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Electricity reform, tariff and household elasticity in Turkey

Murat Çetinkaya [a], Alparslan A. Başaran [b, *], Necmiddin Bağdadioğlu [b]

[a] Turkish Competition Authority, Bilkent, Ankara 06800, Turkey
[b] Department of Public Finance, Hacettepe University, Beytepe, Ankara 06800, Turkey

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ABSTRACT

This paper assesses the progress of Turkish electricity reform with a particular emphasis upon tariff structure and elasticity which are essential components of a successful reform. This is done through estimating price and income elasticity using the pooled data approach for the first time for the Turkish households covering the period of 2003–2012. The results strongly suggest that both the sector regulator EMRA and the private distribution companies ought to take into consideration the households' characteristics while designing electricity tariff following the envisaged introduction of cost-based tariff after 2015.

1. Introduction

As an accession country, Turkey has been aligning its electricity market with the European Union electricity market by taking steps towards a more liberalized market since 2001. The liberalization process has geared up following the revision of the Electricity Market Law of 2001 in 2008. Since then, the privatization of regional electricity distribution companies has been completed, the generation companies have been offered to private investors, and the market opening rate has reached to 75% after the decision of the sector regulator, Energy Market Regulatory Authority (EMRA). EMRA has recently lowered the eligibility thresholds to 4500 kWh for 2014, and starting from 2015 expected to let the distribution companies to design their own electricity tariff (Bağdadioğlu, 2011).

Privatization of all state owned electricity distribution companies[1] as of 2013 is an important step towards the liberalization of the Turkish electricity market. However this timing of the privatization process falls behind the timetable indicated in the "Strategy for the Electricity Market and Security of Energy Supply" of 2009 (the 2009 Strategy Document hereinafter). Insufficient infrastructure in the distribution regions, highly divergent technical loss and theft ratios among the distribution regions and the increasing electricity demand particularly after 2009 are among the main reasons behind this time lag.

Following the 2009 Strategy Document, public investments regarding the transmission network are increased. Nonetheless, these investments crowed-in the private investments both in the production and the distribution sides. The electricity trade with Europe has increased, as well. By June 2011, the Turkish electricity transmission system is integrated with the European Union network and necessary technical capacity is adopted. After the integration with ENTSO-E (the European Network of Transmission System Operators for Electricity), Turkey initiated electricity trade with both Greece and Bulgaria. By April 2014 Turkey has fully and permanently integrated its electricity network with the Continental Europe. In this context, by completing the privatization process and with the expected accomplishment of 100% electricity market openness in 2015 or 2016, Turkey has moved forward to fully integrate its electricity market with the European Union, starting with the countries of Eastern Europe. The next step is introducing competition within the Turkish electricity market which requires a cost-based tariff design according to the end-users' demand characteristics, which is the subject matter of this paper with a particular focus on households' consumption patterns.

As part of the reform package the privatized distribution

* Corresponding author.
E-mail addresses: mcetinkaya@rekabet.gov.tr (M. Çetinkaya), aab@hacettepe.edu.tr (A.A. Başaran), necbag@hacettepe.edu.tr (N. Bağdadioğlu).

[1] The 21 electricity distribution companies are Dicle, Vangölü, Aras, Çoruh, Fırat, Çamlıbel, Toroslar, Meram, Başkent, Akdeniz, Gediz, Uludağ, Trakya, İstanbul Anatolian Region, Sakarya, Osmangazi, Boğaziçi, Kayseri and periphery, Aydem, Göksu and Yeşilırmak (TEDAS, 2012).

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companies are obliged to separate structurally and carry out their production, distribution and retail activities under different legal entities and are expected to decrease the technical loss and theft ratios in their regions. The former requirement of the reform has been already fulfilled while the fulfillment of the latter requirement seems to be problematic. For instance, the regions at the Eastern Turkey, particularly Dicle and Vangolu regions where the technical loss and theft ratios are too high with 75% and 55% respectively, stay as challenging regions against the privatization and liberalization process. Furthermore, the annual electricity consumption was about 61 million Megawatt/hour in Turkey in 2012 where the technical loss and theft ratio was almost 25% (24 million Megawatt/hour). It is observed from the yearly consumption patterns that the technical loss and theft ratios have their peak points between June and August, which are the hottest months of the summer seasons (TEDAS, 2012). It shows that the key problems in front of the electricity reform process are the technical loss and theft ratios and the magnitudes of the technical loss and theft of electricity across the regions and among the seasons.

Besides these structural deficiencies, the demand for electricity in Turkey has a dramatically increasing trend along with remarkable growth rates. For instance, it is witnessed that in September 2014 the highest daily electricity consumption with 827 million kilowatt/hour is recorded, which is the peak consumption since 2012.

Because of these transformations and modifications in the market, the awareness of the demand characteristics of electricity consumption will be important for both the private electricity distribution companies and their tariff approval body, EMRA. A recent study indicates that the electricity tariff was not prepared by taking into account of either price or income elasticity of Turkish households (Bağdadioğlu et al., 2009). In this regard, this paper aims to estimate the price and income elasticity and then propose a tariff structure. To the best knowledge of the authors, this involves the first attempt of electricity demand estimation for the Turkish households by using the most detailed publicly available information provided in the household budget surveys carried out by the Turkish Statistical Institute (TSI) covering the years between 2003 and 2012.

The paper consists of four main sections. The following section briefly reviews the previous studies. The third section introduces the residential electricity demand model. The fourth section explains the data used for the estimation of the Turkish household electricity demand and the electricity tariff structure in Turkey. Following the empirical results and assessments in section five, the paper concludes with a proposal of a tariff structure based on the findings.

2. Previous studies

The country-wide electrification rate has increased significantly in Turkey, from 51.5% in 1970 to 99.7% by the end of 1980s. The sectoral ratio of household electricity demand has dramatically increased from 15% in 1970 to 26% recently (TEDAS, 2009–2012). Despite this outstanding change, the household responses to the changes in income and electricity prices in Turkey have not attracted noticeable academic interest in the electricity literature (Halicioglu, 2007; Erdogdu, 2007). The existing studies applied time series analysis techniques on aggregated data without accounting for either differences in demographic and geographic characteristics of Turkish subgroups, or analyzing micro or cross-sectional Turkish data, as conducted, for instance, for the Indian households in Filippini and Pachauri (2004). A report on the Turkish electricity consumption conducted by the World Bank is the only micro level research that uses data from the TSI's Household Budget Surveys of 2008 and 2009 (World Bank, 2011).

Contrary to the Turkish case, there has been a growing literature on the electricity demand estimation conducted for different sectors (Houthakker, 1951; Taylor, 1975; Espey and Espey, 2004). In these researches which consider the electricity demand estimation in various sectors, an emerging interest in household electricity consumption is also witnessed. The main motives behind this interest stems from the concerns to reveal and properly understand the likely impacts of energy crisis, energy sector regulations and regulatory reforms on households by also taking into account of socio economic characteristics and other regional and seasonal factors. In this context, the micro level data gained much more attention than the aggregate level data, since the analysis of micro data allows policy makers to reach significant information and more policy oriented results that considers the household characteristics.

Following the pioneering research of Houthakker (1951), the literature mainly focused on the tariff structure that the households face with. There is also a wide debate regarding the proper price variable (i.e. average or marginal prices) as the best indicator of the actual tariff prices that the households take into account during their consumption decisions. The key reason behind this debate is that the households bear the costs of subscription, connection and etc. which are not related with the usage, as well as the non-linear tariffs which are directly related with their consumption levels and the posted tariffs. The chosen price variable is likely to raise an identification problem in the estimation of demand equation (Bohi, 1981). In the case of an increasing block tariff structure, marginal or average prices are to be imposed to the econometric demand model. While Houthakker (1951) and more recently Reiss and White (2005) are in favor of using marginal prices, Taylor (1975), Metcalf and Hasset (1999), Alberini et al. (2011), Fell et al. (2014), Borenstein (2008, 2009) and Ito (2014) emphasize the necessity of using average prices. Ito (2014) asserts that in the case of an increasing tariff structure the households take into account the average prices rather than the price levels that increase as a result of rising consumption. However the shortage of detailed information regarding the consumption and multiple tariff plans in the micro data sets necessitates the usage of average prices (Alberini et al., 2011).

Another problem in the estimation of household electricity demand arises where the electricity is indirectly used and the households gain benefit by the usage of appliance stock. In this case, households respond to the prices as a result of the given stock of appliances. On the other hand, households also may respond to the price changes by shifting the appliance stock in the long run. The appliance stocks issue results with a derived demand in gas, fuel, electricity and other energy products usage. Consequently the prices, energy efficiency features and other characteristics of appliance stocks become a part of the analysis of the electricity prices and household electricity consumption. Nevertheless as in the case of tariff structures, the insufficient nature of micro data constraints the researchers and force them to assume that prices of the appliance stocks as homogeneous between the different geographic areas (Filippini, 1999).

It is identified in the literature surveys regarding the research in which the micro data is used that the price and income elasticity of household electricity demand is lower than one, with a tendency of price elasticity to rise in the long-run as shown in Appendix A, Table A1. The aggregate data analysis concerning the