



The causes of electricity theft: An econometric analysis of the case of Turkey[☆]



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ABSTRACT

This paper, attempts to comprehend and analyze the determinant socio-economic background of illegal electricity consumption by estimating an energy theft equation through applying different econometric techniques. For the estimation, provincial electricity theft and socio-economic data for the period of 2002–2010 are employed. In Turkey, electricity theft leads to loss of substantial amount of dollars annually. This is a primary and thorough study in literature that aims to help prevent electricity theft in Turkey by determining the underlying socio-economic drives. Income, social capital, rural population rate, temperature index, Southeastern Anatolian Region dummy, and agricultural production rate were identified as significant determinants of electricity theft. Certain policy advice is also provided based on the findings.

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1. Introduction

In this paper, we focus on the issue of electricity theft and attempt to comprehend and analyze determinant socio-economic motives underlying this consumer behavior. Upon a thorough comprehension of these motives, possible policy suggestions from a socio-economic perspective to prevent electricity theft is discussed.

In Turkey, the industrial privatization process of electricity distribution is about to be completed, and private companies of the sector are seeking for ways to prevent illegal electricity use (referred to as “electricity theft” in the literature), which leads to a substantial amount of dollar loss annually. We believe that, with a better understanding of the causes, electricity theft can be prevented, that is, companies can prevent this illegal action that distorts social justice and investment decisions and consequently the growth of the economy. The prevention efforts for this illegal action, which has underlying socio-economic causes, is expected to be effective only through a collaborative work of the firms and the government. Hence, we’ll attempt to provide a guide for this collaborative infrastructure.

The literature commonly approaches this problem from an engineering perspective. It investigates the engineering techniques used to detect theft, given that there is electricity theft (Depuru et al., 2011; Ghajar and Khalife, 2003). However, it is likely to

prevent this behavior prior to the occurrence of theft. This paper analyzes this phenomenon for a single country with a complete socio-economic approach.

Electricity theft ratios in developed and developing countries differ substantially. The theft rate in the US and the West Europe is very low, approximately 1–2%. The OECD average is approximately 7%. In developing countries such as India, Malaysia, Bangladesh and Turkey, the size of the loss is far more considerable (Bhattacharyya, 2005). In India, the rate reaches to record levels as high as 30% of the produced total electric energy. By observing the relatively higher theft ratios in developing countries, one can assert that, this theft is merely related to poverty. However, this phenomenon is at times challenging to explain with the example of China where the theft rate is much lower. Factors other than income should be carefully examined. The struggle against electricity theft continues in all of the related countries, but this is mainly conducted through different special devices, engineering techniques and other various detective methods. To suggest effective policy recommendations for such a sensitive subject, which contains social, economic, and natural elements, the underlying drives of high rate of illegal consumption should be determined.

In the international economics literature, there are scarce studies that estimate the amount of economic loss caused by theft (Bağdadioglu, 2011), approach the subject in a descriptive manner (Steadman, 2009; Gümüşdere, 2004), or compare the efficiency of different engineering approaches and different techniques that are used to prevent electricity theft (Depuru et al., 2011). Therefore, to the best of our knowledge, this is the first paper in literature that

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aims to help prevent this behavior in Turkey before it takes place by determining the underlying socio-economic and natural reasons with a complete econometric approach.

Through the employed econometric techniques, we find education, income, social capital, rural population rate, temperature index, Southeastern Anatolian Region dummy and agricultural production to be the important determinants of electricity theft. We suggest the implementation of the social tariffs and specially designed education programs as possible solutions to prevent electricity theft.

The paper is structured as follows. In section 2, the studies in the international literature, with an emphasis on the papers focusing on the Turkish case is reviewed. In section 3, information about the Turkish electricity market is provided. In section 4, we present our estimation technique along with the underlying reasons of our choice of such technique. In addition, the explanatory variables used in the study, and our data set are presented. In section 5, we provide the results of the estimation process along with an interpretation. After offering policy suggestion to overcome electricity theft in Section 6, we briefly conclude in Section 7.

2. Literature review

Steadman (2009) examines the causes of the illegal use of electricity in Jamaica. In the paper, the author modeled Jamaica's illegal electricity considering the local dynamics, and found that income and education levels affect the tendency toward illegal electricity consumption. However, Jamaica is a very small country that has an area of 10,991 square kilometers and a population of 2,900,000. Noting the fact that this small country has its own distinct social and political dynamics, the generalization of the paper's results becomes implausible.

Smith (2004) examined the tendency of electricity theft in different countries and reached the conclusion that governance indicators can be used to understand the different theft related behaviors in different countries. However, when analyzing the case of Turkey, it is clear that on a smaller level, a different approach is needed. Initially, Turkey does not have a detailed data on governance indicators on city level. In addition, other local dynamics of Turkey should be evaluated. In this study, these special characteristics will be considered, and other missing data will be approximated with proxy variables for the city level.

In the literature, we see important studies for water theft as well. Ray and Williams (1999) studied evaluation of price policy in the presence of water theft in India. They showed that water theft increase the social cost of price policies. Meehan (2013) studied the water theft problem in Tijuana, Mexico. The author showed that the alternating tolerance and repression of water illegality is largely used by authorities to maintain hydrosocial order and, in effect, to control informal modes of development.

For Turkey, Bağdadioglu (2011) noted the negative effects of electricity theft on the ongoing privatization process (for a brief history of the privatization process in Turkey, see Table 3 in the appendix). Turkey currently applies a national tariff for electricity, and Bağdadioglu shows that regional cost-based tariff applications may bring efficiency to the tariff system by giving the responsibility to consumers about electricity theft in their region.

In a UNDP – Hacettepe University Center for Economics and Entrepreneurship report (2009), public utilities consumption, including electricity in Turkey is analyzed through qualitative method. With the help of statistical analysis and an effortful field study, strategies of poor households for public utilities consumption are also displayed by the authors. By these, the authors demonstrate that, expenditures on these utilities create a significant burden for the poor and to maintain a minimum consumption level they resort to different solutions including illegal use. Tariffs

that consider the consumption pattern of poor people are suggested as a fair solution to the problem.

Ulusoy and Oguz (2007) showed that a free market for electricity distribution could decrease the total amount of electricity that is used illegally. They conclude that the profit motive of the companies in the free market will unavoidably cut the electricity theft ratios through the use of a better detection mechanism implemented by the private companies.

Finally, in his master thesis, Gümüşdere (2004) focuses on the implications of electricity theft for a more efficient tariff design just before the formal privatization of the electricity distribution process has started. To understand the topic better, he also conducted some empirical analyses by which he discusses education and income as important determinants of theft. He has certain econometric issues in his work. For example, he does not consider the endogeneity problem in the analysis. The period of his data covers the term before the privatization process. This paper uses data from the privatization process, which gives more insight due to the supporting electricity theft prevention efforts. These efforts help to increase the variation of electricity theft in each province as well. In addition, our study will add to this paper by considering not only economic but also social, political and natural variables (some of which were used for the first time in the literature, such as a temperature index, migration rate, and the electoral participation rate) in different cities of Turkey with a solid econometric approach.

3. Turkish electricity market

In Turkey, each year approximately 16 billion kilowatt-hours of electricity is illegally used. This figure represents approximately around 15% of the total electricity supply and has a monetary value that is approaching \$ 1 billion yearly¹ (TEDAŞ (Turkish Electricity Distribution Company), 2011).

The consumers who pay their electricity bills regularly bear the burden of this \$ 1 billion annual electricity theft, with a special payment category named “illegal usage share” (there is no variation of the “illegal usage share” among different provinces) in the monthly bills. This causes a debate in terms of social justice. The electricity theft ratios vary a great deal among different parts of Turkey (Fig. 1 below). One may doubt whether the efficiency of electricity service, the time between the application for and connection of electricity service, and the expectancy rate of any form of gift payment for an electrical connection during the application are similar across the country. The data we derived from the World Bank's enterprise surveys (2008) showed no regional difference (Tables 4–6 in the appendix). Despite the similarity, the map of average electricity theft ratios of provinces of Turkey below shows us a different pattern especially for the southeastern part of Turkey with high electricity theft.

According to First Geography Congress, which was held in Ankara in 1941, Turkey is composed of seven geographical regions. This separation is up to date and based on geographical and social factors. Regions defined in this context are merely for geographic, demographic, trade and production related purposes and do not refer to an administrative division.

In addition to many control variables that is later explained, we will use a dummy for the Southeastern Anatolia Region of Turkey to

¹ Under the label of illegal electricity use, there are also operational losses; however, the data on these technical losses are not separately calculated in Turkey. In addition, electric authorities claim technical losses to be quite uniform among cities and do not consider them to be the major problem to be solved (Energy Institution, 2011). Therefore, in this study, we refer to the numbers provided by TEDAŞ as the electricity theft ratios; however, please keep in mind that the real numbers could be slightly lower for each city.

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