THE RESTRUCTURING AND PRIVATIZATION OF ELECTRICITY GENERATION SECTOR IN PAKISTAN: A SOCIAL COST-BENEFIT ANALYSIS

By

Muhammad Hamza Jamil

Reg. No. 00000276207

Supervised By

Assistant Professor Dr. Kafait Ullah

A Thesis Submitted to the USPCASE in partial fulfillment of the requirements for the degree of

MASTERS OF SCIENCE in

ENERGY SYSTEMS ENGINEERING

U.S. – Pakistan Center for Advanced Studies in Energy (USPCAS-E)

National University of Sciences and Technology (NUST)

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THESIS ACCEPTANCE CERTIFICATE

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Dedication

Thanks to Allah Almighty for His blessing to make me able for completing this degree and my respected parents for their moral support and prayers. I dedicate my research and efforts to my honorable Supervisor and GEC members for their guidelines during research and paper publication. Special thanks to Mr. Noor Saleem Khan (Additional Director NEPRA) for his continuous guidelines and support during my research endeavor. Without his association and commitment, this thesis work was not conceivable. Thanks to all faculty members at USPCAS-E who gave profitable inputs, remarks and for their tenacious support towards this research work and publication.

Abstract

The power sector of Pakistan has undergone a substantial, yet protracted, reform process which began with the power sector reform program in 1992. Under this program, the government allowed participation of Independent Power Producers (IPPs), followed by the dismantling of Water and Power Development Authority (WAPDA) into various entities and the establishment of power sector regulatory authority, namely NEPRA in 1997. The power sector reforms in Pakistan have not been evaluated sufficiently to determine the actual costs and benefits incurred by different segments of the society, so to correct the path of upcoming reforms. This thesis attempts to investigate the socio-economic impacts of restructuring of WAPDA's generation segment and private sector participation in the electricity generation sector of Pakistan by using a social cost-benefit analysis approach. The study has analyzed the impacts of reforms on government, private sector and consumers (domestic, commercial, industrial and agriculture) of the power sector. The results shown that the main benefit of private sector participation came from the timely expansion of generation capacity. However, the environmental and electricity generation costs became exorbitant after power sector reforms. Consumers and government remained net losers, while IPPs were winners in the process of restructuring and privatization. This paper concludes that power generation sector reforms with private sector participation have impacted the overall social welfare adversely. It further concludes that had regulation been scrupulous with adequate supportive role of government with social obligations, consumers and government could have benefited from restructuring and privatization of the power sector generation sector in Pakistan.

Keywords: Power sector reforms; social cost-benefit analysis; welfare analysis; private sector; Pakistan.

Table of Contents

List of Figures

List of Tables

Abbreviations & Acronyms

WAPDA	Water and Power Regulatory Authority
KESC	Karachi Electric Supply Company
IPP	Independent Power Producers
KE	Karachi Electric
GoP	Government of Pakistan
R&P	Restructuring and Privatization
SCBA	Social Cost-Benefit Analysis
KAPCO	Kot Addu power company
NTDC	National Transmission and Dispatch Company
GENCOs	Generation Companies
DISCOs	Distribution Companies
SEPCO	Sukkur Electric Supply Company
TESCO	Tribal Areas Supply Company
IESCO	Islamabad Electricity Supply Company
LESCO	Lahore Electricity Supply Company
PPAs	Power Purchase Agreements
PPIB	Private Power Infrastructure Board
NEPRA	National Electric Power Regulatory Authority
WPPO	WAPDA's Private Power Organization
PCRET	Pakistan Council of Renewable Energy Technology
NEECA	National Energy Efficiency & Conservation Authority
CPPA-G	Central Power Purchasing Agency (Guarantee) Limited
AEDB	Alternative Energy Development Board
R&D	Research and Development
VOLL	Value of Lost Load
MoF	Ministry of Finance
PC	Planning Commission of Pakistan
PEPCO	Pakistan Electric Power Company
HDIP	Hydrocarbon Development Institute of Pakistan
ADB	Asian Development Bank
CS	Consumer Surplus
GHG	Greenhouse gas
EPC	Engineering and Procurement
KWh	Kilowatt Hour
GWh	Gigawatt Hour
TDS	Tariff Differential Subsidy
FBR	Federal Board of Revenue
CBR	Central Board of Revenue
NPV	Net Present Value
PSDP	Public Sector Development Program

Chapter 1

Introduction

1.1. Power sector reforms: a premier

Power sector reforms have been a major pillar of sectoral reforms and a matter of intensive debate across the world since 1980. Until these reforms, the power supply industries of most countries were vertically integrated between generation transmission and distribution with a statutory national and regional monopolies [1]. The standard defense of this structure was the perception of governments across the world under the assumption that economies of scale make the power sector a natural monopoly [2]. However, by the early 1980s, the issues with this structure become obvious, as the government-owned vertical monopolies were in dire financial straits and exhibited poor technical performance [3,4].

Accordingly, with the globalization of the world economy and rapid technological advancements, existed institutional arraignments had become obsolete and relocation of property rights was needed. Moreover, the roles of state and private investors were needed to be redefined [5]. In the face of such circumstances, power sector reforms were being pursued in many developed and developing countries with the promise that the reformed system would be more effective and efficient in meeting power demand and fulfilling the sustainable power agenda [3]. Additionally, international financial organizations such as the World Bank and International Monetary Fund pressured countries of former centrally planned economies and developing countries for this movement.

1.2. Slow and stalling reforms process in Pakistan

Like many other developing counties, Pakistan has also attempted to improve the governance of its electricity sector by introducing electricity sector reforms in 1992 following a period of severe power shortages [6]. The severe power crisis and WAPDA's inability to handle the soaring power demand led the government of Pakistan to issue the power sector reforms plan renowned as "power sector strategic plan for restructuring and

reform" in the early 1990s. International development partners instructed the government of Pakistan (GoP) to adopt a "textbook" reforms template, which was the culmination of the general model proposed by the World Bank [2,7]. This template introduces radical changes to the power sector and includes the following three reforms: Restructuring and Privatization (R&P), regulation and competition by introducing wholesale markets and allowing consumers to choose their suppliers in retail markets [2].

This plan laid the foundation for electricity generation sector reforms in Pakistan. But before the implementation of this plan, there was a change in government and a new government came into power in 1993. The newly elected government (PPP) decided to continue the proposed plan of the previous government and their first aim was to expand the installed generation capacity through private investment. To achieve this objective, GoP announced the country's first power policy in 1994. National power policy 1994 allowed IPPs to participate in the electricity generation sector of Pakistan. Power policy 1994 was formulated with lucrative terms and conditions to attract IPPs [8]. However, it took almost six years to implement the planned step of restructuring WAPDA and only two of those dismantled companies[1] have been privatized until now due to political and economic barriers [6]. Furthermore, seven major institutional changes have been made and eight power policies have been formulated over the past 25 years to make the power sector efficient, environment-friendly and cost-effective for end consumers[2]. However, despite these major steps, the power sector of Pakistan has continued to suffer many issues like inefficiencies, high generation cost, low electrification rate and circular debt leading to frequent and large blackouts. Figure 1 presents the announced and actual reforms in Pakistan from 1990 to 2015.

1.3. Problem Statement

In 1992, the government of Pakistan aimed to make the power sector efficient and sustainable and adopted a law in 1994 to reform the sector through the restructuring of WAPDA and private sector participation. This study endeavors to examine how the

[1]Karachi Electric Supply Company (KESC) and Kot Addu power company (KAPCO).

[2] These changes, i.e., structural transformations, institutional development, and legislation and policy development have been discussed in detail in chapter 2.

restructuring of WAPDA and IPPs induction into the power generation sector of Pakistan have affected the social welfare of different stakeholders. Pakistan is an Asian country that introduced private investors' participation in the power generation sector through IPPs and adopted a reform model that was mainly designed for early reforming countries such as the US, Chile and UK [9]. We seek to investigate whether and to what extent these generation sector reforms have contributed to the social welfare of Pakistan. This research will help to reignite the policy debates and will help to put a value on the policy of restructuring and privatization.

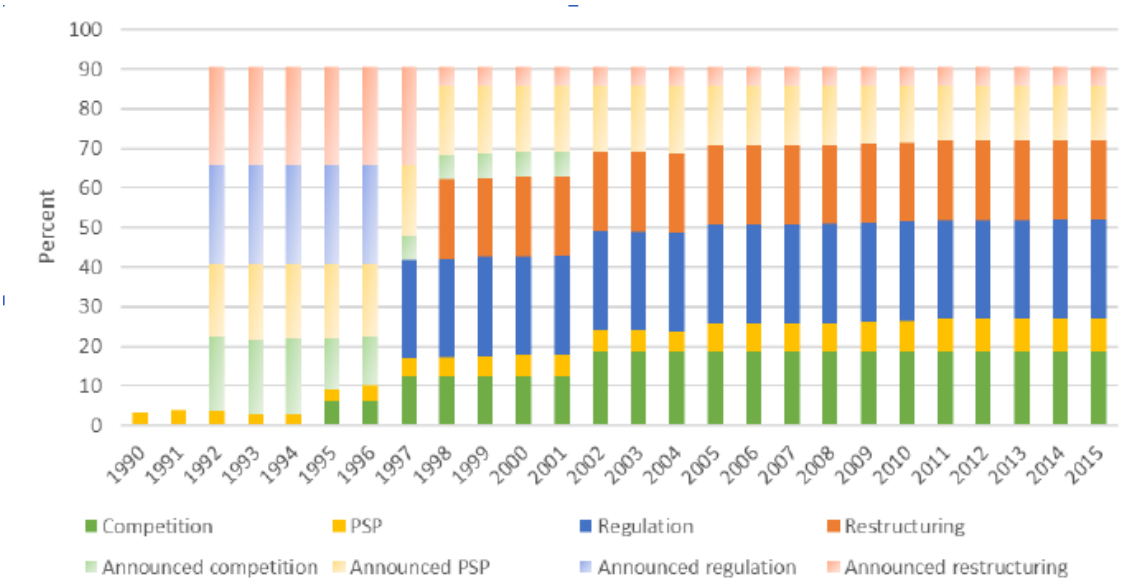


Figure 1: Announced and actual reforms in Pakistan, 1990-2015. Source: World Bank [10]

PSP= Private Sector Participation

1.4. Justification for the selection of the topic

Power sector reforms have been a major pillar of sectoral reforms and a matter of intensive debate across the world since the 1980s. Many studies (in both developed and underdeveloped countries) have been conducted around the globe to investigate the impacts of these reforms. However, not a single study has attempted to evaluate the welfare impacts of these reforms in Pakistan. This study attempts to depict a holistic picture of the social impacts of these reforms on different stakeholders and also estimates the net welfare change after the restructuring and privatization.

1.5. Objectives

The key objectives of this study are highlighted below,

i- To evaluate net welfare changes: Does the cost of restructuring and privatization warrant the present-day benefits gained by society?
ii- To address the distributional aspect of the problem: Who gained, who lost (if anyone), and by how much in the process of restructuring and privatization of the electricity generation sector in Pakistan?

This research adapted Social Cost-Benefit Analysis (SCBA) methodology to achieve this objective in a partial equilibrium model, a case study approach that develops counterfactual scenarios. Power sector reform promises or expectations are the hypotheses in this research. Furthermore, this research pays particular attention to the context and local circumstances within which reforms were undertaken [3]. To the best of our knowledge, this is the first attempt to evaluate the welfare impacts of electricity generation sector reforms in Pakistan.

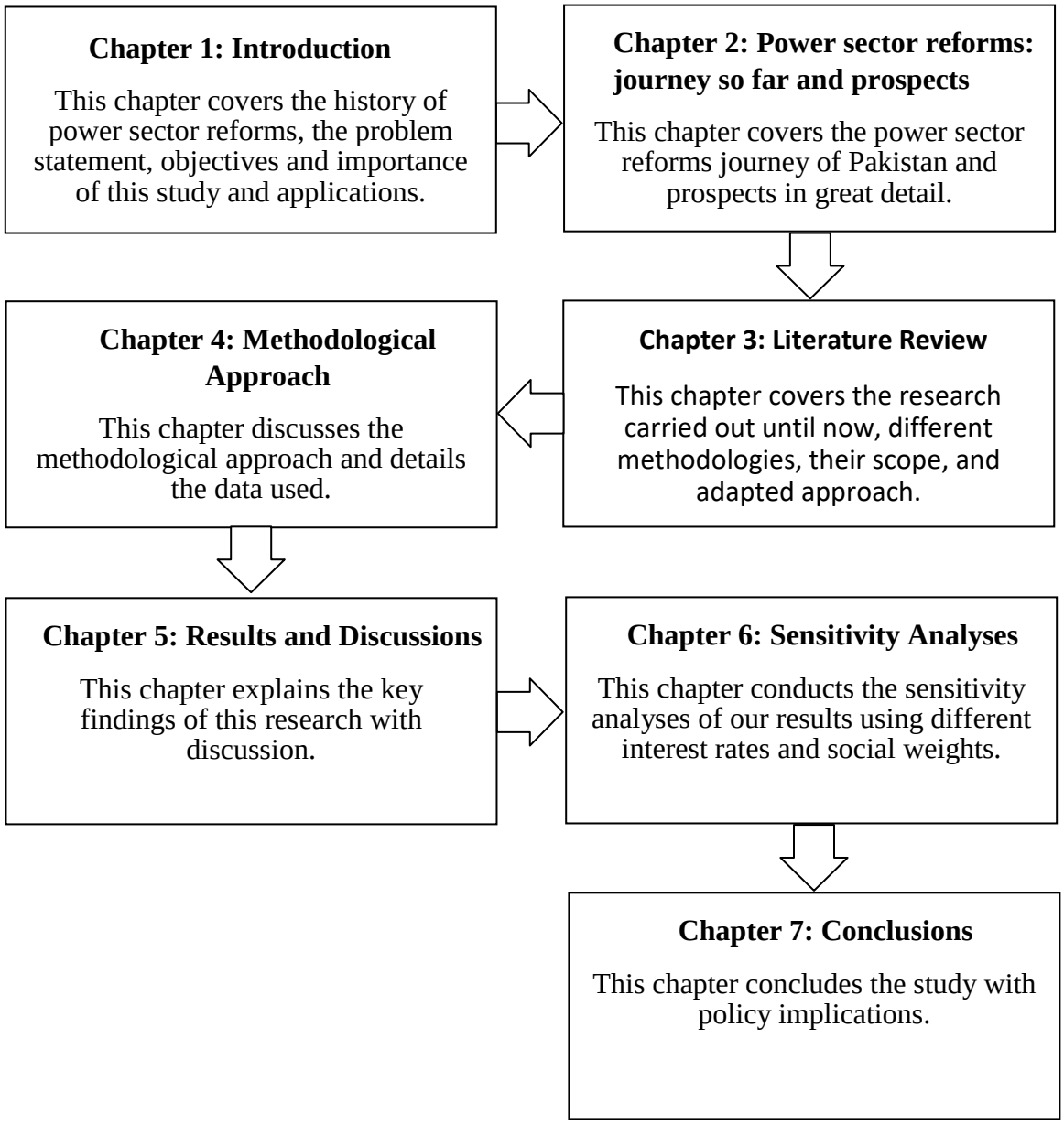
1.6. Applications of results

Decision makers should not be precluded from considering the economic costs and benefits of different policies in the development of regulations. Thus cost benefit analysis is required for all major regulatory decisions. This analysis can help or hinder policies in energy sector of Pakistan and a lesson for other developing countries. Furthermore, this research will help to reignite the policy debates and will help to put a value on the policy of restructuring and privatization because Pakistan's electricity sector is still under reforms and to track and investigate the performance of these reforms is very important before considering further policies.

1.7. Organization of thesis

The rest of the thesis is structured as follows. Chapter 2 presents the review of power sector reforms in Pakistan and prospects. Chapter 3 elaborates the literature review. Chapter 4 discusses the methodological approach and details the data used in this paper. Chapter 5 describes the counterfactual scenarios and presents results with discussion,

Chapter 6 conducts sensitivity analyses, while Chapter 7 concludes the study with policy implications.



Summary

Power sector reforms have been a major pillar of sectoral reforms and a matter of intensive debate across the world since 1980. Like many other developing counties, Pakistan has also attempted to improve the governance of its electricity sector by introducing electricity sector reforms in 1992. Many studies have been conducted around the globe to investigate the impacts of these reforms. However, not a single study has attempted to evaluate the welfare impacts of these reforms in Pakistan. This study endeavors to examine how the restructuring of WAPDA and IPPs induction into the power generation sector of Pakistan have affected the social welfare of different stakeholders. Pakistan is an Asian country that introduced private investors' participation in the power generation sector through IPPs and adopted a reform model that was mainly designed for early reforming countries such as the US, Chile and UK. We seek to investigate whether and to what extent these generation sector reforms have contributed to the social welfare of Pakistan. This research adapted Social Cost-Benefit Analysis (SCBA) methodology to achieve this objective in a partial equilibrium model, a case study approach that develops counterfactual scenarios. This analysis can help or hinder policies in energy sector of Pakistan and a lesson for other developing countries. Furthermore, this research will help to reignite the policy debates and will help to put a value on the policy of restructuring and privatization because Pakistan's electricity sector is still under reforms and to track and investigate the performance of these reforms is very important before considering further policies.

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Chapter 2

Power Sector Reforms in Pakistan: Journey so far & Prospects

2.1. Review of power sector reforms in Pakistan and prospects

Almost four decades ago, a new paradigm emerged to reform the power sector fundamentally with the aim of improving operational and financial efficiency of utilities, ensuring reliable power supply and attracting the participation of private sector and fair market forces while setting up a regulatory role for the public sector [1]. In the early 1980s, Pakistan's power sector started facing power shortages and the two main public sector actors KESC and WAPDA failed to address the problem. As a result, in the mid-1980s, Pakistan had endured a major electricity supply crisis in power supply owing to the generation capacity deficit[3], which significantly affected the social and economic development and stability. A decline of 8.3 billion rupees[4] was estimated in value added by the industrial sector due to power outage in just one fiscal year, 1984-85 [2]. USAID estimated 2% GDP fall and 4% decline in manufacturing exports due to load shedding [3].

The major causes of this crisis were, inter alia, (i) growing supply-demand gap due to rapid growth of electricity demand and public sector actor's inability to handle the rising electricity demand; (ii) state-owned energy utilities were inefficient, bill collection was very low, and T&D losses were extremely high; (iii) huge integrated power system of WAPDA and its corruption, dissatisfied customers, centralization, low performance and bureaucratic culture; and (iv) the energy utilities were not fully compensated for losses (their losses were greater than the subsidies) resulted in a cumulative indebtedness which reduced the ability of the sector to expand[5] [4]. These issues paved the way for power sector reforms in Pakistan, later enhanced in the early 1990s by international development

[3] The magnitude of this deficit was 2,000 MW during peak load hours. 40% electrification rate with 300 kWh per capita electricity consumption per annum was extremely low [6].
[4] 1985 Prices
[5] This situation discouraged potential investors once the sector was opened up to IPPs, and continuously led to a major disruption in the sector.

partners, i.e., World Bank and IMF [5]. These reforms activities were carried out in various phases over the last 25 years. Fig 2.1 shows Pakistan's reforms timeline.

2.1.1. Structural Transformation

Pakistan's power sector has undergone several structural transformations in the last 25 years. GoP endorsed a restructuring and reform plan in 1992, and two years later IPPs were allowed to enter the power generation sector, which they did by adding 4500 MW. However, it took six years to execute the plan of unbundling WAPDA [4]. In 1998, WAPDA was vertically unbundled into 3 GENCOs, 1 transmission company and 8 DISCOs, and Pakistan shifted its monopoly model to a single buyer model [7]. The generation sector of power wing WAPDA was separated into GENCOs and WAPDA (hydro). WAPDA (hydro) was made responsible for hydropower plants, whereas the responsibility for operating the thermal plants was given to GENCOs. Both GENCOs and WAPDA hydro were given public sector status [2]. National Transmission and Dispatch Company (NTDC) was made responsible for the single buyer market-clearing entity and transmission of electricity. Eight unbundled ex-WAPDA DISCOs are still operating under GoP with regional jurisdictions. Later, two distribution companies, Sukkur Electric Supply Company (SEPCO) and Tribal Areas Supply Company (TESCO), and one generation company (GENCO IV) were created. Until now, only two of all these companies have been privatized. The Kot Addu power company (KAPCO) was partially privatized in 1996 with a further selling of some of the government's shareholdings in 2005. The only complete privatization that took place was the independent state-owned enterprise, vertically integrated Karachi Electric Supply Company (KESC), now referred to as K-Electric (KE) [4].

In 2013, the government showed the intention of privatizing all the DISCOs — the Islamabad Electricity Supply Company (IESCO), the Lahore Electricity Supply Company (LESCO), and the Faisalabad Electricity Supply Company (FESCO) were to be in the first phase. However, economic and political issues have contributed to the scrapping of the privatization plans and also because the preceding experience of privatizing the KE had not resulted in the targeted outcomes of reduction in subsidy and enhanced customer service provision [4]. In 2015, GoP planned another major structural transformation, i.e.,

to transform the market model from a single buyer model to a wholesale market model.

Currently, the severe power situation in the country has prompted the GoP to expedite the implementation of the next planned transformation, from a single buyer model to a wholesale market model [3]. In Pakistan, the development of a competitive wholesale market was envisioned at the outset of power sector reforms. Wholesale market design is based on the single buyer model, which only opens the sector to new generation competition. The single buyer model was initially designed to allow private investors to construct power stations by selling to an integrated power utility. This was Pakistan's initial market model, with the introduction of IPPs selling to WAPDA through long-term Power Purchase Agreements (PPAs). The upcoming wholesale market model will open the wholesale competition by allowing multiple wholesalers. The wholesale market model basically establishes platforms, systems and mechanisms that enable multiple sellers and multiple buyers to trade as shown in figure 2.2. This upcoming model in Pakistan's electricity market will allow a transition from competition for the market to both, competition for and in the market [5].

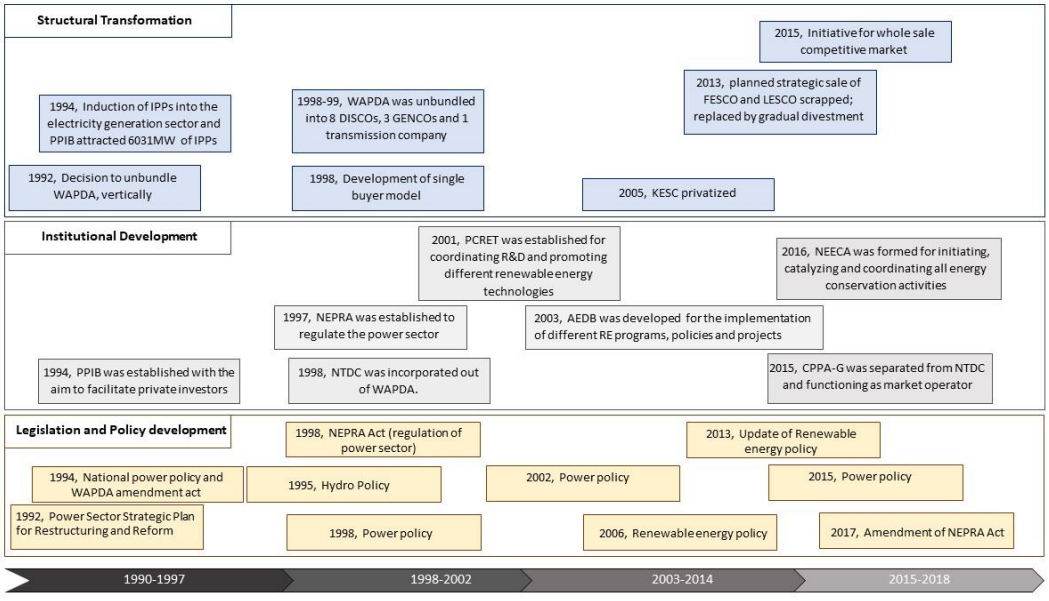

Figure 2.1 Pakistan Power Sector Reforms Timeline. Source: World Bank [4]

2.1.2. Institutional Development

At the outset of power sector reforms, institutional development also started with the aim to provide administrative support to various phases of structural transformation. In 1994, GoP established the Private Power Infrastructure Board (PPIB) as a one-window facilitator whose main function was to facilitate and provide guidance to the private investors for building power plants and related infrastructure. In 1997, in the context of global power sector reforms, Pakistan also established the National Electric Power Regulatory authority (NEPRA) to exclusively regulate the provision of electric power services by ensuring "efficient, safe, reliable and affordable electricity supply to the consumers" (and to) "assist the transition to the competitive environment from a protected monopoly service structure". In 1998, NTDC was incorporated and made responsible for the transmission of electricity and system operation functions[6]. In 2002, NEPRA granted the generation, transmission and distribution licenses to unbundled utilities of WAPDA, and the counterparty to the new PPAs was transferred to NTDC's Central Power Purchasing Authority (CPPA) from WAPDA's Private Power Organization (WPPO) [4]. Pakistan Council of Renewable Energy Technology (PCRET) was developed in 2001 for coordinating Research and Development (R&D) and promoting different Renewable Energy (RE) technologies. In 2003, the Alternative Energy Development Board (AEDB) was established for the implementation of different RE programs, policies and projects. In 2015, CPPA was separated from NTDC and Central Power Purchasing Agency (Guarantee) Limited (CPPA-G) was incorporated and made operational as a market operator. The National Energy Efficiency & Conservation Authority (NEECA) was developed in 2016 to initiate, catalyze and coordinate all activities related to energy conservation in different economic sectors.

[6] Operation functions such as development and implementation of the competitive electricity market and power purchase on behalf of DISCOs.

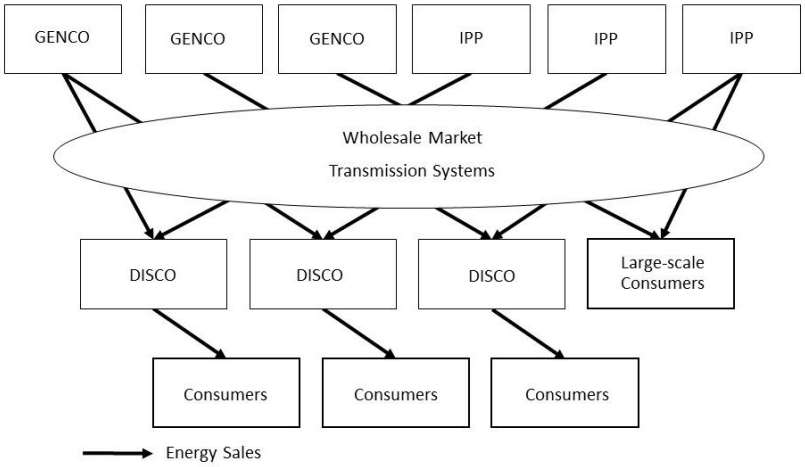

Figure 2.2 Wholesale Market model. Source: CPPA-G

2.1.3. Legislation and Policy Development

As a part power sector reform plan, a number of policies have been devised by the GoP since the early '90s. The overarching idea of these policies was to fulfill the rapidly growing energy demand by attracting the private investor and creating a competitive electricity market. A total of seven power policies have been introduced and implemented so far since the first-ever formal power policy, which was announced in 1994 followed by the second power policy in 1995. In both policies, lucrative fiscal terms and guarantees (Such as tax exemptions, availability of fuel and foreign exchange) were introduced for private investors; and IPPs flocked to harness the investor-friendly regime with the guaranteed rate on investments [3]. Lucrative fiscal terms of first power policy, attracted private investors and they added approximately 4500 MW of installed capacity [4]; provided legal basis for the implementation of a single buyer model; however, they didn't invest in the country's rich indigenous resource: hydropower[7].

The third power policy was introduced in 1998 by the newly elected govt. which was fundamentally a revised 1994 policy with further rationalization [7]. This policy allowed

[7]GoP announced 1995 policy to seek hydro power projects but unfortunately this policy could not fetch even a single project and failed owing to unstable political situation in country.

private investors to conduct a pre-feasibility of the desired power project. Additionally, hydro and thermal-based power projects were allowed to operate under Build-own-operate-transfer (BOOT) and Build-own-operate (BOO) models respectively. Foreign investors were also allowed under this policy to issue corporate shares and bonds to meet their financial obligations [2]. However, this policy was failed; sanctions due to nuclear tests in 1998 urged the government to cease foreign reserves [3].

To promote private, public-private partnership and public sector projects in the generation sector, the military government announced another policy in 2002. This policy terminated the bulk tariff practice and introduced a competitive bidding mechanism. A two-part tariff model, comprised of capacity purchase price and energy purchase price was also introduced in this policy. Moreover, high rate of returns (ROR) were offered to private investors; and other major incentives, such as exemptions from customs duties, sales and income tax were also provided to foreign investors. These incentives attracted a number of IPPs and as a result, approximately 2800 MW of installed capacity was added to the national grid [3]. This policy also paved the way for establishing AEDB in 2005, which introduced the first renewable energy policy of Pakistan in 2006. This policy was announced to encourage renewable energy technologies (viz., wind, solar and small hydro-power) for power generation in Pakistan. To mobilize the private investment in renewable energy technologies, a number of incentives were offered including tax and duties exemptions on imported machinery and equipment required for setting up the project.

To meet the country's soaring energy demand, the newly elected govt. announced another National Power Policy in 2013 with varied objectives: to shift from expensive thermal power generation to renewable energy technologies (such as wind, solar and biofuel) and cheaper fuels (such as coal), to reduce subsidies, and to eradicate the electricity generation shortage by providing incentives for investments in renewable energy technologies. In this policy, competitive bidding and upfront tariff models were envisaged to reduce the electricity generation cost; and a number of incentives were devised which provided a roadmap for establishing the wholesale electricity market model. Last but not the least, GoP has announced a power generation policy in 2015 aims to provide sufficient

electricity generation capacity at minimum cost; utilizing indigenous resources while protecting the environment; taking all the stakeholders on board, a win-win situation [8]. All the policies discussed above were formulated with significant efforts behind them; nevertheless, in all cases, a lack of mechanism for thorough implementation is evident [7]. Key features of these policies are illustrated in table 2.1.

Table 2.1 Salient features of power policies of Pakistan

Power Policy 1994	• A bulk power tariff of US 6.5/KWh was offered for sale of electricity to KESC/WAPDA. • A premium of US cents 0.25/KWh was also offered based on power sold to KESC/WAPDA during the first decade of projects operations, to the power projects above 100 MW and commissioned by the end of 1997. • The bulk power tariff was applicable to all thermal power projects, small hydro projects (up to 20MW) and RETs. • It was made obligatory for KESC and WAPDA to purchase power from IPPs under long term PPAs (typically for 15 to 30 years). • IPPs were exempted from corporate income tax and they were allowed to import machineries and relevant equipment without payment of customs duties, taxes, import license fee and other surcharges. • Payment of capacity price on monthly basis was also envisaged, regardless of its electricity generation. • Foreign Exchange Guarantee (FEG). Fuel Supply Agreement (FSA).
Hydropower Policy 1995	• In continuation to the fiscal incentives in preceding power policy, PPAs and concessions were introduced for hydropower projects.

	• A bulk power tariff of US 6.1/KWh was offered for sale of electricity to KESC/WAPDA. • Free of cost ownership transfer to govt. after 25 years. • Force majeure risk protection was provided. • FEG and protection against changes in taxes and duties were extended.
Power Policy for new IPPs 1998	• Tariff was based on open bids from private investors and denominated in PKR. • Bidders were supposed to bid their tariffs in two parts: Capacity Purchase Price (CPP) and Energy Purchase Price (EPP); they were allowed to conduct feasibility studies of desired project before bidding.
Power Generation Policy 2002	• Bulk power tariff was eliminated and competitive bidding mechanism comprised of CPP and EPP was envisaged. • Power policy was extended to public, private-public and private sector projects. • Income tax was imposed on oil-powered power station. • Custom duties were also imposed on imported machinery and equipment. • One-window support was provided to IPPs, to coordinate with different agencies for the rapid implementation of projects. • Unsolicited proposals were made permissible for the raw sites whose feasibility studies were not conducted.
RE Power Generation Policy 2006	• Sales tax, income tax and custom duty exemptions for machinery required for initial installation, maintenance, replacement or expansion of RE projects.

	• Deportation of equity was freely allowed along with dividends. • Parties were permitted to raise local and foreign finance especially for RETs. • Non-residents and non-Muslims dividends were declared exempted from zakat payment.
National Power Policy 2013	• Competitive bidding and upfront tariff models were envisaged to decrease the soaring electricity prices. • Subsidies minimization. • Shifting to low-cost fuels, such as hydro power and indigenous coal. • Efficiency enhancement by controlling theft and decreasing distribution losses. • Financial efficiency enhancement across the system. • Fuel supply to IPPs was supposed to be gradually shifted.
Power Generation Policy 2015	• Being cheap, indigenous and clean resource; encouraging and ensuring exploitation of raw hydropower sites. • Attune to protect environment. • Taking all the stakeholders on board; a win-win situation. • Encourage efficiency enhancement. • Attractive IRR/ROE allowed in tariff • Non-residents and non-Muslims dividends were declared exempted from zakat payment. • Free repatriation of equity with dividends.

Summary

In the early 1980s, Pakistan's power sector started facing power shortages and the two main public sector actors KESC and WAPDA failed to address the problem. As a result, in the mid-1980s, Pakistan had endured a major electricity supply crisis in power supply owing to the generation capacity deficit, which significantly affected the social and economic development and stability. These issues paved the way for power sector reforms in Pakistan, later enhanced in the early 1990s by international development partners, i.e., World Bank and IMF. These reforms activities were carried out in various phases over the last 25 years. In these 25 years, Pakistan's power sector has undergone several structural transformations including dismantling of WAPDA and privatization of dismantled companies. At the outset of power sector reforms, institutional development also started with the aim to provide administrative support to various phases of structural transformation. Besides this, a number of policies have been devised by the GoP since the early '90s. The overarching idea of these policies was to fulfill the rapidly growing energy demand by attracting the private investor and creating a competitive electricity market. In this chapter, structural transformation, institutional development and policy developments are discussed in great detail.

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Chapter 3

Literature Review

3.1. Literature review on ownership effect

The world has witnessed deregulation, liberalization, restructuring and privatization of the electricity industry at the end of the twentieth century. Many studies have been conducted across the globe to investigate the impacts of restructuring and privatization. Toba [1] discussed the four approaches to analyze the difference in the performance of government-owned and private electric utilities. The first and most simple approach is to look at the financial and physical indicators of privatized companies (e.g., [2]). The second approach is to examine the impact of privatization on productivity growth using either total factor productivity or labor productivity (e.g., [3]). The third approach is frontier analysis in which the performance of individual firms is measured against an efficient production or cost frontier (e.g., [4]). The fourth approach is to conduct a social cost-benefit analysis (SCBA) of privatization to analyze the welfare impacts of privatization (e.g., [1]). The first three approaches are, however, partial approaches to measure social welfare and can be easily dismissed as a substitute for social cost-benefit analysis[8]. Unlike the first three approaches, the social cost-benefit analysis attempts to examine the real variable of interest i.e., the welfare impacts of privatization [1].

As compared to other approaches, relatively a small number of studies have focused on the welfare impacts of privatization. Some studies in the literature (e.g., [6]) analyzed the social welfare impacts of power sector reforms but did not provide the direct measure of the difference in performance between private and public-owned electricity companies [1]. Social cost-benefit analysis of power sector reforms in Chile [11], UK [7,8], Brazil [9] and Philippines [1] did analyze such difference. In this study, we have adapted a SCBA framework to analyze the impacts of restructuring and privatization of the power generation sector in Pakistan.

[8] SCBA studies [1,7,8] have addressed the failure of first three approaches.

The essence of the SCBA approach is to construct a behavior and cost model of the industry (electricity industry in our case) and stimulates it over the post-reform period with and without sundry changes in the policy. This allows us to keep constant changes in the environment common to the targeted organizational structure and differentiate the impacts of organizational changes [7]. The only issue of SCBA is to ascertain what would have happened, had the power sector been left under the vertically integrated utility (WAPDA in our case). In order to address this problem, three counterfactual scenarios are constructed based on economic data and historic figures, and we have predicted its behavior in the years 1997-2018. Therefore, counterfactual scenarios (i.e., power sector without R&P) are designed to function as a control group as opposed to an actual scenario (i.e., restructuring and privatization of power sector) as a treatment group. The difference between the counterfactual scenario (what would have happened without R&P) and the actual scenario (what actually happened after R&P) is then evaluated to examine the social welfare impacts of R&P. Although, we can never know exactly what would have happened to the power sector under public ownership, however, we have strengthened our study by studying historical trends, constructing counterfactual scenarios and conducting sensitivity analyses, as it is a required condition for the SCBA [8]. A better overview of relevant studies and their methodological approaches to evaluate the power sector reforms globally and for Pakistan are presented in Table 3.1.

Table 3.1 A review of global literature - Evaluating power sector reforms

Authors	Region	Approach	Key Findings
(Polemis, Energy Policy, 2016) [11]	OECD Countries	Econometric	Ownership transfer of state-owned vertically oriented electrical utilities to private sector has decreased the performance of electricity sector.
(Du et al., Energy Policy, 2009) [12]	China	Econometric	Regulatory reforms between 1995 and 2004 substantially increased the performance of generation plants for labour and non-fuel inputs. However, no

			evidence of efficiency gains in fuel input was found.
(Natsuko Toba, Energy Policy, 2007) [1]	Philippines	Social cost-benefit analysis	Consumer and private investors were net gainers, while the government's revenue decreased and environmental pollution increased in the process of restructuring and privatization.
(Cullmann and Christian, Journal of Productivity Analysis, 2008) [13]	Poland, Czech Republic, Slovakia, Hungary	Frontier Analysis	Technical efficiency is improved after privatization in the four countries.
(Junki Kim and Kyuhyun Kim, Infrastructure Regulation: What Works, Why and How Do We Know? Lessons from Asia and Beyond, 2011) [14]	Korea	Financial and physical indicators	The electricity industry reform in Korea has had positive impacts on the performance of companies.
(Karahan and Toptas, Energy Policy, 2013) [15]	Turkey	Econometric	The privatization of electricity distribution business in Turkey did not yield the expected decline in prices and outcomes of reforms are unsatisfactory.
(Zeng et al., Renewable and Sustainable Energy Reviews, 2016) [16]	China	Case study	Power sector reforms in 2002 have addressed several urgent issues, however, some planned policies could not be implemented due to lack of executing abilities. That is why several issues such

			as inefficient utilization of renewable energy resources and distorted price mechanism have occurred in power industry of China.
(Zakria and Noureen, Renewable and Sustainable Energy Reviews, 2016) [17]	Pakistan	Frontier analysis	The cost of electricity is high due to line losses and inefficiencies in electricity distribution networks. Restructuring of WAPDA could not resolve the issues of inefficient electricity distribution networks.
(Mirza et al., Utilities Policy, 2017) [18]	Pakistan	Total factor productivity	The technical efficiency of distribution companies has improved up to 4.8%, however, 10% productivity decline is recorded after restructuring.
(Robert Bacon, The World Bank, 2019) [19]	Pakistan	Case Study	Electricity access and affordability have increased for the poorest domestic consumers, however, overall electricity tariffs are significantly increased. Furthermore, T&D losses were very high and bill collection was also problematic with negligible progress on the security of electricity supply.

Summary

The world has witnessed deregulation, liberalization, restructuring and privatization of the electricity industry at the end of the twentieth century. Many studies have been conducted across the globe to investigate the impacts of restructuring and privatization. Toba discussed the four approaches to analyze the difference in the performance of government-owned and private electric utilities. After almost thirty years, a global review reveals that power sector reforms have fallen short in many countries. For some countries, the reform model was not fitting with the economic pre-conditions of their power sectors; for others, the required policy changes and their implementation often encountered political challenges. Many studies have reported that impacts of reforms on prices and on the performance of the electricity sector; however, only a few studies have evaluated and cautioned the impacts of power sector reforms on overall social and economic welfare in developing countries such as in Pakistan. Bacon provided an updated assessment of power sector reforms in Pakistan but did not attempt to address the social impacts of reforms. Thus, the governance of the power sector is a fundamental challenge for policymakers interested in socio-economic development and sustainability.

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Chapter 4

Methodology

4.1. Methodological Approach

In this study, we have adapted a SCBA framework to analyze the impacts of restructuring and privatization of the power generation sector in Pakistan. Galal et al. [1] identified three main groups of the society to be affected by divestiture – namely, consumers, government and private producers. A full SCBA analysis, in theory, can address the impacts of privatization and restructuring on the economic efficiency and equity [2]. The first objective of this research is to evaluate net welfare changes: Does the cost of restructuring and privatization warrant the present-day benefits gained by society? Our second objective is to address the distributional aspect of the problem: Who gained, who lost (if anyone), and by how much in the process of restructuring and privatization of the electricity generation sector in Pakistan? The first question is related to the productive efficiency and environmental impacts of restructuring and privatization, while the later issues consider the equity [2].

We shall follow the method set out in [2,3,4], the fundamental approach is to set up and compare two scenarios: IPP and WAPDA. Under the WAPDA scenario, it was assumed that WAPDA continues to dominate the vast majority of new generations under public ownership (Counterfactual scenario). Under the IPP scenario, restructuring and IPPs participation is considered in the power sector of Pakistan (Actual Scenario). Comparison of these two scenarios not only allows us to investigate the distributional and net welfare impacts of power sector reforms on society but also permits us to put a value on the policy of restructuring and IPPs induction in the electricity generation sector of Pakistan.
To examine the distributional welfare change, the distributional function is adopted from [2]:

$$\Delta W \equiv \Delta X + \Delta G + \Delta P \qquad (1)$$

Where ΔW is the overall welfare change of the society, ΔX is the change in consumer's

welfare, ΔG is the change in the government's welfare and ΔP is the change in private investor's welfare. Consumer welfare has been calculated in terms of consumer surplus and costs avoided, government welfare in terms of taxes and subsidies and the private investor's welfare gains has been estimated as residual using equation 2, following [5],

$$\Delta P = \Delta W - \Delta X - \Delta G \qquad (2)$$

Equation (1) calculates the net present value (NPV) of change in the welfare of each group (consumers, producers, and government as in partial equilibrium model) and accumulates these values to find the sum of NPV of change in social welfare, affected by restructuring and IPPs participation in the electricity generation sector. The results have been calculated firstly by giving equal social weights and then by giving three different sets of social weight to all three groups. Power sector reforms will be considered socially worthwhile and beneficial if $\Delta W > 0$, a negative value would imply a net societal loss.

Distributional social welfare has been estimated using models postulated above (Eq. (1, 2)) and the net welfare impact of reforms has been estimated by developing a model (in line with [4]) as follows:

$$\Delta W = \Delta I + \Delta E + \Delta S - R\&P + AC + \Delta C \qquad (3)$$

Where ΔC is the change in controllable cost, ΔS represents the change in subsidization cost, ΔI represents the change in investment cost[9] (to examine the change in investment efficiency in terms of capital and fuel costs), ΔE represents the change in externalities cost (environmental pollution and greenhouse gases social cost from gas and oil-fired power plants), R&P is the restructuring and privatization component, and AC is the avoided costs (in terms of the value of lost load (VOLL)).

The variables of welfare functions in (1), (2) and (3) are discussed below.

4.2. Data

To undertake our SCBA, large amount of published and unpublished data were collected

[9] Capital cost, direct fuel cost and controllable costs are the constituents of the cost of electricity generation [7]. In this study, efficiency gains are evaluated in terms of change in capital, direct fuel and controllable costs after the restructuring and privatization. We have evaluated this change by deducting these cots after the privatization from the counterfactual costs calculated for the pre-reform scenario.

from various sources including National Transmission and Dispatch Company (NTDC), Pakistan Bureau of Statistics (PBS), World Bank (WB), Private Power and Infrastructure Board (PPIB), Ministry of Finance (MoF), Planning Commission of Pakistan (PC), Central Power Purchasing Agency (CPPA), K-Electric (KE), Asian Development Bank (ADB), Pakistan Electric Power Company (PEPCO), Hydrocarbon Development Institute of Pakistan (HDIP), Water and Power Development Authority (WAPDA), National Power Regulatory Authority (NEPRA).

Our dataset covers data of pre and post-reforms periods, from 1985 up to 2018 (some from 1980). The obtained dataset is detailed and disaggregated as much as possible. Based on the historical data and trends, counterfactual and actual scenarios are constructed. Data from 1985 to 1997[10] are used to construct the counterfactual scenarios, and data from 1998 to 2018 are used for the actual scenario. Furthermore, we shall refer to the counterfactual or pre-reform scenario as 'WAPDA scenario (the power sector continuing WAPDA monopoly)' and the actual or post-reform scenario as 'IPP scenario (restructuring of the power sector and generation is shared between IPPs and WAPDA)'.

4.2.1. Consumer Surplus

The theory of estimating consumers' benefits in terms of the consumer surplus is relatively straight forward. For our SCBA, consumer surplus of 4 major consumers, viz., domestic, commercial, industrial and agriculture is calculated. Detailed published and unpublished data were obtained from NTDC, including average electricity prices, annual electricity consumption, no. of consumers and the price elasticity of demand for electricity to calculate consumer surplus. For counterfactual scenarios, electricity prices were estimated following the patterns of past data (1980 to 1997). Moreover, short-term (E_{SR}) price elasticities have been acquired from [28] and interpreted to long-term elasticities (E_{LR}) using the relation adopted from [23].

$$E_{LR} = E_{SR}/(1 - L_{El}) \qquad (4)$$

[10] Although private sector participation and restructuring of WAPDA was envisaged in 1994, but implemented in 1997. That's why the years 1994 to 1997 are included in the pre-reform period.

Where L_{El} represents the lag elasticities obtained from NTDC.

In order to estimate consumer surplus, the Market price Method (MPM) was applied. Brown and Zhang [6] proposed a plausible and practical framework to apply MPM for the estimation of consumer surplus for electricity. A derived demand function and its price elasticities are used to find the area under the demand curve which is consumer surplus by definition. In line with [6] and [7], we assumed a linear negative demand function for all the consumers. In general, a numerical value of CS, which is highlighted area in figure 4.1, can be calculated as,

$$CS = \frac{1}{2}(p_a - p_b)\,(q_b - q_a) \qquad (5)$$

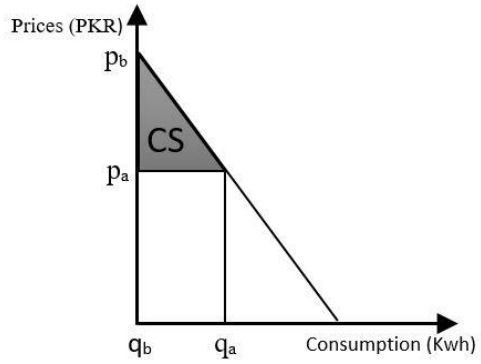

Figure 4.1 Graphical approach to access Consumer Surplus

4.2.2. Capital Cost

We estimated the capital cost of each type of power plant to examine whether the institutional changes that had taken place have affected the per unit capital cost of power projects between public and private projects, as presented in table 4.1. It was estimated that IPP project costs (including Engineering and Procurement Cost (EPC), Non-EPC, project development cost, land cost, duties and taxes, financial charges, insurance during construction and interest during construction (IDC)) were, on average, 59.35% lower than WAPDA project costs. The main reasons of the high capital cost of WAPDA projects than IPPs could be: (i) private investment was mainly limited to fast track power plants (i.e., thermal power projects) whereas WAPDA had a substantial share of hydropower projects which are highly capital intensive; (ii) miss-management, bad governance and financial

indiscipline led to the inefficiency of the WAPDA projects, while IPPs were potentially in line with modern management practices; and (iii) projects of WAPDA, due to poor management, undergone many issues like time overruns and cost overruns which guaranteed the negative impact on the investment efficiency.

Table 4.1 Capital cost estimation for WAPDA and IPPs power plants

IPPs Capital cost	IPPs' capital costs estimations were based on the various published documents by NEPRA (i.e., license and tariff determination files). Data of 77 IPP projects (from 1997 to 2018) were extracted from above-mentioned documents including 38 thermal power projects, 44 renewable energy projects with installed capacities of 15,663MW and 1,779MW respectively.
WAPDA Capital cost	To complement the few data available in annual reports published by WAPDA, we extracted data from project completion reports published by ADB and WB as many plants were funded by ADB and WB. Whereas, capital costs of GENCOs were taken from the licenses issued by NEPRA. For those IPP and WAPDA projects for which capital costs data were not available, we used the average cost of similar types of power plants installed in Pakistan.

4.2.3. Fuel Cost

Secondly, we considered the fuel usage and its cost as part of the investigation of changes in investment cost. After the privatization, the plant mix was dominated by thermal fuels including high-speed diesel, furnace oil, and natural gas [8], which altered the pattern of investment and fuel use in new plants and hence altered not only the capital but also the fuel cost of generating electricity. We have incorporated these fuel alterations with capital costs of power projects as part of the examination of changes in investment cost. Change in fuel consumption and fuel costs were calculated using detailed published data obtained from Pakistan energy yearbooks (1985-2018) such as electricity generation, fuel consumption and average fuel prices per unit of energy. Based on available data, it has

been estimated that fuel consumption per GWh is on average 6.18% increased after privatization. The obvious reason for this increase is the decrease in the share of hydropower in the power generation mix from 41.7% in 1994 to 22.1% in 2018, as presented in figure 4.2. Concurrently, this increase in fuel consumption has exacerbated the fuel costs after the entry of IPPs.

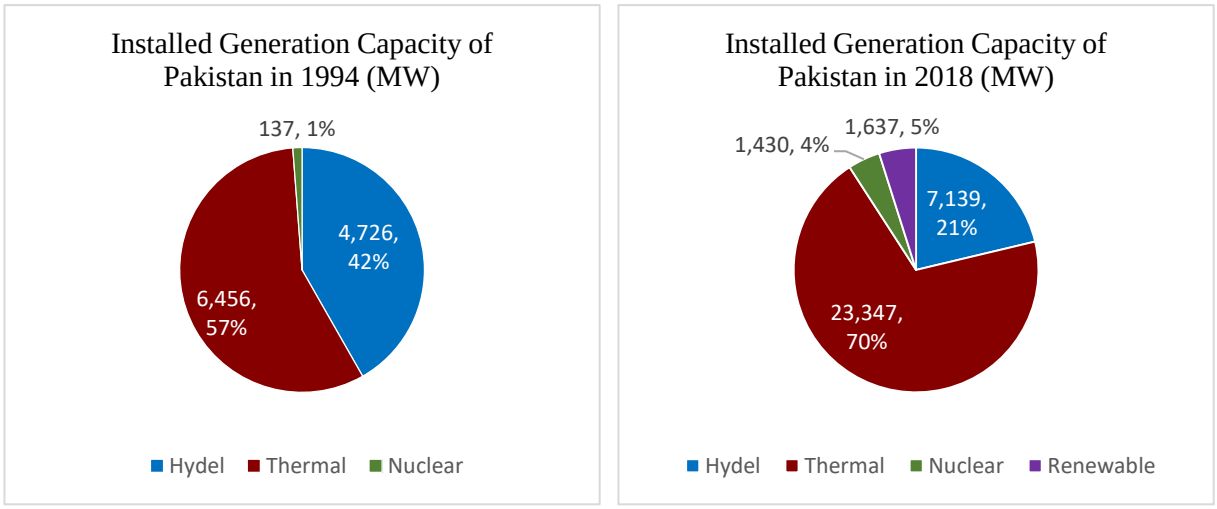

Figure 4.2 Electricity generation installed capacity by fuel types.

Source: Pakistan energy year books.

4.2.4. Controllable Cost

Next, we looked at the savings in controllable cost to examine the efficiency gains following [4,5]. Controllable costs include fix and variable operation and maintenance costs including employee cost, administration cost and repair maintenance cost, depreciation cost but exclude decommissioning and fuel cost. Electricity generation was shared between IPPs and WAPDA after the privatization. Thus, we consolidated WAPDA and IPP accounts to estimate the controllable costs for the actual scenario, and for counterfactual scenarios' estimations, we have constructed 'would have been' WAPDA accounts without privatization. Details and data required to calculate controllable costs are presented in Table 4.2. It has been estimated that controllable costs under WAPDA would have been 20.81% higher than IPPs, if WAPDA power plants were constructed instead of IPPs.

Table 4.2 Controllable cost of electricity generation sector

Item	Source and details
Controllable cost of WAPDA	We obtained the controllable costs of WAPDA plants from WAPDA audited financial statements and project completion reports published by ADB.
Controllable cots of IPPs	We obtained the controllable costs of IPPs from tariff determination files published by NEPRA. Controllable costs of thermal power plants constructed under the 1994 policy were not available, so we have used the average cost of other thermal power plants installed by IPPs.
Controllable costs of WAPDA power plants that would have been constructed in place of IPPs power plants	We used the controllable cost of existing WAPDA power plants and constructed 'would have been' WAPDA accounts to estimate the controllable cost of WAPDA power plants that would have been constructed instead of IPPs.
IPP and WAPDA electricity generated units (GWh)	We extracted published data of actual electricity generations, both for IPPs and WAPDA operated plants, from Pakistan energy yearbooks (1985-2018).

4.2.5. Externality Cost

1994 policy allowed IPPs to enter into the power sector but none of the IPPs invested in Pakistan's wealthy indigenous resource – hydropower. Instead, they invested in 'fast track' plants such as gas and oil-fired power plants. A hasty increase in fossil fuel consumption (viz., coal, furnace oil, diesel oil and gas) has been observed after the induction of IPPs. Concurrently, these thermal power plants have exacerbated the environmental and social impacts. Greenhouse gases (CO2, N2O and CH4) and air pollutants (NOx, SO2, CO) are the most obvious effects of these power stations. Increased GHGs concentrations in the atmosphere are raising the average temperature of the earth by trapping heat, which further contributes to air pollution, fog, rise in sea level and global

warming, renowned as climate change. At the same time, air pollutants like NOx, SO2 and CO further accelerate environmental degradation. These pollutants are a serious threat to not only health but also to human welfare.

To conduct a full social cost benefit analysis the incorporation of these externalities into this analysis was required. For this purpose, the measurement and valuation of environmental impacts need to be estimated. We have developed GHG and pollutant inventories using IPCC (Inter-governmental Panel on Climate Change) Inventory software[11]. We have employed the tier 1 approach using emission factors of revised 1996 guidelines (following [9–11]). Tier 1 employs the country-specific activity data and emission factors established by the IPCC. The purpose of considering this approach lies in the limitation of country specific data availability of fuel and technology [10]. Whereas, the activity data of Pakistan's power sector in terms of fossil fuel consumption has been taken from Pakistan Energy Year Books (1985-2018) published by HDIP. Moreover, for the valuation of environmental externalities, the social cost of greenhouse gases and air pollutant emissions for developing countries in terms of $/ton has been acquired from ADB[12]. The rationale for acquiring these costs from ADB is the unavailability of such cost estimations for Pakistan. It was further assumed that GHGs' and pollutants' per-unit cost of social damage remains unchanged throughout the study period.

4.2.6. Restructuring and Privatization Cost

In 1992, a strategic plan was adopted by the GoP for the restructuring and privatization of the power sector to address the persistent crisis in the power sector [12]. In support of this plan, GOP and World Bank signed an agreement for the project, named as, Power Sector Development Project (PSDEP). This project had three main components, inter alia, (i) restructuring and privatization component, (ii) investment component, and (iii) technical assistance component. Restructuring and privatization component supported: (i) Unbundling and corporatization of WAPDA into separate generation, transmission and dispatch, and distribution companies. (ii) Establishment of an independent regulatory body (NEPRA) to set standards, improve efficiency and regulate the privately operated

[11] Version 2.691
[12] See [13]

power sector. (iii) Mobilizing and encouraging the private sector investments for new energy supply to meet the anticipated deficit in power supply by establishing incentives for private investors. (iv) Development of a labor transition plan that would allow the privatization of the power sector to take place in a manner that provides the power sector with sufficient managerial flexibility while addressing labor concerns. (v) Initial bid for the divestiture of parts of WAPDA's assets to the private sector. The investment component covered: (i) improvement of system's reliability in order to make it efficient and attractive to private investors; (ii) implementation of WAPDA's four-year time-slice (FY95-98) investment program. And the third component, technical assistance, supported training and consultancy services for the components discussed above, as well as strengthening the environmental management capability of WAPDA [14]. Costs associated with these components are documented in implementation completion reports of power sector development project. These costs have been extracted from (World Bank, 2002, 1994). Furthermore, restructuring and privatization costs were assumed to be zero after 2002.

4.2.7. Avoided Cost

The key benefit of private sector participation is that they tackled the power crisis faster than WAPDA could have done alone, which would have delayed the economic growth, recovery and development. It is assumed that power shortages would have delayed the economic growth and development for one year[13] in the counterfactual scenario, without IPPs contribution. This cost, i.e., the cost to consumers in the absence of an adequate service, assuming that WAPDA would have not been able to solve the demand-supply gap during the crisis period owing to the institutional and financial constraints, is referred to as avoided cost [4].

In this study, we have interpreted this avoided cost during the shortage period as Value of Loss Load (VOLL), or the value of unserved energy, which is a measure of the value of the customer's opportunity cost of outages or benefits lost by interrupting the electricity

[13] We have assumed a delay in economic growth and development for only one year because, after a long period of unreliable electricity service, consumers tend to be better prepared for outages and install the backup power supply. Furthermore, these avoided costs are assumed for the year 1997 when IPPs participated in the electricity generation sector and aided to increase installed capacity.

supply [15]. Table 3 lists the various studies conducted and methodology employed in different regions and countries. In general, there are two types of approaches that exist to estimate the VOLL, i.e., direct or survey and indirect approach [16]. Direct or survey methods (directs costs, willingness to accept, blackout studies) obtain their information directly from end-users about the costs of power interruptions, whereas indirect methods (revealed preference, macroeconomic approaches) demand other sources of information, such as statistical data [17]. For simplicity, we have used the production function method (indirect approach) for VOLL estimations[14] following [4,25,26]. We have adopted this method due to its low cost and simple linkage to input-output analysis. Furthermore, this approach is also attractive because it requires macroeconomic data (i.e., GDP and total electricity delivered) which is relatively easily accessible [18]. We have reviewed various studies to value VOLL (or Avoided cost), presented in Table 4.3. Our estimates (1.05 US$/KWh) for Pakistan are lower than those of others' for Developed countries[15]. This is justifiable because Pakistan is categorized as a developing country with a much lower electrification rate and electricity consumption per capita[16] as compared to developed countries. Furthermore, different situations among various regions such as consumers' patterns of electricity use, culture-related variations in the social and economic structures, etc., might affect the estimations of avoided cost [16,19].

Table 4.3 A review of VOLL estimation studies

Study	State/Region	Method	VOLL Estimations
(Willis and Garrod, 1997)	England And Wales	Production Function (Indirect)	US$ 2.36/KWh (1995 Prices)
(LaCommare and Eto, 2006)	United States	WTP (Surveys)	Commercial $ 56.8 Billion Annually, Industrial $ 20.4 Billion Annually, Residential $ 1.5 Billion

[14] We did not use the survey method to estimate VOLL due to time and budget constraints.
[15] In 1997, Pakistan's GDP was US$ 62.443Billion in 1997 prices and the electricity supply was 59,125 GWh [27].
[16] Electricity consumption capita has a significant impact on the country's economic growth [28]. Pakistan's low electricity consumption per capita is also a major reason for low avoided costs than those of other developed countries.

			Annually and Total $ 79 Billion Annually (2001 prices)
(Cramton and Lien, 2000)	United States	Production Function (Indirect)	US$ 2.42/KWh (1999 Prices)
(Framework and Sector, 1994)	Philippines	NA	0.43 US$/KWh (for 1991-93)
(Willis and Garrod, 1997)	British Consumer (firm) Study	Contingent Ranking Method (Direct)	The cost of unfed energy per KWh is not standardized. Estimated outage costs have a positive linear relationship between outage duration and cost.
(Leahy and Tol, 2011)	Ireland	Production Function (Indirect)	Households €24.6/KWh, Commercial €14/KWh, Industrial €4/KWh and Total (weighted average) €12.9/KWh
(de Nooij et al., 2007)	Netherlands	Production Function (Indirect)	Households €16.38/KWh, Government €33.50/KWh, Construction €33.05/KWh, Transport €12.42/KWh, Manufacturing €3.90/KWh, Services €7.94/KWh and Total (weighted average) €8.56/KWh (2001 prices)
(Bertazzi et al., 2005)	Italy	Surveys (Direct)	Households €10.8/KWh and Business €21.6/KWh (2003 prices)
(Toba, 2007)	Philippines	Production Function (Indirect)	US$ 2.50/KWh (1996 Prices)

(Castro et al., 2016)	Portugal	Production Function (Indirect)	Agriculture and fisheries €3.38/KWh, Manufacturing €1.28/KWh, Transportation €6.03/KWh, Construction and public works €15.52/KWh, Services €6.67/KWh, Household €7.43/KWh and total (weighted average) €5.12/KWh (2010 prices)
Author's Estimations	Pakistan	Production Function (Indirect)	US$ 1.05KWh (1997 prices)

4.2.8. Subsidization Cost

Next, we have incorporated subsidization costs in our investigation as welfare loss to society. The government of Pakistan grants billions of rupee annual subsidy as Tariff Differential Subsidy (TDS) to cushion the domestic power users against the increasing electricity generation cost. The increasing cost of thermal power generation, mainly from IPPs, forced the government to increase the amount of subsidy to ensure the availability of electricity to the poor segments of the society. Although subsidy schemes are intended to protect the poor segments of society, the evidence shows otherwise. Electricity subsidies piles up the financial burdens causes the crowding-out effect, increases the amount of deadweight loss (due to over-consumption of electricity [20]) and tapers consumer welfare [25].

A common problem faced by many developing countries is the development of an appropriate scheme for electricity subsidies. Studies suggest that the reduction in subsidy significantly reduces the fiscal deficit and, thus, reveals the government's financial hardships [21-23]. Furthermore, a reduction in subsidies will potentially improve the productivity of the power sector as money available from discounted subsidies can easily be transferred to the fuel (such as oil and gas) suppliers. That's how circular debt can be controlled and a smoother flow of money can be confirmed. Additionally, improved productivity of the electricity sector reduces electricity prices, augments electricity

consumption, creates employment opportunities, and contributes towards improved social welfare [21]. Thus, subsidization cost was incorporated as welfare loss in our SCBA. Subsidies related data has been extracted from Pakistan's budget documents.

4.2.9. IPP Benefits

Private investors' net benefits are estimated as residual, i.e., after subtracting government net benefits (ΔG) and consumer net benefits (ΔX) from the total net welfare (ΔW) excluding the cost of externalities (as discussed in section 4 eq. (2) above). Private benefits are further divided between domestic and foreign investors, assuming 35% of the profit goes to domestic investors and 65% to foreign investors, as the majority of IPP projects were financed from foreign sources.

4.2.10. Government Benefits

Government benefits are represented in terms of change in the government's revenue, i.e., $\Delta G = \Delta T - \Delta S$. Where ΔG is the total change in government's revenue, ΔT is the change in tax collection and ΔS is the change in TDS provided to the consumers in order to bridge the gap between the high cost of electricity production and billed rate. Data on tax revenue has been extracted from year books[17] published by FBR and CBR and data related to TDSs has been taken from "Budget in Brief" documents published by the Finance Division.

[17] These books are available at the National Library of Pakistan.

Summary

In this study, we have adapted the SCBA framework to analyze the impacts of restructuring and privatization of the power generation sector in Pakistan. To undertake the SCBA, we collected a large amount of published and unpublished data from various sources including National Transmission and Dispatch Company (NTDC), World Bank (WB), Private Power and Infrastructure Board (PPIB), Ministry of Finance (MoF), Asian Development Bank (ADB), Pakistan Electric Power Company (PEPCO), Hydrocarbon Development Institute of Pakistan (HDIP), WAPDA, CPPA-G, KE and NEPRA. Our dataset covers pre and post-reforms' period i.e., from 1985 up to 2018 (some from 1980). The obtained dataset is detailed and disaggregated as much as possible. Based on the historical data and trends, counterfactual and actual scenarios are constructed. Data from 1985 to 1997 are used to construct the counterfactual scenarios, and data from 1998 to 2018 are used for the actual scenario. Furthermore, we shall refer to the counterfactual or pre-reform scenario as 'WAPDA scenario' and the actual or post-reform scenario as 'IPP scenario'.

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Chapter 5

The Results and Discussion

5.1. Counterfactual Scenarios

We have taken a number of different assumptions in undertaking the analysis and constructed the three most plausible scenarios, viz., WAPDA, Central (preferable), and IPP scenario. Counterfactual scenarios (WAPDA, central and IPP) are basically WAPDA scenarios without restructuring and privatization. We have constructed these three scenarios and stimulated their behavior over the post-reform period. These scenarios act as the control group while the actual post-reform scenario (with R&P) is the treatment group. The difference between the control group and the treatment group is estimated to evaluate the impacts of R&P (as explained in section 4). Furthermore, we have constructed more than one counterfactual scenario because we can never know what would have happened without R&P. however, we have strengthened this study by constructing multiple scenarios, as it is a requirement for SCBA.

5.1.1. Central Scenario

The main impact of R&P is that IPPs had contributed to reduce the power crisis faster than WAPDA could have done alone due to financial and institutional constraints, which would have delayed economic growth and development. In the central scenario, we assume that without IPPs' contribution, economic growth could have delayed for one year. The second effect of R&P is on the investment and operating efficiency of power plants because of private investors' interest in profitability and cost reduction. In the central case, we have assumed counterfactual controllable costs fall 0.5% p.a. of WAPDA power plants in real terms. The third effect of R&P is that IPPs prevented least the cost and environment-friendly power generation and fuel mix which not only increased the electricity generation cost but also damaged the human welfare. Thus, patterns of investment, power generation and fuel usage were altered after R&P. We have assumed that WAPDA would have utilized the country's rich indigenous resources and WAPDA's power mix, with 55% share of thermal power plants, would have been less damaging for the human welfare

without R&P.

5.1.2. IPP Scenario

There are only two differences between IPP and Central scenario: (i) 0% decrease p.a. in counterfactual controllable costs of WAPDA power plants is assumed (in real terms). (ii) A conservative value for the valuation of GHGs and pollutants is used. Also, presuming that WAPDA would have installed more thermal plants than hydel, this scenario estimates investment efficiency by assuming 60% share of thermal power plants for the counterfactual scenario.

5.1.3. WAPDA Scenario

WAPDA scenario assumes a lower counterfactual controllable cost than the other scenarios, i.e., 1% p.a. in real terms and a lower share of thermal fuels (50%) in the counterfactual power mix. It further presumes a delay of six months in economic growth and development due to the power crisis without private investment and higher values for the valuation of externalities. Differences in counterfactual and actual controllable costs between the IPPs and WAPDA in three scenarios are presented in figures 5.1-5.3.

All the calculations are in 2018 prices and converted into US$ using the respective year's nominal exchange rate, adopted from World Bank's database. The base year of NPV is 2018; 6% interest rate is used for each analysis, and, 5% and 7% interest rates are used for sensitivity analysis[18].

[18] In 2018, Pakistan's real interest rate was 6%. That's why have used 6% interest rate for central case.

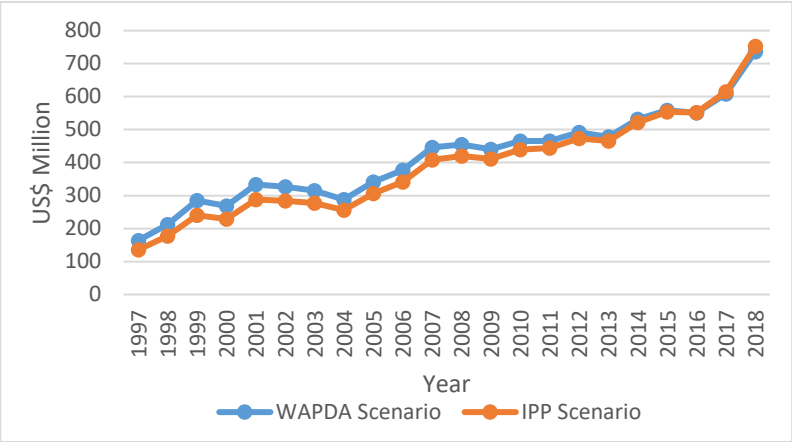

Figure 5.1 WAPDA Scenario total Controllable Cost (2018 Prices)

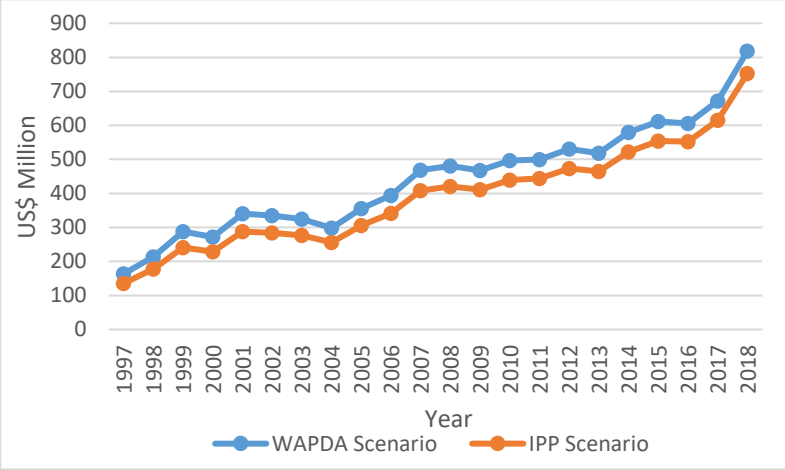

Figure 5.2 Central Scenario total Controllable Cost (2018 Prices)

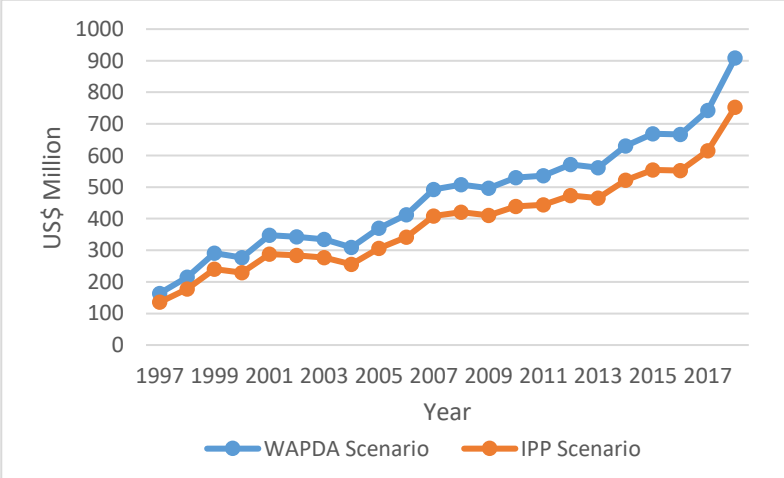

Figure 5.3 IPP Scenario total Controllable Cost (2018 Prices)

5.2. Total Net Benefits

The net impacts of R&P come from six different channels – the investment cost (including capital and fuel costs), the environmental externality cost, the restructuring and privatization cost, the avoided cost in reducing the power crisis, the efficiency gains in terms of reduced controllable cost, and the subsidization cost. These impacts are quantified separately in Table 5.1.

Table 5.1 Distribution of net benefits (1997-2018) of IPPs participation in electricity generation sector (Billion USD) (2018 prices)

Interest Rate 6%	WAPDA	Central	IPP
Investment Benefits			
Capital Cost	10.220	9.503	7.173
Fuel Cost	-14.730	-9.291	-5.188
Total Investment Savings	-4.51	0.212	1.985
Externality Benefits			
GHGs	-4.02	-2.91	-2.18
Pollutants	-2.027	-1.260	-0.49
Total Environmental cost from fossil fuels	-6.04	-4.17	-2.67
Restructuring Component			
Restructuring & Privatization cost	-2.635	-2.635	-2.635
Avoided Cost	6.932	13.865	13.865
Efficiency Gains			
Controllable Cost	0.546	1.144	1.787
Subsidization Cost			
Subsidies granted	-20.386	-20.386	-20.386

Total Net Benefits			
Including externalities	-26.093	-11.97	-8.054
Excluding externalities	-20.053	-7.8	-5.384
Excluding Avoided cost	-33.026	-25.835	-21.919

The net impacts of R&P were equivalent to an NPV of US$ -11.97 billion in the central scenario, an NPV of US$ -8.054 billion in the IPPs scenario, and an NPV of US$ -26.093 billion in the WAPDA scenario; net benefits are estimated negative in all three scenarios. It is an unlikely outcome because practically WAPDA, without IPPs, would not have been able to meet the required energy demands. As it is stated clearly in [1], the government was not been able to meet power demands, the magnitude of the shortage was 2,000 MW during peak hours[19], per capita consumption of electricity per annum was extremely low at 300 KWh. Moreover, the Public Sector Development Program (PSDP) was insufficient and could not finance power projects. That's why government assumptions of all risks and the IPPs' introduction was a rational response to the power crisis. However, the government was slow to reform the sector and Pakistan has made little progress until recently on energy sustainability due to an absolute shortage of generation capacity, compounded by the inability to operate and manage the nationally owned-generation, transmission and distribution capacity in an efficient way. Although IPPs have played an important role in the addition of new generation plants, their efforts have been fallen sort, as the government has not yet been able to make the sector sufficiently attractive to investors [2].

Moreover, GoP has no integrated energy plan that would define the best energy mix. Pakistan's power mix is dominated by imported thermal fuels since the IPPs' entry, while the wind and solar tariffs have been reduced across the world. This situation has not only increased the generation cost and environmental pollution but also gave birth to some serious issues in the power sector, like circular debt. Although renewables, apparently encouraged by the regulatory system, have practically found it difficult to enter the sector owing to planning delays. Due to these possible reasons, the power sector reforms in

[19] In 1994

Pakistan did not bear fruit.

The major benefits of R&P come mainly from three sources i.e., avoided cost, investment efficiency and operating efficiency improvements. The contribution of the avoided cost of US$ 13.865 billion in IPP and central scenario is very large. In our estimations for Pakistan, the ratio of cost avoided to GDP is about 4.40% based on the 2018 GDP of USD 314.6 billion (World Bank, 2020) and the annual average of avoided coat, when the avoided costs were assumed, was USD 0.6602 billion (2018 prices) during 1997-2018. However, this estimation of the avoided costs may still be a conservative measure as according to [3], the loss due to industrial load shedding was estimated 2% (RKR 210 billion) and 2.5% (PKR 310 billion) of GDP by the Institute of Public Policy in 2008 and 2009, respectively. This was not an avoided costs, but a loss even with the additional power generation of IPPs' – our assumption of one-year economic growth delay was supported by these facts. On the other hand, subsidization cost and air pollution cost have imposed severe implications on social welfare after R&P. Figure 5.4-5.7 shows the difference in greenhouse gas and pollutant emissions before and after power sector reforms between WAPDA and IPP scenario.

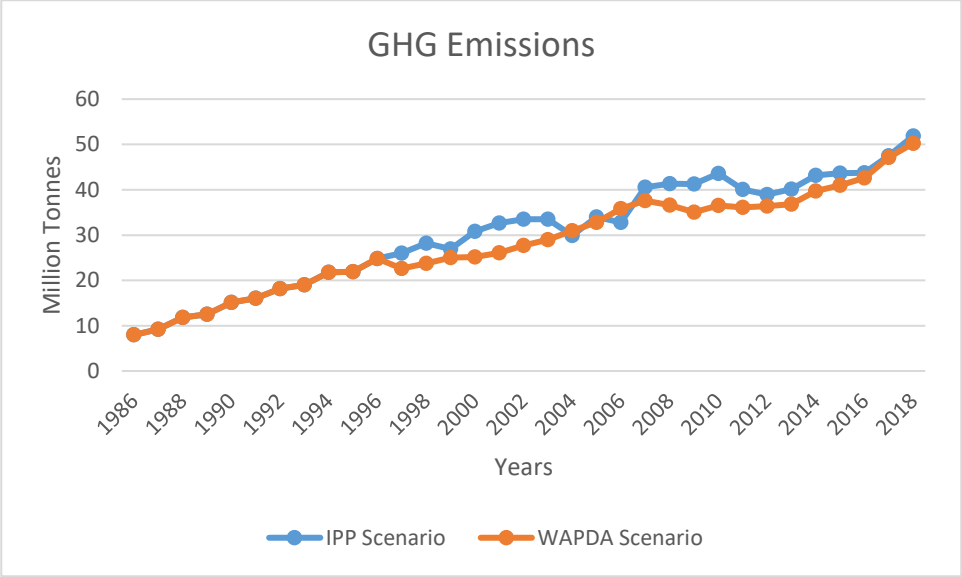

Figure 5.4 IPP and WAPDA GHG Emissions, 1985-2018

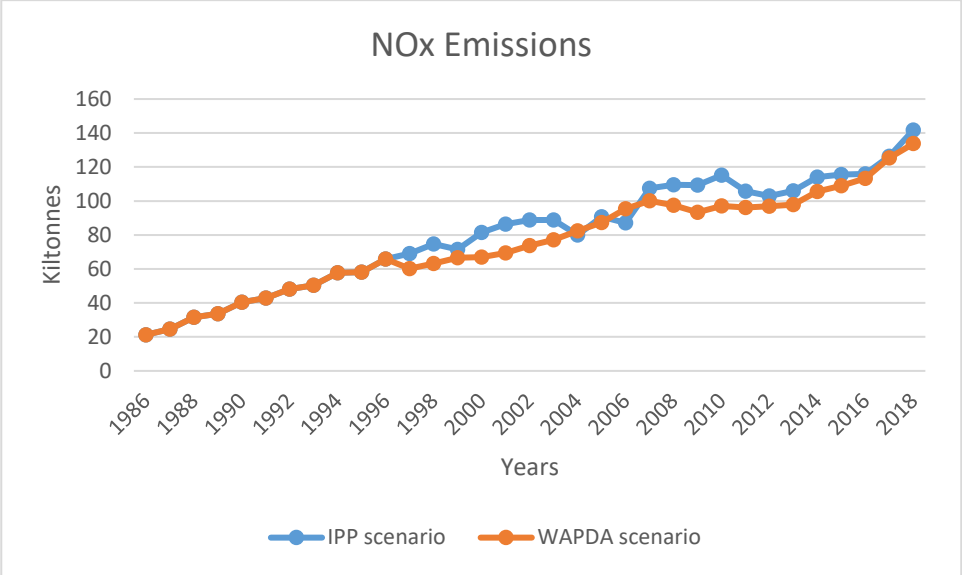

Figure 5.5 IPP and WAPDA NOx Emissions, 1985-2018

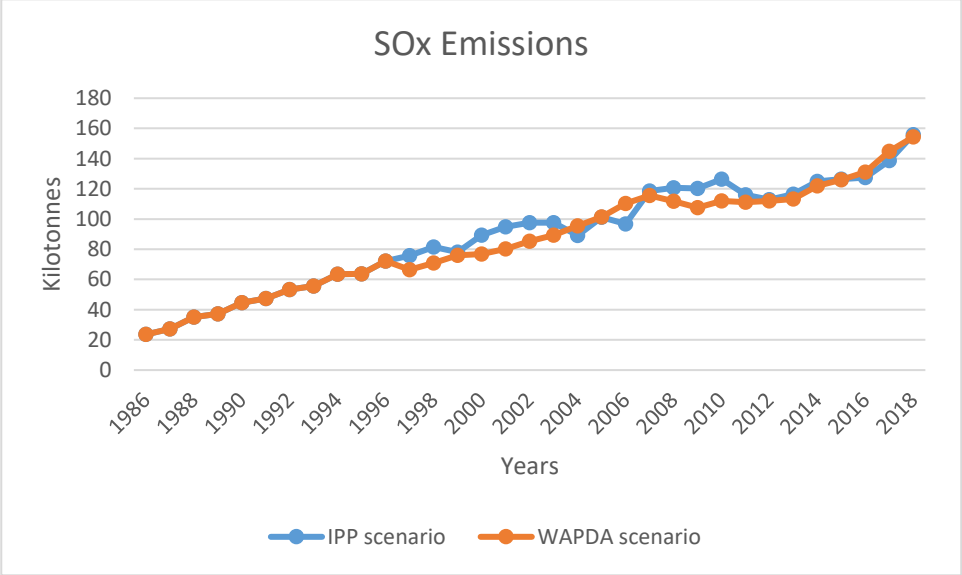

Figure 5.6 IPP and WAPDA SOx Emissions, 1985-2018

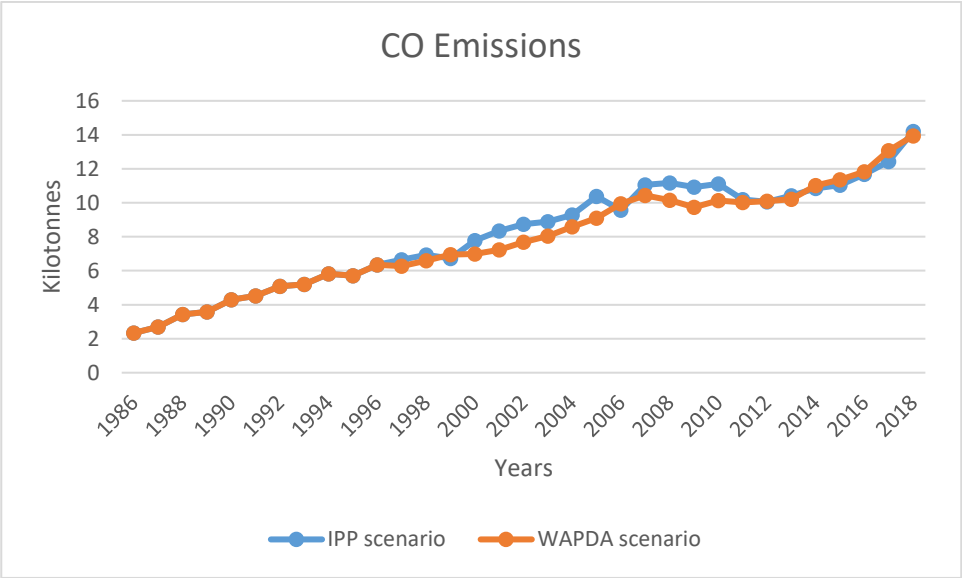

Figure 5.7 IPP and WAPDA CO Emissions, 1985-2018

5.3. The Distributional Impacts

The estimated distributional impacts, on social welfare, from the net benefits excluding externalities, are represented in table 5.2.

Our estimations show that consumers got benefits due to avoided costs; however, the inclusion of consumer surplus captures general equilibrium effects. In all three scenarios, consumer surplus, especially for industrial consumers has significantly reduced which costs more than the avoided costs. Figure 5.8-5.11 presents the difference in consumer surplus between WAPDA and IPPs. Consumers and government are losers in all three scenarios due to high electricity generation cost and unclean energy. Government welfare loss is estimated to an NPV of US$ -18.049 billion after R&P which is mainly due to large tariff differential subsidies. These tariff differential subsidies have substantially piled up the government's financial burdens (see section 5.8). Nevertheless, a better scheme for subsidies could have been developed by the government. Moreover, sales tax, income tax and custom duty exemptions for IPPs could not increase the government's tax collection significantly; however, a net gain of US$ 2.3 billion (NPV) from electricity billing is estimated after R&P. Domestic and foreign investors are winners in the process of R&P due to lucrative terms and condition, with 65% of estimated benefit occurring to the

foreign investors. The resultant loss in global social welfare was equivalent to an NPV of US$ -7.8 billion while domestic social welfare loss was equivalent to an NPV of US$ -26.6 billion for the base case scenario.

Table 5.2 Distributional benefits (1997-2018) (Billion USD) (2018 prices)

Interest Rate 6%	WAPDA	Central	IPP
Net benefits (excluding externalities)	-20.053	-7.8	-5.384
Consumers			
Avoided Costs	6.932	13.865	13.865
Consumers Surplus			
Residential Consumers	-9.04	-9.04	-9.04
Commercial Consumers	-4.15	-4.15	-4.15
Industrial Consumers	-17.66	-17.66	-17.66
Agriculture Consumers	-1.69	-1.69	-1.69
Δ Consumer Welfare	-25.608	-18.675	-18.675
Government			
Income and Tax	2.337	2.337	2.337
Subsidies	-20.386	-20.386	-20.386
Δ Government Welfare	-18.049	-18.049	-18.049
Private Investors			
Foreign 65%	15.342	18.800	20.371
Domestic 35%	8.2614	10.123	10.969
Δ IPPs Welfare	23.604	28.924	31.34
Change in global social welfare (ΔW)	-20.053	-7.8	-5.384
Change in domestic social welfare (ΔW)	-35.395	-26.6	-25.755

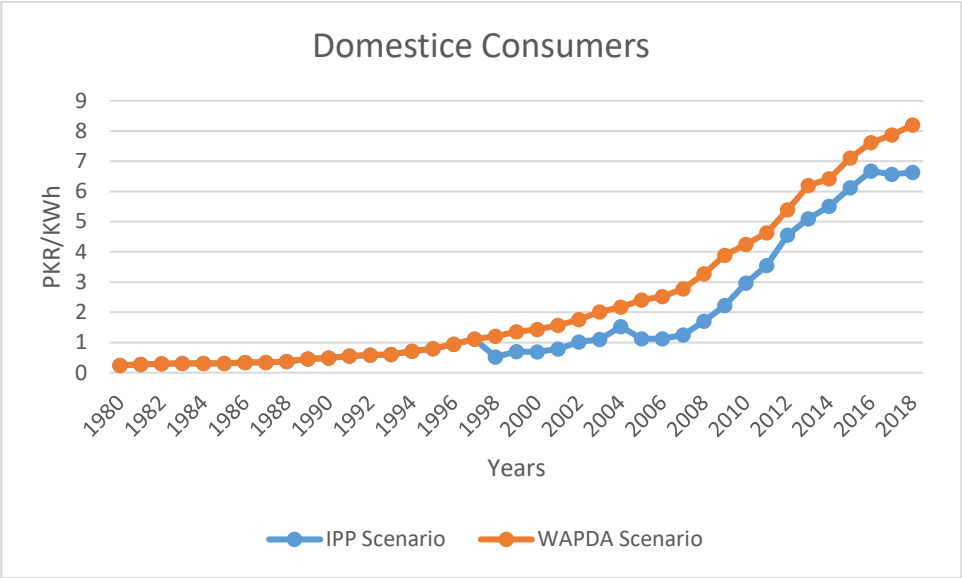

Figure 5.8 Consumer Surplus (Domestic) per KWh - IPP and WAPDA Scenarios, 1980-2018

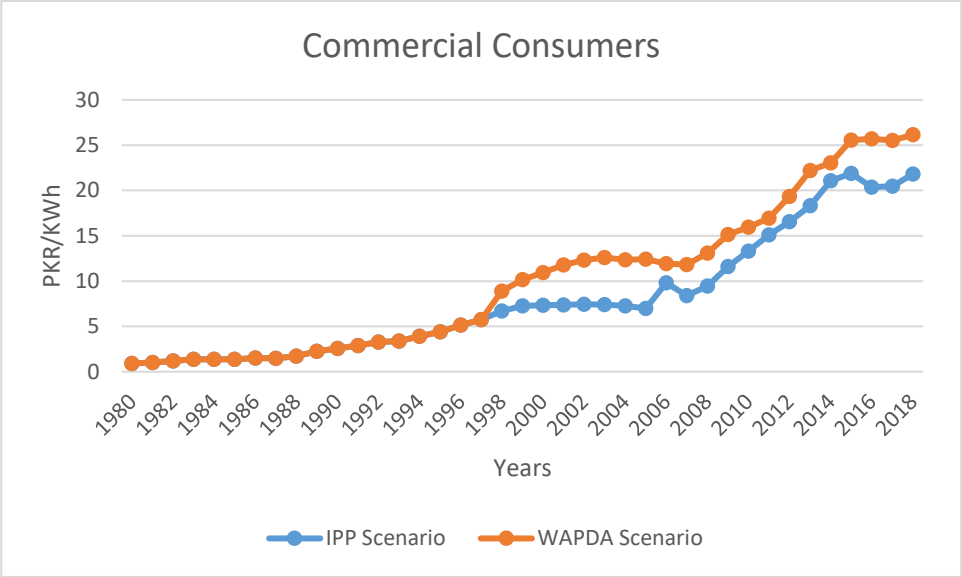

Figure 5.9 Consumer Surplus (Commercial) per KWh - IPP and WAPDA Scenarios, 1980-2018

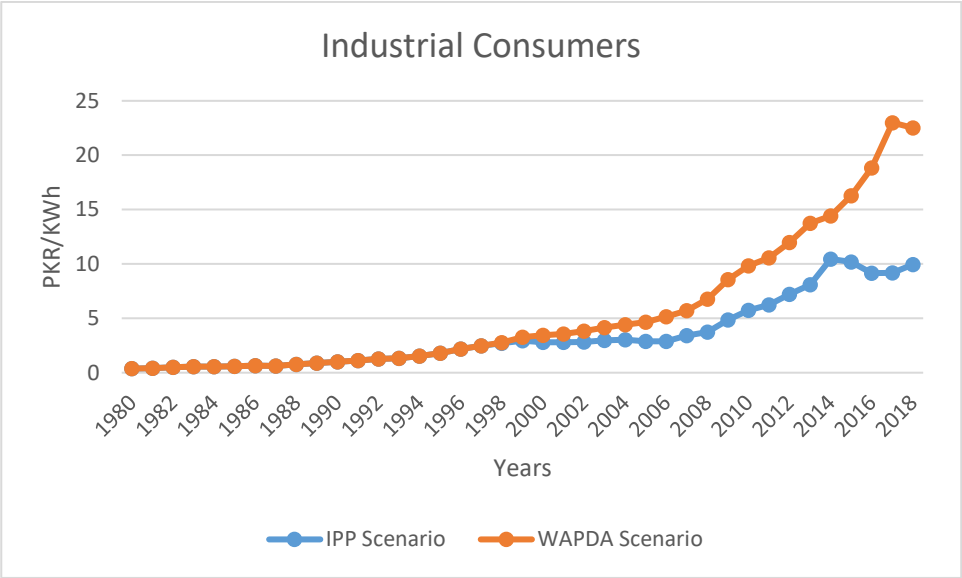

Figure 5.10 Consumer Surplus (Industrial) per KWh - IPP and WAPDA Scenarios, 1980-2018

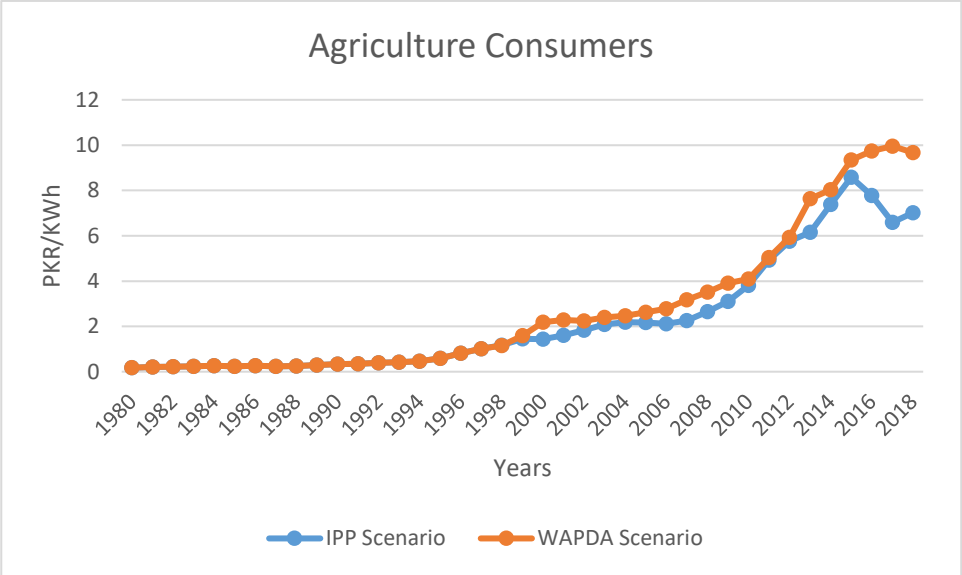

Figure 5.11 Consumer Surplus (Agriculture) per KWh - IPP and WAPDA Scenarios, 1980-2018

Summary

The net impacts of R&P come from six different channels – the investment cost, the environmental externality cost, the restructuring and privatization cost, the avoided cost in reducing the power crisis, the efficiency gains in terms of reduced controllable cost, and the subsidization cost. These impacts are quantified separately in this chapter. Our estimations show that consumers got benefits due to avoided costs; however, the inclusion of consumer surplus captures general equilibrium effects. In all three scenarios, consumer surplus, especially for industrial consumers has significantly reduced which costs more than the avoided costs. Consumers and the government are losers in all three scenarios due to high electricity generation cost and unclean energy. Moreover, the GoP has not adopted an integrated energy plan to define the best energy mix. Pakistan's power mix is dominated by imported thermal fuels since the IPPs' entry, while the wind and solar tariffs have reduced across the world. This situation has not only increased the generation cost and environmental pollution but also gave birth to some serious issues in the power sector, like circular debt. Although renewables, apparently encouraged by the regulatory system, have practically found it difficult to enter the sector owing to planning delays. Due to these possible reasons, the power sector reforms in Pakistan did not bear fruit.

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Chapter 6

Sensitivity Analyses

We have conducted sensitivity analyses for each of the three scenarios presented in tables 4 and 5. Further variations of the central case are presented in table 5.3-5.5.

Table 6 shows the sensitivity analysis of the base case scenario with different interest rates. Change in interest rate makes noticeable differences in net benefits showing that net welfare is highly sensitive to interest rates, especially avoided cost and investment benefits fluctuate significantly with different interest rates. Table 7 quantified the sensitivity analysis of distributional benefits and follows the same variations as in table 6. Consumers' and government's net benefits are less sensitive to interest rates. However, investors' benefits are more sensitive to the interest rate. To be conservative, we would still prefer 6% interest rate that is the official real interest rate of Pakistan in 2018. Furthermore, sensitivity analysis of distributional benefits applying different social weighs is presented in table 8. We have assumed the three most persuasive sets of social weights keeping reforms agenda and basic social and economic structure of Pakistan into consideration[20].

The social weight set 1 weighs the public money and input as 1 and regards its value the same as the printed value of the currency. The consumers' money is also valued the same as the printed value of the currency in set 1 and the private investors' value of money is taken half the printed value of the currency by weighing 0.5, as their recipients are wealthier than electricity consumers. On the other hand, set 2 was assumed in a broader scope that provides a multiplier effect of public and private investment into Pakistan's economy. It puts more weight on the public and private investors' money than the printed value of currency i.e., 3 and 2 respectively. Consumers' money in set 2 is taken the same as the printed value of currency i.e., 1. However, a questionable issue in social weights set 2 is the private investors' profits, especially that of foreign investors, whether their profits would be reinvested into Pakistan's economy or somewhere else. If foreign investors

[20] Due to the unavailability of social weights for Pakistan, we've assumed three sets of social weights for sensitivity analysis. We could not calculate social weight due to data and time constraints.

reinvest their money somewhere else, then social weight for private investors would have a different value. To address this issue, social set 3 is introduced with lesser weightage on private investors' money. This set assigns social weights 3, 1 and 1 for the public, investors' and consumers' money respectively.

Since the government is the policy decision-maker and we are evaluating social impacts from the point of view of government, we choose the public money as the numeraire and all social weights sets are adjusted accordingly (i.e., social weight divided by government's social weight). Each set of social weights imposes a significant difference in results, shown in table 8. Compared with the unweighted results, set 1 and 3 reduce social welfare significantly and set 2 decreases the social loss to 34.33%. It should also be observed that, if we choose consumers as numeraire, instead of the government, social welfare does not change so significantly because the welfare loss of both stakeholders is almost same. However, we will still prefer conservative results without social weights due to the limitations in estimating the social weights. Sensitivity analysis demonstrates that the choice of interest rates and the selection of different social weights can dramatically change the estimated social welfare impacts.

Table 5.3 Distribution of net benefits (1997-2018) of IPPs participation in electricity generation sector (Billion USD) (2018 prices)

Central case scenario	5%	6%	7%
Investment Benefits			
Capital Cost	4.108	9.503	16.964
Fuel Cost	-8.696	-9.291	-9.948
Total Investment Savings	-4.861	0.212	7.016
Externality Benefits			
GHGs	-2.56	-2.91	-3.32
Pollutants	-1.10	-1.260	-1.44
Total Environmental cost from fossil fuels	-3.66	-4.17	-4.76

Restructuring Component			
Restructuring & Privatization cost	-2.243	-2.635	-3.091
Avoided Costs	11.362	13.865	16.887
Efficiency Gains			
Controllable Cost	-0.228	1.144	2.832
Subsidization Cost			
Subsidies granted	-19.30	-20.386	-21.53
Total Net Benefits			
Including externalities	-18.93	-11.97	-2.646
Excluding externalities	-15.27	-7.8	2.114

Table 5.4 Distributional benefits (1997-2018) (Billion USD) (2018 prices)

Central case scenario	5%	6%	7%
Net benefits (excluding externalities)	-15.27	-7.8	2.114
Consumers			
Avoided Costs	11.362	13.865	16.887
Consumers Surplus			
Residential Consumers	-8.26	-9.04	-9.90
Commercial Consumers	-3.79	-4.15	-4.56
Industrial Consumers	-16.77	-17.66	-18.62
Agriculture Consumers	-1.59	-1.69	-1.81
Δ Consumer Welfare	-19.048	-18.675	-18.003
Government			
Income and Tax	2.210	2.337	2.476
Subsidies	-19.305	-20.386	-21.531
Δ Government Welfare	-18.095	-18.049	-19.055

Private Investors			
Foreign 65%	14.217	18.800	25.461
Domestic 35%	7.655	10.123	13.71
Δ IPPs Welfare	21.873	28.924	39.172
Change in global social welfare (ΔW)	-15.27	-7.8	2.114
Change in domestic social welfare (ΔW)	-29.487	-26.6	-23.347

Table 5.5 Central case distributional benefits with social weights (1997-2018) (Billion USD) (2018 prices)

Interest rate 6%	No Social Weights	Social weights set 1		Social weights set 2		Social weights set 3	
Net benefits (excluding externalities)	-7.8		-7.8		-7.8		-7.8
Consumers							
Avoided Costs	13.865	1	13.865	0.33	4.575	0.33	4.575
Consumers Surplus							
Residential Consumers	-9.04	1	-9.04	0.33	-2.983	0.33	-2.983
Commercial Consumers	-4.15	1	-4.15	0.33	-1.369	0.33	-1.369
Industrial Consumers	-17.66	1	-17.66	0.33	-5.827	0.33	-5.827
Agriculture Consumers	-1.69	1	-1.69	0.33	-0.557	0.33	-0.557
Δ Consumer Welfare	-18.675		-18.675		-6.162		-6.162
Government							
Income and Tax	2.337	1	2.337	1	2.337	1	2.337
Subsidies	-20.386	1	-20.386	1	-20.386	1	-20.386
Δ Government Welfare	-18.049		-18.049		-18.049		-18.049
Private Investors							
Foreign 65%	18.800	0.5	9.4	0.66	12.408	0.33	6.204
Domestic 35%	10.123	0.5	5.061	0.66	6.681	0.33	3.340
Δ IPPs Welfare	28.924		14.462		19.089		9.554
Change in global social welfare (ΔW)	-7.8		-22.262		-5.122		-14.657
Change in domestic social welfare (ΔW)	-26.6		-31.662		-17.53		-20.861

Summary

We have conducted sensitivity analyses for each of the three scenarios. The sensitivity analysis of the base case scenario with different interest rates shows that change in interest rate makes noticeable differences in net benefits showing that net welfare is overly sensitive to interest rates, especially avoided cost and investment benefits fluctuate significantly with different interest rates. Consumers' and government's net benefits are less sensitive to interest rates. However, investors' benefits are more sensitive to the interest rate. To be conservative, we would still prefer a 6% interest rate that was the official real interest rate of Pakistan in 2018. Furthermore, we have assumed the three most persuasive sets of social weights keeping reforms agenda and basic social and economic structure of Pakistan into consideration. Each set of social weights imposes a significant difference in results. Compared with the unweighted results, set 1 and 3 reduce social welfare significantly and set 2 decreases the social loss to 34.33%. It should also be observed that, if we choose consumers as numeraire, instead of the government, social welfare does not change so significantly because the welfare loss of both stakeholders is almost the same. However, we will still prefer conservative results without social weights due to the limitations in estimating the social weights. Sensitivity analysis demonstrates that the choice of interest rates and the selection of different social weights can dramatically change the estimated social welfare impacts.

Chapter 7

Conclusion and policy implications

This study attempted to estimate the cost and benefit of IPPs introduction into the electricity generation sector of Pakistan. We have made different assumptions and constructed multiple scenarios about what might have happened had IPPs not been inducted into the power sector of Pakistan. We found that the main benefits came from three sources. The first is avoided costs due to the contribution of IPPs during the power crisis, which fostered economic growth. The other benefits are operating and investment efficiency gains in the generation, arising from efficient technology and better management than WAPDA. On the other hand, environmental and subsidization costs are found exorbitant. Moreover, we assessed the distribution of these net impacts among different stakeholders: consumers, government and private investors. Our findings show that consumers and government are net losers and private investors are winners. Further sensitivity analyses suggest that caution is needed in choosing interest rates and social weights and in making assumptions.

We conclude that partial power sector reforms through private investment were a good option available at that time considering all the circumstances. However, the reform journey proved to be slow and long in Pakistan due to political instability and timely implementation of policies. For example, the need for restructuring WAPDA and IPPs participation was identified in the early 1970s but took place in 1997 after 25 years and the first privatization of KE did not materialize for another 8 years[21] until 2005 [1]. Furthermore, our analysis does not imply that IPPs' introduction was the only solution to power shortages in Pakistan. It could well have been the case that freeing up WAPDA from financial and institutional constraints could have been more beneficial for social welfare without IPPs.

Have the power sector reforms and IPPs participation increased social welfare? Based on

[21] Moreover, the intended transition towards the competitive power market remains at the single buyer stage.

our analyses, our answer would be negative. In 2018, a few decades after the GoP began considering the power sector reforms in the 1990s, power sector reforms are still going on and electricity generation cost is in Pakistan among the highest in Asia. The reasons for this high generation cost are IPP-friendly PPAs and dominancy of imported fuels in the electricity generation mix of Pakistan since the IPPs' participation. These imported thermal fuels not only increased the electricity generation cost but also exacerbated the environmental cost.

We believe that power sector reforms could be fruitful if these were accompanied by consistent political support. This is because private enterprises can mobilize investment and can deliver faster than state-owned enterprises. Our study found private enterprises more efficient than state-enterprises and this is the significance of our findings that governments are not created to take part in productive activities such as power services, but to support these activities carried out by the private sector [2]. Conversely, in Pakistan, inadequate supporting role of government, such as delay in the creation of competitive power market, lax regulation for private investors and absence of social obligations such as environmental protection and cheap electricity supply for consumers resulted in social welfare loss. That's why in Pakistan's context, the legacy of IPP participation to solve the power crisis imposed a burden on consumers. However, without this solution, Pakistan could bear a greater economic loss during the power crisis. Therefore, although IPPs aided the expansion in installed capacity, the legacy of IPPs friendly PPAs with lucrative terms and conditions, inadequate supporting role of government, and ad-hoc power reforms have been still dragging Pakistan's economy.

Based on the derived results, several important policy recommendations regarding Pakistan's electricity generation sector are listed below:

- Penetration of renewable energy resources in the electricity generation mix to safeguard the environment.
- For a win-win situation for all the stakeholders (investors, government and end-users i.e., consumers), IPPs should be inducted only, if through demand forecast and Integrated energy planning calls for it.
- If the demand analysis calls for induction of new generation capacity, then all

such capacity should be inducted through transparent international competitive bidding and the incentivized tariff regime must be avoided.

- While inducting new generation capacity, the indigenous/local component in the projects must be maximized (in terms of financing, fuel, manpower and available technology etc.) to avoid pressure on foreign exchange reserve and to counter circular debt.

- To reap the low hanging fruits of privatization and competition in the power sector, the wholesale competitive electricity market may be established on war footings.

- It is important to build a better scheme for tariff differential subsidies to minimize social welfare damage.

References

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