution charges which are retained by both DISCOs and privately owned KESC. Even though KESC is better at reflecting price change to the consumer, it still charges more distribution fees from its consumers.

As we have seen previously, the distribution margins have increased over the year, which might be due to the poor performance of distribution companies. Due to less efficiency, the cost of operation increased, which led to increased distribution charges retained by companies to compensate for their inefficiency. In order to increase consumer welfare by decreasing electricity prices, the operating efficiency must be increased, and power losses and theft must be curtailed.

This is also supported by the study conducted by [1], which analysed the reforms using stochastic frontier analysis on 8 distribution companies between 2003-2013. The study concluded that the distribution companies are only cost-effective to about 72.5%. This led to high prices being charged to end-user consumers. Similarly, another study concluded that due to electricity theft and low bill recoveries lead to high electricity prices being paid by end user consumers [2].

These results concluded that even after restructuring the objectives, which involved the decrease in electricity prices were not witnessed and similar results like these were reported in other studies as well [3], [4]. Different regulatory reforms impact the electricity prices differently, while some increased the prices of electricity, few

led to decrease in prices as shown in study based on both developing and developed countries [5], [6]. For the reforms like unbundling to be successful there need to have a liberalized electricity market [7], [8] which is case of Pakistan is still under consideration, so this might be one of the reason the unbundling did not led to decrease in electricity prices. Several other studies concluded that weak institutional structures, political instability, and poor policies in the past resulted in below par development of the power sector of Pakistan [9], [10].

KESC which was privatized 2005 have electricity prices which are higher than the state-owned distribution companies. The similar trend was obtained in various studies available in global literature where after privatization increase in electricity prices was witnessed [8], [11]–[16][17]. Similarly, another study concluded that the slow reforms in the Asian countries were mainly due to poor management, political interference and lack of long term planning [18], [19].

Another possible reason for these high prices can be due to non-technical losses in the system, which might be due to electricity theft, resulting in increased consumer tariffs to recover the losses. So, to overcome this problem of low efficiency, investment in the distribution sector is the need of the hour to enhance the system efficiency and increase consumer welfare, and policymakers need to identify the shortcomings of the past reforms as well [20], [21].

Lastly, a possible reason for high charges retained by distribution companies might be due to regional monopoly. All PEPCO-based 10 distribution companies and KESC operate in their specified regions allocated with no interference. This might lead to a disparity between the power purchase price and the end consumer tariff. This increases the profit and decreases consumer welfare.

So, these might be few reasons that led to high consumer prices by increasing distribution margins retained by distribution companies.

Summary

This section first presents the results and then discusses some possible reasons for these outcomes. Based on the results, we can clearly see that the reforms of unbundling do not lead to decrease in consumer tariff in both Nominal and Real terms. Even though the power purchase price was decreased, but the consumer tariff increased in Real terms. Similarly, the result for privately-owned bundled utility KESC do not paint good picture as well as it ends up charging more than most of the state-owned distribution companies. This increase led to increase in distribution margin that is portion of consumer tariff retained by distribution companies. One of the possible reasons of this increase might be poor operation of unbundled distribution companies as the cost of operation increases due to inefficiency and this led to high electricity prices being paid by consumers. Another, possible reason for unsatisfactory result might be due to the regional monopolies of these distribution companies, the performance went down. Policymakers in Pakistan are currently working on the remaining parts of power sector reforms, like formation of wholesale market and privatization of distribution companies to improve the power sector performance. However, there exist some serious challenges that the experience of privatization of KESC has not fared well. So, careful planning is needed to improve power sector while keeping in view the past experiences.

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Chapter 6: Conclusion and Policy Implications

Pakistan initiated its power sector reforms almost 30 years ago with the aim of reducing the demand-supply gap, improving efficiency by reducing losses and theft, and increasing consumer welfare by increasing electricity access at affordable prices. However, even after all those years, we have only successfully formed an Independent Power Regulator (NEPRA), followed by process of vertical unbundling of the whole power sector and, finally, the introduction of IPPs. The unbundling led to the formation of 14 companies which includes 4 generating companies (GENCOs), 9 regional-based distribution companies (DISCOs), and 1 transmission company (NTDC). These all companies were registered under PEPCO in 1998, which was formed to facilitate future reforms in the sector. The reason for these slow reforms could be managerial issues, political instability, and weak institutions of the country.

The unbundled distribution companies were operationalized in 1998 and were initially 9 regional-based companies to be privatized in the future. However, only Karachi-based regional company KESC was privatized in 2005, and all others are still state-owned utilities. Another two regional-based companies SEPCO and TESCO were formed in 2012 and 2013, respectively. Now, ten state-owned Distribution companies are working under PEPCO, and only a single privately-owned company, KESC, operates in the Karachi region.

This study examined the impact of unbundling of DISCOs on electricity prices over the years. Due to limited data availability, we analysed the impact between FY 09 to FY 19. We have also included KESC to compare the results of state and private-owned utilities. There are very few studies based on Pakistan to study unbundling impact on prices in the literature available. This study uses Economic analysis by using price indicators to analyse the impacts.

The key findings showed that the nominal price increase was negligible over the years after unbundling compared to the nominal consumer tariff for both PEPCOs and KESC. However, when prices were inflation-adjusted, we found that the real purchase price went down, but the consumer tariff went up for both PEPCOs and KESC. Similarly, there was no cost reflectiveness observed in PEPCOs tariff also over the year's distribution fees went up. However, in the case of KESC, there was more cost reflectiveness, but still, they end up charging more distribution fees compared to PEPCOs companies. Based on these results, below are few policy recommendations that we can adapt to overcome the issue of high prices.

The parts of the reforms that are left include privatization of the distribution sector, formation of the electricity wholesale market. Finally, the introduction of the retail market will play a major role in the transformation of the current electricity market to a more efficient one. Moving towards liberalization will increase the performance of the sector. Also, this study, as a benchmark, can be useful to future reforms.

One of the steps that can be taken is the introduction of incentive-based regulation. This will help increase the regional based companies' competition and, on the basis, on these, the rewards would be given to the best performing company. The rewards can be in terms of the bonuses to employees, and this will also help in increasing their performance.

One of the major contributors to high distribution losses is electricity theft. DISCOs can reduce this by identifying the areas of low recoveries and installing prepaid electricity meters. Although this will require some investment but the problem of non—technical losses will be greatly reduced.

Similarly, policies should be made to ensure that with the advancements of technologies for generating electricity and reducing fuel cost due to the introduction of Renewable technologies, the consumer tariff should also be brought down at the same rate as the generation cost to enhance consumer's welfare.

Based on the results presented in this paper, we can see that unbundling did not lead to a decrease in electricity tariffs for consumers. This clearly shows that consumer welfare was not achieved as expected. Some of the reasons for this are explained previously in the discussion section, which might help policymakers readjust and recalibrate their policies to enhance consumer welfare when moving towards

liberalizing the electricity market in coming years. Due to data limitations, we have solely focused on electricity prices. However, in the future, we can employ other strategies like social cost and benefit analysis to quantify further the impact of unbundling of DISCOs on electricity prices.

Appendix A: Publication

Paper Tile: Performance Analysis of distribution companies in Pakistan during 2011-2020

Conference: International conference on Sustainable Energy Technologies (ICSET 2021)

Proceedings of the 3rd International Conference on Sustainable Energy Technologies (ICSET 2021)
Peshawar, Pakistan, 12 August 2021

Performance analysis of distribution companies in Pakistan during 2011-2020

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ABSTRACT

The power sector of Pakistan has undergone significant reforms, which began in the late 1980s, to improve the sector's performance. Power sector reforms include vertical unbundling of the power sector, followed by participation of IPPs in the power generation sector, formation of an independent regulator, and privatization of distribution utilities. These reforms aimed to improve the performance of the power sector. This study explicitly analyses the performance of the power distribution sector after unbundling of WAPDA during the last decade (2011-2020). We have used time-series analysis to analyse the different parameters in the domain of efficiency, reliability, and management. Moreover, distribution losses, bill recoveries, system average interruptions in terms of minutes and numbers, pending applications of a new connection, and fatal incidents are used as indicators for mentioned parameters. The time-series analysis indicates that distribution companies in Pakistan are operating quite inefficiently in almost all indicators. However, there are only a few exceptions where only IESCO has performed better and within the quality benchmark given by NEPRA. The poor performance of distribution companies is one of the reasons contributing to high electricity prices in Pakistan. To overcome the poor performance of the distribution sector of Pakistan, we recommend some serious policy initiatives must be taken by the government. We further conclude that investment in infrastructure, penalties, and incentives in terms of performance can lead to better efficiency of distribution companies.

KEYWORDS: Power Distribution, Efficiency, Reforms, Time-series analysis, Distribution companies