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Cost function estimates, scale economies and technological progress in the Turkish electricity generation sector

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ABSTRACT

Turkish electricity sector has undergone significant institutional changes since 1984. The recent developments since 2001 including the setting up of a regulatory agency to undertake the regulation of the sector and increasing participation of private investors in the field of electricity generation are of special interest. This paper estimates cost functions and investigates the degree of scale economies, overinvestment, and technological progress in the Turkish electricity generation sector for the period 1984–2006 using long-run and short-run translog cost functions. Estimations were done for six groups of firms, public and private. The results indicate existence of scale economies throughout the period of analysis, hence declining long-run average costs. The paper finds empirical support for the Averch–Johnson effect until 2001, i.e., firms overinvested in an environment where there are excess returns to capital. But this effect was reduced largely after 2002. Technological progress deteriorated slightly from 1984–1993 to 1994–2001 but improved after 2002. Overall, the paper found that regulation of the market under the newly established regulating agency after 2002 was effective and there are potential gains from such regulation.

1. Introduction

There is a large literature on scale economies and technical change on different stages of electricity supply with applications to many countries. Enduring popularity of such studies reflects the continuing debate over the liberalization of the electricity sectors. Much of the research focuses on the effect of vertical disintegration since in most countries the regional and national electricity sectors have been organized as vertically integrated monopoly companies.

Liberalization of the electricity sector is an important policy discussion also in Turkey. Until 1984, different stages of electricity supply (generation, transmission, distribution, and trading) were dominated by a large vertically integrated state-owned company. Since then, the government has undertaken reforms to regulate the sector with an ultimate aim of complete liberalization. With the establishment of a regulating agency in 2001 and the adoption of a strategy paper in 2004, deregulation of the sector has taken a start. From the introduction of private ownership of electricity supply facilities first in 1984 until 2001, various types of ownership–production structures were observed in the regulated electricity sector. The regulation of the sector was ensured by the high judicial organs of the state. Deregulation is still under way and the Turkish electricity sector is currently regulated by a regulatory agency to enable smooth implementation of deregulation.

Developed countries started deregulation of their electricity sectors in the 1980s. The proponents of deregulation generally argue that the regulating agencies provide no incentives for cost reduction and regulation causes distortions and limited competition (Ramos-Real, 2005). Deregulation took the form of vertical disintegration of the state monopolies in these countries. In the stages of electricity supply where regulation was maintained (in most cases, distribution) regulation is generally maintained through the introduction of various incentives.

Various papers have assessed liberalization of the electricity sectors in different countries from different perspectives. Much of the discussion about ownership and regulation is centred on efficiency. Jamasb and Pollitt (2000) reviewed a large number of such studies and argued that size and ownership structure during regulation period are strongly related to efficiency of the electricity sector. The issue is controversial, however. Bagdadioglu et al. (1996), for instance, found that private electricity utilities are more efficient than public utilities in Turkey whereas Pollitt (1995) found no significant gain from privatization of the electricity sector.

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In evaluating the liberalization of the electricity sector, it is necessary to consider the organizational changes that took place during the process. Ramos-Real (2005) has shown that the organizational structure and market mechanism in the electricity sector presents some characteristics that complicate the process of vertical disintegration. He argues that it is essential to know the cost function of the sector when evaluating deregulation. A cost function demonstrates the relation between the total cost of production for different levels of output and factor input prices and technical change. In doing this, one can choose between parametric and nonparametric methods. Parametric methods are generally preferred to nonparametric methods on the ground that they can be estimated econometrically and they allow hypothesis testing. An appealing cost function is the translog cost function due to its flexibility and simplicity.

The parametric cost function approach allows the researcher to investigate scale economies. In this study, the cost function in Turkish electricity generation sector is estimated using long-run and short-run translog cost functions. The primary aim is to estimate the scale economies and the extent of overcapitalization in the electricity generation sector. It is not reasonable to estimate scale economies without separating the generation, distribution, and transmission phases since previous studies have shown that each of these phases are characterized by different levels of competition and regulation in varying degrees across countries (e.g., Nelson and Wohar, 1983; Kaserman and Mayo, 1991; Nemoto et al., 1993). In Turkey, the existence of private entrepreneurship and competition is substantial in the generation stage whereas the distribution and transmission stages are regulated. Therefore, it is preferred to conduct the analysis for the electricity generation sector due to the opportunity of relating the findings with ownership structure. Some methodological issues distinguish this study from other studies on Turkish electricity sector. First, this study estimates a translog cost function for the Turkish electricity sector. The paper is motivated by the unavailability of an estimation of scale economies for the Turkish electricity generation sector. Testing the Averch–Johnson effect is another important contribution of this study.

The rest of the paper is organized as follows. Section 2 reviews recent developments with a focus on institutional changes in the Turkish electricity sector. Section 3 presents the method of analysis and the features of the model used. Section 4 reports the findings for scale economies, overcapitalization, and technological progress. Finally, Section 5 concludes with final remarks and policy implications.

2. Recent developments in the Turkish electricity generation sector

Several descriptive studies in recent past have provided critical reviews and assessments of the organizational and legal changes in the electricity sector in Turkey, such as Atiyas and Dutz (2005), Hepbasli (2005), Israfil (2006), Yilmaz and Uslu (2007), Erdogdu (2007b), Cetin and Oguz (2007), and Ulusoy and Oguz (2007). This section provides a review of these studies.

Until 2001, the electricity sector in Turkey was dominated by a vertically integrated public company, Turkish Electricity Authority (TEK), which undertook generation, transmission, and distribution. TEK was granted full-monopoly status in 1982, but as part of the liberalization effort of the government during the early 1980s and as a step to prevent the recurrence of the energy crisis of the late 1970s, the government initiated significant changes in the electricity sector and the monopoly status of TEK was abolished in 1984. Consequently, private investors were allowed to engage in electricity generation activities. TEK was restructured into a vertically integrated public company, which undertook generation, transmission, and trading. At the same time, with legal amendments, domestic and foreign private entrepreneurs were allowed to build electricity production facilities and operate the existing production and distribution facilities without ownership rights (which still remained with TEK). Ten private firms entered the market after the mid-1980s.

Early attempts of the government to privatize the electricity sector suffered from legal obstacles. The constitution deemed electricity supply as public service and did not let private entrepreneurs own production facilities. Despite these legal obstacles, the government in the early 1980s, which dedicated itself to the liberalization of the economy, introduced various ownership rights for the existing and newly built facilities. The most important of these were (i) build–own–transfer (BOT), (ii) build–operate–own (BOO), and (iii) transfer-of-operation-rights (TOR) systems. In the BOT system, the private investor builds and operates the facilities for a period of about 20 years and returns the facilities to the state at the end of the term. In the BOO system, the ownership right remains with the private investor and all generated electricity is purchased by TEK. Finally, TOOR system allows full private ownership and operation of the facilities. On the other hand, private manufacturing companies (called autoproducers) were allowed to generate electricity for their own needs in their production activities. Two private companies, Cukurova Electricity Corporation and Kepez Electricity Trading Company, were also granted concessionary rights to generate and sell electricity to consumers in their respective regions (Adana and Antalya regions in southern Turkey). The period until 1994 is therefore characterized by very strong regulation of the electricity sector.

TEK went into restructuring in 1993 and was split into Turkish Electricity Generation and Transmission Company (TEAS) and Turkish Electricity Distribution Company (TEDAS), both of which enjoyed the status of state-owned-enterprise. TEAS, autoproducers, the two abovementioned concessionary companies, and other private generation facilities (the ones with transferred ownership rights and private production companies which numbered around 30) were allowed to generate electricity but only TEAS and concessionary companies were allowed to sell electricity from the generators. The concessionary rights of Cukurova and Kepez companies were granted to a large private business group in 1994 for a period of 10 years. These two companies were seized by the government in 2003 with a claim that the private business group breached competition rules and violated the licensing agreement. In short, the interim period 1994–2001 is characterized by a restructuring attempt where the previously integrated state monopoly was still at the centre with a new role as the main buyer of generated electricity.

During the period 1994–2001, there were discussions about privatizing the electricity generation and trading sectors. In 1999, the Constitution was amended to allow international arbitration in electricity production. Prior to this amendment, electricity production was regarded by high judicial organs as a strategic issue for the nation and international arbitration was not allowed. Following, the Electricity Market Regulatory Agency (EMRA) was established in 2001 and TEAS was split again into three separate companies, Turkish Electricity Generation Company (TEUAS), Turkish Electricity Transmission Company (TETAS), and Turkish Electricity Trading and Contracting Company (TEIAS). In addition, TEDAS was privatized into regional distribution companies. The unbundling of the public companies allowed the separation of the supply process of electricity to be undertaken by separate entities. EMRA was given the duty of implementing the reforms towards privatization. In 2003, EMRA granted generation licenses for premises with installed capacity larger than 3000 mega-watts