

Estimation of Residential Energy Demand in Turkey and Expenditure Groups: Evidence From 2012

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Aim:

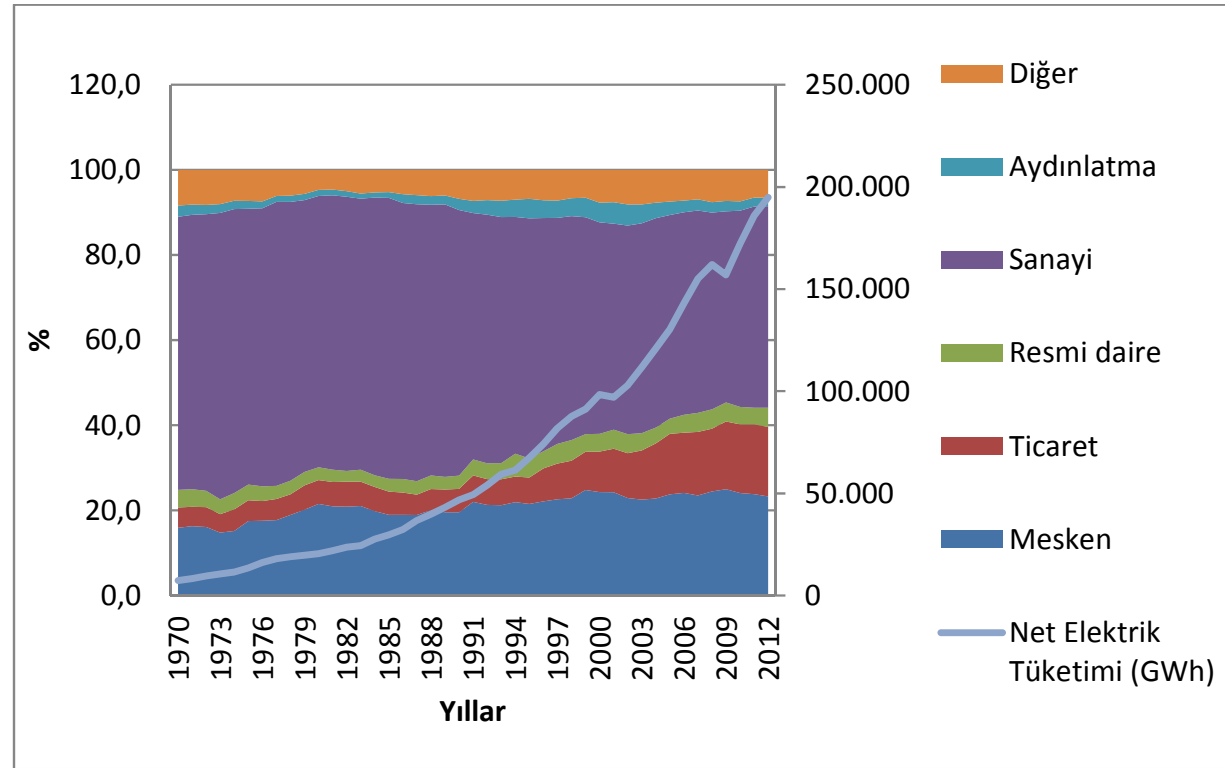
- In this research, price and expenditure elasticities of energy demand in the overall residential sector and in different expenditure groups along with the effects of lifestyle related variables and demographic variables.

Turkey's Energy Outlook

- When Turkey's primary energy consumption is taken into account Turkey ranks 18th in the world in 2014.
- In 2012, 9% of the crude oil demand was met by domestic production, natural gas this rate was 1.6%.
- 2001- Electricity Market Law (Energy Markets Regulatory Authority)
- 2001-Natural Gas Market Law in 2001.
- 2013 - Electricity Market Law

Electricity Demand in Turkey and Households

Şekil 1. Net Elektrik Tüketiminin Sektörlere Göre Dağılımı



Kaynak:

TEDAŞ, Türkiye Elektrik Dağıtım ve Tüketim İstatistikleri

A Brief Literature Review

- Houthakker (1951), England, 42 Cities, in 1937-38 (electricity demand)
- Dubin & McFadden (1984) value of the elasticity of electricity may vary for different purposes.
- Filippini & Pachauri (2004) Takes into account the seasonality of household electricity demand in urban India
- Yoo et al. (2007), selection model, Seoul, household energy demand

A Brief Literature Review

- Jamasb ve Meier (2010), England, 1991-2007, panel data set, analyse household energy spending (i.e. electricity, oil and natural gas), income groups
- Bernard et al. (2010), multiyear cross section data, Quebec, 1989, electricity and gas demand. Estimates showed that electricity and natural gas are substitutes.
- Bařaran (2011) household electricity demand, 2003 to 2009 using household budget survey data

Data

- Household Budget Survey (HBS) of Turkish Statistical Institute (TURKSTAT).
- Electricity price is collected from Turkish Electricity Distribution Company (TEDAŞ).
- In 2012, the survey was applied to 13,248 households, and 9,987 responses were received from households. At the same time the weighted household number is 20051454.

Data

- Household consumption expenditure types are classified under 12 groups:
- 1-Foods and non-alcoholic beverages,
- 2-Alcoholic beverages, cigarette and tobacco,
- 3-Clothing and footwear,
- 4-Housing, water, electricity, gas and other fuels,
- 5-Furnishings, household equipment and maintenance of the house,
- 6-Health,
- 7-Transportation,
- 8-Communication,
- 9-Entertainment and culture,
- 10-Educational services,
- 11-Restaurants and hotels,
- 12-Miscellaneous goods and services .

Data

Table 1. Missing Data According to Income Groups.

Income Groups	Electricity
First Group (Poorest)	25.38%
Second Group	13.81%
Third Group	10.93%
Fourth Group	8.35%
Fifth Group (Richest)	6.31%
Total	12.96%

Model

- Household energy consuming appliance stock is fixed (the short run demand).
- Energy demand covers both electricity and gas demand for the year 2012.
- log-linear functional form
- the index variable from the data set in order to adjust all monetary values to price developments.

Model

- Household appliances are controlled by dummies.
- Household demographic attributes cover living in urban areas, household size, hot water and natural gas utilization. Also the function includes dwelling size as a housing attribute.

- $$\ln E = \beta_0 + \beta_1 \ln Y + \beta_2 \ln P_E + \beta_3 G + \beta_4 Old + \beta_5 Urban + \beta_6 Com + \beta_7 Ac + \beta_8 Wm + \beta_9 R + \beta_{10} Dw + \beta_{11} Tv + \beta_{12} Hhs + \beta_{13} Water + \beta_{14} Size$$

Model

- Heckman's (1979) Sample Selection Model to fix the undesirable impacts of missing data.
- Sample selection model is estimated using maximum likelihood technique.
- First stage equation: the dependent variable is equal to one if the household reported information on the residential energy demand and zero otherwise,
- The demand equation, the dependent variable is the natural logarithm of the real residential energy demand. All the monetary values are adjusted to price developments.

Estimation Results /1

	All	1st Group	2nd Group	3rd Group	4th Group	5th Group
Income	0.284	0.359	0.682	0.180	0.327	0.214
	(19.54)**	(6.57)**	(4.99)**	(0.99)	(2.39)*	(4.87)* *
Price	-2.414	1.868	-1.220	-2.316	-4.412	-5.042
	(8.60)**	(3.00)**	(2.00)*	(3.40)**	(7.24)**	(8.07)* *
Old	0.049	-0.017	0.039	0.070	0.092	0.104
	(2.83)**	(0.50)	(1.10)	(1.80)+	(2.12)*	(2.29)*
Computer	0.091	0.123	0.081	0.061	0.032	0.186
	(5.68)**	(2.78)**	(2.61)**	(1.90)+	(0.90)	(4.59)* *
Urban	-0.104	-0.157	-0.122	0.034	-0.067	-0.075
	(5.61)**	(4.29)**	(2.66)**	(0.83)	(1.59)	(1.45)

+ $p < 0.1$; * $p < 0.05$; ** $p < 0.01$

Estimation Results /2

	All	1st Group	2nd Group	3rd Group	4th Group	5th Group
Air conditioner	0.147	0.162	0.150	0.170	0.197	0.083
	(7.87)**	(2.48)*	(3.43)**	(4.03)**	(5.22)**	(2.43)*
Washing Machine	-0.001	-0.035	0.078	0.205	0.176	-0.374
	(0.03)	(0.66)	(0.79)	(1.15)	(1.11)	(1.58)
Dish Washer	0.100	0.068	0.098	0.180	0.049	0.096
	(5.87)**	(1.57)	(3.06)**	(4.96)**	(1.35)	(1.92)+
Refrigerator	0.259	0.362	0.174	0.335	0.083	0.269
	(2.72)**	(2.45)*	(0.88)	(1.35)	(0.40)	(3.41)**
Lcd TV	0.049	0.055	0.103	-0.002	0.026	0.048
	(3.01)**	(1.12)	(2.71)**	(0.04)	(0.79)	(1.45)
Household Size	0.050	0.049	0.038	0.030	0.057	0.036
	(11.19)**	(4.84)**	(3.56)**	(2.62)**	(5.85)**	(3.85)**
Natural Gas	0.510	0.345	0.558	0.609	0.511	0.458
	(29.80)**	(5.56)**	(14.38)**	(15.88)**	(14.74)**	(13.73)* *
Hot Water	0.059	0.090	0.064	0.032	0.111	0.081
	(2.40)*	(2.46)*	(1.45)	(0.49)	(1.39)	(0.62)
Dwelling Size	0.122	-0.005	-0.015	0.115	0.101	0.394
	(4.82)**	(0.11)	(0.27)	(1.90)+	(1.74)+	(7.07)**
Constant	-1.549	2.825	-2.562	-1.045	-3.819	-4.644
	(4.47)**	(3.60)**	(1.98)*	(0.60)	(2.78)**	(5.60)**

Conclusions

- The estimated model suggests that there is a significant difference among households considering the income groups. We find that income elasticity is lowest for the richest group and inelastic for the all groups. On the contrary, the price effect is strongest for the richest group. For the lowest income group an increase in the prices also increases the demand. In addition, medium income level acts like an inflection point in most cases.

Conclusions

- Significant effects are estimated for socio-economic variables and household appliance stock in energy demand. The results also indicate these variables (such as dwelling size, old member, using refrigerator, having access to natural gas etc) have significant effects on energy demand in Turkey.
- Our findings show that heterogeneity is evident for households according to their income levels. Thus policy makers should take into account this heterogeneous effect in order to achieve successful policy implications.

Thank you For Listening!

- Your Questions/Comments Are Always Welcome

Appendix 1 Heckman's Selection Model First Stage Estimates

	All	1st Group	2nd Group	3rd Group	4th Group	5th Group
Yearly Disposable Income	0.241	0.183	0.048	-0.093	0.162	-0.079
	(7.14)**	(2.94)**	(0.60)	(0.96)	(2.77)**	(0.74)
Refrigerator	0.498	0.678	0.333	0.280	-0.164	0.641
	(4.19)**	(4.31)**	(1.12)	(0.77)	(0.30)	(0.98)
Washing Machine	0.347	0.231	0.611	0.528	0.292	-0.211
	(5.12)**	(2.56)*	(4.20)**	(2.45)*	(1.05)	(0.54)
Dish Washer	0.174	0.111	-0.015	0.184	0.087	0.413
	(3.79)**	(1.03)	(0.17)	(1.99)*	(0.82)	(2.98)**
Lcd TV	-0.110	-0.307	-0.158	-0.231	0.052	-0.100
	(2.43)*	(3.05)**	(1.64)	(2.36)*	(0.50)	(0.85)
Air conditioner	0.038	-0.084	-0.097	0.137	0.188	0.132
	(0.69)	(0.66)	(0.85)	(1.14)	(1.33)	(0.86)
Urban	0.548	0.609	0.594	0.329	0.491	0.600
	(13.17)**	(8.19)**	(6.83)**	(3.51)**	(4.46)**	(4.51)**
Household Size	-0.077	-0.097	-0.101	-0.099	-0.039	-0.040
	(8.47)**	(6.00)**	(4.84)**	(4.40)**	(1.54)	(1.72)+
Natural Gas	0.332	-0.018	0.253	0.638	0.420	0.369
	(5.48)**	(0.12)	(2.06)*	(4.04)**	(3.05)**	(2.58)**
Hot Water	0.291	0.230	0.136	0.266	0.386	0.883
	(6.11)**	(3.19)**	(1.38)	(2.27)*	(2.47)*	(4.16)**
Dwelling Size	0.021	0.062	-0.039	0.011	-0.090	0.002
	(0.34)	(0.65)	(0.27)	(0.07)	(0.50)	(0.01)
Constant	-2.483	-2.206	-0.137	1.210	-0.636	0.635
	(6.69)**	(3.45)**	(0.14)	(1.04)	(0.58)	(0.44)
athrho	-0.333	-0.250	-0.081	0.839	-0.554	-0.142
	(4.75)**	(1.92)+	(0.28)	(5.83)**	(3.56)**	(0.96)
Insigma	-0.453	-0.548	-0.533	-0.396	-0.446	-0.414
	(45.02)**	(21.70)**	(26.77)**	(16.68)**	(18.67)**	(21.56)**

- ❏ Stata does not directly estimate ρ , it estimates the inverse hyperbolic tangent of ρ . Stata defines this variable “ $\text{atanh}(\rho)$ ”. The standard error is computed using the delta method.
- ❏ The standard error of the residual is called “ $\text{sqrt}(\sigma^2)$ ”.