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ELECTRICITY CONSUMPTION IN TURKEY: ANALYSIS OF SPURIOUS REGRESSION VIA COINTEGRATION AND FORECASTING

TÜRKİYE'DE ELEKTRİK TÜKETİMİ: KOİNTEGRASYON VE TAHMİN YOLU İLE SAHTE REGRESYON ANALİZİ

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ABSTRACT

When the forecasting models and projections for electrical energy consumption of Turkey are analyzed, it is expected that the electrical energy demand will continue to 2020 increase and energy intensity with the high rates will also have a tendency to increase.

Whether the regression model constructed for electrical energy consumption reflects a real or a spurious relation is analyzed by a unit root test within the context of cointegration. According to the results of the analysis, it is concluded that the regression model is not spurious. After obtaining the real regression, the electrical energy consumption till the year 2020 is projected using forecasting analysis and it is concluded that the consumption of electrical energy has a tendency to rise.

ÖZET

Türkiye'nin elektrik enerjisi tüketimi için yapılan tahmin modellerine ve projeksiyonlarına bakıldığında, elektrik enerjisi talebinin 2020 yılına kadar artış trendini devam ettireceği ve enerji yoğunluğunun da yüksek oranlara ulaşarak, artış eğilimi göstereceği beklenmektedir.

Elektrik enerjisi tüketimi için oluşturulan regresyon modelinin gerçek bir ilişkiyi mi yoksa sahte bir ilişkiyi mi yansıttığı kointegrasyon konusu içinde yer alan birim kök testi ile analiz edilmiştir. Analiz sonuçlarına göre; oluşturulan regresyon modelinin sahte olmadığı anlaşılmıştır. Gerçek regresyona ulaşıldıktan sonra elektrik enerjisi tüketimi, gelecek 2020 yılına kadar gelecek tahmin analizi ile tespit edilmiş ve elektrik enerjisi yoğunluğunun artış trendinde olduğu sonucuna ulaşılmıştır.

Enerji, Elektrik, Elektrik Tüketimi, Sahte Regresyon.
Energy, Electricity, Electricity consumption, Spurious regression.

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INTRODUCTION

Energy is an input which has a strategic significance in every area of social life. This aspect of energy makes it an indispensable end product not only in industrialization process but also in socio-cultural activities and daily life.

Due to its structural relation to other sectors as a production input, energy is the prerequisite of economic development. Thus, those consumers are provided with energy with a reasonable price as much as its production is within the domain of public responsibility. Regulative and supervisory intervention of the state in the construction of a competitive market in the sector would certainly increase the efficacy of privatization.

Per capita energy consumption is high in countries where per capita income is high. This indicates that there is a significant correlation between electrical consumption and economic growth. More energy is consumed in developing countries when the pace of industrialization is fast. However, since energy is not utilized efficiently, above mentioned countries experience a continuous rise in additional energy demand.

This research, taking into account the structural transformation of the energy sector in Turkey since the Fifth Planning Period, constructs a forecasting model and projection for electrical energy consumption and evaluates the results.

1. ELECTRICAL ENERGY CONSUMPTION IN TURKEY

Developments such as the rapid increase of population, industrialization and the spread of the means of mass communication constantly increase world energy consumption. Consequently, the issue of controlling world energy resources carried a cutthroat competition among countries well into the 21st century.

However, while the developing countries implement policies to find solutions to their energy problems, they face the need to establish a common equilibrium between energy sources and economic growth for a sustainable development. In this regard, the functional relation among cost-efficiency-growth is the starting point for a process in search for a common equilibrium.

Even though Turkey is among the first twenty big economies of the world and has a population of about seventy million, it is not self-sufficient in terms of energy. Thus, Turkey's energy demand is increasing fast, making it necessary to import more, especially oil and natural gas.

As the energy alternatives of Turkey include certain confusion and dangers, the problem of from where and how the energy is obtained remains to be crucial. As Turkey does not wish to be dependent on a single energy source, energy has become an important component of Turkey's international

policy. The goal of decreasing energy dependency has evolved into the most crucial element of Turkey's overall regional energy strategy[1].

The structure of Turkey's energy sector has undergone a significant change since the Fifth Planning Period (1985-1989). Natural gas, as an alternative to oil and coal, has increased its share and importance in the sector. From 1994 onward, liquidities natural gas (LPG) has found its way into the energy sector as well. Natural gas is expected to retain its importance during the Eighth Planning Period and onwards. Therefore, Turkey's dependence on import is going to continue.

In the Fifth Planning Period (1985-1989), annual energy consumption went up from 39,2 mtep to 50,4 mtep by an average increase rate of 6,55%. In addition to the import of natural gas from Russia for the first time, the steady decrease of electrical energy import and having the efforts of sector privatization speeded up, were the important developments of the period.

During the Sixth Planning Period (1990-1994), the targets concerning the energy sector were expressed as: planned expansion of the natural gas consumption according to economic criteria; the continuation of privatization efforts; increasing the share of private sector in investments and embarking on the process of transition to nuclear energy technologies. During this period primary energy consumption increased by an average of 4,4% annually (12,2% for the natural gas consumption). Besides, Turkish Electricity Institution (TEK) General Directorate was divided into two as general directorates of Turkish Electricity Generation, Transmission Joint Stock Corporation (TEAS) and Turkish Electricity Distribution Joint Stock Corporation (TEDAS) as a part of the privatization process and Build-Operate-Transfer projects contracted by the private sector gained momentum.

During the Seventh Planning Period, primary energy production increased by 1,3% and primary energy consumption went up by 4,5%. Although the investments for electrical energy production constituted 6,7% of the total investments, the increase in consumption was about 8% annually. The economic crisis Turkey went through in the year 2001, resulted in a decrease in the upward trend of energy demand as it did during the crisis of 1994. When the consumption of electrical energy is analyzed, it is seen that especially the share of the industrial sector decreased to 48,4%.

[1] B. Sasley, "1990'larda Türkiye'nin Enerji Politikaları (Turkey's Energy Policies During 1990)", **Günümüzde Türkiye'nin Dış Politikası**, der. Barry Rubin-Kemal Kirişçi, B.Ü.Yayınevi, İstanbul, 2002, p.326.

Table I: Raise of Growth, Energy, Production and Consumption in Turkey's Planned Terms

Terms	GNP Raise (%)	Primary Energy Production Raise (%)	Primary Energy Consumption Raise (%)
5th Planned Term (1985-1989)	4,7	4,0	6,5
6th Planned Term (1990-1994)	3,5	0,9	4,4
7th Planned Term (1996-2000)	3,5	1,3	4,5
8th Planned Term (2001-2005) (*)	6,7	1,2	6,1

(*) Forecast

Source: State Planning Organization, 6th,7th and 8th Five-Year Development Plans.

The increase in the primary electricity production during the Eighth Planning Period is estimated to be 1,2%, whereas the increase in primary electricity consumption is expected to be 6,1%.

There is a close relation between economic growth and energy consumption. The increase in electricity consumption has been high in the high rate growth period following the economic crisis of 1994. The increase in electricity consumption has been limited owing to the frequent crises experienced in the economy. The net electricity consumption, which was 98.296 Gwh in the year 2000, decreased to 97.070 Gwh in 2001 due to the economic crisis (Graph I). Net per capita consumption decreased to 1.431 kwh in the year 2001. As the crisis is over and transition to a stable growth is achieved, electrical energy consumption is expected to increase.

Even though the installed generating power of electrical energy in Turkey which was 16.317,6 MW in 1990, increased to 27.264,1 MW in 2000 and to 28.332,1 MW in 2001, public sector failed to invest in electrical energy as needed. Since the year of 1990, public investments have lagged behind the planned ones and especially in 1994 (Program: 900 million $-Realization: 715 million $), in 1995 (Program: 1.041 Million $-Realization: 715 million $), in 1996 (Program: 1,121 million $ –Realization: 796 million $), and 1999 (Program: 1.709 million $-Realization: 1.274 million $), the programs of electricity, transmission and distribution investment were realized as far behind the planned. This has been the source of difficulties Turkey experienced in energy supply.

According to the plans of the Ministry of Energy and Natural Resources (ETKB) and TEAS, no less than a 5 billion dollar investment is required annually for the realization of electricity production, transmission and distribution plants. Every year in which the necessary investment is not made, increases the investment required for the next year[2]. The necessary financing to realize sector investments and resource import is expected to

[2] TÜSİAD (Turkish Industrialists' and Businessmen's Association), **21.Yüzyıla Girerken Türkiye'nin Enerji Stratejisinin Değerlendirilmesi** (The Assesment of Turkey's Energy Strategy at the Beginnig of 21. Century), No: TÜSİAD-T/98-12/239, İstanbul, 1998, p.53.

cause significant bottlenecks via economy. In this regard, the realization of the investments can only be possible with the participation of both domestic and foreign investments.

Actual electricity production was 122,7 billion kwh in the year 2001. The net electricity import which was 3,8 billion kwh in 2000, was in the order of 4,6 billion kwh in the year 2001 (Table II).

Table II: Progress of Turkish Electricity Power Consumption

Terms	1985	1990	1995	2000	2001
Generation Capacity(MWh)	9.119,1	16.317,6	20.954,3	27.264,1	28.332,1
Production (GWh)	34.219		86.247,4		122.724,7
		57.543		124.921,6	
Import (GWh)	2.142		---		4.579,4
		176		3.791,3	
Export (GWh)	---		695,9		432,8
		907		437,3	
Consumption Gross) (GWh)	36.361	56.812	81.858,6	122.488,9	120.831,5
Per Capita Consumption					
Gross	718	1.006	1.411	1.964	1.870
Net	586	829	1.112	1.505	1.431

Source: Various issues of Turkish Ministry of Energy and Natural Resources and Turkish Electricity Production Transmission Corporation statistics.

Graph I: Net Electricity Power Consumption (Nepc)

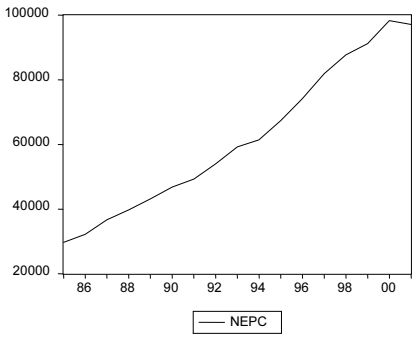

Table III: According to Consumer Groups Distribution of Turkish Electricity Power Consumption (%)

Time	Residential	Village	Commercial	Government Offices	Industrial	General Illumination	Others	Total
1985	16,8	2,2	5,5	3,0	66,0	1,4	5,2	100,0
1990	19,4	0,2	5,5	3,1	62,4	2,6	6,8	100,0
1995	21,5	--	6,2	4,5	56,4	4,6	6,8	100,0
2000	24,3	--	9,5	4,2	49,7	4,6	7,7	100,0
2001	24,3	--	9,7	5,0	48,4	5,0	7,6	100,0

Source: Various issues of Turkish Electricity Production Transmission Corporation statistics.

In the distribution of electrical energy in terms of consumer groups, the share of industrial sector was under 50% in 2000 and 2001; the share of residential consumption was 24,3%, commercial consumption was 9,7%, and government offices and public lighting's share was 5% in 2001.

2. COST AND SALES OF ELECTRICITY

In order that Turkish industry can compete with European Union and get more share in world trade, the supply and cost of energy as one of the most important inputs of industry has a crucial significance. It is known that in highly competitive sectors while the profit rate decreases the cost of input increases in importance. As a result of this, price of energy as compared to the prices of other countries determines the competitiveness of the domestic industry.

In Turkey, while the cost of electrical energy is determined by the General Directorates of TEAS and TEDAS, the selling prices of distribution companies are determined by the companies themselves in accordance with the TEDAS price lists and are approved by the Ministry of Energy and Natural Resources.

The selling prices of electrical energy are determined by the board of TEDAS in accordance with the principles stated in "Regulations Regarding Electricity Price" by the Ministry according to the Article No: 35 of the decree having the force of a law No: 233. There are companies which distribute electricity other than TEDAS. As the Ministry holds the principle of applying the same price to all consumer groups, the above mentioned companies also act in accordance with the price list of TEDAS [3].

Table IV: Cost and Sale of Electricity Power in Turkey

	Costs						Sales		
	Average Gross Production Cost		Delivering Point Industrial Cost		Delivering Point Commercial Cost		Total Electricity Power Sale	Average Sale Price	
	TL/kWh	Cent/kWh	TL/kWh	Cent/kWh	TL/kWh	Cent/kWh	GWh	TL/kWh	Cent/kWh
1985	9,93	1,92	17,58	3,39	19,27	3,72	27583,3	29,34	5,66
1990	80,81	3,10	145,67	5,59	179,65	6,89	44620,6	165,47	6,34
1995	865,83	1,89	1183,03	2,59	1522,69	3,33	72571,6	1571,85	3,44
2000	15508,33	2,49	26862,33	4,31	28668,67	4,60	101434,0	25333,90	4,06

Source: Various issues of Turkish Ministry of Energy and Natural Resources and Turkish Electricity Production Transmission Corporation statistics.

Moreover, auto producers can sell the surplus electricity to TEAS, TEDAS and the affiliates of TEDAS with a price which can be at most 70%

[3] İSO (Istanbul Chamber of Industry) and ASO (Ankara Chamber of Industry), **Elektrik Enerjisinde Ulusal Politika** (National Policy in Electricity Energy), 2000, pp.49,50.

more of the selling price of electricity as sold to end consumers by distribution companies[4].

According to the report of International Energy Agency, as of the data of the last quarter of 2001, the price of electricity used in industry in Turkey is above the prices of the countries with which Turkey competes in world market. If we take into consideration that the price of electricity for industry in European countries is 4.3, Turkey is the second country after Japan as the country with the highest price for electricity among the 32 countries most of which are developed countries.

Table V: Price of Industrial Energy Consumption by Selected Countries (*) ($ / Unit)

Countries	Fuel Oil (ton)	Natural Gas (10^7 kcal)	Coal (ton)	Electricity Power (kWh)	
				Industrial	Residential
Turkey	143,11	216.99	33,28	0,0805	0,0849
USA	125,75	135,73	32,19	0,0427	0,0850
Canada	145,85	106,94	--	0,0386	0,0601
Japan	205,67	452,69	31,77	0,1426	0,2144
Germany	137,18	187,93	--	0,0790	0,1666
France	140,61	178,67	65,91	0,0358	0,1017
England	169,06	138,74	46,42	0,0496	0,1010
Finland	181,65	124,74	86,16	0,0394	0,0789
Belgium	122,94	111,65	--	0,0477	0,1323
Denmark	189,70	--	78,75	0,0597	0,1953
Portugal	201,93	256,02	39,29	0,0659	0,1177
Czech Republic	127,20	165,72	16,19	0,0468	0,0611
Hungary	126,54	171,43	45,58	0,0521	0,0698
Poland	106,73	179,48	43,16	0,0476	0,0834
Slovakia	109,71	108,67	25,25	0,0435	0,0628

(*) 2001 Year Fourth Term Retail Prices.

Source: IEA (International Energy Agency), **World Energy Statistics**, 2002.

The prices for electricity in Turkey had a sharp increase in 2001 and this increase was 118% for the period of January 1st.-December 31st. During the stated period WPI was 88,6% and CPI 68,5%. As a result of this, an additional cost was created between the WPI for industrial sector and electricity prices and hence a decrease in competitiveness was realized. In the prevailing economic situation of 2001 when the sharp decrease in demand caused the production to slow down, input prices increased enormously as the business could not transfer the huge increases in input prices to sales and they worked under their production capacity. Thus the companies were not able to raise their assets.

While the prices of industrial goods of Turkey are below the prices of other countries, Turkey is among the first few countries in terms of the

[4] DPT (State Planning Organization), **Sekizinci Beş Yıllık Kalkınma Planı Enerji Özel İhtisas Komisyonu Raporu** (Eighth Five-Year Development Plan, Energy Private Specialization Commission Report), No:DPT-2610- ÖK-621, Ankara, 2001, p.18.

price of electricity used as an input in the production of industrial goods[5]. Turkey is the second country following Japan, as the country where the price of electricity as an energy resource used intensively in industry is the highest.

In Turkey, whereas different prices are applied to natural gas and fuel-oil, this is not the case for electricity. However, that there is almost no price difference for residential and commercial buildings is a striking fact. For instance; in the U.S.A, Germany, England, Finland and Poland prices for residential buildings is twice as the ones for commercial buildings and the ratio is three times or more for Belgium and Denmark.

The cost of energy whether it is of production or import must be reflected in the prices completely and objectively and an optimal production structure in the industry must be established. Implementing an appropriate price policy for inputs and especially for energy is the prerequisite for proper structuring of the industry, for the right choice in production methods and technologies and profitability[6].

That the price of electrical energy in Turkey is high has its own significant reasons. One of these reasons is the extremely high losses and illegal consumption. The rate of losses and illegal consumption in electricity has continuously been increasing since 1991. The rate which was 23,9% in 1998 with free of charge consumption (OECD average is 7,0% and European Union average is 6,6%), went up to 26,3% as of 2000. The cost of losses and illegal consumption is estimated to be 1,6 billion $ for the year 2000.

Another reason for this is the high percentage of Value Added Tax (VAT) on energy prices and other expenses. The VAT rate of 18% on electricity price is extremely high. Besides, when the costs that are not tax-deductible such as the Municipal Consumption Tax, share for Turkish Radio and Television (TRT) added, they result in a significant energy cost for industrialists.

1% Municipal Consumption Tax is collected on electricity. The government decreased the 3,5% TRT share to 2% in order to abolish the TRT share charged on gross sales of electricity gradually with the aim of decreasing electricity price. However, in order that the growth by export can be sustained and foreign capital can be attracted to the country, energy costs are needed to be decreased to the level of rival countries and be kept at that level.

Another reason for the high electricity price is that costly energy agreements are signed. Terms and conditions of many international agreements about energy are not revealed to the public. The reason for the high price is either intermediary companies set high profit rates or the agreements signed. The energy produced by the Build-Operate-Transfer

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[5] İSO, "2002'de Sanayiyi Etkileyen Sorunlar Artan Enerji Maliyeti" (Problems Influence The Industry, Increasing Energy Cost in 2002) , **İSO Dergisi**, Şubat 2002, İstanbul, p.18.

[6] TÜSİAD, **Enerji Sektöründe Geleceğe Bakış Arz Talep ve Politikalar** (Future View to Energy Sector, Supply, Demand and Policies), No: TÜSİAD-T/94,11-168, İstanbul, 1994, p.122.

models implemented by the government had to be bought by the state with high costs and that increased the energy production costs.

Moreover, because the operation rights of the thermic plants (total production share is approximately 60%) could not be transferred, necessary investments could not be made and these plants could not be run efficiently cause the energy production costs to increase.

Personnel and organization costs (especially because the efficiency according to the increasing number of personnel is low) are among the other reasons why the electricity costs are high.

With the introduction of Electricity Market Law No: 4628 and Natural Gas Market Law No: 4646 that went into effect in 2001, a transformation in electric and natural gas sectors is intended by which private companies can freely operate within the frame of certain regulations and a liberal economy where competition takes place. This new structuring will be effective in decreasing the electricity prices. Besides, by the Petrol Market Law that was put into effect in the late 2003 and aimed to discipline the sector, another important step was taken to let the petrol prices be determined by the world free market. By this law, the activities such as refining, processing, transmission were combined under a single law and the Institution of Energy Market Regulation was authorized regarding the petrol market as well.

Taking into consideration that there companies which applied to the Institution of Energy Market Regulation and undertook the responsibility of generating electricity with a much lower price and asked for license, state-owned producers will have to reconsider their prices. Moreover, production facilities that need renovation investments in a large scale have to be privatized urgently as a result of financial problems. Otherwise, losses of TEAS will get larger. Prices must be decreased by eliminating the high prices of the Build-Operate-Transfer and Build-Operate plants that were established with the contracts which guaranteed the purchase of TEDAS.

3. A MODEL FOR ELECTRICITY DEMAND ESTIMATION AND FORECASTING

The existing literature in electricity demand analysis: One of the first applications of the Engle and Granger (1987) cointegration method was to forecast monthly electricity sales[7]. Abeysinghe and Boon (1999) tested six methods for estimating elasticity. Dahl (1994) surveyed studies on electricity demand and found that most of the studies used static or partial adjustment models. Jones (1993) tested the forecasting ability of the static and partial adjustments models comparing them with the general to specific (GTS) or

[7] R.F. Engle - C. Mustafa and J. Rice, "Modelling Peak Electricity Demand", University of California, San Diago Department of Economics", **Working Paper**, July 1989, pp.35-89.

dynamic regression model. Jones (1993) concluded that "the general to simple approach appear to offer a satisfying new methodology for generating superior forecast models of petroleum consumption and other energy use patterns. Chan and Lee (1997) disputed the Jones results, arguing that although the GTS approach had the advantage of reducing potential misspecification errors, it may overlook that most of the time series data are non-stationary. Fatai, Oxley, Scrimgeour (2003) attempt to model and forecast electricity demand using two econometric approaches: Engle-Granger's error correction model (ECM), and the Autoregressive Distributed Lag regression (ARDL) approach. They investigated which model has the lowest forecasting error using a series of forecasting measures. Saab, Badr, Nasr (2001) and Al-Iriani (2002) studied on modeling and forecasting demand for electricity. Each of papers used the different modeling methodology from this paper.

In this paper, the electricity consumption of Turkey during the period of 1985-2000 is analyzed by using a annual time series data. It is aimed to eliminate the problem of spurious regression by taking the trend in time series into account. Whether the regression reflects a real relation or a spurious one is of vital importance in an analysis[8]. In regressions that use time series, a spurious regression occurs when the values obtained are satisfactory but when analyzed further doubtful results are obtained. This situation is explained by a cointegration concept in time series. By a cointegration pre-testing, spurious regression is avoided. There are two important concepts in cointegration, these are: the characteristic of being stationary and the unit root test which is used to determine this quality.

The most common test of being stationary in time series is the unit root test. This test is used to determine the degree of being stationary of the series. The most common test that is applied is Dickey-Fuller test. The critical values of this test with 1%, 5% and 10% importance degrees are calculated according to Monte Carlo Simulations done by Mackinnon[9].

Time series might not be stationary as a result of trend. Consequently, the relation between may depend on the trend. However, if they are all stationary of the same order, then we can talk of a cointegration among series, and this is the indication that the regression is not spurious[10]. That is, the relations of the regression are real.

$Y_t = \rho Y_{t-1} + \varepsilon_t$ according to the equality of

$H_o: \rho = 1$ and

$\Delta Y_t = \delta Y_{t-1} + \varepsilon_t$ according to the equality of

$H_o: \delta = 0$

[8] D.J. Hodgson, "Spurious Regression and Generalized Least Squares", **Econometric Theory**, Vol.10, No.5, 1994, p.957.

[9] H.O. Zapata and A.N. Rambaldi, "Monte Carlo Evidence on Cointegration and Causation", **Oxford Bulletin of Economics and Statistics**, Vol.59, 1997, pp.285-298.

[10] P.C.B. Phillips, "Understanding Spurious Regressions in Econometrics", **Journal of Econometrics**, Vol. 33, No.3, 1986, p.311.

Hypothesis reflects the state of being non-stationary. Within the frame of these hypothesis, if the absolute value of DF test statistics (in practice, the value called t (tau) or DF statistics is taken as a base instead of frequently used t-statistics) is larger than the absolute value of critical values, Ho is rejected and that the series is stationary can be inferred.

3.1. The Empirical Model

During the period of 1985-2001, that the demand for electricity in Turkey was affected by population, price and share of residential buildings and industry from GDP is accepted. This was concluded by trials in which numerous affecting factors were taken into account. Statistically non-significant variables were eliminated from the model and the best possible model was attained.

$$NEPC_t = f(P_t, H_t, IND_t, POP_t) \quad (2.1)$$

$$NEPC_t = \beta_0 . H_t^{B_1} . IND_t^{\beta_2} POP_t^{\beta_3} . P_t^{\beta 4} . e^{u_t} \quad (2.2)$$

$$LNNEPC_t = \beta_0 + \beta_1 \ln H_t + \beta_2 \ln IND_t + \beta_3 \ln POP_t + \beta_4 \ln P_t + u_t \quad (2.3)$$

3.1.1. Analysis of Spurious Regression via Cointegration

In the model*:

$NEPC_T$: Net electricity power consumption in time t

P_t : The real price of electricity in time t

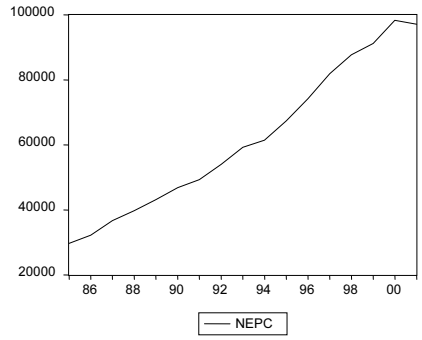
IND_t : The share of industry from GDP in time t

H_t : The share of residential buildings from GDP in time t

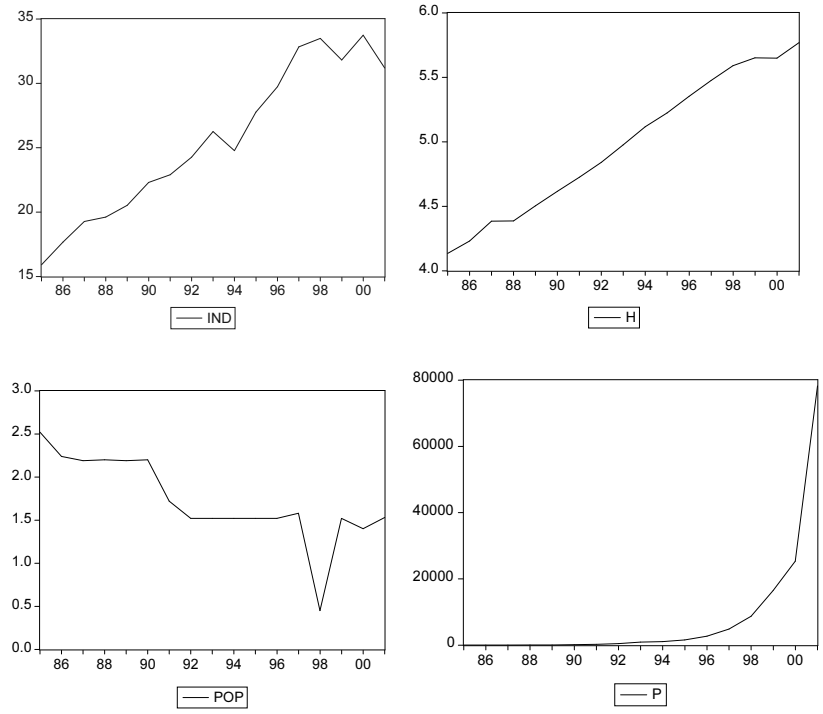
POP_t : Population in time t

Below are the graphs of the original form of the series included in the model.

Graph II: Original Time Series Date



* 1) All the variables considered in the model are annual and expressed in natural logarithms.
2) It doesn't make problem non-stationary data because of cointegration approaches.



The series in regression are analyzed with the assumption that their logarithms must be used (Graph II). Thus obtained regression is then again analyzed within the cointegration concept to see whether they are spurious or not, and series were tested to see if they were cointegrated by using unit root tests.

ADF Test Statistic	*-3.78*	*1%*	*Critical Value**	*-2.7760*
		5%	*Critical Value*	*-1.9699*
		10%	*Critical Value*	*-1.6295*

*Mackinnon critical values for rejection of hypothesis of a unit root.

When we consider the above results after numerous trials, the logarithmic form of the net electricity consumption is stationary of a second order. The reason for this is that, ADF test statistics –3,78, 1% is larger the absolute value of the critical value of Mackinnon. That is, the series is cointegrated of a second order.

ADF Test Statistic	*-5.238369*	*1%*	*Critical Value**	*-2.7760*
		5%	*Critical Value*	*-1.9699*
		10%	*Critical Value*	*-1.6295*

*Mackinnon critical values for rejection of hypothesis of a unit root.

Again if we consider the results of many trials, the logarithmic form of the share residential buildings get from GDP is stationary of a second order. For the ADF statistics –5.24, 1% is larger than the Mackinnon critical value in terms of absolute value. The share of residencial buildings from GDP is cointegrated of a second order.

ADF Test Statistic	*-4.555065*	*1%*	*Critical Value**	*-2.7760*
		5%	*Critical Value*	*-1.9699*
		10%	*Critical Value*	*-1.6295*

*Mackinnon critical values for rejection of hypothesis of a unit root.

When the above results are examined, the logarithmic form of the share of industry from GDP is stationary of a second order. For, the ADF statistics –4,56, 1% is larger than the Mackinnon critical value in absolute value. The share of industry from GDP is cointegrated of a second order.

ADF Test Statistic	*-3.725331*	*1%*	*Critical Value**	*-2.7760*
		5%	*Critical Value*	*-1.9699*
		10%	*Critical Value*	*-1.6295*

*Mackinnon critical values for rejection of hypothesis of a unit root.

We see that the logarithmic form of the price of electrical energy is stationary of a second order from the above results. For, the ADF statistics –2,98, 1% is larger than the Mackinnon critical value in absolute value. The series is cointegrated of a second order.

The logarithmic form of the population is stationary of a second order according to the best results obtained from the trials done. For, the ADF statistics –3,73, 1% is larger than the Mackinnon critical value in term of absolute value. Accordingly, the series is cointegrated of a second order.

According to the results of the unit root test, all the series to be used in the demand analysis are cointegrated. For, all of the series are cointegrated of the same order. The regression analysis based on this result would provide us with a real relation. Thus the reliability of the results obtained would increase.

When the *(2.3)* model is analyzed by the *OLS* regression analysis (Table VI), according to the results we obtain the below model:

Table VI: Estimation Results of Model (2.4) Modified for Time Series Characteristics of Data

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.297931	1.143500	0.265143	0.7989
LNIND	0.512607	0.095516	5.366746	0.0002
LNH	1.134981	0.347614	3.265066	0.0068
LNP	-0.086641	0.012434	-2.696804	0.0492
LNPOP	1.782356	0.314107	5.674358	0.0001
R-squared	0.998990			
σ	0.014320			
DW	1.824825			

According to the above results:

$$InNEPC_t = 0.298+0.52InIND_t+1.14InH_t-0.087InP_t+1.78InPOP_t \qquad (2.4)$$

The test statistics of the explanatory variable IND_t in *(2.4)* model is significant in $p=0.0002<0.05$. There exists a relation between the dependent variable and IND_t variable which is expected to be positive. That is, as the share of industry from GDP increases, the electricity consumption also increases.

The test statistics of the explanatory variable H_t is significant in $p=0.0068<0.05$. The dependent variable and the H_t variable are directly proportional. As the share of residences from GDP increases net electricity consumption increases as well.

T-test statistics of variable P_t is significant in $p=0.0492<0.05$. The dependent variable and the price of electricity are inversely proportional. When the price increases, the net electricity consumption decreases and people show a tendency to consume electricity more efficiently.

The t-test statistics of POP_t variable is significant in $p=0.0001<0.05$. The dependent variable and the explanatory variable POP_t is directly proportional. As the population increases the consumed energy always increases accordingly. Consequently, electrical energy consumption would increase as well.

The most crucial conclusion reached at this stage of the analysis is that the regression between the time series in demand analysis is real by using the unit root test.

3.1.2. Forecasting Analysis

Attaining the regression analysis, the estimation of the course of electrical energy consumption in Turkey till the year 2020 is the second stage of this research.

Electrical energy intensity that is the amount of net electricity consumption per unit of *GDP (NEPC/GDP)*, which was obtained by using

the expected net electrical energy series estimated by the *(2.4)* model, showed an increasing trend during the forecast period (Table VII).

Table VII: Expected Net Electricity Power Consumption Intensity

	2010	2015	2020
NEPCF* (Gwh)	137.338,0	159.426,5	181.515,0
GDPF* (1987 P-Billion TL)	150.717,0	167.218,7	183.720,5
NEPCF / GDPF	0,91	0,95	0,99
Per capita NEPCF (Kwh)	1926,3	2189,5	2452,6

(*) Forecast

Depending closely on the structure of industry and geographical location of each country, the national income and the per capita electrical energy consumption values (intensity of electrical energy) changes. Intensity values are decreased and thus fewer financial means are used by modifications in the life styles of people and the technologies used in the consumption of electrical energy and economizing on the energy.

With the existing technology level and current energy prices in developing countries, 20% saving on commercial energy consumption is estimated[11].

CONCLUSION

Since the Turkey's Fifth Planning Period (1985-1989), the increased share of natural gas as an alternative resource for oil and coal is expected to increase during the Eighth Planning Period (2001-2005) and onwards. This means that Turkey's dependency on import regarding energy is going to continue.

Whereas, it is of crucial importance that the policies which would decrease or eliminate the dependency on import for Turkey in constructing energy policies in an environment where the demand for energy increases rapidly be chosen. The usage of domestic resources in energy production would eliminate the economic and political risks of dependency on import.

When import is imperative due to the inadequacy of domestic resources, it is obvious that the differentiation of the energy resources imported and the countries contracted for import would decrease the mentioned risks to minimum. In this regard, especially the energy resources which we depend on import must be substituted by domestic resources. It is of necessity for the security of supply system that domestic resources have a large share and import sources be differentiated.

[11] TÜSİAD, **Enerji Sektöründe Geleceğe Bakış Arz Talep ve Politikalar** (Future View to Energy Sector, Supply, Demand and Policies), pp.79,80.

When the forecasting models and projections of the electrical energy consumption in Turkey are analyzed, that the demand for electrical energy will continue to increase till 2020 and energy intensity will increase reaching high rates is expressed. This shows that the issue of reaching a balance between demand and supply in the energy sector will continue to have an important place in the construction of future strategies and policies of Turkey. As a matter of fact, this the fundamental issue for a sustainable growth and industrialization.

Whether the regression model for Turkey's electrical energy consumption reflects a real or spurious relation is analyzed by using a unit root test within the context of cointegration and according to the results of the tests, it is found out that all the series to be used in the analysis of electrical energy demand are cointegrated series. For, all the series are cointegrated of the same order. The regression which is formed based on this result would give us a real relation. Accordingly, the reliability of the results thus obtained would increase and correct results in forecasting would be attained.

The most important result of this research is that the regression of the time series used in electrical energy consumption analysis is real by using the unit root test and having a reliable forecasting accordingly.

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