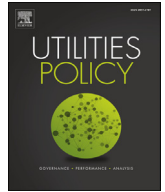




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Assessing the efficiency dynamics of post reforms electric distribution utilities in Pakistan

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ABSTRACT

The power sector of Pakistan has undergone major reforms since 1994 with the objectives of increasing technical and financial performance of the sector. This study estimates and analyzes post reforms efficiency dynamics of electric distribution utilities from 2006 to 2013. Fixed effects stochastic frontier analysis results indicate that technical efficiency of utilities increased by 4.8 percent. However, total factor productivity experienced a negative growth of 11 percent as all components of index remained negative except for efficiency change. Productivity of electric distribution utilities can be enhanced by adjusting their scales of operation and reducing their size through further horizontal separation.

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1. Introduction

Pakistan's electricity market has undergone major reforms and restructuring since 1994. Insufficient generation capacity, inadequate framework and incentives for private investment and poor governance of electrical supply infrastructure were among the major reasons for restructuring (Kessides, 2013). These reforms were initiated with the intention of improving operational, managerial and technical aspects of the power sector in Pakistan (Malik, 2012). Moreover, these reforms were based on the view that state owned monopolies were inherently inefficient and their vertical and horizontal separation could increase competition among utilities resulting in efficiency improvements and cost savings (Coelli et al., 1998).

As part of power sector policy, several reforms were

implemented. An important aspect of the reforms required the separation of state owned vertically integrated monopoly, The Water and Power Development Authority (WAPDA), into one National Transmission and Dispatch Company (NTDC), four Generation Companies (GENCOs) and eight publicly owned distribution utilities (sometimes referred to as distribution companies of DISCOs).¹ Another reform in 1997 involved the formation of an autonomous regulatory authority; National Electric Power Regulatory Authority (NEPRA) (Khan, 2014).

Despite the implementation of these reforms, the power distribution sector in Pakistan is still facing many difficulties including heavy distribution losses, inability of distribution utilities to recover cost from bills, insufficient investment into distribution infrastructure, prices below the cost of service, inexperienced work force, inappropriate transformer capacities and low power factors. Taking these and associated problems into account, the analysis of efficiency dynamics of distribution utilities in post reforms periods carries paramount importance. Furthermore, in recent years, the

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¹ NEPRA. (2013). State of industry report. Islamabad, Pakistan.

power sector in general and electricity distribution utilities in particular have been confronting with the problem of “circular debt”² caused by line losses and other technical and efficiency issues related to power distribution with a domino effect all the way to the generation sector. In this regard, Government of Pakistan paid about Rs. 500 billion to the generation companies in order to reduce their debts in 2013 but this financial bailout package could not help the sector at this juncture and the circular debt remounted to 313 billion rupees in 2015.³ In the past, very limited focus has been given to enhancing the efficiency and productivity of the electricity sector in general and Pakistan's distribution utilities in particular.

Empirical studies have found that reforms can significantly improve the productivity of the electricity markets by providing better services at relatively lower prices to consumers (Jamash and Pollitt, 2002; Nagayama, 2009; Sioshansi, 2008; Xavier, 2015). Several studies (Barros and Peypoch, 2007; Mota, 2004; Weyman-Jones, 1991) have concluded that policies such as separation of vertically integrated utilities and increasing competition among them are possible ways of improving efficiency of the electric industry. Moreover, several empirical studies across the globe have confirmed the hypothesis that reforms have had a positive impact on the technical efficiency of electricity supply chains (Cullamnn and Hirschhausen, 2007; Senyonga, 2014; Celen, 2013; Cullmann et al., 2006).

As far as the analysis of efficiency and productivity in the South Asian region is concerned, very few empirical studies are available in the existing literature. The available literature focuses on very limited attributes of electricity distribution in the region. We are aware of only two studies focusing on Pakistan (Saleem, 2007; Zakaria and Noureen, 2016). Saleem (2007) aims to quantify the level of technical efficiency in the electricity distribution sector in Pakistan. This study is among the pioneering efforts to assess the efficiency dynamics of post reforms electric utilities in Pakistan, but is outdated and incomplete. The results reveal that total factor productivity of electric utilities increased by 3 percent during 1998–2003. Furthermore, efficiency change, pure efficiency change and scale efficiency change deteriorated over the study period.

Zakaria and Noureen (2016) employ panel data to estimate the technical efficiency score for each distribution utility. This study ignores dynamic aspects of efficiency and productivity change for each utility and the goal was only to benchmark the most and least efficient distribution utility and provide some commentary on scale economies. Furthermore, the paper carries no empirical analysis to decompose total factor productivity into its subcomponents.

With this background, the prime objective of this study is to estimate the technical efficiency of distribution utilities in Pakistan. In addition, we explore the productivity growth of electric utilities in Pakistan by parametrically decomposing the total factor productivity growth index into technical change, scale change and efficiency change. This study also examines changes in the efficiency score of each of the distribution utility over time. We use a true fixed effects approach to stochastic frontier analysis for estimation purposes. Using this methodology, we are able to treat the measurement errors and to test the hypothesis relating to both the functional forms and the parameters (Pantziros et al., 2011). Our study, by identifying the reasons for inefficiency and sources of

growth of total factor productivity, can inform the development of Pakistan's regulatory framework.

This paper proceeds in following manner. Section 2 provides an overview of electric distribution utilities of Pakistan. Section 3 discusses the data, methodology and estimation strategy. Section 4 presents results and discussion and section 5 concludes the paper with suitable policy recommendations.

2. Electricity distribution in Pakistan

Electric distribution utilities carry electricity from medium-voltage grids to low-voltage grids and consumption nodes. The distribution network in Pakistan consists of 10 distribution utilities⁴ and K-Electric.⁵ Under the single buyer model, the Central Power Purchase Agency (CPPA) takes electricity from all available resources, including WAPDA hydro, independent power producer's thermal, public sector GENCO's and nuclear plants and imports. This electricity is provided to all distribution utilities in the country for supply to the residential, commercial, industrial and agricultural customers of Pakistan. Karachi Electric can also acquire electricity from CPPA in case a shortage of power is felt in its system (please see Fig. 1). Distribution utilities are also responsible for maintaining and operating grid stations and transmission lines of 132 KV and below. Distribution utilities operating in Punjab province serve a larger share of the overall power consumers due to high population density. These utilities have shown better performance in overcoming technical and non-technical losses, which is evident from various indicators mentioned in the annual reports of the electric power regulator (NEPRA, 2015).

As per the long-term distribution licenses issued by the electric power regulator (NEPRA), the separated yet publicly owned distribution utilities were required to overcome their technical and non-technical losses in order to prepare for the next step of reforms, namely privatization. However the distribution entities still fail to comply with that aspect of their operating licenses. They incur huge technical losses from multiple factors including poorly configured grids and distribution lines as per load requirements; inefficient electrical machinery, and the inadequate condition of wires and meters. Non-technical losses in distribution utilities constitute the major portion of distribution losses in Pakistan. These losses largely stem from governance failures such as unmetered and unbilled electricity supply, low rates of bills recovery, and managerial malpractices have encumbered not only the distribution segment but also the entire supply chain. The overall impact of the technical and non-technical losses by the distribution utilities results in shortage of operating revenues and perpetuation of the inter-corporate circular debt (Fig. 2).

Fig. 2 depicts the units of electricity purchased, sold and lost from 2008 to 2013 under PEPCO system. Electricity purchased by distribution utilities rose from 77475 (GWh) in 2008–82518 (GWh) in 2013. Electricity sold to the end users has increased from 62719 (GWh) to 64984 (GWh) while distribution losses increased from 14756 (GWh) in 2008–17534 (GWh) in 2013. This indicates that along with the increase in the electricity sales, the distribution utilities have been incurring higher losses that increase their cost

² The problem of circular debt arises due to the disturbance of payments flow in the power supply chain. Due to failure of distribution utilities to pay back to the transmission companies, the transmission companies do not pay to the electricity generators. As a result, the generation companies become unable to make fuel payments to the oil and gas companies. In this regard, the whole energy sector enters into a debt trap carrying huge implications for the macro economy.

³ Retrieved from: <http://www.dawn.com/news/1212748>.

⁴ These distribution utilities include Peshawar Electric Supply Company Limited, Islamabad Electric Supply Company Limited, Gujranwala Electric Power Company, Lahore Electric Supply Company Limited, Faisalabad Electric Supply Company Limited, Multan Electric Power Company, Hyderabad Electric Supply Company Limited and Quetta Electric Supply Company Limited. Sukkur Electric Supply Company Limited was given license in 2011 while Tribal Area Electricity Supply Company Limited was granted license in 2013.

⁵ K-Electric is a vertically integrated private sector monopoly that serves Karachi and its adjoining areas.

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