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Essays on the Electricity and Banking Industries in Pakistan

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My parents are my first teachers; they motivated and encouraged me to pursue higher education. My wife supported me immensely during my research, her compassion made me focus on studies. I am unable to mention the long list of teachers and friends, who all gave time and commented on my research during talks and presentations.

Declaration

I certify that this thesis is my original work done for PhD Economics Degree and submitted at University of Warwick; I have not submitted this thesis for a degree to any other University.

Amir Jahan Khan

March 2014

Abbreviations and Acronyms

CIB	Credit Information Bureau
CPPA	Central Power Purchase Company
DM	Distribution Margins
DISCOs	Distribution Companies
FESCO	Faisalabad Electric Supply Company
GEPCO	Gujranwala Electric Power Company
GENCOs	Generation Companies
GOP	Government of Pakistan
GWh	Giga-watt Hours
HESCO	Hyderabad Electric Supply Company
IESCO	Islamabad Electric Supply Company
IMF	International Monetary Fund
IPP	Independent Power Producers
KIBOR	Karachi Interbank Offer Rate
KESC	Karachi Electricity Supply Company
KWh	Kilo-watt hours
LESCO	Lahore Electric Supply Company
MEPCO	Multan Electric Supply Company
MMCF	Million Cubic Feet
MTon	Million Tons
MW	Mega Watt
NEPRA	National Electric Power Regulatory Authority
NTDC	National Transmission and Dispatch Company
PEPCO	Pakistan Eclectic Company
PESCO	Peshawar Electric Supply Company
PPA	Power Purchase Agreement
QESCO	Quetta Electric Supply Company

SAIFI	System Average Interruption Index
SAIDI	System Average Interruption Duration Index
SBP	State Bank of Pakistan
SO	System Operator
SOE	State Owned Enterprises
UNCTAD	United Nations Conference on Trade and Development
WAPDA	Water and Power Development Authority

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Introduction

During early 1990s many developing countries initiated liberalization, privatization and deregulation reforms. The context and nature of reforms were country specific, but there was a common premise that the market system can enhance economic efficiency, spur growth and increase consumer welfare. There was "consensus" among policy makers that government owned businesses not only are less efficient but they also utilize scarce public resources[1]. In order to save tax money and improve performance of state owned businesses, the policy makers ventured to either privatize the state owned enterprises or restructure these organizations in the first stage and then subject businesses to regulation, before privatizing these entities at latter stage. The liberalization reforms allowed entry for new businesses that changed the competitive structure of the corresponding industries. In this thesis I have analysed specific aspects of the policy reforms started in Pakistan in the 1990s and discussed their fallout on the electricity and banking industry of Pakistan. There are three chapters in the thesis; Chapter 1 and Chapter 2 cover issues in the electricity industry, while Chapter 3 documents price-concentration relationship in post reform banking industry. The positive analysis documents the economic

[1] Privatization of State Owned Enterprise (SOEs) is one of the important conditions of International Monetary Fund (IMF) bailout programs received by successive Pakistani Governments over the years.

performance, nature of competition, industry structure and regulation issues in the electricity and banking industries, while policy options are discussed and major lessons are drawn in light of positive analysis where possible.

Understanding functioning of markets and related supply-side issues is at the heart of industrial organization. The supply side constraints in developing economies partly results from limited private sector investment and lack of availability of the supportive infrastructure for the private enterprise and economic growth (World Bank, 1997). According to UNCTAD[2], poor infrastructure, and lack of support services are among the main supply-side constraints facing firms in the developing countries. The role of basic infrastructure and regulatory institutions for sustained economic growth and private sector development is well documented in academic literature and policy documents (World Bank, 1997). The basic infrastructure which includes transportation, energy, water supply, and financial services is essential for sustained growth and poverty reduction. In this context, electricity and financial services fall into the supportive infrastructure that can be supplied by public or private firms but is essential for the well-functioning of a wide range of production activities in the economy. The banking industry including and the electricity industry are subject to government regulations in Pakistan. The regulatory authorities

[2] United Nations Conference on Trade and Development

control these two industries through quality, price and entry regulation. Therefore the analysis of electricity and banking industries require documentation of the regulatory framework in place and the consequences on market based reforms in the electricity industry.

The choice of industries for this thesis requires some considerations, the electricity industry has been under reforms since the 1990s with the objective to transform the industry from a state owned monopoly to market based firms either working in public sector or to be privatized at some stage. After more than two decades of reforms there is still no clarity of status of reforms and the electricity industry in Pakistan is in chaos, pervasive shortage of the power supply and the overall system losses are beyond comparable international industry standards. The research agenda in this thesis is to unpack the issues in the electricity industry and highlight the sources of economic inefficiency and constraints in the process of market based reforms. The research questions addressed in Chapter 1 and Chapter 2 are related to the electricity industry and are fundamental in nature and important for the understanding of the industry. Apart from policy and regulatory reports, there is limited research available to understand key parameters of the electricity industry in Pakistan, the research conducted here will bridge that gap in literature and highlight areas of further research.

The electricity industry in Pakistan is an interesting and puzzling area for economics research as there have been reforms which have serious consequences for the economy and welfare of consumers[3]. Chapter 1 documents that reforms occurred in the sense that businesses in the electricity supply chain are unbundled with separate entities for generation, transmission, and distribution[4], however reforms are not obvious as the unbundled state owned electricity businesses operate without any contractual separation in financial and administrative liabilities and performance monitoring. The industry is still a state owned monopoly in a large part of Pakistan[5], with central government supplying continuous large subsidies to finance power purchase, pay debts and sustain the operation expenses of unbundled entities and determine effective electricity tariffs for end consumers. The inability of power supply companies to finance power purchase has resulted in financial chaos, routine long outages (including outages in main urban centres), under investment in new technology and lack of maintenance of current physical stock.

Further, Chapter 1 tries to unpack some of the issues in network segments of the electricity industry. The case study analysed in Chapter 1 covers details of the industry including diseconomies of monopoly network structures, resulting in lower average tariff than average cost and failure or success of regulatory framework. This chapter also comments on future

[3] In terms of increased blackout periods over the years and rising electricity prices over the years
[4] Distribution and retail businesses are performed by same business unit
[5] Electricity in greater Karachi region is supplied by privatized Karachi Electricity Supply Company (KESC)

reforms and the structure of the electricity market, in light of the analysis conducted in Chapter 1. Chapter 2 is a specific study that measures economic efficiency through estimating cost functions for power generation plants. Chapter 2 compares public power plants with private power plants and finds that performance differential exists across plants according to ownership of plants. The utility owned government plants are technically and economically less efficient than privately owned non-utility plants. This chapter argues that merit order and fuel allocation to power plants should be based on economic efficiency.

On the other hand, liberalization and privatization reforms took a faster pace in the banking industry, a number of state owned large banks were privatized during the 1990s and licences were issued too many new private financial institutions. The banking regulation quality increased substantially and the industry conforms to international banking regulation standards, new entry and reforms in the banking industry have changed market structure substantially. In Chapter 3, market outcome data for loans is constructed to estimate the price concentration relationship for the banking industry in Pakistan. The estimated results shows that banks in more concentrated markets charge higher interest on loans compared to markets with a larger number of banks. The data set constructed in Chapter 3 is of potential use for further research, and can be employed to estimate the impact of exogenous shocks and policy changes on corporate lending in Pakistan.

1 Structure and Regulation of Electricity Networks in Pakistan

1.1 Introduction

This chapter is a case study of the network part of the electricity industry in Pakistan, particularly in the context of structural and regulatory reforms started in the 1990s. Published reports by the regulator show that the reforms process is not going anywhere even after two decades and the industry is performing poorly (NEPRA, 2010). The market is not clearing as load demand is higher than total system supply, particularly during the summer season[6]. There is no electricity due to load shedding for long hours in major parts of the distribution networks during the hot and long summer period. An effort is made here to document the basic facts of industry in an orderly manner and to draw major lessons from the failure of the reforms process and poor functioning of the electricity market. The focus will be on network segments of the electricity supply chain and issues in the regulation of the electricity industry, the restructuring of these natural monopoly components of industry will be discussed in detail.

[6] There are no official figures available on load shedding hours. The summer seasons runs from March to October in most parts of the country.

The electricity industry in Pakistan is quite under researched (GOP, 2013), the main source of industry knowledge is based on government publications. According to available research (NEPRA 2011, Afia M, 2007), the rich information available in policy documents and regulatory reports has not been analysed in detail. Therefore, documenting basic industry facts and understanding related issues in this chapter is the main contribution to the existing literature and will be useful for future policy reforms.

The electricity industry in Pakistan has been functioning as a state monopoly for a long time. The state monopoly includes two vertically integrated electric utilities in the country; the Water and Power Development Authority (WAPDA) with a customer base of 20.3 million and the Karachi Electric Supply Corporation (KESC) serving 2.1 million customers[7]. In the last two decades, two major changes have occurred in the electricity industry of Pakistan. Firstly, the two state owned utilities went under structural reforms and unbundling in 2002. Second, regulation of the electricity industry started in 1998 and an authority was put in place to regulate electricity prices, allow entry into the industry and set standards for the electricity supply. The reforms were motivated by the intuition that state owned monopolies were less efficient than private enterprise and there was need to either privatize or restructure state entities. The unbundling process

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[7] In the year 2011, 90 % generation (91,663 GW h) was in WAPDA system while 10 % (10,036GW h) in KESC system (NEPRA 2011).

included separation of the potentially competitive segment (i.e. power generation) from the network based natural monopoly part of the electricity industry (i.e. transmission, and distribution of power), and division of the natural monopoly part of industry into transmission and distribution networks. The network components of industry are subject to regulation, and distribution utilities also perform as retail electricity suppliers.

The restructuring plan for the state-owned power sector was approved by the government of Pakistan in 1992, however the first substantial change in the industry was the commissioning of independent power producers (IPPs) in 1994. The IPPs started supplying electricity to the system in the late 1990s, and this was followed by privatization of a public power plant in 1996. These early initiatives created political debate and legal disputes between government and IPPs due to the lack of transparency in contractual arrangements and no obvious change in the competitive structure of the generation segment.

The regulation of the industry started in 1998 when the National Electric Power Regulatory Authority (NEPRA) was put in place to regulate price, quality, and entry in the industry. NEPRA issued licences to 9 distribution companies (DISCOs) in 2002, including 8 companies in the WAPDA areas. A licence was also issued to the National Transmission and

Dispatch Company (NTDC)[8] for the transmission business in the WAPDA system. The 8 distribution companies and the NTDC are working as government owned monopolies in the distribution and transmission network of WAPDA, structure of the industry is presented in Figure 1.1.

The electricity industry in Pakistan is plagued by financial and operational issues which are affecting the economic efficiency and growth of the industry (GOP, 2013). The distribution companies and the transmission company receive payments from government subsidies[9], 1,290 billion Rupees[10] have been transferred as subsidies to DISCOs from 2007 to 2012 (GOP, 2013). The regulator decides the electricity price for each utility (i.e. a DISCO) after taking into account the consumer mix, transmission losses and operational cost of the DISCOs in accordance with the tariff standards and procedure rules (NEPR 2011). The government decides the final electricity price, which is lower than the price determined by regulators for most utilities. Therefore the central government does not pass all of the production costs to consumers by charging less than the tariffs determined

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[8] This chapter covers transmission and distribution networks of WAPDA system, KESC is a vertically integrated company operational in the greater Karachi region (with no effective separate cost centres) and issues related to KESC might need a different framework for discussion. However, possible experiment can be done to compare performance of KESC with government owned distribution companies.

[9] The issues related to network part of the industry are discussed here in detail, as the focus is on the distribution and transmission segments of the industry in WAPDA/NTDC system.

[10] about 18 billion US dollars

by the regulator[11] to promote economic development. The government introduced price differential subsidies in order to pursue the policy of uniform electricity prices in the country. In this way the performance incentives for firms in power networks can be partially determined by the subsidy allocation mechanism and regulatory tariff structure.

The main objective of this chapter is to present an account of the network part of the electricity industry and analyse the transition from state monopoly to a regulated state monopoly. An effort is made to highlight the factors which are potentially slowing growth of the industry and resulting in poor allocation of resources. The documentation of technical, economic, and institutional factors related to transmission and distribution segments is an integral part of understanding market functioning and incentive structure in the electricity industry (Joskow and Schmalensee 1983)[12]. The economic efficiency in the electricity industry also depends on the contractual nature and consequent incentives in network economy, and the tariff incentive structure applicable to utilities (DISCOs) and system operator (NTDC). The current tariff structure and evolution to its current state is discussed here, with respect to corresponding implications on incentives for firms in the business of electricity networks.

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[11] Government documents show that electricity sale price for all utilities is equal to the lowest determined price for any utility (among all utilities) for a given year (GOP, 2013)

[12] Chapter 2 discusses issues in generation sector in detail.

The electricity networks are an important component of the electricity industry, efficient functioning of transmission and distribution companies and timely capital investment in distribution networks is required for the growth of other segments of the industry. For instance, the power generation segment performance will depend on the reliability and structure of the transmission and distribution networks. The missing interconnection of transmission networks or inadequate capacity in the networks affects the operation of existing power plants and has delayed the commissioning of new power generation plants (NEPRA, 2010).

The analysis of incentive mechanism for the electricity networks assumes the separation of network segments into clearly defined distribution and transmission networks (Joskow, 2008). Although the unbundling of electric power in WAPDA system occurred in 2002 with the establishment of distribution companies DISCOs and transmission company NTDC, however formal contractual relationships between DISCOs and NTDC are not in place and they were under “de facto” common management until recently (NEPRA, 2011). The role of key public institutions[13] during transition needs to be discussed in order to understand the incentive structure and resulting behaviour of DISCOs and NTDC (see Figure 1.1 for structure of the Industry). The electricity networks in the main system are

[13] One example, Pakistan Electric Power Company (PEPCO), PEPCO’s main responsibilities included to oversee WAPDA’s unbundling, and to restructure and to corporatize distribution and generation public firms (NEPRA 2010)

government owned regulated monopolies where the authority (i.e. NEPRA) oversees the regulation and determines tariffs for power generation, transmission, and distribution. The knowledge on regulatory effectiveness and incentives creation by tariff structure or regulator lag is quite limited for Pakistan (Afia M, 2007). The documentation of all the institutional details with potential economic consequences for the electricity industry will be useful for the future reforms of the electricity industry in Pakistan.

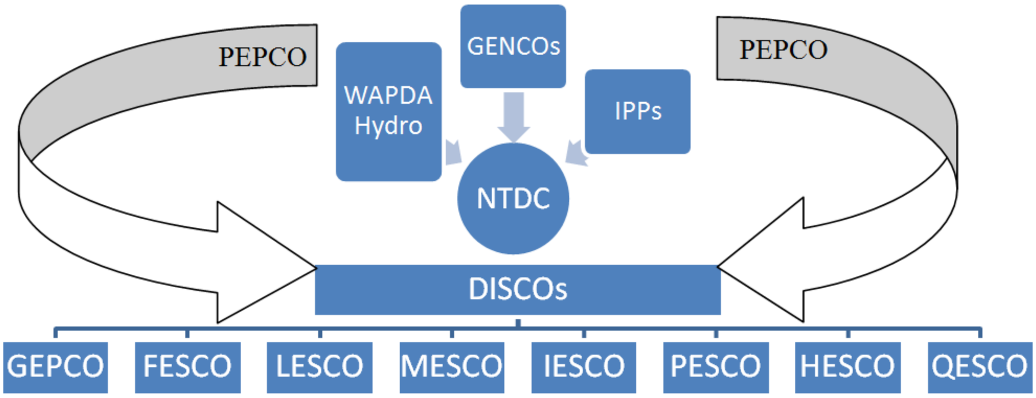
The following discussion in this chapter is divided into five sections, the next section discusses issues related to the structure and management of electricity distribution networks, the natural monopoly role of electricity networks and its implications for economic efficiency are also analysed in this part. The section 1.3 documents incentive regulation particularly relevant to electricity networks and compares it with current practice in Pakistan. The section 1.4 expands discussion to the public sector role in the power industry particularly in electricity networks and incentive mechanisms for market based reforms. Section 1.5 includes unbundling reforms experience of other developing countries and documents any implications for Pakistan. Some policy recommendations based on positive analysis and concluding remarks are documented in the section 1.6. Additional appendix tables are given in the section 1.7.

1.2 Structure of Electricity Networks

In this section I will discuss the implications of “electricity network” structure on economic efficiency of the electricity systems in the context of theoretical considerations and general practice in the electricity industry. The distribution networks operator also plays the role of retail business in Pakistan, the issues related to the quality of electricity supply are also documented in this section. The structure of electricity networks is considered as a regulated natural monopoly like gas or water supply networks, where duplication cost can be avoided by serving a geographical market with a single transmission or distribution company, instead of more than one firm doing the same job (Joskow and Schmalensee 1988). Transmission networks carry high voltage power and connect a generator to other generators and the load centres in the system, while the distribution networks supply electricity on low voltage to consumers and are connected to high voltage transmission networks through boundary grid stations.

In Pakistan, government owned distribution companies DISCOs and system operator NTDC are functioning as distribution and transmission monopolies respectively, while government owned generation companies (GENCOs) are competing with private power producers to supply electricity in the system (Figure 1.1 below). This structure of industry shown in Figure 1.1 requires explanation of the past institutional context.

Figure 1.1 The unbundled structure of the state owned monopoly



Historically, utilities in Pakistan were vertically integrated in their generation, transmission and distribution[14] businesses. Incentives for vertical integration of distribution with generation-transmission arise due to some basic complementarities. The distribution networks are load centres and they provide reliable load forecast to generation and transmission firms for the efficient function of the electricity system. The accurate load forecasts are also necessary for short term planning and long term investments in a generation-transmission system (Joskow and Schmalensee 1983).

The distribution and transmission networks were part of vertically integrated state-monopoly Water and Power Development Authority (WAPDA). As a result of WAPDA's restructuring in 2002, the regulator

[14] In Pakistan distribution companies also perform the role of electricity supplier or retailing. In principle, a government or a private firm can run retail business by procuring electricity and paying to intermediary firms in power supply chain. The words distribution companies, DISCOs, and utilities are used interchangeably in this chapter for electricity suppliers.

issued licences to distribution companies DISCOs and transmission company NTDC to work as unbundled natural monopolies. Further, Pakistan Electric Power Company (PEPCO) was formed to manage the unbundling process and to make sure that electricity networks make a successful transition. However, centralization incentive persisted with central government in guise of NTDC/PEPCO as the current governance system is without any effective contractual arrangements between distribution firms and other parts of the industry, until recently distribution companies DISCOs were under the management of NTDC and PEPCO (NEPRA 2010). However distribution companies DISCOs are functioning as unbundled units and are also performing retail business in monopoly controlled areas.

There is theoretical justification along international practice for the natural monopoly status of distribution networks and the efforts to “unbundle” electric utility in Pakistan were in line with the international experience. The electricity unbundling initiative started in the US in 1980s and a number of countries, including the UK have “unbundled” electricity supply. According to the basic model, the network part of industry became a natural monopoly while power generation firms became part of the competitive market. The intuition for cost saving by one distributor sounds plausible, the unit cost is likely to go down as the number of customers or load increases on a system in a limited geographical location. But there could be limits to economies of scale because grid stations, distribution lines, and interconnectors become overburdened as load increases in a given location. Similarly, diseconomies in equipment maintenance and overheads along other x-inefficiencies can be imagined as distribution network area expands unboundedly.

1.2.1 Distribution Networks

The distribution networks supply electricity from the transmission system below 220 kilo volt, the network infrastructure includes distribution lines and 132 kilo volt and lower capacity grid stations. As shown in Table 1 below, the electricity industry suffers with high system losses (including theft) and high revenue losses. The non-theft system losses can be attributed to the current state of technology and size of the distribution network. The resistance loss increases as the size of a distribution network increases and the system loss can also increase as demand increases. The regulator reports that *"distribution system in urban centres is over stressed and needs to be upgraded, augmented, and expanded"* (NEPRA 2010). Therefore technical line losses can arise both in large networks (due to resistance) and small congested networks due to resistance and high demand.

Picture 1: Overloaded Distribution Networks

Source: Pakistan Today, The News

On the other hand, system losses caused by theft and revenue losses can arise from managerial inefficiency and corrupt governance. Even technical losses resulting from poor engineering design and system operation can be a result of bad governance and lack of planning. The influence of managerial effort and pure technical losses cannot be disentangled, as disaggregate data for the required analysis is not available, however conjectures can be made where decentralized system loss data is available for a distribution network. Similarly, the potential of theft can be assessed from the number of customers and total households in a given distribution network.

The average area of a government owned distribution system is 98 thousand square kilometres with average density of 67 customers per square kilometre, as shown in Table 1.1. There is considerable variation in peak load demand and composition of urban towns among networks. There is significant negative correlation (-0.65) between network density and system losses (including theft) or recovery (billing) losses[15]. Technical, structural and managerial diseconomies exist in large distribution companies. For instance, Hyderabad Supply Company HESCO is losing more than one-third electricity from the system and at the top recovering less than 60 per cent of final electricity sold[16]. The trends in Table 1.1 persist over time (see Table 1.2, and Table 1.3).

The genuine system losses are not disentangled from theft losses, but three companies QESCO, HESCO, PESCO are susceptible to huge theft losses due to political instability and lawlessness in the region[17]. The high losses also suggest that basic infrastructure is getting overstressed and requires maintenance and replacements, while investment in substations, distribution lines, and human capital will depend on the financial health of the firm which in turn depends on system losses and billing losses.

---

[15] Except privatized KESC distributing electricity in Karachi, high line losses in KESC are probably caused by theft and lawlessness in a city of 12.9 million.

[16] The regulation authority appears to be concerned about the inefficiencies in large distribution networks; HESCO was divided into two distribution companies in 2011 (HESCO and SEPCO).

[17] This is validated by published regulator reports and unstructured interviews with officials.

Table 1.1 Electricity Prices, Density, and Losses for Distribution Companies, 2010

Distribution Company	*Consumers*	*Peak demand (MW)*	*Density (consumer/area)*	*System[1] Losses (%)*	*Billing Losses (%)*	*Power Purchase Price (rupee/kWh)*
IESCO	2,059,207	1457	88.9	9.8	4.1	7.6
LESCO	3,182,292	3916	166.9	13.7	8.2	8.2
GEPCO	2,454,254	1813	142.6	11.0	4.0	8.1
FESCO	2,879,188	2298	65.0	10.9	3.0	8.2
MEPCO	4,057,491	3006	38.5	18.9	4.2	8.7
PESCO	2,947,108	3685	29.0	37.0	14.6	11.4
HESCO	1,511,878	1797	11.2	34.8	40.2	11.0
QESCO	490,805	1316	1.4	20.7	42.3	9.0
KESC	2,051,964	2562	315.7	34.9		

Source: NEPRA, State of Industry Report 2010-11, 1 distribution network losses

Table 1.2 Distribution Network, Total System Losses[1], (%)

Distribution Company	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Peshawar	31.8	32.2	32.4	35.2	34.7	35.2	34.9
Islamabad	13.3	12.2	10.3	10.8	9.8	9.7	9.5
Lahore	10.2	11.7	11.2	10.7	11.0	12.0	11.2
Gujranwala	13.1	12.8	12.5	13.3	13.8	13.3	13.5
Faisalabad	11.6	11.5	11.1	10.6	10.8	11.2	10.8
Multan	20.5	18.7	18.5	18.4	18.9	18.2	19.3
Hyderabad	39.2	37.0	35.9	35.1	34.8	28.6	27.7
Sukkur						49.4	49.4
Quetta	20.7	21.4	20.8	20.1	20.7	20.4	20.8
Karachi	37.5	34.2	33.8	38.5	37.3	34.8	32.6

Source: NEPRA, State of Industry Report 2010, 2011, 1 percentage gap between units purchased and sold/billed by the firm

Table 1.3 Distribution Network, Revenue Losses[1] for Domestic Consumers, (%)

Distribution Company	*2008*	*2009*	*2010*	*2011*	*2012*
Peshawar	23.0	48.3		28.0	48.8
Islamabad	2.0	-3.0	0.4	4.0	-1.1
Lahore	1.0	3.8	3.1	0.8	-1.5
Gujranwala	2.0	3.1	4.1	2.0	3.4
Faisalabad	1.0	1.8	1.7	0.8	0.2
Multan	1.0	2.2	3.6	1.7	1.2
Hyderabad	26.0	42.1	51.1	54.1	36.7
Sukkur[2]					62.8
Quetta	10.0		28.2	31.0	26.5
Karachi	100.0	0.0	0.0	17.1	16.2

Source: NEPRA, State of Industry Report 2010, 2011. 1 percentage gap between amount billed and amount recovered, 2 Sukkur was part of Hyderabad before 2012. The negative numbers shows additional recovery on account of deferred payments for previous years

Despite area-losses correlation, the other factors in poorly performing distribution regions cannot be ignored, these include lack of good governance, law and order, and economic development[18]. High system losses of distribution companies manifest in the power purchase price for distribution companies, in 2010 price ranged from 7.6 rupees per kilowatt hour to 11.4 rupees per kilowatt hour[19]. The high revenue losses in technically inefficient distribution companies suggests that incentives for improvements in management are low, while new investment is not taking

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[18] Particularly poor law and order and weak political administrative structure in Quetta QESCO, Hyderabad HESCO, and Peshawar PESCO regions

[19] The variation in regional power purchase price is not in contradiction with uniform tariff policy as average tariffs are affected by consumer mix and other tariff adjustment by the regulator (as shown in Table 1.9).

place due to poor financial performance that in turn will restrict the capability of firms to improve system losses, and that becomes a vicious circle.

Tables 1.2, 1.3, and 1.4 show the time trend for system losses, revenue losses and potential consumers without electricity respectively. In theory, housing units without formal electricity connection are not connected to the system, but in practice they might be informally connected to the system without any billing meter[20], particularly in congested areas and remote areas where monitoring of the system is poor or staff submit to bribes. A major fraction of household consumers are not connected to the system in distribution networks operating in Peshawar (PESCO), Hyderabad (HESCO), Karachi (KESC), and Multan, coincidently the distribution system losses are also high in these firms (Table 1.2). This supports the hypothesis that households not connected to congested systems, such as KESC, enjoy electricity stolen from the system. However, it is difficult to attribute system losses to theft in low density networks, such as HESCO, because the system is losing at low voltage lines while supplying electricity to a dispersed population, for instance a high feeder is supplying electricity on long low voltage lines to a few scattered houses with low demand.

[20] An illegal connection to system without a meter is called "kunda" (the hook on the wire) in local jargon

Picture 2: Electricity Theft, Illegal Connections with Distribution Lines

Source: DAWN

On the other hand, all is not well with medium density low distribution loss networks as high technical inefficiency and system losses prevails in these networks as well. Again this can be a result of poor engineering design, other technical losses, and managerial inefficiency. For instance Gujranwala Electricity Company (GEPCO) is considered to be among the better performing utilities according to regulator reports, however in more than 40 % of GEPCO sub-divisions system losses are higher than 12 %.

Table 1.4 Domestic Consumers without Electricity, (%)

Distribution Company	*Potential Consumers 2012*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Peshawar	2,761,232	45.2	42.7	41.5	41.2	37.4	36.6	36.0
Islamabad	1,882,619			0.0	0.0	0.0	0.0	0.0
Lahore	2,258,940	14.1	11.5	8.6	7.3	4.9	2.6	0.6
Gujranwala	2,808,748	20.6	17.1	14.6	12.5	10.0	7.7	5.7
Faisalabad	2,712,234	30.4	25.7	21.2	18.1	15.8	13.4	11.3
Multan	3,888,629	45.4	40.2	35.8	33.8	31.2	29.5	27.3
Hyderabad	718,422	71.2	70.5	70.3	70.2	70.1	70.1	67.5
Sukkur	552,110							72.8
Quetta	394,843	71.9	71.2	70.6	70.0	69.7	69.6	69.4
Karachi	1,659,766	22.2	21.3	21.6	22.5	21.5	20.6	20.8

Source: NEPRA, State of Industry Report 2010, 2011, estimate suffer substantial downward bias due to lower estimated total potential consumer data in the distribution network, particularly in later years, the last Population Census was conducted in 1998 and the available projections are much lower than actual figures based on partial housing census of 2012.

Overall issues with system losses, engineering design, and managerial practices will affect cost of electricity supply. The system losses result in higher average unit cost of electricity with negative welfare consequences for consumers. The shortage of bulk supply coupled with system losses result in long periods of load shedding and low system reliability. The system reliability in industry is measured by utilities reporting System Average Interruption Index (SAIFI) and System Average Interruption Duration Index (SAIDI). The long durations due to lack of power supply in the system render SAIFI and SAIDI meaningless as it becomes hard to disentangle the interruptions when there was no power supply and the interruptions when power supply was there, but utility network collapsed due to poor technology. SAIFI and SAIDI are reported in Table1.5 below.

Table 1.5 Distribution System Performance, 2008-09

Distribution Company	*Consumers*	*SAIFI*[1]	*SAIDI*[2]
Islamabad	2,059,207	0.5	22.8
Lahore	3,182,292	100.2	6847.7
Gujranwala	2,454,254	17.3	19.4
Faisalabad	2,879,188	64.9	114731.9
Multan	4,057,491	0.03	2.01
Peshawar	2,947,108	193.97	15787.43
Hyderabad	1,511,878	918.53	83969.3
Quetta	490,805	155.4	12757.3
Karachi	2,051,964	0.1	1074.6

Source: NEPRA, State of Industry Report 2010, 1 SAIFI= (Frequency of Interruption/Total Connected Customer) 2 SAIDI= (Hours of Interruption/Total Connected Customer)

1.2.2 Transmission Network

The transmission network plays a fundamental role in coordination and achieving system economies, and enables the reliable, stable, and efficient supply of electricity for final use in homes, markets and industries. The importance of the transmission network in electricity industry depends on its critical function and not just operational cost, as the smaller cost[21] component of the transmission network in total cost of electricity can be misleading (Joskow and Schmalensee, 1983). Generation and transmission

[21] The cost components of generation, distribution, and transmission in Pakistan are 90%, 8%, and 2% respectively. However when system losses are included effective cost of network components increase substantially.

operations of electricity are simultaneous decisions, transmission lines link power plants to load centres, and installing new generation capacity depends on interconnectors and lines facilities provided by transmission companies. The long run, low cost supply of electricity depends on investment and new technology adoption in transmission, and with a high level of coordination between generation and load centres. Lack of coordination and investment in transmission systems can make generation investments ineffective or can delay the supply of electricity due to dysfunctional interconnectors[22], this institutional context of electricity industry has favoured vertical integration of generation-transmission and distribution. The existence of economies of scale in the use of high voltage lines and transmission links make transmission networks work efficiently as a natural monopoly. While the natural monopoly structure of transmission exists in the electricity industry, however for efficiency reasons high level coordination between transmission and other components of industry is required for an efficient and stable system.

Sunk costs in investments, formal and informal contracts, and system externalities are main features of any transmission network. The investment decisions by transmission operators require high level coordination between load centres and generators, as post investment

22 For instance, recently a number of new power plants failed to supply electricity because of inadequate capacity of interconnectors and transmission system (NEPRA 2011).

reallocation of transmission infrastructure and resources becomes costly. It is not clear that decentralization (unbundling) in industry structure will increase or reduce the electricity supply cost in the system. This aspect is important in Pakistan where policy making authority appears to pursue more decentralization and structural disintegration in the system with independent distribution and transmission networks. The successful unbundling of electric power will require mechanisms for the enforcement of formal contracts and regulatory set up to resolve contingencies uncovered in formal contracts.

National Transmission and Dispatch Company (NTDC) works as a licensed monopoly, sole service provider covering a large area. Although there is no optimal scale for system coordination, some past studies (Joskow and Schmalensee, 1988) mention 10,000 MW of peak demand for efficient scale of transmission network. The area coverage and peak load demand suggests problems in NTDC system, constraints in extra high voltage transmission lines resulted in increased forced outage of the power system (NEPRA 2010). Although the overall transmission losses in recent years are comparable with international standards (World Bank, 2012), see Table 1.6.

Table 1.6 Energy Generation, Units Sold, and Losses in NTDC System, 2002-2010

Year	*Net Generation(GWh)*	*Units Sold Billed (GWh)*	*Transmission Losses (%)*	*Distribution Losses (%)*
2002	59545	45204	7.6	16
2003	62694	47421	7.7	16.2
2004	67697	51492	7.3	16.1
2005	71670	55342	7.4	14.9
2006	80404	62405	7.1	14.8
2007	85987	67480	3.7	17.3
2008	84584	66539	3.4	17.5
2009	82705	65286	3.5	17.1
2010	87072	68878	3.1	17.4

Source: GOP, Electricity Demand Forecast, NTDC

The inexorable electricity demand in Pakistan, particularly the air-conditioning during summer months, has pushed the peak demand to 16,000 MW in the system[23] (NEPRA, 2011). In an electricity system, supply needs to meet demand in real time, the system becomes unstable if demand is higher than supply[24]. On the other hand, the system should be able to hold supply to match rising demand. System operators need to check the reliability of transmission systems to sustain peak demand, as policy makers are keen to increase supply to meet unfulfilled demand in the future. It appears that over the years, large gaps between demand and supply of electricity during long summer season has weakened the coordination

[23] The minister for power affairs recently mentioned in an interview that during hot summer month demand keeps on exceeding supply as system add electricity from more production or new plants. In summer, rolling blackouts have been observed since 2008 that imply system operator might not even know exact peak demand during summer.

[24] Constraints in transmission or distribution networks can make power system unstable; the load shedding is required to keep the system stable since 2008 load shedding is prevalent in country particularly in summer months.

system between transmission and distribution networks. The load centres (i.e. DISCOs) are unable to determine potential demand in the summer season, as full demand is not met in all parts of the network at any given time. There are even reported incidents stating that when some DISCOs tried to meet peak demand, the distribution network was unable to sustain the load.

1.3 Tariff Structure and Incentive Regulation

1.3.1 Cost of service and incentive regulation: theoretical aspects

According to the regulator, the electricity industry in Pakistan is subject to price, entry and quality of service regulation (NEPRA, 2010), the regulator, NEPRA, determines tariffs for transmission, distribution, and generation business of electricity. This section examines the theory of incentive regulation in the context of unbundled distribution and transmission electricity networks. The basic idea is to review the issues that arise when the regulator is imperfectly informed and faces asymmetric information about costs and managerial efficiency, and to document the optimal price mechanism in specific scenarios. The prevalent tariff structure in Pakistan is reviewed later to check the conformity with theoretical knowledge and also to see if the electricity industry satisfies basic assumptions for exposure to incentive regulation for unbundled electricity networks (Joskow, 2008).

The knowledge about effectiveness of electricity network regulation in Pakistan is limited, Afia (2007) documented the overview of electricity regulation in Pakistan, and highlighted issues including, the ineffectiveness of the regulator, the lack of autonomy and weak governance of NEPRA, although it is not quite clear what incentives there are for network operators in the current setup to cut cost and enhance efficiency. There are multiple factors affecting the current state of the electricity industry in Pakistan, but regulation framework and related incentives appear to be an important constraint in the growth of the electricity industry[25].

The proper incentives for firms, operating regulated networks, are important for the efficiency of networks and the generation segment, because well performing networks will lead to better decisions and operations by generation firms. The network service cost contributes to final electricity supply cost, better incentives manifested in lower networks cost can improve welfare for society. While documenting the regulatory discussion Kahn, A.E. (1971) noted that "......*the central institutional question have to do with the nature and adequacy of the incentives and pressures that influence private management in making the critical economic decisions*". Ideally networks should be operated at minimum cost and the regulator should specify the efficient network price. However, the

[25] The comparison of electricity industry between a state monopoly (till 2002), and regulated industry since 2002 requires deeper understanding of issues in both periods, and is not feasible due to limited information available.

economic incentives in lowering production costs are more important than enforcing the efficient pricing mechanism. This point is well documented in the literature, as the efficiency loss of high cost is of “first order” (impact all infra marginal units) while tariff or price inefficiency loss is second order (Harberger triangle). These earlier notions and the latter theoretical advances provide the foundation for incentive regulation in electricity and other networks.

In a typical situation ex ante, a regulator is not perfectly informed about managerial efforts, technical processes and other factors to lower networks cost, but can get more information through ex post regulatory hearings and mandatory audits. However, the distribution and transmission companies are better informed about the cost of production and managerial practices adopted to improve efficiency. In this situation two extreme tariff regimes can be followed according to Laffont and Tirole (1993).

The first regime is a fixed price regime, where network fees will be charged to consumers by distribution companies going forward. The fixed network charge will evolve by incorporating exogenous price changes in factor inputs; this is referred to as a price cap mechanism (Joskow, 2008). As a price mechanism is responsive to only exogenous price changes, the firm’s increased effort to lower cost will result in an equal amount added to the profit of the firm. Therefore the effective price cap mechanism provides greater incentives for the network operator to increase managerial efforts to reduce cost, improve system efficiency, and lower system losses. But given that the regulator wants to make sure that the firm meets budget constraints, uncertainty arises about the level of price cap. Too high a price cap can still generate incentives to lower cost but may leave large profits for firms, so the mechanism will not be good from "rent extraction" point of view.

The second regime is standard "cost of service regulation", under this mechanism the network operator will be compensated for all of the production or service costs incurred to run a network. This tariff plan makes sure that firms earn normal profit, so the "rent extraction" issue discussed above can be fixed, but on the other hand there are no incentives for firms to reduce costs as there is no economic rent left by the regulator. Therefore managers will not get a reward for any cost savings in the "cost of service" regulatory plan, or they will overspend in capital expense in line with Averch-Johnson effects. The fixed price (price cap) regime performs poorly on "rent extraction" while "cost of service" regimes will provide no space for being cost efficient. In an ideal situation a mixture of two regimes can perform better than the adoption of a single regime when the regulator is imperfectly informed about network costs (Joskow, 2008), so in effect the price will be contingent on variation in realised cost, while a portion of cost will be fixed ex ante (Schmalensee 1989, Lyon 1996).

As noted by Joskow (2008) the theoretical literature provides partial guidance for incentive regulation in electricity networks, and other circumstance based factors are also incorporated in the practical regulation mechanism adopted by regulatory authorities. In practice, a mix of "price cap" and "cost of service" mechanism is adopted by utilities. An initial price level P_o is set by using cost based or "return to capital employed" yardstick and adjusted with the rate of input price increase (RPI) and productivity factor z of firms in latter time periods, which gives equation, $P_1 = P_0(1 + \mathrm{RPI} - Z)$ (1).

The tariffs are initially imposed for usually five years and at the end of the period P_o and z are readjusted after post regulation audit and incorporating the firm's realized costs. In practice, incentive regulation requires an established cost of the service based regulation system. In Pakistan the cost of service or rate base regulation started effectively in 2004, and from then on the regulator conducts "pricing reviews" to determine tariffs for a period of time, this mechanism is evolving and recent regulatory reports mention methodological process of tariff determination[26]. In the next subsection the tariff or distribution margin determination process for distribution networks is analysed, this will serve two purposes. First, the regulator's information sources for distribution companies costs are highlighted, and the effectiveness of cost reporting protocols are assessed.

[26] NEPRA tariff determination 2012-13

Second, I check the potential of the regulator's current cost information for credible benchmarking of incentive regulation.

1.3.2 Cost of service and incentive regulation: practical issues

The analysis of incentive regulation for electricity networks usually assumes that the electricity supply is unbundled with a clearly defined distribution and transmission network, and the industry is regulated by an independent regulator staffed with adequate strength and skills to monitor the industry and implement regulation activities (Joskow, 2008), both of these assumptions are subject to caveats in Pakistan. Although the electricity delivery is unbundled, contractual relationships between network utilities DISCOs and transmission monopoly NTDC are not well established, at least on transparency grounds (NEPRA, 2010). The appointment of the board of directors for DISCOs and interference of NTDC in DISCOs highlights the lack of independence by utilities to run their managerial affairs. The regulator faces constraints to implement the procedures and monitor generation and transmission activities, and standard procedures to supply basic industry data have not yet been adopted by distribution networks, from regulator reports it appears that although uniform system of accounts for DISCOs were proposed, such systems have not been operational till recently.

The cost of electricity supply includes generation cost, transmission cost, and distribution margins (DM), these tariff components are fixed by the regulator NEPRA. In 2011 the distribution margin including line losses contributed to approximately 25 % of the average electricity cost, while transmission network fees were less than 2 % of average electricity cost[27]. The tariff structure is based on cost of service or rate of return regulation, the electricity networks recover costs through distribution margin and transmission cost. The cost is collected from consumers by Distribution Companies DISCOs, and then DISCOs transfer power purchase price[28] including transmission fees to the central transmission/dispatch company NTDC[29]. In a single buyer model, NTDC procures electricity from all generators at the prices agreed in Power Purchase Agreements (PPA) and transmits bulk power to DISCOs on high voltage lines. The regulator enforces the tariff mechanism under the principle that network operators (transmission and distribution firms) recover sufficient return on capital to cover all operation costs and reasonable funds for capacity expansion for future needs (NEPRA 2010). The tariff is imposed for a period, and intermediate requests for fuel adjustment charges are entertained by the regulator. The frequency of pricing reviews and average cost for a selected

[27] Estimates based on public data (NEPRA 2011)

[28] Power Purchase Price PPP is a pass through cost item.

[29] NTDC is given transmission license for a term of thirty years in 2002 by the regulator. *"The Company is entrusted to act as System Operator (SO), Transmission Network Operator (TNO), Central Power Purchase Authority (CPPA) and Contract Registrar and Power Exchange Administrator (CRPEA)"* (NEPRA 2011).

distribution company are shown in appendix Table 1.1A and Figure1.2 respectively.

The regulatory tariff standards listed in the appendix (see Table 1.2A) and the discussion above imply that the current practice of price regulation in the electricity industry is set in a “cost of service” or rate of return framework. There is no “price cap” mechanism enforced and tariff petitions are settled on a case-to-case basis. The distribution networks are publicly owned monopolies facing no incentives to cut operation costs or line losses as ultimately government through subsidy have to finance the cost of the distribution companies to meet their budget constraints. Earlier, some of the distribution companies proposed multi-year tariffs for five year periods, but the regulator declared an incentive based price cap regime unsuitable for the government owned distribution companies, until the companies are partly divested or privatized (NEPRA 2004). All of the distribution networks in the main system are government owned; therefore the chances of incentive based regulation are minimal until distribution firms are privatized.

1.3.3 Current incentive frame work and payment structure

The cost of service regulation prevalent in the electricity industry of Pakistan along state ownership of generation, transmission and distribution businesses have not allowed any cost minimization incentives in the industry (see section 1.3.2). However, Government of Pakistan is facing stringent financial conditions by International Monetary Fund (IMF) to reduce tariff differential subsidies for electricity industry and to mobilize more resources and lower associated costs of the electricity supply. The transmission and distribution business is owned by government[30] and in addition government also owns some of thermal generation business. In settings of principal agent model, the ministry of water and power (MWP) acts as principal on behalf of government while management of transmission, distribution, and generation companies are agents to the principal.

The top management of state owned entities in the electricity industry directly face incentives as poor performance will result in the removal or transfer of the management. At retail level distribution companies (DISCOs) face incentives to lower distribution losses and eliminate revenue losses (see section 1.2), however institutional capacity and political constraints curtail these incentives. One of the institutional constraints is high exogenous system losses resulting from given state of technology, and in addition the financial health of the distribution companies does not allow for the required investment in infrastructure that will lower the system losses. The political constraints include ineffectiveness of government and non-availability of law enforcement

[30] Except privatized utility KESC in Karachi

apparatus to lower the pilferage and recover unpaid bills particularly in politically troubled parts of the country. There is evidence that incentives faced by lower tiers of management in distribution companies are not consistent with the incentives faced by their top management due to corruption incentives at lower tiers (GOP 2013).

The distribution companies can stop supplying electricity to the areas where revenue coverage is substantially lower and system losses are unreasonably high. However the regulatory authority have shown reluctance to allow distribution firms to stop supplying electricity to a high loss feeder as the minority paying regular bills with a legal connection might suffer from the indiscriminately operated power cuts in the affected areas. The incentive based power cut policy was adopted initially by privatised utility in Karachi and lately government distribution companies have started implementing this policy in some parts of the country.

The incentives faced by the main transmission company, NTDC, are similar to distribution networks, where lowering the losses will result in lower effective wheeling cost. However institutional constraints not allow for required investment to improve system performance. The ministry of water and power (MWP) reports that required investment to revamp the national grid is around $ 6 billion, while currently regulator allows $885 million total annual investment to distribution and transmission segment of the industry[31].

The thermal generation capacity is partly owned by private sector IPPs and partly owned by government owned companies GENCOs. The power plants are allowed a certain heat rate by the regulator and plant manager have incentive to economize on that heat rate by minimizing cost of electricity generation. The IPPs potentially reap any heat based incentives demonstrated by load factor and total output, while government plants have lower available capacity as plants are quite old and not well maintained (see Chapter 2). Therefore government owned plants are restricted to increase total sales with given dependable capacity which is much lower than installed capacity.

The Ministry of Water and Power (MWP) notifies effective tariffs for the sale of electricity to final consumers in the country, these effective tariffs are lower than the tariffs determined by the regulator that results in tariff differential subsidy. The MWP faces incentive to allow regulator determined tariffs that will lower subsidy and free up more fiscal resources. However, political constraints restrict the incentives to increase the tariffs as low income household consumers are concentrated in some of inefficient

[31] Total investment estimates based on various regulatory tariff determination reports

distribution companies, while government want to pursue a uniform tariff policy in the country (see section 1.2.1).

The system of payments in the electricity industry is shown in Figure 1.2. The distribution companies (DISCOs) conduct retail business and collect revenues for the sale of electricity, after deducting electricity distribution costs the DISCOs transfer payments to the transmission company NTDC that also performs the role of Central Power Purchase Agency (CPPA) based on the single buyer model. As the net revenues of distribution firms fail to cover cost of total electricity purchased, the ministry of water and power MWP transfers tariff differential subsidy to the power purchase company to settle the accounts of government owned generation companies and private IPPs. The delay in the subsidy payments and poor recovery of sales revenue by distribution/retail firms create circular debt in the supply chain and effects electricity supply in the system (GOP 2013). The lack of transparency and delay in subsidy payments to the distribution firms impact the financial performance of the distribution companies. The financial dependence of the distribution companies on Central Power Purchase Company (CPPA), which also runs transmission business NTDC, potentially create incentives for distribution companies' management to keep coordination high with CPPA and NTDC management, that forces de facto vertical integration of the government owned electricity supply business.

Figure 1.2: System of Payments in Electricity Supply Chain

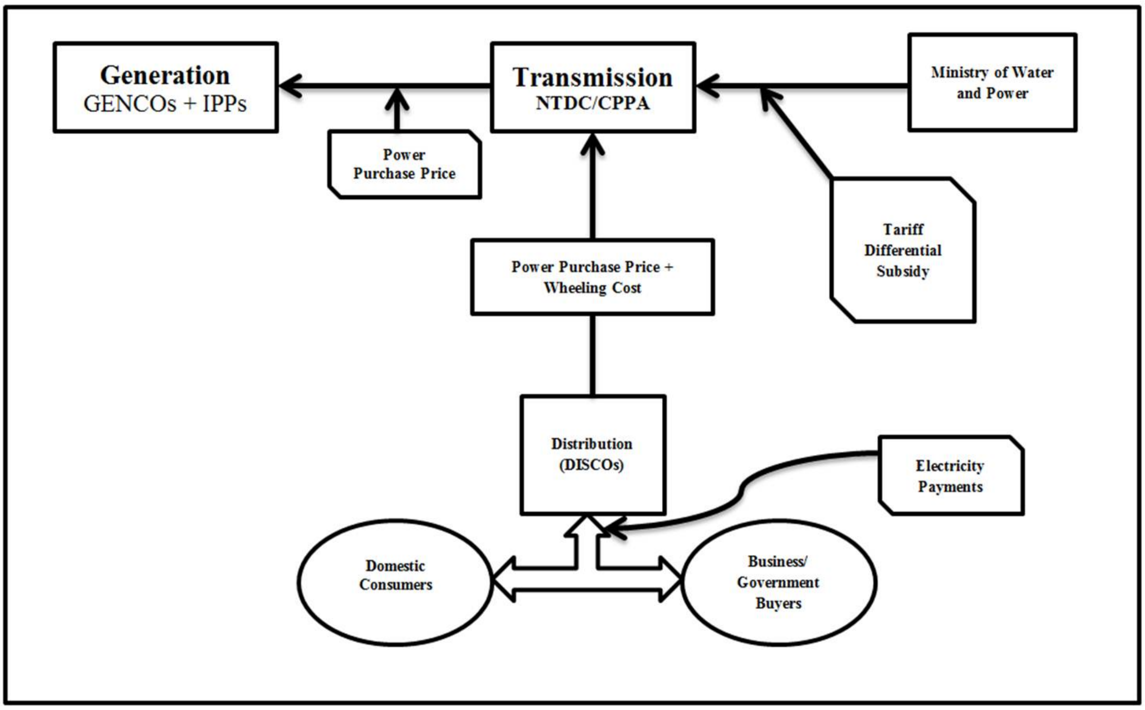
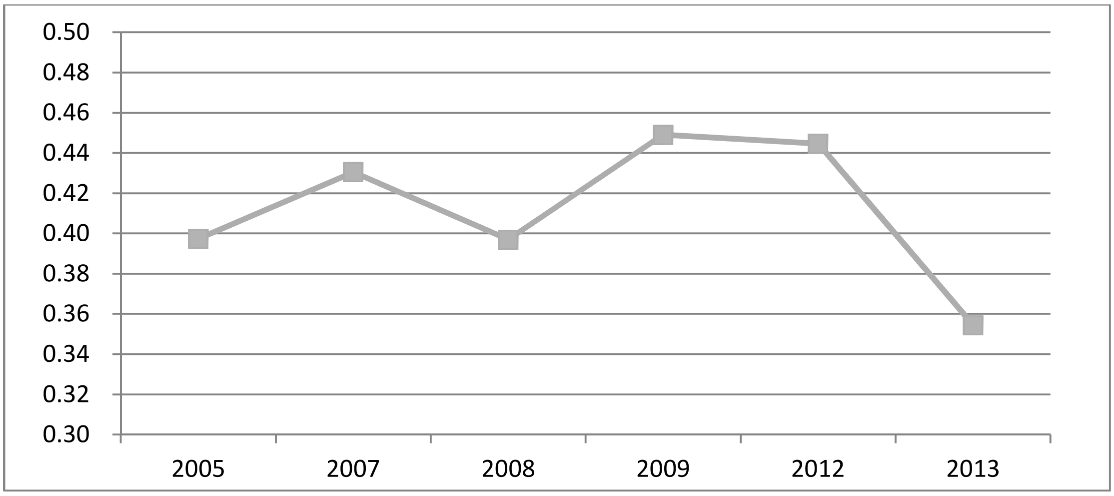


Figure 1.3: Real distribution cost, GEPCO (rupees per kWh)



Source: NEPRA, Tariff Determination Reports Various Issues, 200-01 constant prices

1.3.4 Case study of a distribution network

The analysis based on a sample distribution company, Gujranwala Electric Power Company (GEPCO) shows that the regulator determines a firm's distribution margin on the basis of reported costs for operation and maintenance, depreciation, and Return On Rate Base (RORB) (e.g. cost of capital). The frequency of pricing reviews for GEPCO is given in Table 1.1A. The distribution margin[32] is the economic rent which the firm gets for operating the distribution network. The margin consists of operation and maintenance expenses, depreciation charges, and return on rate base, further

[32] Although revenue requirements of a distribution network includes power purchase price including transmission network user fee but that requirement is part of transfer fees so not directly related to incentive items for a distribution company.

adjustments are made for any income earned by the firm. The detail of the distribution margin components is given in Table 1.7.

Operation and maintenance expenses, including wage and salaries, are the largest component of a distribution network's cost (about 90 %) excluding transfer prices for generation and transmission companies. Distribution networks are public owned companies and jobs are sanctioned for various pay scales historically with employees entitled to post retirement benefits. The regulator allows costs for salaries and wages based on past audited figures with the adjustment of annual pay increases of public employees and the impact of hiring on vacant positions, with very little allowance for new staff hiring, particularly with non-technical contract employees[33]. But pricing reviews reveal information asymmetry with the regulator, for instance, in 2012 the regulator allowed Rs3,563 million for wages and salary, while audited account puts the figure at Rs5,040 million. Apparently, the company spends money through public exchequer and put in prior year adjustments in the next year "pricing review". This shows a lack of consistent accounts data availability for current expenses of workers' wages and post-retirement benefits. The regulator matches the GEPCO request for new staff hiring with the justification for "prudent utility practices", while neither of the firms supply matching information on any

[33] GEPCO is a 100 % Public Sector Company since unbundling the employees are hired on contractual basis and regularised to permanent posts after sometime.

potential “efficient utility practices” gained by new hiring, nor does the regulator specify any yardstick for new appointments. This is quite similar to the situation when new investment requirements by the firm are matched with potential system improvement gains to justify new investment. The lack of information coordination between the regulator and the distribution company underlines the gap in current cost-based regulation regime. This information gap needs to be filled in order to set the platform for incentive based regulation and continual human capital investment in the distribution firm.

Since regulation started in 2004, it is important that in this early stage, standards in cost-based reporting are set and benchmarks are established in order to perform cost-based regulation effectively. To some extent goals were set at the same time as the “rate base” was set in 2004, and updated accordingly in pricing reviews (Table 1.8). However, the basic accounting information is coming from the distribution company through internal audit reports. The regulator requests for the required information from firms, but have not commissioned any study to determine the standards for various cost components, listed in Table 1.7 and Table 1.8.

Table 1.7 Distribution Margin GEPCO, Selected Years (million rupees)

	2006-7	2007-8	2008-9	2011-12	2012-13
Operation and Maintenance	3,298	3,254	3,739	6,318	5,454
Depreciation	510	556	829	971	1,098
Other Income	-970	-970	-1,116	-1,505	-1,960
Return on Assets	893	799	1,522	1,313	1,583
Income Tax		195[1]			
Net Distribution Margin	3,732	3,833	4,979	7,097	6,175

Source: NEPRA, Tariff Determination Reports Various Issues, data is missing for some years. 1: income tax paid on profit earned.

Table 1.8 Rate Base GEPCO, Selected Years (million rupees)

	2011-12*	2012-13**
Opening Fixed Assets in Operation	27,681	31,379
Assets Transferred During the Year	3,698	2,914
Gross Fixed Assets in Operation	31,379	34,239
Less: Accumulated Depreciation	9,387	10,485
Net Average Fixed Assets in Operation(Rate Base)	21,992	23,754
Plus: Capital Work In Progress (closing)	2,811	4,371
Total Fixed Assets	24,803	28,125
Less: Deferred Credit	11,516	13,324
Total Regulatory Base	13,287	14,801

Source: NEPRA, Tariff Determination Reports Various Issues, data is missing for some years,* actual, ** projected

According to regulation rules, sufficient tariffs should be allowed to generate a reasonable investment in technology to maintain the system and improve the reliability of the electricity supply (NEPRA 2012-13). In practice the regulator cares for the effect of a firm's capital investment on rate base, so that chances of overinvestment can be reduced. However there is no mechanism available to ascertain a reasonable amount of investment in infrastructure that will ensure a reliable electricity supply. In regulatory pricing reviews, GEPCO have not provided evidence of any perceived benefits of proposed investment to the regulator, but the regulator allowed investment on the basis of past trends. This shows a gap of information in the regulatory system which can result in overinvestment or under investment in infrastructure for distribution companies. Since a reliable electricity supply depends on continued investment in infrastructure, the regulator should develop a detailed knowledge base for the investment needs of distribution firms after taking into account future demand growth and system reliability.

1.4 Public Sector Ownership, Subsidy, and Reforms Experience

The network part of the electricity supply including distribution companies DISCOs and the transmission company NTDC are publicly owned monopolies[34], this is in line with industry practice in most countries where the natural monopoly part of a power supply chain is treated as a regulated monopoly[35]. The power sector reform started in the 1990s to unbundle electricity and thereby establish distribution networks as independent organizations with their own command and management structure. However corporatization of DISCOs has not been worked out fully and no formal contractual relationship exists among transmission, distribution and generation (government owned) segments of the industry

[34] There are also some generation plants owned by public generation companies GENCOs, status of GENCOs and related issues are analysed in Chapter 2.
[35] Although electricity networks can potentially save resources as regulated natural monopolies, but they are not necessarily government owned in practice.

(NEPRA 2010). A new government-owned establishment, Pakistan Electric Power Company (PEPCO), was formed in 1998, to corporatize generation, distribution and transmission units of the vertically integrated state monopoly WAPDA, and make these entities administratively and financially independent.

Published reports by the regulator suggest that PEPCO continues to interfere in matters of government-owned generation and distribution firms, posing problems for independent and optimal decision making and resource allocation of these firms. The distribution networks claim that noncompliance of efficiency and quality regulation targets results because of centralized management of routine decision making through PEPCO (NEPRA 2011). This gives an impression that the power industry has not completed the transition from state monopoly to unbundled electric supply. On the one hand, the efficiency gains from vertical integration and central planning have decreased, while on the other hand, scant benefits have emerged from unbundling. The actual situation regarding overall management practices in industry might be even worse, as in the past all of the firms were part of a vertically integrated monopoly with coherent managerial hierarchy, while in the post-reforms period there is an increase in an interventionist role of other ministries and corporatization departments[36].

In the following discussion, two questions are raised. Firstly, what is the role of public institutions in allocating resources among distribution firms and how efficient are these transfer mechanisms? Secondly, what is the motivation for changing ownership from public to private enterprise in the electricity industry and is there any evidence within the industry to support this?

The government of Pakistan has adopted a uniform electricity price policy across the distribution networks in the country, although prices vary across different customer categories within each distribution network. The regulator determines the retail price of electricity for a distribution network after taking into account revenue requirements of the firm including distribution margin, while the government only allows a uniform end user price according to the lowest determined price for each customer category among all distribution firms (Government of Pakistan GOP, 2013). The government does not allow the full passing on of the electricity supply cost to customers, the gap between the cost of electricity and government set tariff results in a subsidy referred to as tariff differential subsidy (TDS), Table 1.9 highlights this gap for few periods. The failure of the government

[36] A complete study of history of reforms requires detailed information and goes beyond the scope here.

to settle tariff differential subsidy, regularly results in the accumulation of Circular Debt[37] in the electricity industry. The other major contribution in this resource gap emerges from the inability of distribution firms to collect revenue (either in the shape of no recovery of bills or high system losses, see Table 1.1).

Table 1.9 Average Cost of Electricity Supply and Price charged in Rupees

Period	*Cost Per[1] KWh*	*Price Per[2] KWh*	*Gap Per KWh*
24 February 2007	5.14	4.25	0.89
01 March 2008	5.6	4.78	0.82
05 September 2008	8.42	5.58	2.84
25 February 2009	8.42	5.63	2.79
01 October 2009	8.42	5.96	2.46
01 January 2010	10.09	6.67	3.39

Source: NEPRA, State of Industry Report 2011, 1 Cost based Tariff determined by regulator 2 Consumer-end Tariff determined by Pakistani Government

The tariff differential subsidy is transferred by the central government to central power purchasing company NTDC, and the NTDC allocates the subsidy among distribution firms. During 2007 to 2012 Rs1.29 trillion worth of price subsidies for distribution networks was transferred to the central transmission company. There is no transparent information available for the transfer of these payments (GOP 2013). Assuming transfers are made according to the actual difference between regulator price (cost of

[37] Circular Debt is common terminology in Electricity Industry of Pakistan, the debt is caused by accumulation of deficit which results when payments flow in supply chain of power is affected. The distribution companies do not pay the transmission company (power purchasing agency) that does not pay power generators who do not pay to oil/gas supply companies for fuel.

electricity supply) and the consumer end price (government allowed), the resulting subsidy allocation mechanism lacks any incentive for an efficient distribution firm. On the contrary, subsidy payment compensates for inefficiency caused by a distribution firm.

For instance, Peshawar Electric Supply Corporation (PESCO) experiences the highest operation cost including line losses, but it charges the end consumer the price of the lowest cost supply firm according to the government policy. As a result, PESCO recovers substantial business cost through tariff differential subsidy, while an efficient supply firm collects most resources through consumers. Since fulfilling budget balance constraints and subsidy internalization, the mechanism is not transparent and the exact welfare consequences for each firm are not clear. However, in the current regulation and subsidy transfer system there are virtually no incentives for unbundled electricity networks to increase efficiency and reduce system losses.

Another issue with electricity industry reforms is the public good nature of the electricity supply, although textbook classification will categorize electricity supply as marketable private good but the practical situation might require other considerations on equity grounds. The electricity is generally supplied to domestic customers on low voltage wires and due to resistance the system loss is high on low voltage lines compared to long distance high voltage lines. The bad state of town planning in most urban localities of Pakistan resulted in inefficient engineering design of distribution networks (NEPRA 2011). The situation in rural localities and small towns and villages is even worse where due to political pressure the state monopolies provide electricity connections to remotely located consumers, without evaluating the cost and benefit of the additional connections to the system. The village electrification plan is one example of politically motivated electricity provision as electricity system is owned by the federal government and members of parliament make implicit or explicit commitment to voters for the supply of the electricity. However it can be argued on equity grounds that the people located remotely from the national grid or distribution networks have same right to electricity supply as compared to the people living in towns and located near the distribution network. The poor engineering design of a distribution network increase infrastructure cost and in addition also results in increased system losses, as a result average cost of electricity supply increases for all consumers.

In that context, objectives of the basic model of the market based policy reforms and the future of electricity industry is not very clear according to available policy documents (GOP 2013a). The supply of electricity to additional households based on poor engineering design will result in more system losses and less revenues and if left to market either the system will collapse or the firms have to cut off inefficient connections. In current situation externality cost of system losses increase average cost of electricity supply for an average consumer. Instead of recovering the full cost of electricity from consumers the government is subsidizing the price of electricity by utilizing tax revenues. The reforms proposals by the government are not clear towards the long run ownership of the industry and perennial status of system losses (GOP 2013a).

The typical distribution network in Pakistan covers large geographical areas and with growing demand of electricity continual investment in generation and national grid is required for the secure future supply of the electricity. There is evidence that market alone might fail to generate sufficient investment for secure electricity supply, and the secure future supply of the electricity can be thought as a public good (Abbot 2001). The investment gap in infrastructure and concomitant system and revenue losses make future secure supply of electricity unreliable. Further research is required to understand issues with privatization and market based reforms the one utility so far privatised in Pakistan is still subject to large amount of public subsidies (Khawaja et al 2012).

1.4.1 Privatization Reforms

The basic idea of the 1990s strategic reforms for state monopoly was to make unbundled firms in the electricity industry administratively and financially viable and then sell these firms to the private sector. However, current financial chaos partially caused by the political pricing regulation regime (uniform end user electricity price), lack of financial transparency in unbundled firms, and the Circular Debt, probably provides few incentives to private buyers to invest in the electricity network business[38]. For instance, for some time now, there have been publicly owned distribution firms with high line and revenue losses potentially available for privatization,[39], but so far, have not been privatized despite government efforts.

In theory, if electricity is considered as a basic infrastructure facility and the government wants to continue the supply of electricity to consumers at an "affordable" price, then the government can transmit and distribute electricity in-house or procure through a private supplier. The private owner has an incentive to lower costs while facing a given output price, but the private supplier might lower product quality. The private supplier might lower quality of the product, as quality is non-contractible component of the contract (Hart et al, 1997). In the case of the electricity supply specifying quality of product is relatively easier than another public good such as schooling or hospital as electricity is a homogenous product. The private distribution firms can be monitored by a quality regulation regime with specific parameters including average interruption indices. The efficiency gains and asset ownership incentives also go in favour of the private

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[38] PEPCO formed in 1998 to monitor unbundling and corporatization for two years, the slow pace of reforms can be judged from the fact that PEPCO dissolution occurred in 2012

[39] Some of electricity firms including PESCO, QESCO, HESCO, and FESCO are listed on privatization priority list, not clear about the timing of the inclusion or any future selling date. Privatization Commission Pakistan http://www.privatisation.gov.pk/power/power.htm (Accessed 13 September 2012)

supplier, as private firms can offer a more flexible contract to employees depending on their human capital and experience.

However, it is not clear what the economic gains of privatizing a state monopoly (say a distribution network) will be, if the current regulation with asymmetric information along government's subsidy policy continues. Keeping the regulatory regime unchanged will result in an inefficient private monopoly instead of an inefficient public monopoly. The opinion on privatizing state owned firms is divided among policy makers and politicians (World Bank, 1997), overstaffing, non-performance based worker salaries, and lack of transparent procurement are associated with public owned electricity networks (GOP, 2013). However, in the absence of a fully informed regulator and without an incentive based regulation regime there is a chance that private firms will not function very differently than public firms.

The pace of privatization and market based reforms in the electricity industry is slow, so far one distribution firm, Karachi Electricity Supply Corporation (KESC), has been sold to private firms. KESC was privatised in 2005; the comparison between KESC and other distribution companies can give some idea for potential gains by privatizations on some selected indicators. As the government implements a same tariff policy in the whole country, so KESC also receives a public subsidy to cover the difference between cost of electricity supply and average tariff charged to customers.

However KESC's policy is to cut power for longer hours in the locations where revenue recovery is low and theft or system loss is higher. Although KESC earned profit for the first time in 2012, the system losses are still high (see Table 1.2). There is a modest reduction in KESC losses, again it is not clear if that shows improvement in infrastructure or the effectiveness of a better load shedding management plan. In comparison, no incentives are available to government owned distribution companies (DISCOs) to lower cost and improve quality of the electricity supply. The government recently reconstituted boards of directors for DISCOs and increased the number of private board members in these public companies, but still the utilities are far from privatization.

1.5 Structural reforms in other developing countries

The electricity reforms experience in the developing countries is quite varied and the reforms impact on the welfare of consumers and growth of the industry is not clear. In many instances the reform process includes entry of independent power producers (IPPs), unbundling of generation and transmission, establishment of a regulatory agency, and development of a wholesale electricity market. The cross country empirical evidence shows that neither unbundling nor wholesale market can reduce prices; however an independent regulator may result in a successful transition of the unbundling reforms (Nagayama 2007). The reforms experience also shows that lack of established regulation mechanism in developing countries can result in adverse consequences of structural reforms that impact consumer welfare (Wolak 2008). Although unbundling and structural reforms generate new investment opportunities in the industry but the reforms process puts stress on regulatory oversight, and weak regulation can result in failure of the structural reforms (Wolak 2008).

Some countries allowed commissioning of independent power producers while not changing the structure of state owned vertically integrated utilities, Thailand and Vietnam are sighted examples, where in Vietnam despite entry of IPPs the vertical integrated electricity supply company is owned by Electricity of Vietnam (EVN) (Nagayama 2007). Similarly in India 7 out of 28 state electricity boards (SEBs) are unbundled (Nagayama 2007). In Vietnam the weak regulatory process results in weak enforcement of the strategy to curtail system losses and the regulatory regime allows for tariff below average cost of electricity supply. In India the electricity supply is subsidized to farming sector and too low prices and high cost of electricity supply are restricting further investment in the generation capacity (Wolak 2008), the experience of Nepal is not much different than India where cost of electricity is not covered by consumer paid tariffs and the electricity industry is unable to generate sufficient investment (Nepal and Jamasb 2013).

Wolak (2008) emphasized that without lowering associated costs of electricity supply further restructuring reforms will bring less benefits to the consumers in India. The performance of the industry in Pakistan is quite similar to India or Nepal, where weak regulation allows electricity tariff below average cost and there are no incentives for new investment opportunities. However the source of weak regulation in Pakistan is not the regulator itself, where regulator determines tariff to cover the cost of electricity supply while federal government avoid passing on full cost to consumers and allows tariff differential subsidy. The analysis of industry documented by Wolak (2008) implies that there are higher short run benefits of improving regulatory oversight than the benefits from implementing further unbundling reforms. The unbundling reforms in Pakistan have posed challenges for regulators as well where transition from vertical integration to unbundled supply is not smooth (see section 1.2).

Finally, system losses in India, Nepal, and Pakistan are much higher than Vietnam; the high losses highlight chronic investment deficit and bad governance issues in former three countries. The regulator in Pakistan is reluctant to allow infrastructure investments to network companies under current ownership and performance status. Therefore the government of Pakistan require strengthening the regulation system and removing tariff distortions that will improve financial health of the transmission and distribution firms and provide incentives for second round of the market based reforms.

1.6 Concluding Remarks

The cost of supplying electricity and the price charged to consumers are two basic parameters that can be employed to evaluate the performance of power sector reforms and the future of the industry. The production incentives generated by current ownership structure and the regulatory regime, along with other residual factors, are affecting price and cost of the electricity supply. The price charged for electricity produced is not covering the cost of production giving incentives for consumers to overuse electricity. The inefficiencies in distribution networks including high line losses and low recovery are imposing high costs for the electricity supply.

The technical losses in the system cannot be disentangled from non-technical losses (including theft), continuous investment in physical capital and system maintenance required to improve the reliability of the electricity supply and reduce technical losses. The experience of privatization of one utility does not support that non-technical losses can be reduced in short run with a change of management or ownership structure. The multiproduct nature of the electricity supply requires a reliable demand forecast, as the cost of the electricity supply in high-demand summer hours will be different from the low-demand winter season. The cost of the high-demand season supplies has to incorporate future investment in infrastructure in order to ensure reliability. In the current practice, the regulator and firms lack sufficient knowledge about the required investment and potential costs of the secure electricity supply.

In the current practice, investment rules of utilities that would affect system loss reduction efforts and timely investment for reliable supply of electricity are not being implemented. The distribution firms lack information for the investment gap or at least they cannot justify the required investment to the regulator, while the regulator has not set any tangible yardstick for better utility practices. This information asymmetry between the regulator and utilities is slowing down the growth of the electricity industry and is not reflecting the actual cost of a reliable electricity supply which might be substantially higher than determined by the regulator. The revenue losses and system losses create a real challenge to generate the investments required for revamping the basic network infrastructure, let alone moving to new technologies such as real-time monitoring and smart meters.

Further research should focus on the economic model of electricity supply in Pakistan to address the fundamental question, is electricity a public good, a private good or a marketable public good? The historical experience in Pakistani context puts electricity closer to being a marketable good supplied by the government. In the current situation, privatization will make electricity a privately provided public good as has happened in the case of Karachi Electricity Corporation (KESC), as KESC have supplied heavily subsidised electricity in private ownership since 2005. The politically motivated village electrification plan follows in line with the "cheap affordable electricity" model where the supply of electricity to a scattered housing unit could result in substantial system loss. The future industry reforms should be undertaken in light of further research and clarity on the business model for the electricity supply in Pakistan.

1.7 Data Appendix

Table 1.1A: Tariff Determination, Gujranwala Electric Power Company (GEPCO)

27-03-2013	Determination of the Authority in the matter of Petition filed by Gujranwala Electric Power Company Ltd. for Determination of its Consumer end Tariff Pertaining to the FY 2012 — 13
24-02-2012	Decision of the Authority in the Matter of Reconsideration Request filed by Ministry of Water & Power against Authority's Determination for GEPCO for the FY 2011-12
13-12-2011	Determination of the Authority in the matter of Petition filed by GEPCO for determination of its Consumer end Tariff Pertaining to the FY 2011-12
27-04-2011	Determination of the Authority in the matter of Petition filed by GEPCO for Determination of its Consumer end Tariff pertaining to the 2nd, 3rd and 4th Quarters (October - June 2011) of the FY 2010-11
09-12-2010	Decision of the Authority with respect to Motion for Leave for Review filed under Rule 16(6) of NEPRA (Tariff Standards and Procedure) Rules, 1998 by GEPCO against the Authority's Determination
08-09-2010	Determination of the Authority in the Matter of Petition filed by GEPCO for Determination of Consumer-End Tariff for 4th Quarter (April - June 2010) of FY 2009-10
19-04-2010	Determination of the Authority in matter of Petition filed by GEPCO for Determination of Consumer-end Tariff for 2nd Quarter (October-December) of Fy 2009-10
09-12- 2009	1st Quarterly Determination Based on the FY 2009-10 Determined under NEPRA (Tariff Standards and Procedure) Rules, 1998 for GEPCO
14-09-2009	Determination of the Authority in the Matter of Petition by GEPCO for Determination of Consumer-end Tariff for the Year 2008-2009 under NEPRA (Tariff Standards and Procedure) Rules, 1998.
15-01-2009	Modified Decision of the Authority on Federal Government's Request for the Reconsideration of Gujranwala Electric Power Company Ltd (GEPCO) Decision dated 1st January, 2009 [Case No. NEPRA/TRF-102/GEPCO-2008 (3)]
09-09-2008	Determination of Tariff in respect of Petition filed by (GEPCO) [(Case No. NEPRA/TRF-102/GEPCO-2008 (3)]
30-05-2008	Decision of the Authority on Federal Government's Request for the Reconsideration of GEPCO decision dated January 10, 2008 (Case No. NEPRA/TRF-36/GEPCO-2005)
01-02-2008	Biannual Adjustment in the Consumer-end Tariff on Account of Charge in Power Purchase Price
10-01-2008	NEPRA/TRF-36/GEPCO-2005 (Revised)
28-06-2004	NEPRA/TRF-23/GEPCO-2003

Notes: In between more than 35 “fuel price reviews” were conducted by NEPRA to adjust fuel prices in electricity supply prices.

Table 1.2A: Regulation Standards for Tariff

1. Tariffs should allow licensees the recovery of any and all costs prudently incurred to meet the demonstrated needs of their customers, provided that assessments of licensees' prudence may not be required where tariffs are set on other than cost-of-service basis, such as formula-based tariffs that are designed to be in place for more than one year
2. Tariffs should generally be calculated by including a depreciation charge and a rate of return on the capital investment of each licensee commensurate to the earned by other investments of comparable risk
3. Tariffs should allow licensees a rate of return which promotes continued reasonable investment in equipment and facilities for improved and efficient service
4. Tariffs should include a mechanism to allow licensees a benefit from, and penalties for failure to achieve the efficiencies in the cost of providing the service and the quality of service
5. Tariffs should reflect marginal cost principles to the extent feasible, keeping in view the financial stability of the sector
6. The Authority shall have a preference for competition rather than regulation and shall adopt policies and establish tariffs towards that end
7. The tariff regime should clearly identify interclass and inter-region subsides and shall provide such subsides transparently if found essential, with a view to minimizing if not eliminating them keeping in view the need for an adequate transition period
8. Tariffs may be set below the level of cost of providing the service to consumers consuming electric power below the consumption levels determined for the purpose from time to time by the Authority, as long as such tariffs are financially sustainable
9. Tariffs should, to the extent feasible, reflect the full cost of service to consumer groups with similar service requirements
10. Tariff should take into account Government subsidies or the need for adjustment to finance rural electrification in accordance with the policies of the Government
11. The application of the tariffs should allow reasonable transition periods for the adjustments of tariffs to meet the standards and other requirements pursuant to the Act including the performance standards, industry standards and the uniform codes of conduct
12. Tariffs should seek to provide stability and predict ability for customers; and
13. Tariffs should be comprehensible, free of misinterpretation and shall state explicitly each component there of

Source: NEPRA (2010)

2 Comparative Efficiency of Public and Private Power Plants in the Electricity Industry of Pakistan

2.1 Introduction

The electricity industry in Pakistan has been in transition for the last two decades, the financial constraints in public sector and perceived potential efficiency gains from private enterprise motivated the government to initiate restructuring and privatization in the electricity industry. The Government of Pakistan (GOP) have followed the policy of commissioning new generation capacity in the private sector with the non-utility owned independent power producers IPPs since 1994 (GOP, 1994). The new plants supplied electricity to two state owned utilities[40]. The initial reforms in the power generation segment are followed without much evidence on the productive efficiency of electricity generation plants or any comparative advantage across electricity generating establishments, either between private and non-private or utility and non-utility owned plants. The regulator's reports[41] present technical indicators of the performance of the public plants, but no information about comparative economic efficiency for

[40] During early transition there were two vertically integrated public utilities in Pakistan, Water and Power Development Authority (WAPDA) and Karachi Electric Supply Corporation (KESC). KESC was privatized in 2005, while WAPDA is in erratic transition.
[41] National Electric Power Regulatory Authority (NEPRA), the regulatory authority, publishes annual State of Industry Reports to review electricity industry progress.

public and private plants is documented in these reports, particularly after taking into account their distinct characteristics.

One exception is the study conducted by Saleem (2007), which shows that the public ownership of a plant have a negative impact on technical efficiency. In that study, the technical efficiency comparison between public and private plants is made in the stochastic frontier framework without any explicit discussion on the factor of cost of inputs[42]. The technical efficiency analysis is helpful to understand whether the plants achieve maximum possible output with given inputs, however the analysis does not tell us whether a plant is economically efficient. However, in order to check which system is supplying electricity at the lowest cost, it is important to analyse the performance of power plants from an economic efficiency or operational cost aspect. This chapter measures cost function for electricity generation plants after controlling for entrepreneurial and other relevant characteristics. The estimated unit cost function can give an indication for efficiency differential across government owned and private owned plants.

The electricity industry in Pakistan is performing poorly, as the current system is characterized with high unreliability, pervasive load-shedding, lack of investment in new capacity (to keep up with demand

[42] Different mix of inputs on same isoquant can result in different economic efficiency due to variation in factor prices.

growth), and system losses (both physical and due to theft). The World Bank's enterprise survey 2010 shows that, 65 % of Pakistani firms perceive that electricity is the main business growth obstacle. Rolling blackouts are common not only in small towns but in major cities as well. There can be multiple reasons for the current disorder in the electricity industry, but a first stage could potentially be the evaluation of economic efficiency in the industry. Overall economic inefficiency in the electricity industry can be caused by either issues with electricity prices[43] or operational efficiency in the generation, transmission, and distribution sector. However the main question in this chapter focuses only on evaluating efficiency in the generation component of industry. This is not to deny that the efficiency issues, for instance in the transmission system or distribution network, do not have implications directly or indirectly on the performance of generating units, but the idea is to evaluate in a simple cost function framework whether in the short run, existing generation capacity is being efficiently utilized or being operated at the least cost supply. The efficient performance of generating units can be considered as one of the necessary conditions for the overall economic efficiency of the system.

[43] Electricity price might not be equal to marginal cost.

In one perspective, this chapter evaluates the comparative performance of private enterprise in the electricity industry of Pakistan[44]. Since the generation sector is the major sector having substantial private firms; it is obvious to focus on the generation sector in this chapter. The entrance of the private independent power producers (IPPS) into the electricity industry of Pakistan is in line with international experience in order to increase the competiveness of the electricity generation segment, where the generation segment is thought to be a relatively competitive segment of the electricity industry (Joskow and Schmalensee, 1983). However, it can be argued that, if the reforms to encourage private enterprise in electricity generation are actually framed in order to enhance competition in the industry, or the new capacity is commissioned to cater for high demand that was not being fulfilled with existing public plants supply. According to recent policy briefs, GOP recommend transferring the ownership of public generation companies (GENCOs) to private management to increase the productive efficiency, this indicates that at a policy level there is some recognition that private enterprise is better for business. To draw any policy implications, it is desirable to estimate the productive efficiency according to plant ownership, this can give some idea

[44] However this comparison is not intended for "treatment-evaluation" as plant ownership is not exogenous.

for the extent of existing cost efficiency differential among public and private plants.

As discussed in Chapter 1, the reforms and regulation process could have a differential impact on the electricity generation operations of two large vertically integrated utilities, because Water and Power Development Authority (WAPDA) is still in transition and Karachi Electric Supply Company (KESC) is already privatized. In this chapter, empirical experiments include an efficiency comparison between the utility-owned government plants and utility-owned private plants. The regulation of industry has followed with the corporatization of the public utility-owned plants into generation companies (GENCOs) with changes in managerial practices, while the private utility owned plants[45] are either being substantially restructured or new plants are being commissioned during the sample period.

In order to create technological homogeneity across plants, the analysis in this chapter is based on fossil-fuel power plants (i.e. oil and gas based). Further, there are two institutional reasons for focusing on fossil fuel. First, the private investment is mainly limited to fossil-fuel plants, and the major share of new generating capacity (during last two decades) consists of fossil-fuel plants owned by private firms. About one third of the

[45] These plants are owned by Karachi Electricity Supply Company.

total electricity was produced by private generators in 2002, and the private sector share of production reached about two thirds in 2010. Second, fossil fuel plants are the major electricity producer now, and about two thirds of total electricity in the country is produced by fossil fuel, 57% of which is produced by oil and 42 % is generated by gas. Utility owned plants produce 40% of the electricity, while private sector IPPs generate 60 % of the total electricity produced. Almost all of the non-utility owned generating units installed since the 1990s run on fossil fuels, and the new investment in the generation segment which is mainly undertaken by private firms, is also for the plants running on fossil fuels.

The current evidence of comparative generation performance is more in terms of technical efficiency (Saleem, 2007), with the indication that private plants are more technically efficient. For the fossil-fuel plants, the technology of generation can be described as the process of generating heat from the fuel input (e.g. oil, gas, or coal) and converting that heat into electricity. The standard measure of fuel efficiency in electricity industry is presented as kilowatt-hour per heat unit (i.e. British thermal unit BTU), the available data supports the notion that fuel efficiency is higher for private plants than public plants. These findings are not surprising given the age of the independent private plants, as most of these plants started operation after the 1994 power policy. The important contribution of this study is to measure the economic efficiency of electricity production, as technical efficiency or fuel efficiency only covers the technical aspect of efficiency and does take into account the input cost. It is also important to measure the economic efficiency after controlling for other observable relevant variables which might impact on the performance of the plants.

In the short run the production efficiency can be evaluated from the cost of supplying electricity, which will depend on the efficient maintenance of plant equipment, minimum fuel costs, and the efficient utilization of labour (Joskow and Schmalensee, 1983). In theory, electricity generators connected to the national grid are minimizing costs given inputs and electricity prices, irrespective of the given market structure. Deviations from cost minimization behaviour can occur due to coordination and agency costs involved in plant management. These costs can be amplified when electricity prices are set by an asymmetrically informed regulator (Laffont and Tirole, 1993). Literature shows that management practices can also be an important factor associated with productivity differential across firms (Bloom and Reenen, 2010). There is a potential variation in management practices across plants, because non-utility plants are run by private entrepreneurs, probably in line with modern management practices, while the major portion of the utility owned plants are under bureaucratic management and have government employees, so public plants are still minimizing cost but with certain additional constraints which private producers do not face or can avoid.

The findings in this chapter show that, for the given sample, in the major part of the national grid the non-utility private owned plants[46] performed better than the utility-owned public plants. The average unit cost difference is large and significant between utility-owned public plants and private plants after controlling for the other factors. The findings raise doubts about the policy of using public plants as base-load plants, at least on the basis of average fuel cost comparison. It appears that high tariff charged by private firms might be blocking the way to use them as base-load plants.

The following analysis in the chapter is divided into seven sections. The next section discusses the institutional details of the electricity generation segment in Pakistan and the possible implications for cost of generation are followed by information about the sample in section 2.3. The empirical model is specified in the section 2.4, findings are presented in section 2.5. Section 2.6 contains a brief conclusion, and data appendices are included in section 2.7.

2.2 Electricity Industry of Pakistan

Historically, the electricity industry in Pakistan consisted of two vertically integrated utilities that were government monopolies. Karachi, the largest metropolitan area in Pakistan, is served by the Karachi Electricity Corporation (KESC) and the rest of the country was covered by the Water

[46] The term "non-utility private plant" and "independent power producers (IPPs)" are used interchangeably.

and Power Development Authority (WAPDA)[47]. The electricity industry is an important sector of Pakistan's economy, providing 15 % of final energy consumption. The power generation segment is also a major consumer of primary energy, 30 % of the total gas consumption and 42 % of the total oil consumption in the country is attributed to fuel consumption in the power generation segment. The electricity industry also receives a substantial subsidy (more than one third of electricity revenue) through the public exchequer. The industry has been in transition for the last two decades, with privatization, deregulation, and corporatization strategies running parallel.

The 1994 Power Policy allowed private firms to establish power plants and sell electricity to KESC, and WAPDA (GOP, 1994). This was in line with the industry experience that the generation segment does not need to be efficiently served by a few suppliers as compared to the transmission or distribution segment (Joskow, 1997). The Government of Pakistan 1994 Power Policy says that *"Presently the total installed capacity in the country is 10,800 MW. This capacity is insufficient to meet the demand on a year round basis....The system is characterized by a high degree of suppressed demand. Conservative projections for annual average increase in the demand are nearly 8% per year for the next 25 years,……such an ambitious*

[47] The current industry status changed with the privatization of KESC in 2005 and privatization and restructuring of WAPDA started in 1998, the fossil-fuel based power generation companies GENCOs of WAPDA work under Pakistan Electric Company PEPCO, in practice WAPDA is still a vertically integrated utility and restructuring and disintegration has not been worked out (Afia ,2007; NEPRA 2010)

programme cannot be financed in the public sector due to ceilings on Public Sector Development Programme (PSDP), and resource mobilization in the private sector is essential for meeting these development targets".

As new private sector investment was limited to electricity generation, it is desirable to understand the processes behind productive efficiency according to plant ownership, and to document any differential impact of the institutional changes on the unit cost of energy production between private and public plants. In the short run the production efficiency can be evaluated from the cost of supplying electricity, which will depend on the efficient maintenance of plant equipment, minimum fuel costs, and efficient utilization of labour (Joskow and Schmalensee, 1983), therefore it is essential to note the impact of reforms on each component of operational cost.

The fossil-fuel power plants currently connected to the system have homogenous technology; however there is a substantial variation in the vintage of these plants. The private plants are mostly new plants, while public plants are fairly old plants. The basic technology converts heat input (British Thermal Units) derived through oil or gas into electricity produced (kilowatt-hours). This means that technical efficiency will be higher in newer plants (i.e. private) than older plants (i.e. public), assuming that new technology can produce more output with a given heat input, after controlling for the calorific value of fuel. Recent reports by the regulator show that the average technical efficiency for private plants is about two times that of public plants, this indicates that government plants have a declining generation capacity and poor technical efficiency (NEPRA 2010). However, it is not clear whether the technical efficiency differentials are manifested in the cost performance of the power plants and overall economic efficiency of the system. In the absence of any existing research, published regulator reports and available data can be employed in order to understand the comparative economic performance of the power plants.

The early industry reforms were intended to disintegrate the main public utility (i.e. WAPDA) and convert public plants into independent generation companies (GENCOs), which will compete with the private producers to supply electricity to the national grid. At face value, the GENCOs are working as an independent establishment, however the failure of corporatization of WAPDA affected the financial independence and performance of public plants. Even the routine services of public plants are not timely performed, For instance, the failure of a timely procurement of spare-parts because of the lack of liquidity of the GENCO resulted in poor maintenance and operations of these plants (NEPRA 2010). The regulator's reports show that the existing public power plants need to be utilized round the clock to meet the persistent high demand over the year, this means the plants are probably used as base-load plants. The lack of mandatory shutdowns resulted in the poorly planned maintenance of government plants (i.e. major overhauling, hot gas path inspection, combustion inspection, and annual boiler inspection), therefore the plants run on partial load and forced outages of the plants also increases.

The average availability, peak load sharing to installed capacity, varies from 42 % to 58 % for public plants, which is much lower than for private plants. The load factor, an important industry indicator, defined as the ratio of total output to potential output at the maximum load assigned to a plant, also indicates the weak state of government plants. The average load factor for public plants is 50 % while for private plants it is 78 %. The lower load factor for the public plants (for a given amount of electricity produced) implies that the plant runs for a longer period in order to produce the given output, and possibly has more plant deterioration and higher fuel consumption to produce any given amount of electricity.

The privately owned electricity plants work under the 1994 Power Policy, this means that under the payment mechanism of the power purchase agreements (PPAs), monthly capacity payments consisting of debt service, fixed operations and maintenance costs, insurance and return on equity on an internal rate of return basis, were all assured even if no electricity was purchased. In addition private plants receive payments for energy purchased on a per unit energy charge basis. The upfront tariff mechanism can give an incentive not to operate the least cost supply plant, as the tariff system was not based on a competitive framework of installing a new generation capacity (GOP, 1998)[48]. The IPPs probably forecasted that plant factor for the initial years of production will be lower, given the growth and demand for electricity in the late 1990s, and therefore cash flows will depend on capacity price. How this affected their decision making during the investment process is not clear.

Labour efficiency can be a factor in the efficiency differential between government owned and private owned plants. The private generation companies are well managed, have better human resources (Khwaja et al 2012). Anecdotal evidence goes in favour of the transfer of experienced and skilled staff from public to private plants or elsewhere in the private sector, this is due to better incentives for engineering and non-engineering staff. The failure of corporatization of WAPDA raise doubt on any efficiency gains of better human resource management in government plants (NEPRA 2010). Similarly KESC privatization in 2005 might not have affected the labour management substantially, at least for the first few years[49]. In the public sector, over-staffing and related costs run high during the politically elected governments. Between 1999 and 2007 there was no major political change (i.e. a mix of authoritarian and democratic setup), but

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[48] It is less clear if Averch-Johnson effect is present as the average size of non-utility plants is smaller than utility owned plants. The political motivation arise from lack of transparency in firm selection process, and missing competitive bidding failed to sort out generation unit on least cost basis (Fraser, 2005).

[49] KESC's new management tried to reduce over staffing in utility recently, but failed to do that due to political pressure. Although the proposed staff reduction may not be for the generation component of the utility

GENCO’s were part of WAPDA and were exposed to political over-staffing before 1999 under successive democratic governments.

2.3 Data and Related Issues

The main sources of data are published reports by the National Electric Power Regulatory Authority (NEPRA). The estimation of plant level short-run variable cost efficiency requires sub firm level or unit level data, while collecting data the maximum possible disaggregation is utilized given data availability constraint. In the electricity industry a plant can house several independent units of various vintage. The definition of ‘the plant’ in this study depends on a mix of managerial, accounting and regulatory context. For instance, non-utility private plants are dispatched as a single unit, while public plants are dispatched unit wise or in blocks of units depending on fuel input used. However, unit level data makes arguable sense for short-run working cost performance, but in this analysis a plant can be an aggregate of several units or a single unit, depending on the availability of data.

As the analysis is focused on oil and gas based fossil-fuel power plants, the plants producing hydroelectricity have not been included in the sample. Further, two nuclear plants and one coal plant are also not included due to possible differences of fuel cost and technology compared to oil and gas based plants. The full sample includes 83 electricity generating plants/units that were operational between 2006 and 2011, and the sample size is 356 plant-years. Interestingly there is a match between disaggregation in available data and disaggregation required at plant level due to the unit variation of vintage within a plant. For instance, the variation in unit age within a plant is higher for public plants, and the disaggregated data is available at a unit level for public plants, so that any inefficiency differential in vintage can be captured there. On the other hand, the non-utility owned private plant data is available at aggregate plant level (aggregated for all units within a plant). Since most of the private firms started operation during a short span of time with the possibility of homogenous units within a plant, the chances of a cost efficiency differential due to data disaggregation at a unit level for public plants, and data aggregation for private plants, are reduced if not eliminated.

The necessary data needed to estimate the variable cost function includes fuel prices, fuel consumption, total wage bill (i.e. labour cost), and variable maintenance expenditure. In addition, data on total cost of production, total electricity generated and maximum plant load assigned is required at plant level. The main sources of data are published reports by the National Electric Power Regulatory Authority (NEPRA), the National Transmission and Dispatch Company (NTDC) and Karachi Electricity Supply Corporation (KESC)[50]. NEPRA State of Industry report includes

[50] The complete list of variables collected is give in appendix Table 2.1A

plant level data on generating capacity, electricity generated in a year, fuel quantity, and load factor. The detailed information on required variables is available for the majority of government plants, however operation and maintenance expenditure and labour cost variables are missing for private plants (i.e. IPPs). Since the focus here is on fossil-fuel based plants (i.e. oil and gas run plants), the fuel expenditure is likely to be the most important component of total variable cost. This intuition is supported by the evidence that fuel cost is about 94 % of total variable cost for the given sample for the public plants, and the corresponding estimated figure for private plants is about 93 %[51].

2.4 Empirical Production Model

In the case of single output production process, productive efficiency can be assessed by observing whether the firm is maximizing output given the inputs and if the best mix of inputs is employed given input prices. The production function describes the possibilities of transforming inputs into an output without taking into account the relative prices of inputs. On the other hand, cost minimization assumes that firms minimize production costs for a given level of output by incorporating the input prices. An electricity plant might be producing maximum electricity using a given mix of plant,

[51] The estimate for private plants is based on fuel cost component and operation and maintenance cost component of upfront power tariff

material, fuel, and labour, but it may not be minimizing cost if labour was cheaper than material, while the plant used more of material and less of labour. Even if there are different types of fuel used to produce heat input, it will be cost effective to use cheaper fuel for a given amount of heat produced. So if it is possible to produce the same level of goods by using more labour and less material or different fuel, then the plant can lower cost by employing a different mix of inputs. Therefore the efficient electricity generating plant will minimize the cost of producing any amount of electricity, given input prices.

The productive efficiency comparison between utility owned and non-utility (private) owned electricity generation plants in this chapter is based on cost function specifications. Duality between the production function and cost function allows an econometrician to recover production parameters from the cost function under certain regularity conditions (Diewert 1971), and similarly the cost minimizing factor demand expressions can be derived from production function. Nerlove (1963) and Christensen and Greene (1976) are two works celebrated for the earliest application of duality theory in the empirical analysis of the electricity industry. Their motivation hinged on the exogeneity of factor prices and the exogeneity of electricity output, this is because factor prices are typically determined in competitive markets or through regulation, while electricity output is mainly determined by the load demand. Therefore fuel prices and electricity output are not related with unobserved heterogeneity in the cost function. Estimating production function complicates matters as inputs become endogenous for the plant manager and then a full structural specification will be required in order to consistently estimate the technology parameters (Markiewicz, Rose and Wolfram 2004), with limited data available for Pakistan, the structural estimation of the production function will not be feasible.

Recent empirical studies in industrial organization literature have employed cost function estimation to address various performance related issues in the industry (Maloney 2001), and estimating cost function can be a good starting point to build base knowledge about the performance of the power generation industry in Pakistan. The price and output exogeneity appear to be credible assumptions in the case of Pakistan, as plants are forced to produce the required electricity, and profit maximization by the power generation firms does not seem plausible. The oil and gas regulator controls the fuel prices, while the power generator purchases fuel according to plant technology. The ownership of a plant can change the level of cost function, or as mentioned in NEPRA reports, utility owned plants may generate a particular amount of electricity at higher cost as compared to non-utility owned plants, but to improve on average unit cost comparison, an econometric cost function can control for all observed relevant factors

.These different empirical experiments along summary statistics are discussed in section 2.5.

2.4.1 Base specification of cost function

I have specified the simplified form of trans-log cost function in the style of Foreman-Peck and Waterson (1985) as goal function, which is the extension of previous work (Christensen and Greene, 1976). Further, trans-log framework can be used to study substitution effects, scale effects, and technological changes (Greene 1980). The specification proposed here is quite informative as it incorporates the effect of load factor on the average unit cost of electricity generation. Load factor ($load$) is defined as total electricity output (q) in a period, divided by the product of maximum load (m) and the time plant remain connected to load (v) (i.e. $load = \frac{q}{m*v}$). Load factor is an important factor affecting the cost of electricity generation (Foreman-Peck and Waterson 1985). The adapted version of trans-log cost function is given below in the equation (1).

$$\log(C_{it}) = \alpha + \beta_1 \log(q_{it}) + \beta_2 (\log(q_{it}))^2 + \beta_3 \log(p_{it}) + \gamma \log(load_{it}) + \lambda \log(age_{it}) + \rho\, private_i + \sum_{t=2}^{T} \rho T_t + u_{it}$$

(1)

and $i = 1, 2, \ldots\ldots, N \qquad t = 1, 2, \ldots\ldots, T$

Where (C) is unit cost of production as Rupee per kilowatt-hour, p stands for fuel price per million British thermal unit (MMBTU),

age variable capture vintage of the plants, and $private$ is an ownership dummy, takes value 1 if the plant is owned by a private firm and 0 if the plant is owned by a public generation company. The electricity output is scaled in kilowatt-hours, while capacity utilization is based on maximum load in kilowatts and the proportion of time the plant remained connected to load. Recent studies have employed different expressions of capacity utilization, for instance, Maloney (2001) used an added term to model 1 (given above) called intermittent idling (electricity generation time as a proportion of total time in year), this term may be more useful when coal based generation is high, which is not the case in Pakistan. The above specification is estimated for fuel unit cost only, because in fossil fuel based power generation, funds allocation on fuel input is likely to be substantial. This intuition is supported by the available data, where on average 93 % of total variable expenditure can be attributed to fuel cost in both public and private power plants. There is also a limitation of data for price indices for labour cost and maintenance cost of the private power plants.

2.5 Findings and Results

The summary statistics for the variables used in regression analysis are presented in Table 2.1 are for the sample of public and private plants for the plant years with positive production and non-zero fuel inputs. The private plants were further subdivided into utility owned and non-utility owned groups, where utility owned plants are owned by the Karachi Electric

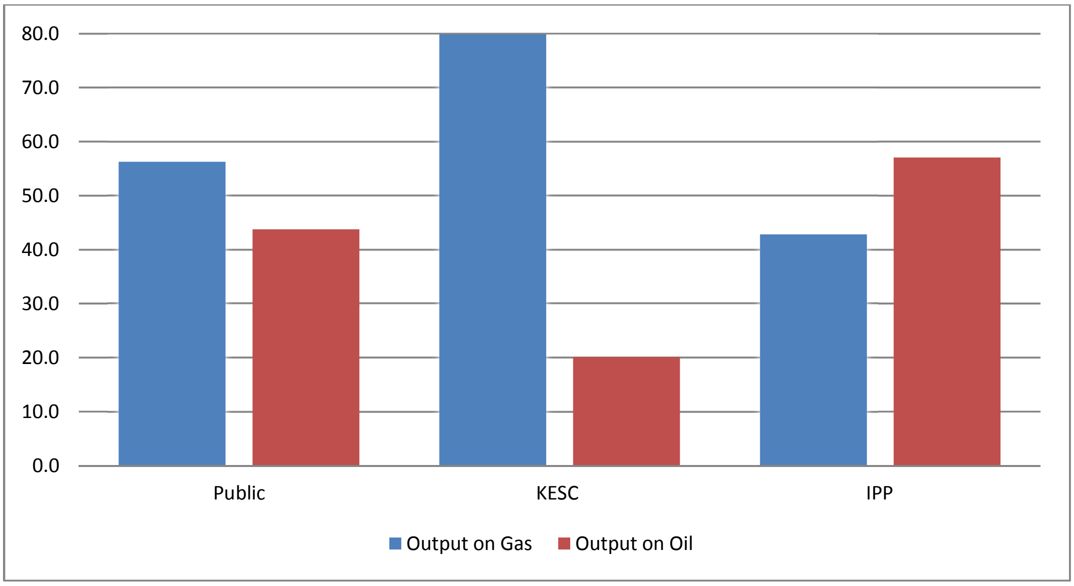
Supply Corporation (KESC). The summary statistics presented in Table 2.1 are for an aggregate sample and can miss the variation across plants over time. The average fuel price (rupee per MMBTU) is lower for public plants and utility owned private plants compared to non-utility owned private plants, this is mainly due to the composition of the fuel mix used for power generation (Figure 2.1). On the other hand, public plants produced electricity on higher average unit cost (rupee per kilowatt-hour) than private plants. There are substantial differences in average plant age according the plant ownership. On average, private non-utility plants (IPPs) are about 17 years younger than utility owned plants. The average capacity utilization, as measured by load factor, was higher for private non-utility plants compared to public plants

Table 2.1 Summary statistics for power plants

Variable	Observations	Mean	Standard Deviation	Min	Max
Government Plant					
Output (GWh)	184	506.9	456.8	0.5	1887.1
Unit Output Cost (Rupee per KWh)	184	3.8	2.1	0.8	10.6
Fuel Price (Rupee per MMBTU)	184	295.7	182.7	41.1	798.0
Load Factor (%)	184	49.1	26.6	0.2	97.0
Plant Age	184	27.9	10.2	10.0	51.0
Private Plant (IPPs)_					
Output (GWh)	73	2121.0	2402.1	50.4	9140.8
Unit Outpu Cost (rupee per KWh)	73	3.6	1.8	0.6	7.1
Fuel Price (Rupee per MMBTU)	73	429.2	209.2	73.4	839.8
Load Factor (%)	73	77.2	18.3	5.1	98.6
Plant Age	73	10.4	3.0	1	19.0
Private Plant (utility owned)					
Output (GWh)	99	451.1	477.3	0.1	1553.5
Unit Output Cost (rupee per KWh)	99	2.9	1.1	1.3	8.7
Fuel Price (Rupee per MMBTU)	86	223.5	101.6	126.5	705.1
Load Factor (%)	98	82.4	8.8	49.4	96.8
Plant Age (years)	99	22.6	11.3	1.0	42.0

Notes: Estimates based on plant year data for 2006 to 2011, 1MMBTU≈293 kWh

Figure 2.1 Fuel Source of Electricity Production 2006-2012, (%)



Cost function specification (1) described in the previous section is employed to produce regression estimates for public and private plants, results are given in Table 2.2. Results for three experiments are presented in Table 2.2; the column titled (1) includes the comparison between all public and private power plants in the country. The next two columns in Table 2.2 include the comparison between public plants and IPP plants, and the comparison between public plants and utility owned private plants respectively. The performance difference between public and private plants should be manifested in either the difference in slope coefficients, or an intercept shift, or both, for the estimated cost function. Structural stability tests cannot accept the hypothesis of equal coefficients between public and private plants for year dummies and vintage coefficients for three experiments mentioned above, further, the coefficient on log prices is also statistically different between non-utility private plants (IPPs) and public plants in column (2) of Table 2.2.

Regression results in column (1), column (2) and column (3) of Table 2.2 are produced after allowing for separate vintage effects for private plants and for the adjustment of separate slope coefficients for fuel prices in column (2). The log fuel price coefficient is statistically significant in all of the models and the estimated price elasticity of average unit cost for the full sample is 0.90. This shows less than one to one percentage change in average unit cost with respect to the change in fuel price. In column (5) of Table 2.2, the estimated fuel price elasticity for utility owned private plant IPPs is higher than public plants. The price elasticity of unit output cost is also higher for utility owned private plants in column (6). This shows that the partial effect of fuel price change on average unit cost is higher for the private plants compared to the public plants. That also shows that on average private plants use relatively expensive fuel compared to public plants.

The estimated plant vintage coefficient for public plants is statistically different than private plants, the estimated coefficient for the two groups is-0.001 and 0.014 respectively. The impact of private plant aging on unit cost is positive which that implies the newest IPP plant will produce at 26.6% lower average unit costs compared to the oldest IPP plant, holding other factors constant. The vintage coefficient for public plants is not statistically significant, showing no substantial impact of plant aging on unit cost of public during the sample. However, the public plants are quite older than most of the private plants and due to deterioration over the years, the group of public plants consists of technically inefficient and homogenous plants.

Table 2.2 Comparisons of pooled regression estimates of cost function, dependent variable log output unit cost

Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)
Log fuel prices	0.902***	0.873***	0.884***	0.880***	1.025***	0.977***
	(0.02)	(0.022)	(0.02)	(0.021)	(0.027)	(0.058)
Log electricity output	-0.321	-0.471*	-0.375	-0.304	-0.441	0.793
	(0.191)	(0.204)	(0.246)	(0.259)	(0.822)	(0.533)
Square of log electricity output	0.005	0.01	0.007	0.005	0.01	-0.022
	(0.005)	(0.005)	(0.006)	(0.007)	(0.019)	(0.014)
Log load factor	0.043	0.05	0.04	0.054	0.002	0.236
	(0.024)	(0.029)	(0.023)	(0.034)	(0.085)	(0.199)
Age of plant	-0.001	0.0004	0.0001	-0.002	0.009	0.009***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
Age of plant*Private plant interaction	0.015***	0.013*	0.009***			
	(0.002)	(0.006)	(0.002)			
Dummy for private plant	-0.330***	-1.239***	-0.153**			
	(0.053)	(0.163)	(0.055)			
Log Fuel Prices * private plant interaction		0.147***				
		-0.032				
Constant	0.208	1.657	0.691	0.264	0.003	-12.329*
	(1.841)	(1.949)	(2.298)	(2.362)	(8.455)	(5.6)
Observations	343	257	270	184	73	86
R Square	0.945	0.960	0.943	0.947	0.987	0.926

Notes: The estimates are based on pooled sample for 2006 to 2011, standard are clustered at plant level, * p<0.05, ** p<0.01, *** p<0.001, standard errors in parentheses clustered at plant level, specifications are titled with column numbers, where (1) covers overall sample, (2) private IPPs and public plants, (3) public and utility owned private plants (KESC plants), (4) Public Plants only, (5) IPPs only, and (6) Utility Owned (KESC) private plants. R-square for all models is between 0.93 to 0.99, further Ramsey RESET reject the null hypothesis that models have no omitted variables in most of the specifications.

In a cost function scale, economies can be evaluated on the basis of output coefficients. Output and output square coefficients have expected signs but are not statistically significant in most of the regressions in Table 2.2 (except Column 2). Therefore, there is no clear evidence of scale effect on cost reduction for public and private plants. However, the subsample of plants running on gas fuel demonstrates substantial scale economies as shown in appendix Table 2.2A. There might be potential confounding between scale economies and vintage, the IPPs plants running on gas are younger in age and larger in size, while public plants operating on gas are fairly old and small in the size. The estimated scale economies ($SCE = 1 - \partial \log(c) / \partial \log(q)$) are presented in Table 2.3 below.

Table 2.3 Economies of scale for gas based units

	SCE	Standard Error
All Plants	1.14***	0.02
WAPDA System	1.10***	0.02
Public plants and KESC plants	1.00***	0.04

Statistical significance *** p<0.001

The estimate on the plant ownership dummy in column (1) of Table 2.2 tells that private plants in the system produced electricity at 33 % less unit fuel cost as compared to public plants, after allowing for different slope coefficients for the year dummies, and plant vintage, and after controlling for other observable factors. Similarly, results in column (2) of Table 2.2 show that public plants produce electricity at a substantially higher average unit cost compared to private IPP plants. The bulk of non-utility owned private IPPs are in the WAPDA system where private plants produce electricity on substantially lower unit fuel cost than public plants. The comparison between private plants owned by the Karachi Electric Supply Company (KESC)[52] and public plants in the WAPDA system is shown in column (3) of Table 2.2; the estimates show that the average unit cost for private utility owned plants is 15 % less compared to the average unit cost for public plants. The results for public, IPPs and utility owned private plants (i.e. KESC plants) are given in last three columns of Table 2.2 respectively. However standard errors of individual regression results in column (5) and column (6) might be problematic due to a small number of clusters for IPP plants and utility owned private plants.

The regulator reports present declining fuel efficiency for public plants in the WAPDA system on the basis of technical efficiency alone (the ability to convert given amount of heat into kilowatt-hours), this left room for the perception that public plants were operational at a low cost due to generating electricity with gas as fuel input (a relatively cheaper fuel). But evidence on the economic efficiency here reinforces the notion that public plants are not only less technically efficient but are also economically

[52] The private plants in KESC system, the only type, are mainly utility owned plants. The two main systems are WAPDA (or NTDC) system and KESC system KESC grid is inter-connected with the NTDC grid system through two double circuit 220 KV transmission lines, KESC purchased on average 330 gigawat-hours annually from WAPDA system during 2005 to 2010.

inefficient, particularly relative to IPPs in the system. Further, the estimated results in appendix Table 2.2A show that gas fuel based public plants also produce electricity at a higher average unit cost compared to gas fuel plants owned by private companies. Therefore fuel allocation policy, in particular gas supply policy needs reconsideration and scarce gas fuel should be supplied to cost efficient plants wherever possible.

The results in Table 2.2 and Table 2.2A require qualification and may have some implications as well, the analysis is based on the short run cost function where fuel cost is employed to proxy total variable cost, and therefore any implications should be considered in this context. The private plants, IPPs, are younger in age compared to public plants and WAPDA's generation companies (GENCOs) have not invested in new public plants or in any major repair plan for the existing units (that are fairly old) since industry reforms started early 1990s[53]. So the reason for the low efficiency of public plants is likely to be caused by the lack of operational maintenance and missing routine repairs, this point is highlighted in recent regulator's reports as well (NEPRA, 2010).

The absence of data on wage bill and routine maintenance for private plants constrained the estimation of a full specification of short run variable cost function. The future research requires the collection of detailed cost

[53] Kot Addo Power Plant was the only young public plant completed in 1996, but was privatised in 1996. GENCOs plants are being revamped recently with funds supplied by United States Agency for International Development (USAID)

information for private plants in order to incorporate price indices for wage bills and plant maintenance. The findings in this chapter do not state that privatization will improve the efficiency of a given plant. In order to propose a policy like the recent option of transforming public plants into private management will require a further understanding of the issues behind low efficiency in the public plants.

2.6 Concluding Remarks

The estimation of the cost function for power plants is an attempt to compare plant performance according to ownership. The results presented in this chapter show that public plants are less efficient than private plants both technically and economically. This does not say that private plants are performing better on other dimensions of cost, including wage bills and maintenance, because this exercise is based on limited information particularly for private plants. The cost to the overall system not only depends on unit cost of production but also depends on the price charged by private plants to the retail supply companies. To assess the cost of private production to the final supply of electricity, further research is required to analyse the long term contracts between IPPs and the central power purchase company. The public plants are owned by public companies (i.e. GENCOs) but the management of these plants is still part of vertical integrated utility. Dynamic issues in the regulation of other components of utility and issues in the transmission and distribution side have potentially affected the functioning of public power firms and thereby plants.

The current state of public sector plants also needs to be looked in the historic context of industry reforms and vanishing new investments either for repairs on existing plants or for setting up modern vintage sets. Effectively the public plants are still part of vertically integrated utility, so the lack of financial independence and related tariff issues are required to be well understood for the future reforms.

2.5 Data Appendix

Table 2.1A: List of variables

Installed Capacity (MW)
Dependable Capacity (MW)
Units Generated (GWh)
Auxiliary Consumption (GWh) from own system
Auxiliary Consumption (GWh) from other system
Units Sent Out (GWh)
Gross Heat Rate
Net Heat Rate
Gross Efficiency %
Net Efficiency %
Shutdown Hours
Total Running Hours
Maximum Load (MW)
Plant Load Factor (%)
Plant Utilization Factor (%)
Plant Capacity Factor (%)
Plant Availability Factor (%)
Gas Consumed (MCF)
HSD Consumed (Liter)
RFO Consumed (MTon)

Figure 2.1A: Unit fuel price (Rupees per MMBTU)

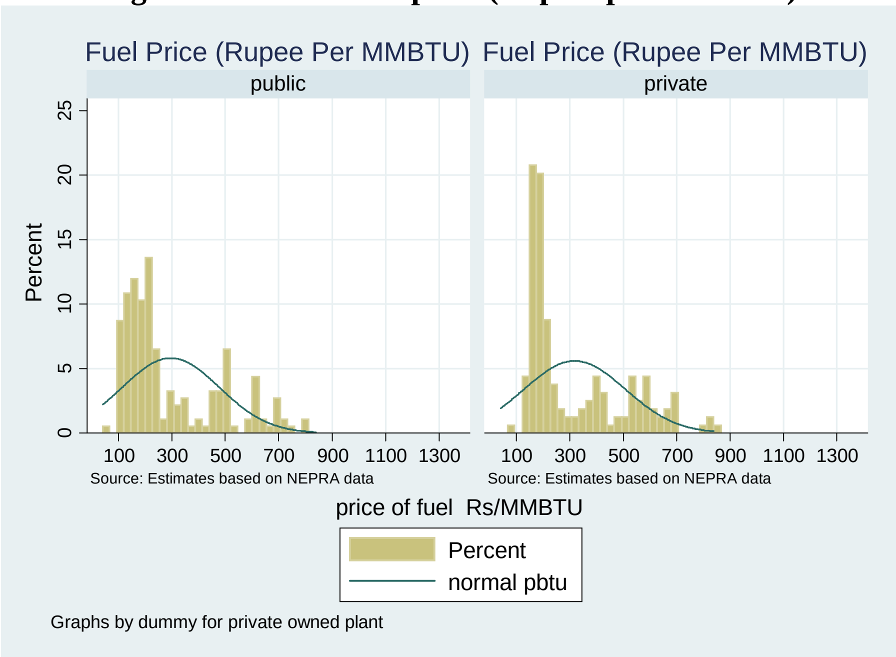


Figure 2.2A: Unit fuel cost (Rupee per Kilowatt hour)

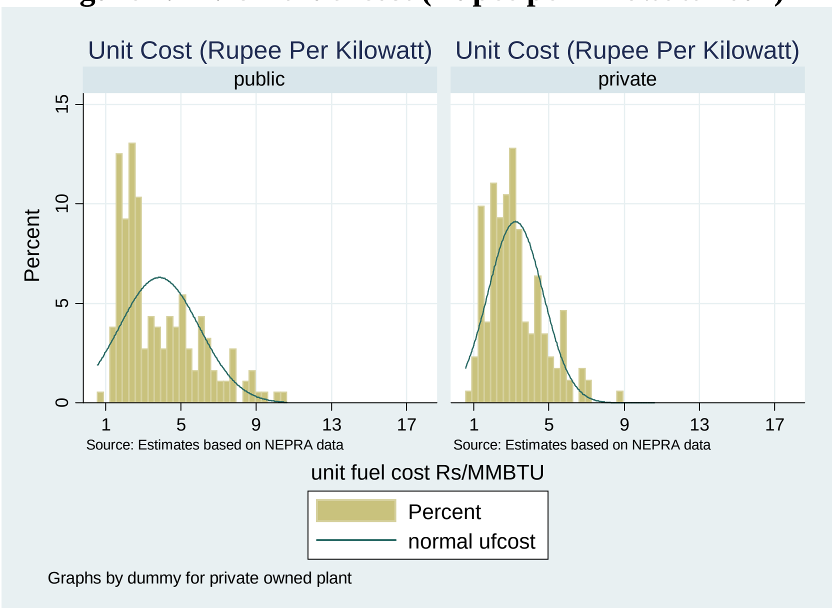


Table 2.2A: Comparisons of pooled regression estimates of cost function, dependent variable log output unit cost (plants running on Gas)

Explanatory Variable	(1)	(2)	(3)
Log fuel prices	0.897***	0.893***	0.876***
	(0.029)	(0.033)	(0.033)
Log electricity output	-0.501*	-0.777***	-0.883***
	(0.189)	(0.185)	(0.231)
Square of log electricity output	0.009	0.017***	0.021**
	(0.005)	(0.005)	(0.006)
Log load factor	0.043	0.042	0.034
	(0.024)	(0.023)	(0.018)
Age of plant	-0.008**	-0.005	-0.001
	(0.003)	(0.003)	(0.004)
Age of plant*Private plant interaction	0.021***	0.014*	0.011*
	(0.003)	(0.006)	(0.004)
Dummy for private plant	-0.581***	-1.087***	-0.195
	(0.084)	(0.216)	(0.119)
Log Fuel Prices * private plant interaction		0.083*	
		(0.039)	
Constant	2.418	4.710*	5.515*
	(1.856)	(1.827)	(2.114)
Observations	181	139	150
R Square	0.930	0.957	0.930

Notes: The estimates are based on pooled sample for 2006 to 2011, standard are clustered, * p<0.05, ** p<0.01, *** p<0.001, standard errors in parentheses clustered at plant level, specifications are titled with column numbers, where (1) covers overall sample, (2) private IPPs and public plants, (3) public and utility owned private plants (KESC plants). Further Ramsey RESET rejects the null hypothesis that models have no omitted variables in most of the specifications.

Table 2.3A: List of plants used in empirical analysis

Public Plants

- GTPS Faisalabad (Unit 1 to Unit 8)
- GTPS Kotri (Unit 1 to Unit 6)
- NGPS Multan (Unit 1, Unit 3, Unit 4, and Unit5)
- SPS Faisalabad (Unit 1 and Unit 2)
- TPS Guddu (Unit 1 to Unit 4 and Unit 9 to Unit 12)
- TPS Jamshoro (Unit 1 to Unit 4)
- TPS Muzaffargarh (Unit 1 to Unit 6)

Private IPPs

- AES Lal Pir Limited
- AES Pak Gen (PVt.) Limited
- Altern Energy Limited
- Engrow Energy Limited
- Fauji Kabirwala Power Company Limited
- Gul Ahmed
- Habibullah Costal Power Company Limited
- Hub Power Company (HUBCO)
- Japan Power Generation Limited
- Kot Addo Power Company (KAPCO)
- Kohinor Energy Limited
- Rousch Pakistan (power) Limited
- Saba Power Company
- Southern Electric Power Company
- Tapal Energy
- Liberty Power Limited
- Uch Power Limited

Private KESC (utility owned)

- Bin Qasim Thermal Power Station (Unit 1 to Unit 6)
- Korangi GTPS (Unit 1 to Unit 4)
- Korangi CCGT (Unit 1 to Unit 4)
- Korangi GTPS-II
- Korangi Thermal Power Station (Unit 1, Unit 3, and Unit 4)
- Site GTP (Unit 1 to Unit 5)
- Site GTPS-II

3 Competitive Structure and Bank Loan Rate?

3.1 Introduction

In this chapter, I estimate the relationship between the loan price and number of banks in the corporate loan market of Pakistan. I have constructed an original dataset that includes loan price (interest rate) and market structure (number of banks) in more than 300 markets across Pakistan. The constructed loan data set is based on loan level universe from Pakistan which includes all loans issued to the corporate borrower between 2006 and 2012. I utilize variation in market structure (number of banks) along variation in borrower and lender characteristics in order to highlight the important factors that affect interest rate in the loan market. The literature in the developing countries context focuses primarily on policy interest rate pass-through and the impact of monetary policy on the interest rate (Edwards and Khan, 1986), but there is limited information available about how market structure and related characteristics affect loan price in geographically isolated markets. The analysis in this chapter bridges that gap by employing market level loan data to study the price concentration relationship in the banking industry of Pakistan. To the best of my knowledge this is the first effort to measure a price-concentration relationship in the Pakistani banking industry at market level; the findings can be useful for policy analysis and further research.

The structure conduct (SC) hypothesis says that an oligopolistic structure of markets results in higher concentration and higher prices for loans or lower prices for deposits (Berger and Hanan, 1989). Therefore borrowers will face higher loan prices in the markets where there are few banks or a small number of large banks, compared with the markets where there are a large number of banks with less market power. On the other hand, efficient structure (ES) logic says that the few banks with a large share reflects the efficiency of these banks as they capture the market due to lower cost and thereby lower loan prices (Demesetz, 1973). In Pakistan both forces can be in operation, as post liberalization experience shows an improved efficiency of the banking industry (Burki and Niazi 2010), however the outreach of new private banks is limited to large cities with negligible banking operations in fringe markets (Patti and Hardi, 2005), rendering the local isolated markets relatively more concentrated compared to large cities.

Many developing countries started financial liberalization and privatization reforms in 1990s, the motivation was that liberalization reforms in the banking industry increases efficiency of financial intermediation and spur economic growth (World Bank 1997). The pre-liberalization experience shows that credit was directed towards public sector and inefficient private sector on interest rates below market rates, and the credit rationing crowded out efficient private borrowers (World Bank

2005). The financial liberalization reforms included interest rate liberalization policies, privatization of state owned banks and policies that enhanced role of market in financial intermediation (World Bank 2005). The post liberalization experience of banking performance is varied across countries. The performance of banking industry in India shows that with public ownership and high budget deficit the liberalization benefits remain limited as banks mainly extend credit for government financing (Gupta et al 2011). The Latin American experience shows that market concentration is not related to competitive conduct, however post liberalization foreign entry reduced bank margin and profitability (Yildirim and Philippatos 2007). In many countries banking industry is far from competitive performance and benefits of liberalization are quite limited (Aboagye et al 2008).

The positive correlation between market concentration and bank performance is well documented in OECD countries (Weiss, 1989), but the lack of disaggregated loan/deposit data for developing countries restricted micro level analysis for the impact of market structure on price setting and profitability in the banking industry of many developing countries. The financial reforms started in Pakistan in the 1990s, the post liberalization changes require an inquiry into the banking industry as the new entrants and presence of foreign banks changed the structure of market, which potentially affected the operations of large incumbent market players. The financial market reforms included interest rate liberalization reforms, which allowed banks to offer multiple products at different price levels across different markets in the country. The presence of entry and price liberalization reforms in the banking industry of Pakistan is of potential research interest, but the research in industrial organization of banking is restricted due to the lack of availability of disaggregated data. The availability of market level business loans Credit Information Bureau (CIB) data have made it possible to measure price-concentration relationship.

The interest rate in the loan market can vary due to change in other market factors including interest rate channel, bank lending channel (Kashyap and Stein, 1995) and bank capital channel (Stein 2002). However, in this chapter the focus is to understand the impact of industry structure on the price setting behaviour of banks and to check the robustness of the correlation between market concentrations and the interest rate charged by banks in a given market. In previous studies on the banking industry in Pakistan, Khwaja and Mian (2008) found that there is no significant impact of bank lending channel on loan rates in Pakistan, while Fazal and Salam (2013) estimated an incomplete pass through for interest rate channel.

The banking industry in Pakistan has been exposed to liberalization and regulatory reforms since 1990; this was followed by entry of a number of banks. The potential change in market structure in banking industry makes it interesting to explore the connection between competitive structure and market prices. The studies conducted on post reforms banking industry shows substantial improvement in bank performance and reduction in market concentration at the country level (Mahmood 2009; Patti and Hardy 2005), which probably changed the strategic behaviour of large incumbents as they were facing less competition before reforms and entry[54]. In the early period of reforms, the operations of large banks were on a wider geographical scale than new entrants, but later on central banks encouraged small banks to enlarge their market and open new branches in locations other than large cities as well. The availability of loan data for each corporate borrower and each market, and information about the branch network at a local level can be used to estimate the relationship between competitive structure and market prices in the banking industry.

This chapter is organised in this fashion, the next section reviews selected literature on concentration and price, section 3.3 presents background and structural change in the Pakistani banking industry, section 3.4 explains data and highlights related issues, and section 3.5 explains econometric specification. The summary statistics and results are discussed in section 3.6. Section 3.7 concludes with final remarks and plans for further research. Additional tables and Figures are available in data appendix in section 3.8

[54] The reforms also have direct impact on performance because privatization changed ownership and potentially management practices in incumbent banks.

3.2 Literature Review

Within industrial organisation literature, the interest in market concentration and price is quite old, a number of oligopoly theories predict that price will increase with an increase in concentration level in the market. The classic oligopoly theories of Cournot and Bertrand imply a positive correlation between price and number of firms under specific assumptions for cost and demand conditions (Weiss, 1989)[55]. According to another set of early theories, firms in the market start acting collusively when their market shares reach a certain level (Chamberlin, 1962), the idea is that firms will set price above minimum average cost once they realize they have reached that concentration level. Weiss (1989) and Newmark (2004) document theoretical intuition behind a number of price concentration studies, Weiss (1989) includes empirical studies on price concentration conducted in various industries.

The price-concentration studies were preceded by profit-concentration studies, where profit-concentration studies were based on structure conduct hypothesis, the main prediction of these studies was that market share and profits are positively correlated (Buzzell, 2004). The profit-concentration studies have been criticized due to a measurement error in profitability and the cross industry nature of the data sets employed in these studies, as cost

[55] For example, in Cournot model with zero costs, the price will be proportional to $1/N$ where N is number of firms.

and demand conditions vary substantially across industries (Singh and Zhu, 2008). The studies based on reduced form profit equations are subject to Demsetz's (1973) criticism where superior firms capture market share and charge a low price to compete out other firms. The studies documented in Weiss (1989) try to address critique with profit-concentration studies, as these studies are industry specific and prices are less susceptible to measurement errors as compared to firm profits. Finally, these studies are less open to "superiority critique" similar to Demsetz (1973).

As documented in Weiss (1989) and Singh and Zhu (2008) the price-concentration studies cover a variety of industries including airlines (Borenstein and Rose 1994), banking (Berger and Hanan 1989) and (Calem and Carlino 1991), cable television (Emmons and Prager 1997), driving lessons (Asplund and Sandin1999), grocery (Cotterill 1986), and hospitals (Keeler et al. 1999). In this chapter, price equations similar to Berger and Hanan, 1989 are used to test for structure conduct hypothesis.

In this chapter the number of banks in a given market is considered exogenous and that is a maintained assumption as discussed in the next sections. However, the concentration or number of firms in the price equations is also considered endogenous in previous literate (Schmalensee 1989). In the banking industry the number of banks in a town will depend on demand and cost conditions in that town, while the loan prices will also be determined by the same conditions in that town. For example, a large city with high demand will attract a large number of banks as compared to a more remote, less commercial town with low demand. As argued in the next section, in this chapter the number of banks in a market is treated as exogenous because entry conditions are restricted by licencing arrangements made by the central bank.

Although market structure is assumed exogenous in this chapter, the endogenous market structure has received attention in some current literature, One approach is to use a panel data method with instrumental variable technique in order to fix the OLS bias (Evans et. al, 1993). Singh and Zhu (2008) have used a two-step estimation technique where in the first stage the equilibrium model of entry is estimated to predict the number of competing firms in a market, and in the second stage, the correction term (derived in first stage) is used to correct for correlation between price and competitive structure. Both of these approaches require appropriate data in order to estimate the price-concentration equation, studies such as Evans et. al (1993) require panel data set while the estimation of entry model similar to Singh and Zhu (2008) requires detailed information on demand and cost conditions in the relevant markets. There are limitations to construct a panel data or estimate an entry model by employing banking data provided by the Credit Information Bureau (CIB), the data set used in this chapter for analysis. The main result in the estimation in this chapter is based on exogenous market structure assumption, further details are documented in relevant sections.

3.3 Structural Changes in Banking Industry of Pakistan

The banking industry in Pakistan was dominated by five large government owned banks until financial reforms started in late 1980s. Before the reforms, more than 80 % of the total banking assets were controlled by the five government banks[56], the remaining market was served by 25 foreign banks operating in urban areas and niche markets, and branch operations of these banks were restricted by regulation (Patti and Hardy 2005). The Government of Pakistan initiated broad range financial sector reforms in the late 1980s, the reforms started with privatization of state owned banks and was followed by permission to open 10 private domestic banks and 3 foreign banks in 1991 (State Bank of Pakistan, 2003), see Figure 3.1.

A number of new private banks opened in the following years, the number of domestic private banks increased from 0 to 15 and total banks went up from 25 to 46 between 1986 and 1997 (See Table 3.1 and Figure 3.1). In the same time period, foreign bank branches increased from 51 to 75, while local bank branches went up from 6,955 to 8,446. During the

[56] Five Banks are, Habib Bank Ltd HBL (1450 branches), National Bank Ltd (1245 branches), United Bank Ltd UBL (1082 branches), Muslim Commercial Bank MCB (1025 branches), and Allied Bank Limited ABL (760 branches), number of branches in 2008. UBL, MCB and ABL were privatized during 1991 to 1993.

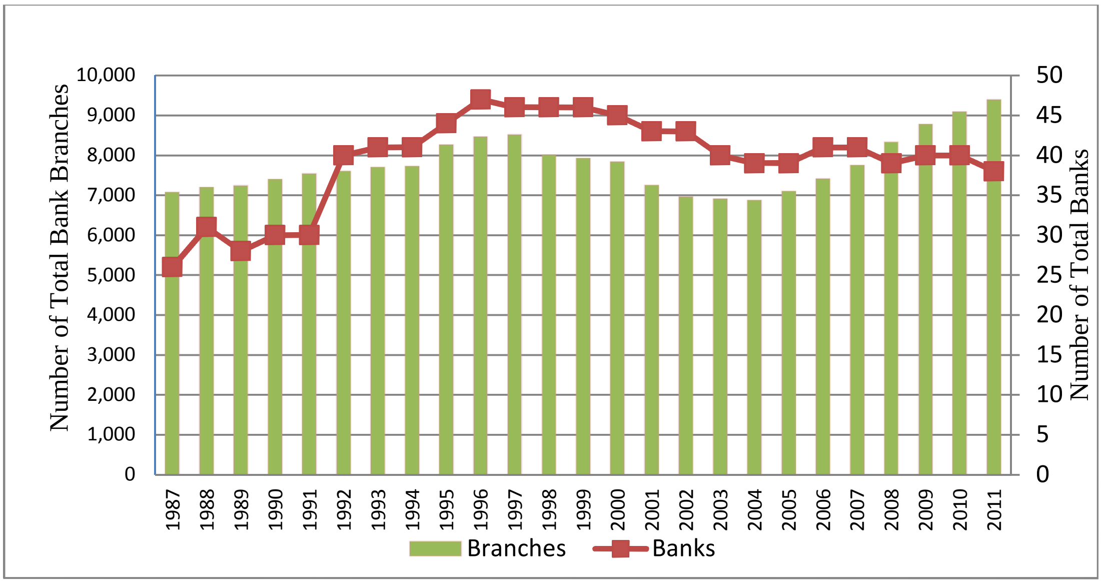
1990's the banking industry witnessed substantial growth and changes in governance and corporate structure of the Banks. The initial banking reforms were followed by an institutional strengthening of the central bank, where the central bank received more autonomy and also increased the quality and spread of banking regulation.

Table 3.1 Number of Banks in Pakistan 1990-2007

	1990	1995	2000	2003	2007
Government Owned	6	6	6	5	4
Domestic Private	0	15	14	18	26
Foreign Private	21	20	20	14	6
Specialized Banks (domestic)	4	4	4	3	4
Total	31	45	44	40	40

Source: Mahmood (2009)

Figure 3.1 Number of banks and bank branches (1987-2011)



Note: Source State Bank of Pakistan, includes all bank branches

Post reforms, market share of the private domestic banks and the foreign banks increased, but the foreign bank focused on selected clients and multinational companies (Mian, 2004). The private bank entry was mainly domestic banks occurred in a time window from 1991 to 1995, and from 1995 onward the issuance of licences to open new banks was implicitly suspended[57], that trend continued during the current analysis period from 2006 to 2012. However, restrictions on the opening of private bank branches (local and foreign) reduced, while government banks were restricted to open new branches in addition government banks were encouraged to closing unprofitable branches (State Bank of Pakistan, 2003). The introduction of risk based capital requirements in 1997, and later an increase in paid-up capital requirements was followed by a central bank facilitated merger and the acquisition of the banking sector in Pakistan (Mahmood, 2009). All of these developments rendered a number of banks quite stable during 2006 and 2012, this supported the assumption that the number of banks is exogenous.

The Pakistani banking market is dominated by big five banks with more than 50% share of total banking advances in 2008, these banks are considered dominant banks with large market share and an extensive branch network throughout the country. The dominant banks owned 5,562 bank

[57] Motivation of moratorium could be bad performance of new banks (Mahmood, 2009), proliferation of banks and restricting foreign bank entry (Patti and Hardy 2005). State Bank of Pakistan issues licence to any bank want to do banking business in the country.

branches out of total 8,274 domestic bank branches in 2008 (foot note 54). Although the big 5 banks are still widely operating across country their country level market share gone down since 1999 (Mahmood, 2009). The new entrants have potentially increased competition as the market share of the big five banks is declining. The non-price competition including quality of services offering new product facilities have motivated the big five banks to catch up with entrants. The Credit Information Bureau (CIB) data reveals that incumbents (big five) and entrants are selling similar products in the corporate loan market.

The empirical analysis in this chapter assumes that the number of banks in the corporate loan market was stable from 2006 to 2012. The consolidation process started in 1997 and negligible new entrants support stagnation in the market structure. The number of total bank branches has gone up since 2006, as shown in Figure 3.1, but that includes all branches while the price-concentration analysis in this chapter is based on bank branches that offer corporate loans to firms. The political situation of the country and capital requirement by the central bank might also have forced an implicit ban on new corporate lending banks in Pakistan between 2006 and 2012.

3.4 The Credit Information Bureau (CIB) Data

One of the contributions of this chapter is to employ a unique loan universe in order to construct market level data that includes loan prices (i.e.

interest rate), and the number of banks for more than 500 markets across Pakistan. The loan level universe is provided by the Credit Information Bureau (CIB) at the State Bank of Pakistan (SBP)[58]. In addition, Bank Branches Data published by the State Bank of Pakistan (SBP) is employed for some analysis. Loan level CIB data and bank branches data are collected by the SBP to implement "prudential regulation" and are used to regulate and monitor financial performance of the Banking Industry in Pakistan. The CIB data used here lists the end of month report for each outstanding corporate loan issued between April 2006 and May 2012, and the universe of loans includes all outstanding corporate loans throughout the country[59]. A corporate loan is a loan given to business organizations; these include listed companies, non-listed companies, and partnerships. Importantly, the CIB universe employed here does not cover single person liability businesses[60] (i.e. the unregistered enterprises owned by individual entrepreneurs).

The CIB data is of an established quality and has been used in the recent banking literature (Mian and Khwaja, 2009, 2010). The CIB data in this chapter covers a quite recent time period and includes new fields including borrower and lender identifier, loan size, interest rate, borrower's

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[58] State Bank of Pakistan (SBP) is central bank and financial regulator in Pakistan.

[59] Only fund based loans, where actual amount was disbursed, are included in the sample and non-fund loans including letter of credit or letter of guarantee are dropped from the analysis.

[60] Unregistered businesses owned by individuals are quite pervasive in informal developing economies such as Pakistan; in the CIB data business loans issued to single person owned unregistered firms are categorized as consumer loans.

type, and loan maturity date. The description of selected variables covered in CIB is presented in appendix Table 3.1A. Khwaja and Mian (2009, 2010) augmented the CIB data with additional borrower and lender characteristics, for instance one of their studies includes information on the political connection of the borrower. Higher confidentiality conditions with the CIB universe employed in this chapter restricts the scope of merging external borrower and lender details similar to Khwaja and Mian (2009, 2010) with the CIB data.

The CIB data reports a loan in the database until the loan is settled, and there is no loan identifier in the data, therefore outstanding loans reported over time cannot be identified with a numeric identifier. However as each borrower is uniquely identified and each bank is also uniquely identified, one can trace a loan issued by a specific bank to a specific borrower on a given date for a given product. Therefore the loan is defined by the borrower-bank-product pair for each reported month. The outstanding loan data is reported in the CIB database for each loan until a loan is settled. However, for the analysis only first time reported data is used because the main purpose is to measure the relationship between the loan price offered by a bank and the number of banks in a given market, and the price of loan and other characteristics can be noted in the first reported transaction. That leaves 36,279 borrowers, 107 lending institutions and 260,332 reported loans in the selected data.

Defining the loan market is critical for estimating the price-concentration relationship, and operationalizing this is not free of problems. The loan market in this chapter is identified according to the location of borrowers (i.e. business location), I have assumed that firms borrow locally or borrow from the nearest town, in case the location is a very small village without any bank. There is no published evidence to confirm that firms actually borrow locally. However, unstructured qualitative interviews with bank managers and CIB officials support the notion that firms borrow locally, particularly for working capital loans and other routine services. Banks issue loans to local firms in order to lower their transaction cost. In most of the transactions, individual guarantees, credit relationships, and physical assets (e.g. land, plant, and other physical assets) are employed as collateral for loans. The bank managers prefer issuing loans to local firms where verifying collateral is easy and past customer experience can lower the risk of a default on a loan. About 9% of total loans issued to the firms that borrow from more than one location are dropped from the analysis.

The market is defined in this chapter according to the location of a borrower with one central concentration of population or urban centre including small locations at margin which in some way are economically connected to the main market centre. The notion of market here is similar to the Metropolitan Statistical Area (MSA) in North America with the exception of villages, as villages in Pakistan are also highly populated. In the case of Pakistan, areas resembling MSAs are concentrated around a large town, usually the capital of an administrative district. The large town and district have the same name in most cases[61]. However, each district has other towns and villages with a concentration of the population, but varying amounts of economic activity. Therefore a market can be a village, a town or a district capital depending on the location of the market and the isolation of that market from surrounding markets.

The market for a loan can also be identified by the lender's corresponding bank branch. The information about bank name and branch address is confidential in the CIB data, however a bank branch can be uniquely identified by the bank-branch pair code, this information matched with secondary information on total number of branches reveals that a quarter of the total bank branches in the country report data to the CIB. One potential reason for fewer reporting branches could be that the data from non-reporting branches is reported by another branch (e.g. head office) of the same bank. Therefore the borrower location is a better candidate for designating a loan market than the bank branch location.

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[61] For example, capital of "District Lahore" is the city of Lahore. And the businesses located in industrial belts around district towns are likely to be borrowing from banks in various locations of Lahore

3.4.1 Loans Sample and Discussion

In total there are 260,332 business loans reported in the CIB data between 2006 and 2012 for 36,279 borrowing firms and 107 lending institutions[62] across 563 markets, Figure 3.1A in the appendix shows the quarterly trend for number of loans. The number of loans declined after 2008, as monetary policy tightened and credit expansion was restricted by banks. There is diversity in the nature of banks, particularly the products that they offer to the consumers. About 76 % of loans are disbursed by private banks, 4 government owned banks issue 10 % of loans, and 2 specialized banks command 7 % market share, the rest of the loans are issued by a large number of small lending institutions (foot note 60). The banks offer a variety of loan products for various business needs; the majority of banks offer more than 10 different types of loans. There are more than fifty types of product offered by banks, but in order to create homogeneity in loan prices, for a given product, the number of products can be reduced according to the nature of product. For example, loans can be classified as working capital, and fixed capital loans. In addition, businesses demand some products locally (e.g. to meet routine needs) so that the

[62] In total forty six banks have been in operation during 2006 to 2012, the rest of the lending institutions including small leasing companies and Islamic “modarabas” are operational in large markets only. The analysis in main text based on data for the banks only, some regressions in appendix are based on data for all lending institutions.

competitive structure in a given location can potentially affect the price (i.e. interest rate) for that product.

The loans are classified into sub categories; 46% of loans are classified as working capital loans or credit lines, and firms usually generate working capital locally as borrowing for the running finance is quite a regular transaction for a business. Another 25 % of loans are based on various specialized transactions related to foreign trade and foreign investment, these loans are possibly issued by specific banks or bank branches in large cities to companies engaged in importing and exporting commodities, thereby the loan market becomes national for these types of loans. In addition, 10 % of loans were disbursed for the fixed capital or the equipment purchases including the lease based capital, and 7 % of loans were issued to businesses related to farming. The disaggregation of loans into different types is useful in order to estimate the price-concentration relationship by nature of localization of product, and empirical specifications can be estimated separately for various types of loans. In this chapter working capital loans and loans disbursed for miscellaneous routine activities[63] (classified as "other type") are employed in the empirical analysis.

[63] mainly physical capital and fixed capital loans

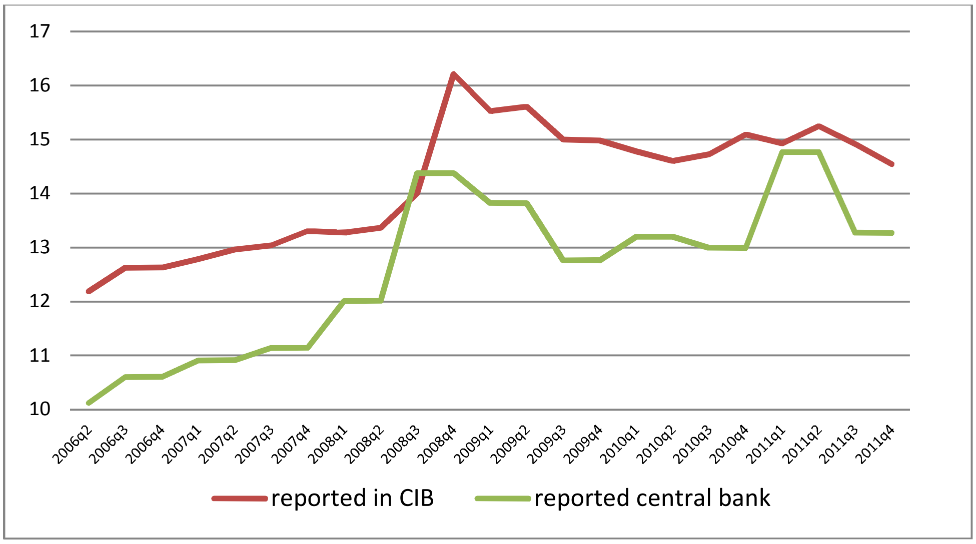
The key dependent variable, interest rate, is missing for more than half of the reported loans in the CIB data. One possible reason[64] for the missing observation could be that banks are reporting the figure in "KIBOR[65]-+premium %" format in the CIB system, this potentially creates a problem as the Credit Information Bureau (CIB) might not be aware of the corresponding KIBOR rate for each transaction which could result in missing values. Although the CIB reports that either the interest rate was not known at the time of reporting the data or the corresponding transaction with missing interest rates are non-fund based loans (e.g. a bank guarantee). The loan size distribution for the missing interest rate cases is quite similar to the distribution of non-missing cases (appendix Figure 3.2A). Therefore there is less of a chance that missing loan rate data might follow some selection pattern.

Interest rate/loan size: Interest rate data appears to be of good quality based on a consistency check presented in Figure 3.2, the trend in the CIB reported interest rate follows the trend in the reported private sector rate in published reports by the central bank. The average interest rate during the sample period is 14 % with a standard deviation of 3.6. The trend depicts monetary policy changes during the period with monetary tightening

[64] confirmed in an interview with an anonymised bank manager
[65] Karachi Interbank Offered Rate (KIBOR)

since 2008 and a relatively steady interest rate period after 2009. The average loan size is 69.4 million Pakistan Rupees[66], with 75 % of loans less than or equal to 40 million Rupees. Loan utilization can be determined by the difference of outstanding loan and actual loan amount granted, both variables can be observed in the CIB data, three quarters of loans have utilized more than 50 % of the allocated loan limit.

Figure 3.2 Quarter wise average Nominal loan rate (%)



On the demand side, less than 5% of firms borrow from more than 5 banks at different times, while 75% of firms borrow from at most 1 bank, and 90 % of loans are borrowed by private firms. The firms that borrow from different banks over the years could be large conglomerates with better access to credit markets. About 88 % of loans have a maturity date within

[66] 0.9 million US Dollars

the sample period, and 95 % loans have about 4 years or less duration, the median duration is 1 year 2 months[67].

Table 3.2 Summary statistics for the variables used in regression analysis

Variable	Observations	Mean	Std. Dev.	Min	Max
Interest rate (%)	61044	14.56	3.08	3	20.7
Number of new banks in a market	61044	29.25	12.64	0	38
More than 5 banks dummy	61044	0.98	0.13	0	1
New private bank/lender dummy	61044	0.89	0.32	0	1
Number of total banks	61044	34.74	12.93	1	44
Loan Size (million Rupees)	61044	74.42	424.58	0.01	23328.9
Loan duration in months	61044	15.37	18.09	0	367
Private borrower dummy	61044	0.92	0.27	0	1

Notes: The sample is based on loans issued for working capital and loans used for multiple purposes including fixed capital loans, the break up for two categories is give in appendix Table 3.2A.

In the light of the above discussion, the sample is restricted to loans for working capital and for other routine services; including loans for fixed capital, machinery and other physical capital. Loans for the farming businesses and loans for the trade related activities are excluded from the sample as both types of loans are concentrated in specific markets and disbursed by the specialized banks. In addition, loans with a missing interest rate are not used for the analysis because no imputation for the missing interest rate can be made. The reduced sample includes 61,044 loans

[67] The duration is calculated on the basis of loan issued date and loan maturity date, in some cases loan maturity date is also loan extension date and for those cases average loan duration will be longer than calculated here.

reported by 39 banks in 302 markets over 25 quarters. Summary statistics for main variables are given in Table 3.2.

3.5 Econometric Specification

The structure-performance hypothesis has been tested in previous research on the banking industry using a simple econometric specification, where the market concentration is treated as exogenous and other exogenous controls are added to basic specification (Berger and Hannan 1989). The fundamental idea is that the competition in a given market will affect loan price or deposit rate, in the main model various concentration measures can be employed to proxy competition in a given market. The basic econometric specification presented in Berger and Hannan (1989) looks like Model 3.1 below.

$$r_{ijt} = \alpha + \beta conc_{ijt} + \lambda' x_{ijt} + u_{ijt} \qquad (3.1)$$

Where r is interest rate charged by bank i in market j during time period t, $conc$ is a measure of the market concentration, usually a Herfindahl index or the 3 firm-ratio is used to proxy for the competition in the market, and x is a vector of exogenous control variables, the coefficient of potential interest here is β. For instance, a high market concentration will result in a lower interest rate offered to depositors by the banks implying $\beta < 0$. The setting in Berger and Hannan (1989) tries to model the interest rate that a bank offers for various deposits. While the loan data employed in this chapter corresponds more to what borrowers were paying for a particular loan, depending on loan characteristics, borrower characteristics and market characteristics, therefore in this case $\beta > 0$ in equation 3.1.

I have conceptualized the structure-performance hypothesis in two models. In the first model, the key variable explaining variation in loan prices according to the market competition is a dummy variable, where the dummy takes the value of 1 if the market contains at least one bank other than the large banks (*BIG5*)[68]. The cut off of "five banks" is used to separate markets that only contain old large banks, from the markets that contain at least one new private bank. This model is given in 3.2

$$r_{ijt} = \alpha_1 + \beta_0 BIG5_j + \nu NEW_{ijt} + \lambda private_{ijt} + \gamma_0 dur_{ijt} + \gamma_1 dursquare_{ijt} + \varphi loan_{ijt} + \theta' t_t + \varepsilon_{ijt} \qquad (3.2)$$

The Model 3.2 controls for the nature of a firm's ownership where *(private)* is a binary variable that takes value 1 if the loan was issued to a private firm, duration of loan *(dur)*, and size of loan *(loan)*, further quarterly dummies vector *(t)* is included to control for time variation, while variable NEW takes value of 1 if the lending bank is a private bank[69].

The nature of competition in different markets is not known here and it is not clear how the five large incumbents compete with new entrants, so

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[68] The large old banks mainly five banks, number of branches given in foot note 54
[69] Complete list of dependent variable, exogenous variable and controls are given in Appendix Table 3.4A

the selection of a concentration measure or cut-off based on the number of banks in a given market may become arbitrary. As discussed earlier, before liberalization five government-owned banks were dominating the banking industry in Pakistan and during reforms started in 1990s, four of these banks were privatised. There was also an issuance of licences to new private banks. The competition in a location can be viewed as the presence of private banks other than large old banks[70] in the market as presented in model 3.2. But intuitively, competition in a market increases with the presence of any additional bank; including fringe banks, as the regulator has set a level playing field for all banks in the industry. Therefore model 3.2 is modified with the inclusion of a number of total new banks in the market. The quadratic form is assumed in the Model 3.3 given below where $BANK$ is the number of new banks in a given market.

$$r_{ijt} = \alpha_2 + \beta_1 BANK_j + \beta_2 BANK2_j + v_1 NEW_{ijt} + \lambda_1 private_{ijt} + \gamma_2 dur_{ijt} + \gamma_3 dursquare_{ijt} + \varphi_1 loan_{ijt} + \theta_1' t_t + u_{ijt} \quad (3.3)$$

In equation 3.3, market concentration is measured by the number of new private banks *(BANK)* in the market. The important assumption here is that the numbers of banks in a market are predetermined and this assumption is supported by the fact that entry and exit in the banking industry in Pakistan between 2006 and 2012 was quite negligible. Although in the latter part of

[70] The summary statistics in Table 1 shows 98 % loans are issued in markets that contain at least one bank other than large old banks, so the result in specifications using $BIG5$ should be taken with caution.

the sample, the number of banks goes down, probably because of closure or the merger of small banks, as these banks were struggling to maintain strict reserve capital requirements introduced under banking regulation. However, the CIB data shows that the small banks were mainly operating in very large markets with little effect on market structure, in most of medium and small markets. The models 3.2 and 3.3 can be estimated by Ordinary Least Square (OLS), although standard errors need to be adjusted for the source of variation in data and preferably clustered at market level, the estimation and results are discussed in the next section.

3.6 Results and Discussion

In this section, the price-concentration specifications 3.2 and 3.3 are estimated by pooled OLS for the samples of working capital loans and multiple purpose loans. The selection of one specific loan category into a subsample will be useful to group loan type according to the nature of the market for that specific product. For example, working capital is required to maintain routine business activities and borrowed in the local markets. The estimates are based on OLS while clustered standard errors are estimated for statistical inference (i.e. clustered at market level). For robustness checks, linear and quadratic functional forms (in terms of *BANK* variable) for equation 3.3 are estimated after controlling for independent variables, the results are given in Table 3.3.

The linear and quadratic functional form results for Model 3.3 are given in column (1) and (2) of Table 3.3 respectively, while results for Model 3.2 are given in column (3) of Table 3.3. In the linear functional form of Model 3.3, the coefficient for the $BANK$ variable measures the effect of the number of banks in the market on average interest rate. The OLS estimated coefficient on $BANK$ reported in column (1) of Table 3.3 shows that loan price for working capital declines by 2.7 basis points[71] with the availability of an additional bank in the market[72]. This statistically significant finding is consistent with the notion that market concentration in a given market is positively associated with the interest rate (the banks charge to businesses in that market). The average effect of an additional bank in the market on working capital loans declines to 1 basis point when a quadratic functional form is employed for estimating equation 3.3, the linear and quadratic $BANK$ terms are jointly significant in column (2) of Table 3.3 for the working capital loans. In the case of multiple purpose loans, the estimation of a linear function shows that on average, the loan rate decreases by 3 basis points with the addition of one more bank in the market. However this effect is not statistically significant when quadratic functional form is used.

[71] 1 basis point (bp) is equal to 1/100th of 1%

[72] The average presence of other competing banks in a market is based on observed Credit Information Bureau data that does not include banks which were present in the market but were not engaged in issuing business loans during 2006 to 2012.

Other estimated coefficients in column (1) and column (2) of Table 3.3 are in line with the corresponding economic intuition that interest rate increases with loan duration, where loan rate is the lowest for 5 year duration loans for working capital and 8 year duration loans for multiple purpose loans. The interest rate declines with the loan size, on average the interest rate declines by 2 basis points with an increase in loan size of 10 % for working capital loans (0.8 basis points for multipurpose loan). The private banks charge a lower loan rate than government owned banks and the results are significant for the working capital loans sample[73], where the average gap is above 80 basis points. This potentially has two implications, first, the lower price charged by private banks is consistent with efficient structure and lower cost of the private banks, and second, the competition will be higher in the markets where private banks are present. The coefficient for private borrower dummy is significant for working capital loans, where on average the private firms pay 34 basis point higher loan rate than government enterprises, but significance declines as borrower and lender interaction terms are incorporated.

Specifications in column (3) of Table 3.3 are based on model 3.2, where $BIG5$ is a dummy variable separating markets containing at least one new private bank from the markets with only large old banks. Although

[73] The effect of private bank dummy cannot estimated for multiple purpose due to collinearity with some of interaction terms

arbitrariness cannot be ruled out in the selection of the $BIG5$, but institutional facts support the inclusion of the intercept shift through the $BIG5$ in model 3.2. The five major government banks in the Pakistani banking industry have dominated the loan market over the years (Mahmood 2009), these are the large banks of the country, with a wide network of branches, and the liberalization reforms exposed these banks to competition from new private local and foreign banks by the late 1990s. The $BIG5$ are capturing the exposure of the market to new competing banks, and comparing markets with new banks to markets with old large banks, the downside of this variable is that only a few markets contain just large old banks, the mean of indicator variable $BIG5$ is 0.98. However, the estimated coefficient on *BIG5* is statistically significant and shows that borrowers in markets containing at least one new bank pay 27 basis points lower interest rate for working capital and 152 basis points lower interest rate for multiple purpose loans, compared to markets containing only large old banks.

The competitive structure of the banking industry is influenced by the operation of the conventional banks in most of the markets across the country, but the CIB data shows that other small financial institutions including Islamic finance companies and leasing companies are also lending to corporate borrowers mainly located in large cities. In order to incorporate the competitive effect of other financial institutions, model 3.2 and 3.3 are estimated for the sample of loans for all financial institutions, the results are presented in appendix Table 3.3A. The findings that loan rate decreases with the increase in the number of banks in a market is present in various specifications in appendix Table 3.3A, where total number of lending institutions is used to proxy $BANK$ variable instead of number of conventional banks. The relationship between number of banks and loan price remains statistical significant in Table 3.3A.

Table 3.3 Pooled regression results for the effect of concentration on loan rates

	Working Capital Interest Rate			Multiple Purpose Interest Rate		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Number of new Banks	-0.027***	0.029		-0.034***	-0.075	
	(0.005)	(0.021)		(0.007)	(0.044)	
Squared number of Banks		-0.001*			0.001	
		(0.001)			(0.001)	
BIG5 dummy			-0.268			-1.524***
			(0.278)			(0.37)
Private Bank Dummy	-0.841**	-0.838**	-1.102**			
	(0.274)	(0.276)	(0.338)			
Private Borrower Dummy	-0.154	-0.171	-0.23	-0.455	-0.401	-0.747
	(0.181)	(0.189)	(0.189)	(0.546)	(0.544)	(0.543)
Log Loan Amount	-0.245***	-0.239***	-0.291***	-0.080**	-0.079**	-0.080***
	(0.044)	(0.041)	(0.048)	(0.025)	(0.025)	(0.023)
Loan Duration	0.026**	0.026**	0.028**	0.039***	0.039***	0.037***
	-0.009	(0.009)	(0.009)	(0.01)	(0.01)	(0.01)
Public Borrower* Private Bank				-1.620**	-1.620**	-2.167***
				(0.598)	(0.601)	(0.619)
Private Borrower* Private Bank	0.554*	0.553*	0.705**	-0.669***	-0.725**	-0.869***
	(0.257)	(0.261)	(0.272)	(0.200)	(0.223)	(0.159)
Constant	-20.950***	-21.300***	-19.842***	-21.299***	-20.819***	-17.198***
	(1.775)	(1.727)	(1.777)	(2.751)	(2.734)	(2.348)
Sample Size	43363	43363	43363	7317	7317	7317
R Square	0.771	0.771	0.767	0.718	0.718	0.714

NOTES: dependant variable real interest rate annual %, results based on pooled sample 2006-2012, * p<0.05, ** p<0.01, *** p<0.001, standard errors in parentheses clustered at market level, quadratic loan duration terms are included in all specifications, further quarter dummies included in all specifications.). R-square for all models is between 0.71 to 0.77, further Ramsey RESET reject the null hypothesis that models have no omitted variables in most of the specifications.

Most of other the coefficients in Table 3.3A are not much different from Table 3.3, although the coefficient of a private lender dummy is higher in magnitude, particularly for multiple purpose loans, this is likely because smaller financial institutions are mostly issuing fixed capital loans that fall under the multiple loan category. For example, the coefficient in column (3) of Table 3.3A for multiple purpose loans shows that private financial institutions charge borrowers 120 basis points lower interest rate compared to government banks, holding other factors constant. The nature of competition between small financial institutions and large banks is not clear, however the CIB data shows that small institutions are mainly leasing companies and Islamic finance companies. The analysis incorporated additional interaction terms for lender type and borrower type for public and private market segments, however majority of results are insignificant, although there is some evidence that for multiple purpose loans government companies get loans from private bank at lower rates compared to what private banks offer to private borrowers.

In the markets where historically large banks are operational competition is neutralized due to long customer relation between big 5 banks and borrowers (i.e. brand loyalty). As before liberalization, most of the businesses were financed by the big 5 banks in virtually all the markets of Pakistan, there is a high probability that the client relationship between firms and banks carried on, particularly in the local markets where no post reforms entry occurred. In credit markets with long customer relationships, banks can charge marginally higher rates to old customers as switching costs might be higher, while new borrowers/firms in large cities can take advantage of competition in the market and switch to the bank with the lower interest rate for business financing[74].

The regression result supports the idea that competitive structure influences market prices, the loan rate declines as the number of banks increases in a market. Although the statistical evidence goes in favour of the structure conduct hypothesis, the findings are not robust to the functional forms as demonstrated in Table 3.3 and Table 3.3A. The weak statistical relationship between market structure and prices potentially results from issues with the description of the market variable, some institutional details, and the nature of the Credit Information Bureau (CIB) data, the discussion below covers two such aspects. One possible solution is to check sensitivity of results by employing different measures of concentration. There is limitation to select other measures of concentration, because the other measures of market concentration are available at aggregate level over the sample period, while loans are reported quarterly, so the additional concentration measure might not capture the actual impact of market concentration on the loan rate. The empirical model can improve by incorporating the impact of entry of high level player into the market, but the required information is not available in the Credit Information Bureau (CIB) data, the main source of analysis is the CIB

First, the identification of a geographical market is based on the borrower's address as the branch details are confidential in the Credit Information Bureau data[75], and most borrowers reported their main region as the location rather than the detailed street level address. Therefore there is some risk that a loan was actually generated by a bank located in a market with a high bank concentration, while the loan was

[74] This notion is reconfirmed with an unstructured qualitative interview with a leading bank manager.
[75] The branch information might not be very useful in identifying market location as well (see Section 3.4).

reported in the CIB system for an urban market according to the main address, and in that market many banks were in operation. This data reporting issue can potentially dilute the influence of the competitive structure of the banking market on interest rates charged by a bank for a given loan in that market.

Finally, in a large informal economy such as Pakistan, most businesses are owned by unregistered firms or firms with single person liability, particularly family or individual owned small firms in the local markets which are usually unregistered firms[76]. The CIB data reports loans only for organized large firms including listed companies, and large corporations (See Figure 3.3A). The variation in borrowing cost for credit is likely to be higher for small businesses across different markets, where borrowing cost depends on the nature of competition in the market. As Credit Information Bureau data only covers established firms and does not includes single person liability firm, so the effect of banking concentration on business loans cannot be estimated for all types of firms in the market. The single liability business loans are classified as personal loans in the CIB data. For further research, enlarging the sample of loans by including single liability firms can provide further insight into the analysis of the structure-conduct hypothesis for the loan market in Pakistan.

3.7 Concluding Remarks and Further Research

This chapter estimates the price concentration relationship for the Pakistani banking industry. It bridges an important gap as there is no substantial empirical literature available on competition and market outcomes of the baking industry in Pakistan at a micro level. The simple model estimated here shows that the interest rate charged by banks decreases as the number of banks grows in a market, and the

[76] Including farming, transport, trade, retail services, and many other small scale activities.

loan price is substantially less in the markets where post liberalization entry has occurred.

The structure performance hypothesis explains results from one dimension, where the concentration and competitive banking structure in a market is affecting the loan rate banks charge to borrowers. The banking efficiency literature shows that new private banks are operating efficiently in the Pakistani banking industry that means low cost entrants are crating competitive pressure for large old incumbents. However the post liberalization private bank entry occurred mostly in large cities, so it might by the case that the cost of the banks in small-town markets is higher compared to large cities, due to overheads that will confound the influence of competition on price with the cost of banking.

On the policy front, the central bank of Pakistan has encouraged banks to open branches in small towns and local markets in recent years, as the major post liberalization entry occurred only in large cities, urban centres, and industrial towns. But before any policy prescription can be laid, the logical question emerges of what determines the number of banks in a given market? And, what factors are important for a bank to decide entry in or exit from the market? These are important research questions which will help policy makers, and future research should be directed in this line.

The data constructed in this chapter can be of potential use for the further research in order to address policy evaluation questions in the banking industry, or in measuring the impact of any exogenous shock in financial markets. For example, the evaluation of any exogenous shocks during the sample period including weather catastrophes on the lending market can be studied with this data. Similarly, market changes which can simulate natural experiments can be matched with the data set constructed here to address policy relevant questions.

3.8 Data Appendix

Table 3.1A: Credit Information Bureau (CIB) selected variables

- Lending Institution Code, unique bank identifier
- Borrower's Code, unique firm identifier
- Borrower's location City, Town or District
- Name of credit facility, type of loan (e.g. working capital)
- Date on which the credit facility was given to the borrower
- Nature of facility (e.g. fund based, non- fund based)
- Maturity date, or renewal date of the credit facility in case credit line is renewed
- Limit amount of the credit facility in Rupees
- Principal outstanding amount against the facility including interest rate in Rupees
- Nature and value (in Rupees) of collateral against the loan facility provided by the bank
- Interest rate at charged for the loan (Annual Percentage Rate - APR)
- Borrower's credit rating if available , including internal and external rating

Source: Credit Information Bureau, State Bank of Pakistan

Table 3.2A: Summary Statistics Group wise

Variable	Observations	Mean	Standard Deviation	Min	Max
Loans for multiple purposes					
Interest rate (%)	7317	14.20	3.46	3	20.68
Number of new banks in a market	7317	26.56	14.12	0	38
More than 5 banks dummy	7317	0.97	0.16	0	1
New private bank/lender dummy	7317	0.79	0.41	0	1
Number of total banks	7317	31.97	14.51	1	44
Loan Size (million Rupees)	7317	120.19	839.10	0.01	23327.97
Loan duration in months	7317	15.54	22.22	0	170
Working Capital					
Interest rate (%)	43363	14.45	3.04	3	20.68
Number of new banks in a market	43363	28.37	13.06	0	38
More than 5 banks dummy	43363	0.98	0.14	0	1
New private bank/lender dummy	43363	0.90	0.30	0	1
Number of total banks	43363	33.84	13.34	1	44
Loan Size (million Rupees)	43363	64.98	289.81	0.01	22820
Loan duration in months	43363	9.97	9.86	0	240

Table 3.3A: Pooled regression results all financial institutions for the effect of concentration on loan rates

Dependent Variable	Working Capital Interest Rate			Multiple Purpose Interest Rate		
	(1)	(2)	(3)	(1)	(2)	(3)
Number of new Banks	-0.011***	-0.001		-0.007**	-0.041**	
	(0.001)	(0.006)		(0.002)	(0.015)	
BIG5 dummy	-0.890**	-0.890**	-0.466*	-1.485***	-1.462***	-1.569***
	(0.283)	(0.284)	(0.216)	(0.29)	(0.29)	(0.378)
Private Bank Dummy	-0.187	-0.202	-1.124***	0.27	0.335	-1.597***
	(0.182)	(0.187)	(0.316)	(0.50)	(0.500)	(0.295)
Private Borrower Dummy	-0.236***	-0.236***	-0.207	-0.120***	-0.115***	0.225
	(0.042)	(0.042)	(0.170)	(0.033)	(0.033)	(0.518)
Log Loan Amount	0.027**	0.027**	-0.289***	0.039**	0.039**	-0.117***
	(0.009)	(0.009)	(0.048)	(0.013)	(0.013)	(0.031)
Loan Duration	0.027**	0.027**	0.029**	0.039**	0.039**	0.036**
	(0.009)	(0.009)	(0.009)	(0.013)	(0.013)	(0.012)
Private Borrower * Private Bank	0.565*	0.572*	0.685**	0.204	0.14	0.265
	(0.276)	(0.280)	(0.260)	(0.332)	(0.328)	(0.353)
Constant	-21.234***	-21.276***	-19.812***	-27.276***	-27.046***	-24.416***
	(1.751)	(1.749)	(1.719)	(3.706)	(3.699)	(3.217)
Sample Size	43719	43719	43719	8349	8349	8349
R Square	0.772	0.772	0.768	0.728	0.729	0.727

NOTES: for dependant variable real interest rate annual %, results based on pooled sample 2006-2012, * p<0.05, ** p<0.01, *** p<0.001, standard errors in parentheses clustered at market level), quadratic loan duration terms are included in all specifications, quadratic BANK term included in specification (2). R-square for all models is between 0.73 to 0.77, further Ramsey RESET reject the null hypothesis that models have no omitted variables in most of the specifications.

Figure 3.1A: Number of Loans (quarter wise)

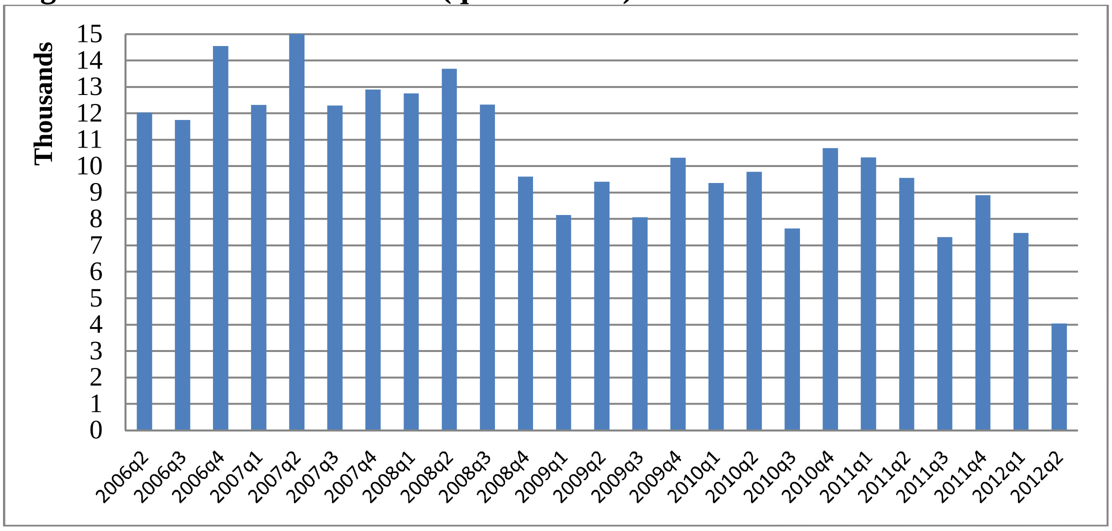


Figure 3.2A: Kernel Densities for Log Loans (2006-2012)

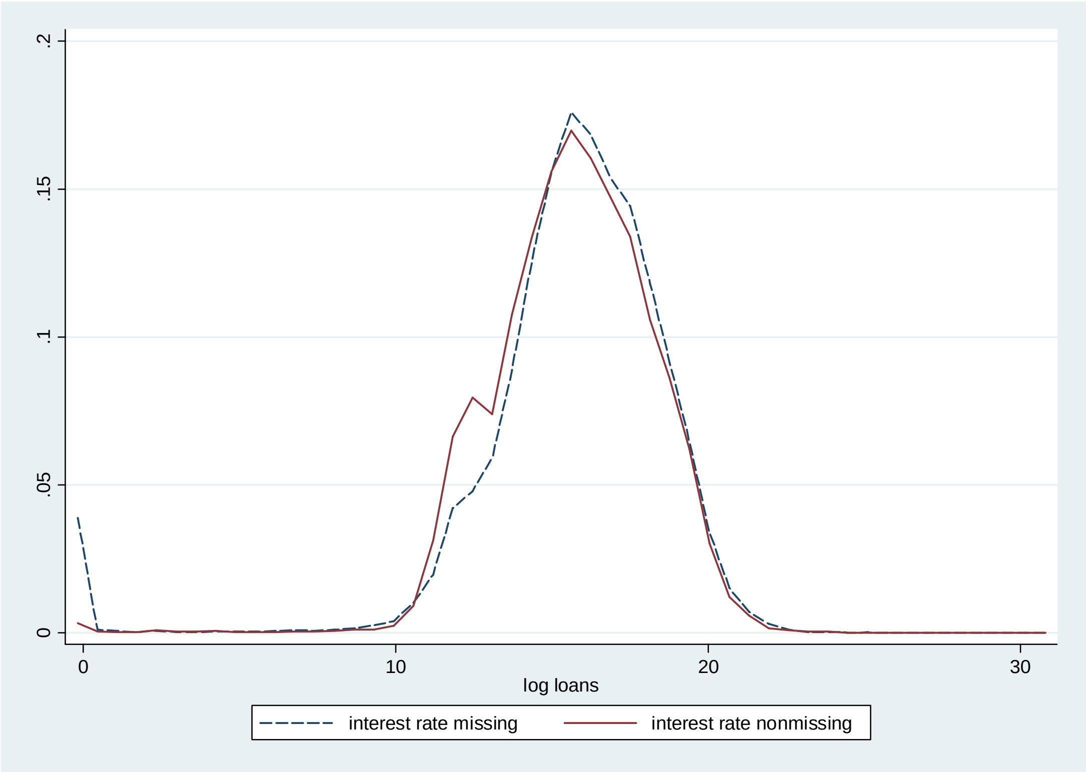
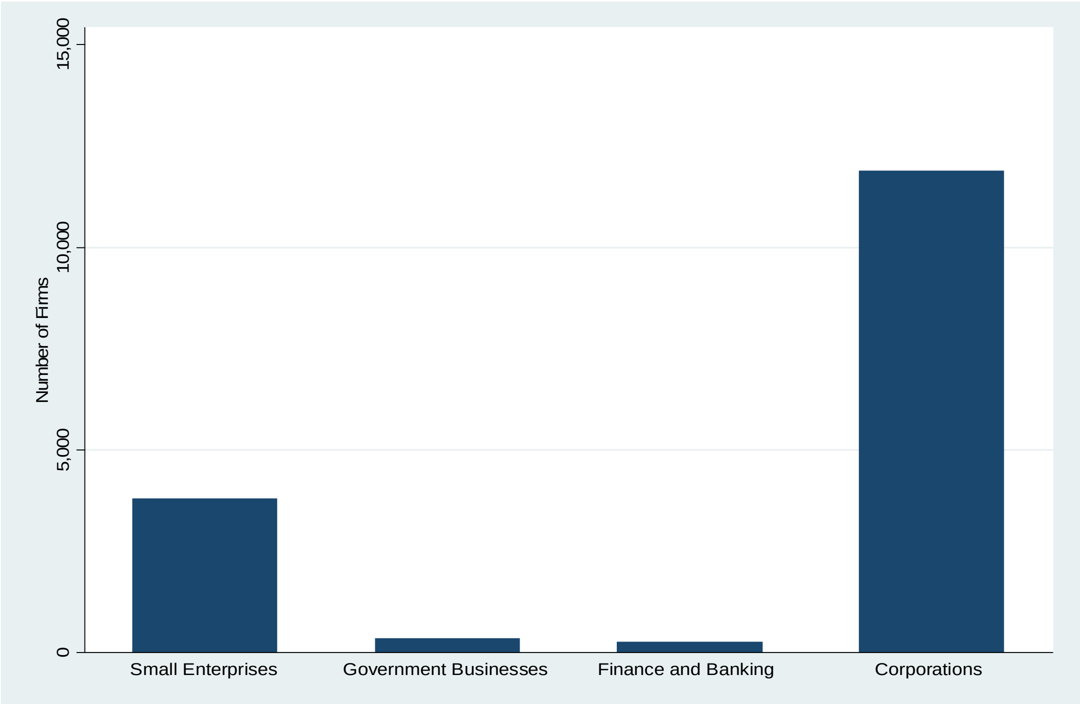


Table 3.4A: Description of variables used in regression analysis

Acronym	Variable	Description
r	Interest rate (%)	Inter rate charged for each loan
Number of new Banks	Number of new banks in a market	Number of total private bank entered and operating in the market after liberalization
BIG5 Dummy	More than 5 banks dummy	Takes the value 1 if loan is issued in a market where at least one bank other than the large banks operate
Private Bank Dummy	New private bank/lender dummy	Takes value of 1 if the loan is issued by a private bank and 0 otherwise
Loan Amount	Loan Size (million Rupees)	Amount of loan in local currency
Loan Duration	Loan duration in months	Loan contract duration in months
Private Borrower Dummy	Private borrower dummy	Takes value of 1 if loan is issued to a private firm, and 0 if a government owned firm

Figure 3.3A: Types of Borrowers



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