Illegal Electricity Use in Turkey: Causes and Policy Implications

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CHAPTER 1

INTRODUCTION

Illegal usage of electricity is a common practice in many parts of the world. The issue now has primary attention of governments because of substantial costs associated with it. Although there are strict penalties for stealing electricity, electricity theft permeates the world and concerns legislators and politicians who try to reduce this practice.

According to Smith (2004), there are four known strategies to connect electricity illegally: hookups, meter tampering, billing irregularities and unpaid bills. First, illegal hookups are used for connecting electric wires to the power systems at places such as a home or a firm. This type of illegal electricity usage is very common, and it has high risk of fire. The second way is meter tampering. This method decelerates the spinning disk, which records how much electricity is used. This method is not frequently observed among poor people or regions primarily because it requires technical knowledge. The third way is through various billing irregularities and usually involves bribery. Customers may choose to offer bribes to an officer to reduce their electric bills. This method is also not common in poor regions. The last method is the unpaid bill.

Illegal electricity usage is one of the main socio-economic and ethical problems of Turkey. This problem has various negative effects: the reduction in government revenue because some electric bills are not paid; a decrease in the profits and competiveness of firms because of their risk of electricity shortage; the creation of the sense of injustice for the people who not only pay their bills regularly, but also undertake covering the unpaid bills of others; and a lack of investment in the energy sector (Kumar, 2004).

How can this illegal electricity usage be explained and what are the policy implications? These are the questions explored in this research.

CHAPTER 2

LITERATURE REVIEW

Turkey has the fastest medium to long term growth in energy demand compared with all IEA[1] member countries (IEA, 2009). Therefore, ensuring a sufficient energy supply to a growing demand remains the government's main policy concern. Illegal usage of electricity and energy security are the major socio-economic problems Turkey has been facing in recent years. A number of studies have been conducted to identify the major reasons for the illegal usage of power. These studies have also attempted to come up with different policy recommendations. Smith[2] (2004) analyzes the correlation between illegal electricity usage and five political measurements for 102 countries. The data in the analysis of these countries were obtained from the World Bank. Generally, the main results of this study showed that illegal electricity usage was very common in the countries which had poor governance. The main claim is that poor governance causes cultural corruption in these countries and establishes the cultural atmosphere for illegal electricity usage. It is not clear which social and productive groups are more involved in illegal usage of electricity. Smith also suggests that there is negative correlation between income and illegal electricity usage.

According to Nielsen (2012), illegal electricity usage has a positive correlation with the rate of illiteracy and with regular events of violence, such as terrorism. If the illiteracy rate and terrorist events in a region or city are higher, illegal electricity usage is expected to be higher because high illiteracy and terrorism usually indicate low income in that region or city. Investments to a city or region are substantially discouraged if the place does not have qualified

[1] International Energy Agency

[2] See Table 13 Summary of References

workers or a secure environment. Studies in the literature support these expectations. The most recent study on electricity theft was done in Brazil (Steadman, 2010). These studies were undertaken to see if there were any association between non-technical loses and socio-economic conditions. The results of these studies indicate that the regions with higher murder rates and lower household incomes are using more illegal electricity. Therefore, crime causes crime. The hypothesis presented here is that more terrorist activity means higher illegal electricity usage.

Finally, a relationship between illegal electricity usages and the regional differences as well as ruling parties in Turkey are expected result. The political atmosphere can affect the rate of illegal electricity usage, especially if the party plays a significant role in bribery (Steadman, 2010). Additionally, illegal electricity usage can be high between regions. For example, illegal electricity usage may be high in the agricultural regions. A similar conclusion was found by Golden and Min (2012). Their study on electricity theft shows that a relationship exists between region and the political government. Illegal electricity usage was observed more often in the western part of India's Uttar Pradesh. Before the new election term, electricity theft increased rapidly in the region. Golden and Min observed that elite farmers can influence politicians easily to reduce their electric bills.

In conclusion, the models cited above provide a promising starting point for a new analysis of illegal electricity usage in Turkey. Findings of studies in the literature suggest that per capita income, illiteracy, unemployment rate, the population size, the ruling political party, the geographic regions, and the terror events are the major causes of variations in illegal electricity usage across regions.

CHAPTER 3

METHODOLOGY AND VARIABLES

The analysis aims to understand and explain the variation in illegal electricity usage in the seven demographic regions of Turkey, its distribution to the 67 cities, and its economic dimensions in Turkey. The explanatory variables are per capita income, illiteracy rate, unemployment rate, population size, governance, geographic region, and the occurrence of terrorist events.

Hypothesis

Based on the literature on illegal usage of electricity, this paper hypothesizes that illegal electricity usage had a negative correlation with income, geographic region, terrorist events and illiteracy rates across the 67 cities in Turkey in 2009.

The data are obtained mainly from the Turkish Statistical Institute, the Supreme Board of Elections Institute, newspapers and TEDAS[3], Turkey's electricity distributor, for 2009. Cities in Turkey are selected for analysis based on data availability. Prevalence of the problem in the country was the other major reason for selection. According to Onat (2010), illegal electricity usage was greater in Turkey than all European countries in 2009.

Measuring line loss is very hard because every system technically loses energy. In many contexts, line loss is known as distribution and transmission loss. A line loss occurs because of some technical factors. For instance, line loss is inevitable and high over long distances because of physical factors. Such technical losses range from 1%–2% in efficient systems to as high as 9%–12% of total power output in less efficient systems (Smith 2004). Many studies show that

[3] Turkish Electricity Distribution Corporation

illegal electricity usage cannot be estimated exactly. The primary outcome variable is illegal electricity usage and loss, measured as the share of electrical power that is distributed from a power station but not billed to customers (Onat, 2010). Illegal electricity usage and loss rate's data for Turkish cities are obtained for 2009 by TEDAS, the only company that had distribution rights.

OLS regression was used to find the determinants of illegal electricity usage. Illegal electricity usage was regressed on income, unemployment rate, population, illiteracy rate, terror events, regions and parties. The regression is:

$$IEU_i = C_i + \beta 1\ Income_i + \beta 2\ Unemployment\ rate_i + \beta 3\ illiteracy\ rate_i + \beta 4\ Population\ Size_i + \beta 5\ Terror_i + \beta 6\ Regions_i + \beta 7\ Political\ Parties_i + \varepsilon_i$$

In the regression, IEU represents illegal electricity usage. C is the constant and ε is the error term.

The first determinant is income that is measured for cities' Gross Domestic Product as the following equation; [Gross Domestic Product (Products purchasing power parity/100)*2009 contribution of city/population of city]. Income and illegal electricity usage and loss rates are predictably negatively related. This variable was chosen because it is the best variable to measure people's income.

A second determinant is the unemployment rate. The unemployment rate is the number of people who are not working and are actively seeking a job relative to the labor force. At the beginning of every year, the Turkish Statistical Institute announces the total number of employed and unemployed people in Turkey. In Turkey, an officially unemployed person must apply to the Labor Institute.

The third determinant is the illiteracy rate, which is the number of people who cannot read and write divided by the population of the city. This variable is chosen for the analysis because other data such as high school and primary school attendance are not available. The illiteracy rate was obtained from the population record system of the country. For example, according to the address-based population registration system, the number of illiterate people and the population of a city are respectively 250 and 1,000. According to the definition, the illiteracy rate is 25% for an average city. In addition, the illiteracy rate and illegal electric usage are expected to be positive correlated in this study.

The fourth determinant is population. This is measured by the Turkish Statistical Institute for every year and it is obtained from the address-based population registration system. According to Turkish law, every citizen has to declare where she or he lives. These data are obtained from the Turkish Statistical Institute.

The fifth determinant is political party. Party data were obtained from the Supreme Board of Elections Institute. This determinant shows which party won management of each city. There are three political parties: Adelet ve Kalkinma Partisi(AKP), Cumhuriyet Halk Partisi (CHP) and Demoktratic Toplum Partisi (BDP). According to Golden and Min (2012), illegal electricity usage is correlated with the party in charge. In addition, this study shows that party and illegal electricity usage are related.

The sixth determinant is the number of terrorist events. Data on terrorist events was obtained from newspapers and Wikipedia. According to newspapers, 20 cities were exposed to terrorist events. The expectation of this study is that illegal electricity usage and terrorist events are positively correlated.

The seventh determinant is region. Turkey is divided into seven regions. One city was selected from each region. Region captures regional fixed effects that might affect illegal electricity usage.

CHAPTER 4

DATA DESCRIPTION

Global Picture

Turkey is not the only country where illegal usage of electricity is a problem; many developing countries are not exceptions to this. Nevertheless, illegal electricity usage in Turkey (18%) was higher than many countries such as China (4.8%), Israel (3.2%) and Argentina (14.7%) in 2009. Although, most countries have electricity theft, reasons for electricity theft are different across the countries. For example, the reason for electricity theft is the lack of access to electricity in Indonesia; however, in India the reason for electricity theft is political (Kumar, 2004).

Turkey

According to Today's Zaman (2010), despite all efforts, the rate of electricity theft in Turkey increased from 14.4% to 17.7% from 2008 to 2009. Recent data from the Turkish Electricity Distribution Company (TEDAŞ) has shown that Turkey faces an energy deficit. The energy deficit rate was 69% in 2009. This problem led to a disadvantage in a competitive market for electricity and slow growth in Turkey. As can be seen in Table 1, the average illegal electricity usage is 18% for Turkey in 2009. Minimum and maximum illegal electricity usages are 2.2% and 79%, respectively.

Education level is an important determinant of consumer behavior. In this study, the illiteracy rate in cities in Turkey is used to measure education. The average illiteracy rate in Turkey is 9.33%. Actually, According to Turkish law, every Turkish citizen has to finish primary and secondary education, but this law was passed after 1998. Therefore some older

people cannot read and write. Minimum and maximum illiteracy rates are 3.39% and 18.52%. All 67 cities are used in this analysis. The average unemployment rate is 12.73% in Turkey. Minimum and maximum are respectively 4.4% and 26.5%. The average per capita income was $12,355 per year in Turkey in 2009. As Table1 shows, the distribution of income is not even. Minimum and maximum incomes per year are $2,595 and $29,419.

Table 1. Descriptive Analysis of Variables

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	18.08	20.66	2.23	79.00
Illiteracy rate	9.33	4.01	3.39	18.52
Unemployment rate	12.73	4.85	4.40	26.50
Terrorist attack	0.27	0.45	0.00	1.00
Income	12,355.24	5,626.67	2,595.00	29,419.00
Population	897,276	1,635,191	74,710	12,900,000

Turkey consists of many ethnic populations such as Turk, Kurd and Laz. The largest populations, respectively, are Turkish (approximately 50 million) and Kurdish (approximately 20 million). Kurds and Turks are scattered all over the country but most Kurds live in the eastern and southeastern parts of Turkey (Wikipedia).

Another problem for Turkey is terror incidents. Approximately, 40,000 people were killed by P.K.K.[4] between 1978-2012. According to Wikipedia (2009) some cities are more exposed to terrorist events initiated by the P.K.K. In 2009, many terrorist incidents occurred in 20 cities.

[4] The Kurdistan Workers' Party, commonly known as PKK, is a Kurdish organization which from 1984 to 2013 fought an armed struggle against the Turkish state.

Regional Descriptive Analysis

Turkey consists of seven regions: Aegean, Black Sea, Central Anatolia, Marmara, Mediterranean, Eastern Anatolia and Southeastern Anatolia. Illegal electricity usage, unemployment rate, income level, illiteracy rate, terror events and population vary by regional and provincial areas in Turkey. In 2009, for example, an amazing 79% of all power used illegally was in the province of Mardin which is in the Southeastern region. In the same year, illegal electricity usage was just 2.2% in the province of Mugla, which is in the Aegean region (TEDAS, 2009).

Aegean Region

The Aegean Region is located in east Turkey. This region has seven cities: Izmir, Usak, Mugla, Manisa, Balikesir, Afyon and Kutahya. As can be seen in Table 2, the main property of this region is that all economic indicators except income are below Turkey's average. According to Table 2, the mean of illegal electricity usage was 6%, while Turkey's average was about 18% in 2009. Respectively, Mugla (3.43%) and Balikesir (8.02%) consumed minimum and maximum illegal electricity usages. The illiteracy rate of the Aegean region was about 6.49% in 2009. Mugla (4.164913) and Usak (8.040798) realized the minimum and maximum illiteracy rates of Aegean region. On the other hand, the unemployment rate in the Aegean region (11.57%) was very close to the average of Turkey's unemployment rate (12%). The minimum and maximum unemployment rates were respectively 9.1% and 16.2%. No terror events occurred in this region. The average population of cities of this geographical area was 1,250,247. This statistic indicates this region is very crowded; about ten million people live in this region. In addition, the Aegean region has high income. The per capita income for this region, $16,364, was higher than Turkey's average in 2009.

Table 2. Descriptive analysis of the Aegean region

Variable	Mean	Std. Dev	Min	Max
Illegal electricity usage	6.06	1.65	3.43	8.03
Illiteracy rate	6.49	1.59	4.16	8.04
Unemployment rate	11.57	2.41	9.1	16.2
Terrorist attack	-	-	-	-
Population	1,250,246	1,202,175	335,860	3,868,308
Income	16,364.14	4,939.97	9,905	21,843

Black Sea Region

The Black Sea Region is located in northern Turkey. This region contains 12 cities: Samsun, Trabzon, Rize, Giresun, Sinop, Corum, Gumushane, Ordu, Tokat, Bayburt, Amasya and Artvin. As described in Table 3, the average illegal electricity usage was 10.9% for this region, while Turkey‘s average illegal electricity usage was approximately 18% in 2009. Minimum and maximum illegal electricity usage was 7.8% and 17% respectively. Illiteracy was about 9% in this region. Amasya (6.54%) and Ordu (12.4%) realized minimum and maximum illiteracy rates. In addition, this region’s average unemployment rate (6.24%) was lower than Turkey’s average (12.72%). No terrorist incidents took place in this region in 2009. The average population of cities in this geographical area was almost half a million. The average per capita income for this region was about $13,000 in 2009. It is very close to Turkey’s average. Gumushane and Artvin had respectively minimum ($8,610) and maximum ($20,320) per capita incomes in 2009.

Table 3. Descriptive analysis of the Black Sea region

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	10.9	2.86	7.81	17.1
Illiteracy rate	8.96	1.89	6.54	12.4
Unemployment Rate	6.24	1.62	4.4	10.4
Terrorist Attack	-	-	-	-
Population	497,847	332,506	74,710	1,250,076
Income	13,068.67	2,987.33	8,610	20,320

Central Anatolia Region

This region includes 9 cities: Yozgat, Nigde, Kirsehir, Nevsehir, Konya, Karaman, Eskisehir, Sivas and Aksaray. As Table 4 shows, 8.09 % of all electricity obtained was illegal. Based on the computation of all the meter readings from all consumers in this region, only 92% of power used was billed. The remaining power is assumed lost or stolen. The illiteracy rate was reported to be approximately 7.23% for this region in 2009. Minimum and maximum illiteracy rates were 3.39% and 9.3%. The unemployment rate in this region was 12.23%.—almost same as Turkey's average of 12.72%. Minimum and maximum unemployment rates of this region were respectively 7.5% and 15.6%. There were no terrorist incidents in this region in 2009. The average population of this region was about 651,000. The per capita income of this regions was $12,555 in 2009.

Table 4. Descriptive analysis of Central Anatolia

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	8.1	1.69	5.07	9.74
Illiteracy rate	7.24	1.86	3.39	9.35
Unemployment rate	12.23	2.64	7.5	15.6
Terrorist attack	-	-	-	-
Population	651,065.1	571,676.5	223,102	1,992,675
Income	12,555.22	4,152.64	5,912	20,435

Eastern Anatolia Region

This region has the largest area in Turkey. It contains of 14 cities: Ardahan, Kars, Erzrum, Agri, Igdir, Van, Hakkari, Mus, Bitlis, Bingol, Maltya, Tunceli, Elazig and Erzincan. All demographic and economic indicators for this region were below Turkey's average. As described in Table 5, illegal electricity usage was 30.56% in 2009. Only 70% of transmitted electricity was paid for; the remaining power was stolen or lost in this region. Thirteen percent of the population of this region could not read and write. Minimum and maximum illiteracy rates were 9.1% and 16.5%. The average unemployment rate of region was 14% in 2009. The minimum and maximum unemployment rates were 6.6% and 19.7%. Many terrorist incidents occurred in this region in 2009. The mean city population was 41, 1553. About seven million people in total live in this region. The average income of this region was $7,164 in 2009. It was lower than the average of all regions.

Table 5. Descriptive analysis of the Eastern Anatolia

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	30.56	20.52	5.90	64.78
Illiteracy rate	13.03	2.79	9.17	16.57
Unemployment rate	14.28	4.55	6.60	19.70
Terrorist attack	1	0	0	1
Population	411,553.7	277783.3	83061	1022310
Income	7,164.93	3,725.88	2,743	14,550

Marmara Region

This region is divided into two parts: Anatolia and Europe. It consists of eight cities: Istanbul, Edirne, Tekirdag, Bursa, Yalova, Bilecik, Kirklareli and Canakkale. As can demonstrated Table 6, illegal electricity usage was about 6% for this region in 2009. In other

words, illegal electricity usage for this region was three times lower than Turkey's average. Minimum and maximum illegal electricity usage were respectively 2.2% and 8.9 %. The illiteracy rate for this region was 4.38%--two times lower than Turkey's average. The Average unemployment rate was 14% for this region in 2009. It was higher than Turkey's average because this region had large population about 17 million. Unfortunately, some terrorist events occurred in this region. The average per capita income for this region was $20,496. The average income of this region was approximately $8,000 more than Turkey's average. The minimum and maximum per capita incomes were in Edirne ($17,150) and Yalova ($29,419).

Table 6. Descriptive analysis of the Marmara region

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	6.03	2.10	2.23	8.95
Illiteracy rate	4.39	0.82	3.68	5.97
Unemployment rate	14.25	3.13	8.50	17.80
Terrorist attack	-	-	-	-
Population	2,232,510	4,385,452	202,061	12,900,000
Income	20,496.50	4,337.87	1,7150	29,419

Mediterranean Region

This region includes 8 cities: Antalya, Adana, Kahramanmaras, Mersin, Hatay, Burdur, Isparta and Osmaniye. Table 7 shows that the mean of illegal electricity usage was 7.4% in 2009. Osmaniye and Mersin had the minimum (5.29%) and maximum (10.56%) illegal electricity usage respectively in this region. Seven percent of this region could not read and write. The average unemployment rate of this region was 15.85% in 2009. It was more than Turkey's average. Minimum and maximum unemployment rates were 5.1% and 26.5%. Eight

million people lived in this region in 2009. The average per capita income was $13,018 in 2009. Unfortunately, some terrorist incidents occurred in this region.

Table 7. Descriptive analysis of the Mediterranean region

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	7.49	1.99	5.30	10.57
Illiteracy rate	7.29	1.86	4.67	10.04
Unemployment rate	15.85	6.47	5.10	26.50
Terrorist attack	-	-	0	1
Population	1,055,910	786,102.5	231,872	2,062,226
Income	13,018	3,422.64	6,986	18,285

Southeastern Region

According to Tigris (2009), this region is the poorest region compared with other regions in Turkey. This region contains 9 cities: Sanliurfa, Mardin, Urfa, Sirnak, Batman, Diyarbakir, Gaziantep and Adiyaman. It had the highest average illegal electricity usage in 2009 (approximately 47.69%). Half of the electric power in this region was consumed illegally. The minimum and maximum illegal electricity usages were 7.3% and 79%. The illiteracy rate was very high in this region (approximately 14%) and the unemployment rate is 16.21%. It was higher than Turkey's average. Many terrorist attacks occurred in this region. The population of this region is about eight million. The minimum and maximum city populations were respectively, 122,104 and 1,653,670. Lastly, the average per capita income for this region was very low—approximately $8,334 for 2009.

Table 8. Descriptive analysis of the Southeastern Anatolia

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	47.69	31.34	7.37	79.00
Illiteracy rate	14.60	3.18	8.96	18.52
Unemployment rate	16.21	2.44	12.80	20.60
Terrorist attack	-	-	-	1
Population	829,210.3	599,667.9	122,104	1,653,670
Income	8,334	4,144.02	2,595	18,126

Election Analysis

The election analysis examines the relationship between illegal electricity usage and elections. In Turkey, there are five major parties—Adalet ve Kalkinma Partisi (AKP)[5], Cumhuriyet Halk Partisi (CHP)[6], Milliyetci Hareket Partisi (MHP)[7], Demokratik Sol Parti (DSP)[8], Demokratik Sosyal Parti (DTB)[9]— and Independents. The last election was in 2009. The MHP and DSP parties were not included in the regression analysis because of insufficient data—the MHP won only two cities and the DSP won only one city. (YSK, 2009).

Justice and Development Party (AKP)

This party is an Islamic party. The Justice and Development Party won elections since 2003. In the last election, it won 37 cities in Turkey. According to Yuksek Secim Kurulu[10], 39% of voters chose Erdogan who is still the prime minister of the Republic of Turkey. Table 9

[5] Justice and Development Party

[6] Republican People' Party

[7] Nationalist Movement Party

[8] Democratic Left Party

[9] Democratic Social Party

[10] Supreme Election Council (YSK)

describes characteristics of cities that are managed by The AKP. The average illegal electricity usage was 14% in 2009, which was lower than for Turkey on average. The averages of economic and demographic data of these cities were very close to Turkey's average. The illiteracy rate was reported as 9.18%. The minimum and maximum illiteracy rates were 3.6% and 16.57% respectively. The average unemployment rate was 11.83% in 2009. The districts with the minimum and maximum unemployment rates were Bayburt (4.5%) and Hatay (19%) respectively. The per capita income ($11,874) was very close to Turkey's average. The city of Mus, which is managed by the AKP, had a minimum per capita income of $2,743 in 2009, and Yalova had a maximum per capita income of $29,419.

Table 9. Description of cities managed by the AKP

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	14.64	16.21	5.07	79.00
Illiteracy rate	9.18	3.38	3.68	16.57
Unemployment rate	11.84	4.71	4.50	19.00
Population	939,548.8	2,095,795	74,710	129,00,000
Income	11,874.19	5,477.9	2,743	29,419

Republican People's Party (CHP)

This party was founded by Ataturk[11] who was first president and founder of Republic of Turkey. The main policy of this party is to preserve and disseminate the principle of secularism. The CHP won 11 cities in the last election and became main opposition party (YSK, 2009). Table 11 shows that all economic and demographic variables of these cities were very close Turkey's average except per capita income. The average illegal electricity usage for these cities was 9.05%. Canakkale (2.2%) and Artvin (17.1%) had the minimum and maximum illegal

[11] Ataturk is translated "Father of Turks"

electricity usage in 2009. The Average illiteracy rate for CHP's cities was 6.12%, which was lower than Turkey on average. The minimum and maximum illiteracy rates were 3.92% and 11.31%. The average unemployment rate was almost same with Turkey's average. Minimum and maximum unemployment rates were reported as 5.6% and 17.6% respectively. About 10 million people live in these cities. In addition, the average per capita income for these cities ($11,009) was higher than for Turkey on average.

Table 10. Descriptive analysis of cities managed by the CHP

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	9.00	4.69	2.23	17.10
Illiteracy rate	6.13	2.50	3.92	11.32
Unemployment rate	12.48	3.92	5.60	17.60
Population	1,040,162	1,086,274	165,580	3,868,308
Income	17,619.45	3,258.25	11,009	21,479

Democratic Society Party (DTP)

This party is known as a Kurdish party. The DTP won only eight cities in the last election (YSK, 2009). All economic and demographic variables for these cities were lower than for Turkey on average. Table 11 shows that 50% of the electricity was consumed illegally. In other words, this energy consumption was not accounted for in billing. The illiteracy rate for these cities was two times higher than Turkey's average. The minimum and maximum illiteracy rates were 11.16% and 18.2%. The average unemployment rate was reported 16.55% in 2009. Four million people live in these cities. The average income was very low—about $6,700 in 2009. Minimum and maximum incomes were $2,595 and $14,550 respectively.

Table 11. Descriptive analysis of cities managed by the DTP

Variable	Mean	Std. Dev.	Min	Max
Illegal electricity usage	52.68	20.85	11.84	70.66
Illiteracy rate	15.71	2.20	11.17	18.52
Unemployment rate	16.55	2.92	12.60	20.60
Population	536,584.1	488,282.9	83,061	1,515,011
Income	6,745.25	3,625.244	2,595	14,550

CHAPTER 5

REGRESSION RESULTS

Having identified the dependent variable as the illegal electricity usage, and independent variables—illiteracy and unemployment rates, income levels, terrorist attacks, regions and political parties in the 67 provinces in Turkey—the OLS estimation and table to measure the magnitude of the relationship between these variables was used. Table 12 summarizes the results of the regression analysis. Table 13 includes regional variables.

Political parties were included to test whether there is a relationship between political parties that won elections in this region and illegal electricity usage. It was assumed that the political parties, unemployment rate and the population affect the illegal electricity usage rates. However, the results showed no relationship among these variables. The scattered distribution of the Turkish population might have had an impact on the results regarding the relationship between population and illegal electricity usage. The relationship between unemployment rate and illegal electricity usage is not significant because this determinant is high correlated with illiteracy rate, terror and income.

The results of the regression analysis show a positive relationship between illiteracy rate and region, and illiteracy rate and terrorist attacks. The analysis indicates that a 1% increase in illiteracy rate leads to a 3.3% increase in illegal electricity usage ($p<.005$). This result was as predicted, and it suggests that people who use illegal electricity have lower income than literate people, which increases the probability that they will await payments for utilities. Furthermore, using a dummy variable for the analysis of terror data showed an increase in the illegal electricity usage by 19.83% compared with the cities where there were no terrorist attacks in 2009.

Table 12. Regression results by general characteristics

Illegal electricity usage	Coef.	Std. Err.	t	P>t
Illiteracy rate	3.27	0.91	3.58	0.00
Unemployment rate	-0.23	0.25	-0.94	0.35
Terrorist attack	19.83	7.33	2.71	0.01
Income	0.00	0.00	1.07	0.29
Population	0.00	0.00	0.28	0.78
Political Parties				
AKP	-2.77	2.74	-1.01	0.32
CHP	-1.32	6.15	-0.21	0.83
DTP	3.92	3.26	1.20	0.23
Constant	-18.65	10.56	-1.77	0.08

A second regression analysis was conducted to examine the regtional differences of illegal electric usage. Other variables were not included in this regression analysis because the correlation between these variables and regions is high and would cause multicollinearity problems. Table 13 summarizes the regression analysis result by region. The Central Anatolia Region was treated as the base. As can be seen, the Eastern and Southeastern regions are significantly positively correlated with illegal electric usage, indicating a comparatively higher probability of illegal electric usage compared to Central Anatolia .

Table 13. Regression results by region

Illegal electric usage	Coef.	Std. Err.	t	P>t
Region				
Aegean	-2.03	7.56	-0.27	0.79
Black Sea	2.81	6.62	0.42	0.67
Eastern Anatolia	22.47	6.41	3.50	0.00
Marmara	-2.06	7.29	-0.28	0.78
Mediterranean	-0.61	7.29	-0.08	0.93
Southeastern Anatolia	39.60	7.08	5.60	0.00
Constant	8.10	5.00	1.62	0.11

CHAPTER 6

CONCLUSION

The results expressed are based on a small sample size and, at best, are exploratory. However, from the results, it may be concluded that the illegal electricity usage in Turkey is not linked with economic factors such as unemployment rate and income. However, the results indicate that illiteracy and terrorist attacks are positively related to illegal electric usage. The result suggest that Mardin either has higher illiteracy and/or a higher number of terrorist events—more than Turkey's average—because an amazing 79% of all power used illegally is in the province of Mardin.

On the other hand, there is no evidence which proves the relationship between electricity theft and political party. This, perhaps, is due to the fact that parties are scattered over all the regions. For example, some cities are governed by A.K.P. but also some cities are governed by B.D.P. In the Southeastern Region, where this is prevalent, there appears to be no relationship between electricity theft and political party.

In conclusion, it is recommended that two measures be employed by the government to reduce illegal electricity usage. First, the government should increase its educational investment to meet broader social and economic objectives such as human capital formation and literacy. This, in turn, should result in reduction in illegal electricity usage.

In addition, a second recommended measure is the use of smart meters to reduce illegal electricity usage. According to Nielsen (2012), smart meters are very helpful in preventing the illegal use of electricity. These measures could be employed in all regions of Turkey.

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Table 14. Summary of References

Paper (see References)	Variables	Sample and Methodology	Main Results
Golden and Min (2012)	*Line loses *Election Year *Criminal Charges *Population *Region *Sectors	* Indian State *2000-2009 period *OLS Estimation	*Electricity Theft is highly correlated with elections *The agriculture sector's illegal electricity usage is greater than other sectors. *Electricity theft also has a high correlation with region and population.
Steadman 2010	*No Technical Losses *Residential Sales *Small Commercial Sales *Large Commercial Sales *Industrial Sales	*Jamaica *1993-2006 period *OLS Estimation	*This study shows that residential and small commercial groups are related to electricity theft. *Also, electricity theft is highly correlated with politics.
Smith(2004)	*Technical transmission and distribution (T&D) losses * Government Indicators	*102 countries * Comparative Analysis	*Electricity theft is highly related with low government effectiveness. *Electricity theft can be reduced by the technological solution such as using a smart meter.
Tigris Development Agency (2009)	*Some social and Economic variables.	*Southeastern Turkey *2010 *SWOTH	It describes the social and economic profile of the region such that the rate of annual population growth is less, but the unemployment rate is 4% higher than Turkey average
Dicle Kalkinma Ajansi (2009)	* Energy demand and supply *Regional electricity loss and theft rate	*Turkey and the southeastern part of Turkey *Comparative and descriptive analysis	*Turkey has a high energy deficit. *The southeastern part of Turkey has the highest illegal electricity usage compared with all regions.