

**ESTIMATION OF THE PARAMETERS OF A LINEAR EXPENDITURE SYSTEM
DEMAND FUNCTION FOR TURKEY**

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Abstract

The paper aims to develop marginal budget share, income and price elasticities of household food consumption for Turkey by applying the Linear Expenditure System (LES) to the data between 2002 and 2011 Household Budget Survey.

In this study, data of the Household Budget Survey (HBS) conducted and calculated by the Turkish Statistical Institute (Turkstat). Marginal budget share, Income and Price elasticities under food group for divided five income groups was estimated within the framework of the Linear Expenditure System (LES) approach in Turkey. Findings for the price elasticities for LES model are consistent with economic theory. At that time, price elasticities are negative.

Key words: *Linear Expenditure system, Marginal budget share, Income and Price elasticity.*

1. INTRODUCTION

The problem in this study stems from the fact that what household demand parameters by food group would be in Turkey. In addition, as for the importance of this study for Turkey, it reveals the expectation that despite advanced technological developments in the globalized world of today. Especially, famine, food insecurity and food consumption will continue to be an important problem in the world and in Turkey in the future, just like it is today.

In this study, calculation of price and income elasticities drawn from the Linear Expenditure System was aimed, by using expenditure data relevant to the food group included in the Household Budget Surveys (HBS) between 2002 and 2011. The main goal of this study is to analyze the food consumption behavior of the households living in Turkey. As it is known, despite the fact that household consumption expenditures are composed of twelve commodity groups, budget shares for expenditures represent an important part of them. With in this study, it is possible to monitor, via the marginal budget share, income and price elasticities, the food group for which the most and the least expenses were made by the consumers. According to the results obtained, consumer demand estimation of the households living in Turkey was analyzed.

There are numerous studies analyzing the demands for expenditure groups in world countries, whereas the number of the studies conducted in this regard in Turkey. In the large majority of these few studies, cross section data are used, yet studies conducted with time series data remain insufficient. There are a few studies analyzing the demands for food items in Turkey and in the World that are as follows:

Howe (1977), Sasaki and Saegusa (1974), Narayana and Vani (1996), Huang and Bouis (2001), Burney and Akmal (1991), Lee, Brown and Seale (1994), Lewis and Andrews (1989), Deaton, Castillo and Thomas (1989), Eastwood and Craven (1981), McConnell (1978), Lluch and Williams (1975),

Lluch (1973), Philips (1972), Stone (1954), Pollak and Wales (1969), Nişancı (2002), Tansel (1986), Şahinli (2010).

In our data was established as a cross-section data set in this study. The econometric model was estimated according to this organized and established Household Budget Surveys (HBS) data. In our study, marginal budget share, income and price elasticities relevant to whole Turkey were obtained between 2002 and 2011. Income and price elasticities were found in line with the parameters estimated from the LES.

This paper comprises four sections that can be follows: In this second part, The Linear Expenditure System is mentioned, in the third part comprises the data section, in the fourth part estimation results are given and the last section is composed of conclusion section.

2. THE LINEAR EXPENDITURE SYSTEM

In production and consumer theory the mostly used production function and utility function is presumably the one due to Cobb and Douglas (1928). A major shortcoming of the Cobb-Douglas utility function is that preferences are homothetic implying unitary expenditure elasticities so that Engel curves are straight lines through the origin.

In the theory of household behavior in a series of articles: Klein and Rubin (1948-1949), Samuelson (1948), Geary (1949-1950) and Stone (1954). Klein and Rubin developed the LES as the most general linear formulation in prices and income satisfying homogeneity, the budget constraint, and Slutsky symmetry. This function is known as the Stone-Geary utility function and the ensuing demand model as the Linear Expenditure System (LES).

If the basic model is written for each commodity, the following equations might be obtained. The Linear Expenditure System is the most frequently used system in empirical analysis of demand. If the equations are to be used for estimations, solely short-term estimations can be made.

The LES model general form is as follows;

$$p_i q_i = p_i \beta_i + \alpha_i \left[w - \sum_{j=1}^m p_j \beta_j \right] \quad , i = 1, 2, \dots, m$$

Where;

m = no. of commodities

p_i = price of ith commodity

q_i = is the commodity of ith commodity

w = total expenditure

β_i = are interpreted as subsistence consumption levels of ith commodity

Advantages:

1. expresses q_i as a linear function of real total expenditure w/p_i and of relative prices p_j/p_i ,
2. is the only demand system that satisfies all the theoretical restrictions.

Maximum likelihood estimators of μ, γ_i^* and $\Sigma \gamma_i^*$ are estimated from α_i and β_i ordinary least squares estimators.

$$\mu = \Sigma \beta_i$$

$$\Sigma \gamma_i^* = \Sigma \alpha_i / (1 - \mu)$$

$$\gamma_i^* = \alpha_i + \beta_i \Sigma \gamma_j^*$$

Regarding with demand elasticities are calculated as follows:

Marginal budget share of i commodity: $\beta_i^* = \beta_i / \mu$

Income elasticity of i commodity: $\eta_{iy} = \beta_i (y / e_i)$

Price elasticity of i commodity: $\eta_i = (1 - \beta_i)(\gamma_i^* / e_i) - 1$

3. THE DATA

As known, TurkStat has launched a continuous survey application in 2002. The essential changes in definition and concepts of the survey arise in 2002 survey which is the first survey after 1994. The series continued in later years, hasn't include significant changes. The name of the survey was changed as "Household Budget Survey (HBS)" since 2002 whereas it was "Household Income and Consumption Expenditure Survey (HICES)" in 1994. The level of estimation was Turkey, urban and rural areas, 7 geographical regions and 19 independent provinces in 1994 HICES whereas, it was changed as Turkey, urban and rural settlements in 2002, 2004-2007 HBS, and Turkey, urban and rural areas, Classification of Statistical Regional Units Level 1 and urban/rural area distinction for each Level 1 and Level 2 in 2003 HBS. It was included 10 expenditure groups in 1994 HICES and 12 expenditure groups beginning from 2002 HBS (Turkstat, 2013).

The consumption expenditure values of the households per month are listed from the least amount to the most amount within the month, the households were divided in five equal parts and quintiles were formed and share of expenditure of each group was calculated. Since the quintiles are formed separately for urban and rural settlements, values for Turkey can not be obtained from the total of the urban and rural values. It is also caused by the fact that each level of settlement was listed independently; the household quintiles were formed and sub features within these groups were calculated separately (Turkstat, 2013).

The HBS data between 2002 and 2011, the method of which is given above by the Turkstat were used in this study. This survey data were organized and changed with relevant to the researcher's aim and objective.

Household Income and Consumption Expenditures Survey of between 2002 and 2011 were obtained from Turkish Statistical Institute. In the data relevant between 2002 and 2011, general sum of total monthly consumption expenditures and expenditure values regarding food group was taken.

12 month-consumer prices index figures were used from the TurkStat's Price Statistics database. Price indexes belong to food group was used. After that price data were converted into real price values.

The data set created for study use was distributed by food group. Moreover, the data which were regions in the cross section and 10 year-observations of 2002 and 2011 in the time section were combined.

4. ESTIMATION RESULTS

The estimation of model parameters was calculated by The Ordinary Least Squares method. Estimation of the model was made by using EvIEWS 7 econometrics package program. The data relevant to the food group which take place in the Household Budget Survey of between 2002 and 2011 were applied to the Linear Expenditure System.

Table 1. Linear Expenditure System Statistics, 2002-2011

Income group	α	β	R^2	DW	t-Ratio	
					α	β
1. %20 Income group	-12.281,2	0.035331	.998	2.021	0.018	0.365
2. %20 Income group	-260.668,1	-0.032436	.999	1.804	0.521	0.455
3. %20 Income group	-582.859,1	-0.069521	.999	2.141	0.793	0.668
4. %20 Income group	-301.555,0	-0.029527	.999	2.045	0.385	0.263
5. %20 Income group	-62.737,1	0.215392	.998	2.156	0.039	0.938

The regression results are reported in Table 1. The results of these equations seem to have a fit by all standards and expectations. The coefficients and determination coefficient have correct signs. The negative intercepts emphasize the inadequate availability that is the existing very low base of consumption of these items which identifies them as superior goods (Table 1).

In Table 1, calculated R^2 and DW values of the Linear Expenditure System are given. While the lowest R^2 value %99.8 was in the first and in the fifth %20 income group, R^2 values of the remains %20 income groups %99.9 are the same. DW values relevant to the Linear Expenditure System are given in Table 1. For 10 observations at 5% level and one explanatory variable taken out of Durbin-Watson table, $d_L = 0.879$ and $d_U = 1.320$. When the DW values are considered, between first and fifth %20 groups, we can't reject null hypothesis or alternative hypothesis because there aren't any positive or negative autocorrelations in this range (Table 1).

Marginal budget share, income and price elasticities values with relevant to food group for the Linear Expenditure System is calculated for estimated parameter values that are as follows in Table 2. The marginal buget shares explain in the expenditure elasticities of demand. If household expenditure per capita is increased by one Turkish lira it is nearly allocated across various items as follows:

Income elasticity for food belongs to five income groups are given Table 2. According to these income groups, income elasticity of food doesn't exceed unity. For that reason, we categorize for food as inferior goods not luxuries or superior goods.

Table 2. Distribution of Marginal budget share, price and expenditure elasticities for food

Income group	Marginal Budget Share (%)	Income Elasticity	Price Elasticity
1. %20 Income group	0.2963041	0.0394328	-1.588756357
2. %20 Income group	-0.2720251	-0.0292387	-2.793267432
3. %20 Income group	-0.5830391	-0.0540235	-4.611739765
4. %20 Income group	-0.2476287	-0.0200746	-2.629507423
5. %20 Income group	1.8063888	0.1186210	-2.393672344
Total	1.00		

Price Elasticity (PE) can be calculated by the percent change in the quantity demanded by the percent change in price. PE measures the responsiveness of a change in demand, after a change in price. When the PE of a good is greater than one in absolute value, the demand is said to be elastic; it is highly responsive to changes in price.

Goods which are elastic, tend to have some or all of the following characteristics: a. They are luxury goods, expensive and a big % of income e.g. sports cars and holidays. b. Goods with many substitutes and a very competitive market. Demands with an elasticity less than one in absolute value are inelastic; the demand is weakly responsive to price changes.

Goods which are inelastic tend to have some or all of the following features: a. They have few or no close substitutes, e.g. petrol, cigarettes. b. They are necessities and addictive. c. They cost a small % of income or are bought infrequently. Demands with an elasticity equal to one in absolute value are unit elastic; the demand is smoothly responsive to price changes.

According to the the Linear Expenditure System model, price elasticities are suitable for economic theory that is values of price elasticities are negative. While food price elasticity of all %20 income groups are elastic.

When the price elasticities of the food group for all income groups are considered, in case of 1% increase food group in first %20 income group, this might be interpreted as demand for food group will grow by 1,588756357%, demand for food group in second %20 income group will grow by 2,793267432%, demand for food group in third %20 income group will grow by 4,611739765%, demand for food group in fourth %20 income group will grow by 2,629507423% and demand for food group in fifth %20 income group will grow by 2,393672344%.

While the lowest price demand elasticity was observed 1,588756357 in first %20 income group, the highest price demand elasticity was observed 4,611739765 in third %20 income group. In line with this, it is possible to say that consumers are more responsive to price changes. Although third %20 income group is more sensitive to food price changes, first %20 income group is less responsive to this food price changes. Price elasticities are calculated to be negative as expected in accordance with the economic theory.

5. CONCLUSION

The study carries out to consumer responsiveness to changes in income and food prices. The used methodology was based on a system approach known as Linear Expenditure System (LES). Household Budget Survey data are used between 2002 and 2011.

The most important findings of the study are summarized as follows:

1. The regression of these equations seem to have a fit by all standards and expectations. The statistics and coefficient of determination have correct signs for expectations. The negative intercepts emphasize the inadequate availability that is the existing very low base of consumption of these items which identifies them as superior goods.

2. The marginal budget shares explain in the expenditure elasticities of demand. If household food expenditure per capita is increased by one Turkish lira, 29.6% goes to food first %20 income group, -27.2% goes to food second %20 income group, -58.3% goes to food third %20 income group, -24.8% goes to food fourth %20 income group and 1.81% goes to food fifth %20 income group.

3. According to the the Linear Expenditure System model, price elasticities are suitable for economic theory that is values of price elasticities are negative and food price elasticity of all %20 income groups are elastic.

4. According to these income groups, income elasticity of food don't exceed unity and we categorize for food as inferior goods not luxuries or superior goods.

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