THE DEMAND FOR MEAT IN TURKEY, 1979-1989.

A Thesis
Submitted to The Department of Economics
and the Institute of Economics and Social Sciences
of Bilkent University
In Partial Fulfillment of the Requirements
for the Degree of

MASTER OF ARTS IN ECONOMICS

By

Jülide YILDIRIM

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I certify that I have read this thesis and in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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I certify that I have read this thesis and in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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ABSTRACT

DEMAND FOR MEAT IN TURKEY , 1979-1989.

Jülide YILDIRIM

Master of Arts in Economics

Supervisor : Asisstant Prof. Dr. Erol ÇAKMAK

November 1990

In this study , pooling of time series cross sectional data is used for constructing a demand model for the Turkish Meat Market. The demand functions are simultaneously estimated by Zellner's Seemingly Unrelated Regression Method, imposing homogeneity and symmetry restrictions. Furthermore, a structural change test is conducted in order to see whether there is a structural change between the subperiods 1979-1984 and 1985-1989. It is found that demand functions do not satisfy homogeneity restriction, implying that there is money illusion. A structural change is found in the demand for mutton implying there is a change in consumers' preferences between two subperiods.

Keywords : Pooling time series cross sectional data, Seemingly Unrelated Regression, Structural Change, symmetry ,homogeneity, Chow Test and F Test.

ÖZET

TURKİYE ET TALEBİNİN TAHMİNİ , 1979-1989

Jülide YILDIRIM

Iktisat Yuksek Lisans

Tez Yöneticisi : Yard. Doç. Dr. Erol ÇAKMAK

Kasım 1990

Bu çalışmada, zaman serisi ve kesitsel verilerin birleştirilmesiyle Türkiye Et Pazari için bir talep modeli oluşturulmuştur. Talep fonksiyonlari eşzamanli olarak Zellner'in Ilişkisiz Görünen Regresyon Metodu ile homojenlik ve simetri kisitlari konularak tahmin edilmiştir. Ayrıca, 1979-1984 ve 1985-1989 dönemleri arasında bir yap sal degisim olup olmadıgını görmek için bir Yapısal degişim Testi yapılmıştır. Talep Fonksiyonlarının simetri kısıtını sagladigi fakat homojenlik kısıtını saglamadıgı görülmüştür. Ayrica, koyun eti talep fonksiyonunda bir yapısal degişiklik bulunmuştur.

Anahtar Kelimeler : Zaman serisi ve kesitsel verilerin birlestirilmesi, Ilişkisiz Görünen Regresyon Metodu, Yapisal Degişim, Simetri, Homojenlik, Chow Testi ve F Testi.

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1. INTRODUCTION

Animal protein sources are very important in peoples diets, due to their special roles in human growing process. The per capita consumption of animal proteins is low in Turkey compared to developed countries, per capita consumption of meat is 0.210 kg/day in Canada, 0.215 kg/day in U.S.A., 0.200 kg/day in France and in Turkey it is 0.038 kg/day 1984 [1]. The determination of the structure of the meat market may be useful for designing policies to increase the animal protein consumption. Accordingly, the purpose of the thesis is to investigate the structure of the meat market.

A demand model for three meat items -mutton, beef and poultry- is constructed for Turkey. Retail prices meat items, price index and income are included as explanatory variables in each of the equations. The demand functions are simultaneously estimated by the method of seemingly unrelated regression.

The classical demand theory requires the demand functions to satisfy two restrictions which are homogeneity of degree zero and symmetry. In the estimation process, these two restrictions will be imposed and tested. So that it can be see that whether the demand equations satisfy the requirements of classical demand theory.

The elasticities estimated by econometric models may change over time. This may be due to shocks in the economy, new products

1:Statistical Yearbook, State Institute of Statistics in the market or changes in consumer preferences. Therefore, in the second part of the study a structural change will be investigated.

The period of study is selected according to the avalible data on quantities and prices of meat items. The data consists of time series figures on aggregate meat items avaible for the period 1979-1989, for fourteen provinces namely Adana, Ankara, Antalya, Bursa, Diyarbakir, Erzurum, Eskisehir, Istanbul, Izmir, Kayseri, Ordu, Samsun, Trabzon and Zonguldak.

2. THEORETICAL FRAMEWORK AND RELATED RESEARCH

2.1. Demand functions

The function that relates prices and income to the demand for a commodity is called consumer demand function. The quantity demanded in the market at each price is the sum of the individual demands of all consumers at that price. Demand is a multivariate relationship, that is, it is determined by many factors simultaneously. Some of the most important determinants of the market demand are its own price, consumers income, prices of other commodities and consumers tastes and preferences.[1]

Since the market demand is the summation of the demands of individuals, the traditional theory of demand starts with the examination of the behavior of the consumer. The consumer is assumed to be rational, that is given this income and market prices, he can choose the bundle of the commodities which gives the maximum satisfaction or utility. He must be able to rank various bundles of goods according to the utility that he takes from each of these bundles. The preferences of the consumer are expressed by a utility function.[2] The utility function takes the form :

$$u = u(x_1 , x_2 , x_3 , \ldots, x_n \ldots) \qquad (2.1.1)$$

Where x_i is the quantity consumed of good i. It is assumed that the classical assumptions (nonsatiation, positive diminishing marginal utility) on the utility functions hold.

1: Koutsoyiannis, Modern Microeconomics (2 nd edition)

2: For the existence of a utility function, see Varian(1984)

The consumer has a given income, which limits his utility maximization. He has to choose commodities which are affordable with his limited income.That is he has to maximize his preferences subject to the budget constraint which can be expressed as

$$\Sigma P_i.X_i = M \quad ....(2.1.2)$$

Where P_i is the price of the i^{th} commodity

X_i is the quantity demanded of the i^{th} commodity

M is the income

Then, the problem of utility maximization can be written as:

max u(x)

subject to $\Sigma P_i.X_i \leq M$

The basic features of this problem are as follows : Firstly, as long as prices and income are positive, there will be a bundle maximizing utility. Secondly, if prices and income change by the same proportion, the optimum consumption bundle will not change. That is the optimal choice is homogeneous of degree zero in prices and income.

The first order conditions of the utility maximization problem are:

$$\frac{\partial u}{\partial X_i} = \lambda P_i \qquad i = 1,.....,n \quad .... (2.1.3)$$

Where λ is the lagrange multiplier.

This expression states that each marginal utility is proportional to the corresponding price

These conditions can be rearranged as:

$$\frac{\partial u}{\partial X_i} \Big/ \frac{\partial u}{\partial X_j} = \frac{P_i}{P_j} \qquad \text{for } i,j = 1,....,n.......(2.1.4)$$

j i

that is marginal rate of substitution equals, economic rate of substitution.

The first order conditions constitute (n+1) equations, which can be solved for the (n+1) unknowns $X_1, X_2, \ldots X_n$ and λ. It follows from the assumptions that the solutions to the problem are unique and positive. This comes from the assumption of strict quasi concavity of the utility function. The optimal quantities depend on prices and income :

$$X_i = X_i(P_1, P_2, \ldots, P_n, M) \quad \ldots\ldots(2.1.5)$$

These are the demand functions.

Under the local nonsatiation assumption, a utility maximizing bundle X^* must meet the budget constraint with equality.

$$\sum_{i=1}^{n} P_i X_i(P,M) = M \quad \ldots\ldots(2.1.6)$$

The income elasticity of commodity i is defined as :

$$\varepsilon_{im} = \frac{\partial X_i(P,M)}{\partial M} \cdot \frac{M}{Xi}$$

If equation(2.1.6) is differentiated with respect to M,

$$\Sigma P_i \cdot \frac{\partial X_i(P,M)}{\partial M} = 1$$

is obtained. By defining the expenditure share of commodity i as :

$$v_i = \frac{P_i X}{Mi}$$

Then,

$$\sum_{i=1}^{n} \frac{P_i X_i}{M} \frac{P_i \partial X_i(P,M)}{\partial M} \frac{M}{X_i} = 1$$

$$\sum_{i=1}^{n} v_i . \varepsilon_{im} = 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.1.7)$$

Alternatively, define the elasticity of good i with respect to price of j^{th} commodity as:

$$\varepsilon_{ij} = \frac{\partial X_i(P,M)}{\partial Pj} \cdot \frac{Pj}{X_i^*}$$

By applying Euler's Theorem to equations (2.1.5),

$$\sum P \frac{\partial X_i(P,M)}{\partial P_j} + M . \frac{\partial X_i(P,M)}{\partial M} = 0 \quad i=1,\ldots,n \ \ldots\ldots\ldots (2.1.8)$$

which implies:

$$\sum^{n} \varepsilon_{ij} + \varepsilon_{im} = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.1.9)$$

Both (2.1.7) and (2.1.9) imply that the demand function are homogeneous of degree zero in prices and income. That is there is no money illusion.

Slutsky equation decomposes effects of a price change on the quantities of goods demanded. There is a substitution effect which comes from the fact that as price of the i^{th} commodity increases, consumers will substitute another commodity, price of which doesn't change, for the i^{th} commodity. the second effect is the income effect, as the price of i^{th} commodity increases real income of the consumer falls resulting a decrease in the demand for the i^{th} commodity. The Slutsky Equation is expressed as

$$\frac{\partial X_i(P,M)}{\partial P_j} = - \; X_i(P,M) . \frac{\partial X_i(P,M)}{\partial M} + \left. \frac{\partial X_i(P,M)}{\partial P_i} \right|_c$$

where $\left. \dfrac{\partial X_i(P,M)}{\partial P_j} \right|_c$ stands for compensated price elasticity, meaning the change in quantity demanded after the compensation of the fall in real income due to the increase of the price of j^{th} commodity.

Defining the compensated price elasticity as:

$$\hat{\varepsilon}_{ij} = \frac{P_j}{X_i} . \left. \frac{\partial X_i(P,M)}{\partial P_j} \right|_c$$

Slutsky equation in elasticity form can be written as :

$$\varepsilon_{ij} = \hat{\varepsilon}_{ij} - v_{ij} \varepsilon_{im}$$

Since

$\dfrac{\partial X_i(P,M)}{\partial P_j} = \dfrac{\partial X_j(P,M)}{\partial P_i}$, it is true that

$$\frac{\partial X_i(P,M)}{\partial P_j} + X_j^{*} \frac{\partial X_i(P,M)}{\partial M} = \frac{\partial X_j(P,M)}{\partial P_i} + X_i^{*} \frac{\partial X_j(P,M)}{\partial M}$$

which is the symmetry condition.

2.2. Related Research on Demand for Meat

Although,there are many studies concerning demand for meat in the foreign literature. There are few studies made in Turkey, by Türkiye Sanayi Kalkinma Bankasi. In this section, empirical studies concerning demand for meat are summarized.

Tryfos and Tryphanulas(1973:647-652), constructed a system of linear, contemporaneously related demand functions for beef, veal pork, lamb and chicken in Canada using annual data for the period 1954 to 1970. The dependent variables were the per capita consumption of beef, veal, pork, lamb and chicken meat and the explanatory variables were the deflated retail prices of meat items, per capita deflated personal disposable income. Since there was correlation among the dependent variables, Zellner's method of estimating seemingly unrelated regression equations was employed. The income and price elasticities were calculated. It is found that all own price coefficients are negative and all other price coefficients are negative positive as expected. Theil's U statistic was employed to test the predictive accuracy of the model. By mean of U ststistic, it is concluded that a large proportion of the variation in the demand for meat in Canada is explained by the model.

Chavas(1983:148-153) investigated for the structural change in demand for meat in United States . He developed a method for investigating structural change. It is presented in the context of a linear model and is based on the Kalman Filter. In order to estimate the variance of the random coefficients, one step ahead prediction error is used. In the first part of the study of Chavas , demand function for the meat items (poultry, beef and pork) were estimated by seemingly unrelated regression based on the data 1950-1970. The dependent variables were the per capita consumption of poultry, beef and pork in poultry, beef and pork equations respectively. The explanatory variables were the reatil prices of these three meat items, price index and per capita disposable income. Furthermore, the zero degree homogeneity and symmetry restrictions were imposed and tested in accordance with the demand theory. It is found that all elasticities have the expected signs except for the income elasticity of poultry. All estimated elasticities are significantly different from zero. Furthermore, homogeneity and symmetry restrictions are not rejected. These elasticity estimates and their variances obtained by SUR, were taken as the prior information in the Kalman Filter, in order to investigate structural change. In conclusion, there was no structural change in pork demand. However, a structural change occured in beef demand, which was reflected in beef own price elasticity. Structural change in poultry demand was reflected in income elasticity.

Chang(1977), tried to adopt a more general functional form for the demand for meat. He argues that, there are two fuctional forms which are generally used. The first is the linear formulation where the quantity demanded is assumed to be a linear fuction of the explanatory variables. The second formulation is the logarithmic formulation where all variables are in the logarithmic form. However, there is not a priori information to make a choice between these functional forms. Furthermore, the use of one of these formulations may be too restrictive or inconsistent with the actual data. Chang states that "a log form implies that the income and price elasticities of demand for meat are constant at any level of price and income. Such an implication might be to restrictive if the variation in income and price is large. On the other hand a linear form implies that the income elasticitity of demand for meat is rising and tends towards unity, if it is less than unity". However, some goods are luxury goods until their consumption reach a certain level. Afterwards, the good becomes a necessity.Therefore,the income elasticity should be falling rather than rising.

Instead of these two formulations, a more general form is introduced:

$Q_t^* = \beta_1 + \beta_2 X_{2t}^* + \ldots\ldots\ldots + \beta_k X_{kt}^* + \varepsilon_t$

where $Q_t^* = (Q_t^\lambda - 1)/\lambda$

and

$X_{kt}^\lambda = (X_{kt}^\lambda - 1)/\lambda$

λ represents a transformation parameter to be determined. It can be seen that if $\lambda=1$ equation is a linear form. If λ approaches zero, the functional form approaches a logarithmic form.Using the time series U.S. data for the period 1935-1974, the parameters of demand for meat equation is estimated by Maximum Likelihood method.The maximum likelihood estimate of λ is (-0.84).Therefore, the hypothesis that the functional form is linear or logarithmic is rejected.It is also found that income elasticity of demand for meat is decreasing as income increases slowly indicating that the logarithmic form is acceptable.

While dealing with the functional form of the demand for meat, Chang, did not concern with the restrictions, imposition of which are required by the classical demand theory. Pope,Green and Eales (1980) employs the same estimation technique, namely the Maximum Likelihood Estimation, and additionally impose the zero degree homogeneity restriction to the demand equations. They used U.S. data on beef, pork, poultry and fish for the years 1950-1975. Variables are the retail prices of the meat items, implicit price indices and per capita income. Test of homogeneity is based on the likelihood ratio procedure.It is found that all elasticities have the correct signs. The estimated income elasticities are positive. In all demand equations homogeneity is rejected.Thus, the hypothesis of no money illusion is rejected.

In Turkey,a study made by Turkiye Sanayi Kalkinma Bankasi in 1981 concerning meat and meat products. The per capita demand for animal protein in Turkey is estimated in that study. In order to find the per capita demanded animal protein, a regression equation which has the quantity demanded animal protein as the dependent variable and the per capita income as explanatory variable, is used. By using per capita income in each province, per capita demanded animal protein figures are obtained. A linear programming model, the objective function of which is the maximization of the protein consumption, is utilised in order to find the distribution of protein demand among milk, meat, egg and poultry-fish. In this linear programming model there are two constraints: Budget for meat and poultry and budget for milk and egg. The model is:

$\text{Max } \Sigma\, a_i x_i$

subject to

$$b_1x_1+b_4x_4<=c_1$$

$$b_2x_2+b_3x_3<=c_2$$

$$x_i<=d_i$$

where $i=1,\ldots,4$; 1=meat ,2=milk ,3=egg ,4=poultry+fish

a_i: protein coefficients

b_i: retail prices of commodities

c_1: per capita expenditure on meat and poultry+fish

c_2: per capita expenditure on milk and egg

x_i: optimum consumption levels

d_i: consumer's income

The protein demand functions are weighted by coefficients which were found to be solutions to the model. So , for each province, they ended up with protein demand functions for meat,milk,egg,poultry and fish. In order to invert protein demand to commodity demand, protein-product converting ratios are used. Hence, total and per capita commodity demanded are found. The values of total demand for the products are given as follows:

	1978	1990
Meat	701	1266
Milk	4514	8149
Egg(million)	2648	4780
Poultry+Fish	169	305

In the study of Turkiye Sanayi ve Kalkinma Bankasi, the demanded quantities are estimated only for 1978 and 1990. However, there is no estimation figures for other years. Furthermore, income and price elasticities are not estimated. In this study, demand functions for three meat items will be estimated and hence the demanded quantities can be computed for each year. The income, own and cross price elasticities of the demand items will be estimated. So,the structure of the Turkish meat market will be determined.

3. RESEARCH METHODOLOGY

3.1. Some Considerations About The Data

The data which is used to estimate the model consists of production figures and retail prices of mutton beef and poultry for each province, which are Adana, Ankara, Antalya, Bursa, Diyarbakir, Erzurum, Eskisehir, Istanbul, Izmir, Kayseri, Ordu, Samsun, Trabzon and Zonguldak. Since meat is not a durable commodity, it has to be consumed when it is produced, it is assumed that the production and the consumption figures are the same. Income figures are real incomes of each province. Prices of other commodities are measured by a single price index base year of which is 1979.

Prices are in TL and quantities are in tons,except for poultry. The data for poultry are reported in heads. However, the quantity of poultry in terms of heads. It is assumed that on the average each head of poultry will have 2 kg of poultry meat.kg.

The income figures are available for the time period 1979-1986. However, the data for the period 1986-1989 were not available. Missing values are generated as follows : Firstly, for each province, average growth rates of income (AGR) are computed as a percentage of real income. Next, the previous year's income is multiplied by the growth rate, then added to the previous year's income. In mathematical form:

$Y_t = Y_{t-1} + AGR(Y_{t-1})$

where Y denotes income

Quantities and prices are taken from Statistical Yearbooks and Agricultural Statistical Yearbooks of State Institute of Statistics. Income figures for the period 1979-1986 are taken from the Statistical Book of Istanbul Trade Commerce.

3.2. Hypothesis

In the present study, the demand functions for mutton,beef and poultry are simultaneously estimated on the basis of annual data for the period of 1979-1989.Since,the time period covered is short cross-sectional data is used.By pooling time series-cross sectional data, a larger set of data is obtained.The cross section data consists of meat consumption figures of fourteen provinces.

Economic theory suggests that the quantity of a given meat product demanded at the retail level depends on the price of that meat product, the prices of other meat products, and income. A negative correlation between the quantity demanded and the own price of the meat product and a positive correlation between quantity demanded and the substitute meat products is expected.Furthermore, the income elasticity of the meat item is expected to be positive because as the income of the household increases, demand for meat should increase. The classical demand theory requires any demand function to satisfy the homogeneity of degree zero and symmetry restrictions.

However, the estimated own and cross price elasticities may change over time due to shocks in the economy.The source of such structural change may be technological adoption, a shift in consumer preferences, a sudden change in retail prices or a shift in consumers′ income.One way to handle this problem is to make a structural change test.

The aim of the study is to construct a demand model for three meat items in order to determine the structure of the Turkish meat market.The demand functions of mutton,beef and poultry will be estimated.The homogeneity and symmetry restrictions will be imposed and tested.Furthermore the hypothesis of structural change will be investigated.

The demand functions are specified as follows in double logarithmic form :

$$\ln Q_{it} = \beta_{io} + \Sigma\beta_{ij}\ln P_{jt} + \delta_i \ln Y_t + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2.1)$$

where Q_{it} is the consumption of the ith meat item at time t

P_{jt} is the retail price of the jth meat item at time t

Y_t is the consumer income at time t

ε_{it} is the disturbance term

3.3. The Methodology of Estimation

3.3.1. Pooling the Time Series Cross Sectional Data

In this study, since the time period covered is short, cross-sectional data is used to estimate the demand functions.

When time series cross sectional data is used, a model which will indicate differences among time series and among cross sectional units should be specified. According to Srivastava and Giles "When data do not support the hypothesis of coefficients being the same, yet the specification of the relationship among variables appears proper, then it would seem reasonable to allow variations in parameters across cross-sectional units and/or over time as a means to take account of individual and/or interperiod heterogeneity." There are cases in which there are changing economic structure implying that the response parameters may be changing over time.

Similarly, according to Judge et al (1985:515), "The problem when using these data to estimate a relationship is to specify a model that will adequately allow for differences in behavior over cross sectional units as well as any difference in behavior over time for a given cross sectional unit".

In general the models considered can be written as :

$$Y_{it} = \beta_{oit} + \Sigma\, \beta_{kit} X_{kit} + \varepsilon_{it} \quad \text{.........................} (3.3.1.1)$$

where $i=1,2,\ldots,N$ refers to a cross sectional unit

$t=1,2,\ldots,T$ refers to a given time period

$k=1,2,\ldots,K$ refers to a given explanatory variable

According to Judge et al(1985), the following cases are considered in the time series cross sectional data:

1. All coefficients and the disturbance is assumed to capture differences over time and individuals

$$Y_{it} = \beta_o + \Sigma\, \beta_k X_{kit} + \varepsilon_{it} \quad \text{.............................} (3.3.1.2)$$

2. Slope coefficients are constant and the intercept varies over individuals

$$Y_{it} = \beta_{oi} + \Sigma\, \beta_k X_{kit} + \varepsilon_{it} \quad \text{.............................} (3.3.1.3)$$

3. Slope coefficients are constant and the intercept varies over individuals and time

$$Y_{it} = \beta_{oit} + \Sigma\, \beta_k X_{kit} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3.1.4)$$

4. All coefficients vary over individuals;

$$Y_{it} = \beta_{oi} + \Sigma\, \beta_{ki} X_{kit} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3.1.5)$$

5. All coefficients vary over time and individuals

$$Y_{it} = \beta_{oit} + \Sigma\, \beta_{kit} X_{kit} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3.1.6)$$

In this study, it is assumed that slope coefficients vary over individuals indicating that different behavior over individuals will be reflected not only in a different intercept but also in different slope coefficients. Then, time series cross sectional model can be written as :

$$Y_{it} = \Sigma\, \beta_{ki} X_{kit} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3.1.7)$$

$$i=0,1,2,\ldots,N$$

$$t=0,1,2,\ldots,T$$

where $X_{oit}=1$

According to Judge et al (1985),"Our assumptions imply that the response of the dependent variable Y_{it} to an explanatory variable X_{kit} is different for different individuals, but for a given individual, it is constant over time. "When the response coefficients β_{ki} are fixed parameters, equation (3.3.1.7) can be viewed as the "Seemingly Unrelated Regression Model".

3.3.2.Seemingly Unrelated Regression Models

Kmenta(1986:635),states that "Under the assumptions of classical normal linear regression model, the least squares estimators of the regression coefficients were found to be unbiased and efficient. This result was derived on the understanding that the specification of the model represents all there is to know about the regression equation and the variables involved". Otherwise, the properties of the least squares estimators can't be established.One additional piece of information, that is not taken into account,is the knowledge that the disturbance in the regression equation could be correlated with the disturbance in some other equation. Then, the system of M equations is called a system of Seemingly Unrelated Regression Equations.

Let,

$$Y_\mu = X_\mu \beta_\mu + \varepsilon_\mu \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.3.2.1)$$

be the μth equation of an M equation regression system where

Y_μ is a $T\times1$ vector of observations on the μth dependent variable

X_μ is a $T\times k_\mu$ matrix of observations on the k_μ independent variable

β_μ is a $k_\mu\times1$ vector of regression coefficients

ε_μ is a $T\times1$ vector of random error terms

The system of which the equation (3.3.2.1) is an equation may be written as:

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \cdot \\ \cdot \\ Y_M \end{bmatrix} = \begin{bmatrix} X_1 \ldots\ldots\ldots 0 \\ 0 \; X_2 \ldots\ldots 0 \\ 0 \; 0 \ldots\ldots\ldots 0 \\ 0 \ldots\ldots\ldots\ldots 0 \\ 0 \ldots\ldots\ldots\ldots X_M \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \cdot \\ \cdot \\ \beta_M \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \\ \\ \varepsilon_M \end{bmatrix} = \ldots\ldots\ldots\ldots(3.3.2.2)$$

(3.3.2.3) is assumed to have the following variance covariance matrix:

$$\Omega = \begin{bmatrix} \sigma_{11} I & \sigma_{12} I \ldots\ldots\ldots\ldots \\ \sigma_{21} I & \sigma_{22} I \ldots\ldots\ldots\ldots \\ \cdot & \cdot \ldots\ldots\ldots\ldots \\ \cdot & \cdot \ldots\ldots\ldots\ldots \\ \sigma_{M1} I & \sigma_{M2} I \ldots\ldots\ldots \sigma_{MM} I \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \sigma_{12} \ldots\ldots\ldots \sigma_{1M} \\ \sigma_{21} & \sigma_{22} \ldots\ldots\ldots \sigma_{2M} \\ & \cdot \ldots\ldots\ldots \\ & \cdot \ldots\ldots\ldots \\ \sigma_{M1} & \sigma_{M2} \ldots\ldots\ldots \sigma_{MM} \end{bmatrix} \otimes I$$

$$\ldots\ldots\ldots(3.2.2.4)$$

Where I is a unit matrix of order $T \times T$ and $\sigma_{mm'} = E(\varepsilon_{mt}\varepsilon_{mt}')$ and $\sigma_{mp} = E(\varepsilon_m \varepsilon_p')$.That is, the disturbance terms of different equations are mutually correlated.

When ordinary least squares is applied to each equation, unbiased and consistent estimators are obtaineble,the only problem is the efficiency of the estimators, because the mutual disturbances must be taken into account. Therefore, the system is redefined as follows:

$$Y_M = X_1^{(m)} \beta_1 + X_2^{(m)} \beta_2 \quad + X_M^{(m)} \beta_M + \varepsilon_M$$

where $X_p^{(m)} = X_p$ if $m=p$

$= 0$ if $m \neq p$

so, each equation contains the same number of explanatory variables.This is the case of pooled time series cross sectional observations on a single equation.The BLUE of the model is given by Aitken's GLS formula:

$$\hat{\beta} = (X'\Omega^{-1} X)^{-1} X'\Omega^{-1} Y$$

There are two special cases under which the we can use OLS to estimate the coefficients of SUR, that is GLS and OLS estimators are identical. First, although it is thought that the equations are seemingly unrelated, they are actually unrelated. That is $\sigma_{mp}=0$. Secondly, if the regression equation contain the same number of explanatory variables, GLS and OLS give identical results.

Since three demand functions are being estimated and a mutual correlation among the disturbance terms of each equation is expected, the regression equations are estimated by Seemingly

Unrelated Regression Estimation Method. In this case GLS and OLS gives identical results, because there is same number of explanatory variables in each equation.

In this study, demand equations are specified in double logarithmic form. One attractive feature of the double logarithmic form is that, the regression coefficients give the elasticities. But at the same time this form has some restrictive implications. According to Chang(1977) logarithmic form implies that the income and price elasticities are constant at any level of income and prices.Such an implication might be too restrictive if the variation in in income and price is large. But, the data shows no large variation neither in income nor in prices.

3.3.3. Imposition of The Restrictions

The important problem facing the empirical analysts of demand relations is that whether the demand equations satisfy the classical theory of utility maximization. Byron(1970), states that "The postulates of consumer demand theory are developed for the individual, but are generally assumed hold in aggregate.The least that can be said is that the postulates of classical demand theory provide useful working hypothesis which can be used for point estimation".

In this study,the homogeneity and symmetry restrictions are imposed. The homogeneity condition implies that if all prices and income is multiplied by some positive constant, budget set will not be changed, and thus the optimal choice will not change (Varian 1984). The homogeneity condition implying that the consumer faces no money illusion can be written as:

$$\sum_{j=1}^{m} \varepsilon_{ij} + \delta_i = 0 \quad \text{...(3.3.3.1)}$$

where ε_{ij} is the elasticity of demand for good i with respect to the price of j^{th} commodity and δ_i is the income elasticity of the i^{th} commodity.

The symmetry condition is expressed as :

$$(\varepsilon_{ij} / w_j) + \delta_i = (\varepsilon_{ji} / w_i) + \delta_j \quad \text{.....................(3.3.3.2)}$$

where w_i is the income share of the i^{th} commodity.

The symmetrical terms are sometimes referred as the Hicks-Allen elasticities of substitution:

$$\sigma_{ij} = \varepsilon_{ij} + w_j\delta_i = \varepsilon_{ji} + w_i\delta_j = \sigma_{ji}$$

Where σ_{ji} terms are income compare price elasticities $w_j = \frac{P_jQ_j}{Y}$ is the income share of the j^{th}.

The σ_{ij} terms are equivalent to income compensated price elastic. all of these σ_{ij}can be written as the elements of a matrix

$$\sigma_{ij} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & . & . & \sigma_{1m} \\ \sigma_{21} & \sigma_{22} & . & . & \sigma_{2m} \\ . & . & . & . & . \\ . & . & . & . & . \\ \sigma_{m1} & \sigma_{m2} & . & . & \sigma_{mm} \end{bmatrix} \quad \text{..........................(3.3.3.3)}$$

which is called the substitution matrix.

"The symmetry restrictions require that the matrix (σ_{ij}) be symmetrical, the conditions to ensure that utility is maximized rather than attaining some other type of stationary value require that (σ_{ij}) be a matrix of a negative semi definite quadratic form" (Court 1967).

Such restrictions are valid for any well behaved utility function. The imposition restrictions in elasticity form implies a form of isometry on the indifference curves. If the above hypotheses are rejected it may be a can sequence of a number of reason quite apart form incorrect prior information.

3.3.4. Test For Structural Change

As it is mentioned in the previous section, a structural change may occur due changes in intercept or slope terms, or due to changes in all coefficients of the estimated model. But we want to test for structural change, it would be more meaningful to test the hypothesis that whether there is a change in all of the coefficients. In order to test the structural change hypothesis, Chow Test is utilized.

Let, there be two sets of data sizes n_1 and n_2 and the regression equation is

$$Y = \alpha_1^1 + \beta_1^1 X_1 + \beta_2^1 X_2 + \ldots\ldots + \beta_K^1 X_K + u \quad \text{for the first set} \ \ldots.(3.3.4.1)$$

$$Y = \alpha_1^2 + \beta_1^2 X_1 + \beta_2^2 X_2 + \ldots\ldots + \beta_K^2 X_K + u \quad \text{for the second set} \ \ldots(3.3.4.2)$$

which are the unrestricted equations.

The null hypothesis of no structural change is set up as

$$\alpha 1 = \alpha_1^1, \quad \beta_1^1 = \beta_1^2, \quad \ldots.., \quad \beta_k^1 = \beta_k^2$$

If the null hypothesis is true, the restricted system is

$$Y = \alpha + \beta_1 X_1 + \ldots\ldots. + \beta_k X_k + u \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.3.4.3)$$

for the entire time period.

In order to get to unrestricted residual sum of squares the equations (3.3.4.1) and (3.3.4.2)are estimated, residual sum of squares are got, then added. This has a degrees of freedom $(n_1-k-1) + (n_2-k-1) =(n_1 +n_2 -2k-2)$. To obtain the restricted sum of squares, the data is pooled and the equation (3.3.4.3) is estimated, which has a degrees of freedom ($n_1 + n_2 - 2k - 2$). Then the F test is applied:

$$F = \frac{(RRSS - URSS)/k-1}{URSS \,/\, (n_1 + n_2 - 2k - 2)}$$

where RRSS is the sum of squares of restricted model

URSS " " " " " unrestricted model.

4. RESULTS OF THE STUDY

In this study, demand functions for three meat items, which are mutton beef and poultry are estimated by seemingly, unrelated regression based on data from 1989 to 1989 for fourteen provinces. Classical demand theory, requires both homogeneity and symmetry restrictions imposed and tested when estimating the demand equations. However, these restrictions are imposed individually, instead of imposing them together. Because if they were imposed together both of them may be accepted, although one has to be rejected. Such a misleading result may come from the fact that, one restriction may be so strong that although the other one has to be rejected both of them are accepted. Therefore, three models are estimated. In the first two models homogeneity and symmetry restrictions are imposed individually. In the third one both of the restrictions are imposed.

The three demand functions are specified as follows:

$$\ln Q_{it} = \ln_{io} + B_{ij} \ln_j + P_j + \alpha_i \ln Y_t$$

where i stands for mutton, beef and poultry

Q_i : the consumption of mutton beef and poultry in each of the equations respectively

P_j : the prices of mutton beef poultry and other prices which is measured by a price index.

Y_t : the income of each province.

4.4.1 Model 1: Homogeneity Restriction Imposed

In this model only the homogeneity restriction is imposed which is

$$\sum \beta_{ij} + \delta_i = 0$$

The regression results of model is given in Table 1.
When the signs of the coefficients are analyzed, it can be seen that the own price elasticities of mutton and beef are negative as expected. That is when there is an increase in prices, quantity demanded of these goods falls. However, the own price elasticity of poultry is positive contrary to our expectations. It was expected that when there is a decrease in poultry price, its quantity demanded falls, so a negative own price elasticity was expected. When the cross price elasticities are examined,it can be seen that all cross-price elasticities in mutton equation have positive signs as expected indicating a substitution among the three meat items. But when poultry and beef equations are analyzed, it can be seen that there is a complementarity between beef and poultry. Since beef and poultry are thought as substitutes, a decrease in demand for poultry when there is an increase in beef price is contrary to our expectations. As there is an increase in price of one commodity, people will shift their consumption from the expensive commodity to its cheaper substitutes. Furthermore, as price increases the real income of the consumer falls. Therefore, as price of the commodity increases the quantity demanded of that commodity falls.

When the t-statistics are examined, it can be seen that in mutton equation all of the coefficients except the coefficient of the price index variable are significantly different from zero at 10% level of significance. In beef equation only intercept and the coefficient of income is significant. In the poultry equation only the coefficients of price index and income are significant.

The test statistics X^2 with 3 degrees of freedom is 23.53 which is greater than the critical X^2=16.26 implying the rejection of the homogeneity restriction. If the joint significance of the coefficients are tested, an F test must be utilized for each of the equations. The null hypothesis is:

$H_0 = \beta_0 = \beta_1 = \beta_2 = \ldots\ldots = \beta_N = 0$

The F statistic to be computed is

$$F = \frac{R^2}{1-R^2} \cdot \frac{NT - (T+N+K-1)}{P}$$

where R^2 is the coefficient of determination

P number of restrictions

N " " observations

k " explanatory variables

T time period.

The computed F statistics are given in tables. The critical F ratio is $F^{0.05}_{6,125}$=2.17. Since, the computed F ratios are greater than the critical F value in all equations, implying that all equations are wholly significantly different from zero.

4.4.2 Model 2: Symmetry Restriction Imposed

In this model only the symmetry restriction is imposed. The coefficient estimates of this model is presented in Table 2. When the equations are analyzed, it can be seen that all of the coefficients except that of price index and price of poultry are significantly different from zero at 5% level of significance. The own price elasticity of mutton is negative as expected.

TABLE 1: REGRESSION RESULTS WITH HOMOGENEITY RESTRICTION IMPOSED.

independent var. / depen. var.	cons.	prices of mutton	prices of beef	prices of poultry	price index	income	R^2	F
MUTTON	-8.281 (-4.88)	-5.762 (-6.577)	3.263 (4.01)	0.887 (1.94)	0.550 (1.09)	1.06 (9.22)	0.516	22.27
BEEF	-2.165 (-1.85)	0.0075 (0.012)	-0.797 (-1.42)	-0.229 (0.72)	0.357 (1.02)	0.661 (8.33)	0.384	12.96
POULT.	-1.13 (-1.28)	-0.641 (-1.40)	0.611 (1.44)	-0.061 (-0.25)	0.483 (1.84)	0.573 (9.6)	0.54	25.11

Notes: CHI-SQUARE(3)=23.53
Values in the parenthesis are the *t* ratios.

TABLE 2: REGRESSION RESULTS WITH SYMMETRY RESTRICTION IMPOSED.

independent. var. / depen. var.	cons.	prices of mutton	prices of beef	prices of poultry	price index	income	R^2	F
MUTTON	-8.05 (-5.14)	-3.65 (-6.0)	1.61 (4.1)	-0.11 (-.37)	1.03 (1.66)	1.05 (9.66)	0.48	19.95
BEEF	-3.38 (-2.93)	1.62 (4.11)	-1.62 (-3.92)	0.39 (1.52)	-0.71 (-1.67)	0.62 (7.93)	0.43	15.69
POULT.	-1.06 (-1.17)	-0.111 (-0.37)	0.39 (1.52)	-0.087 (-0.27)	-0.70 (-2.1)	0.55 (9.61)	0.54	24.8

Notes: CHI-SQUARE(3)=11.49
Values in the parenthesis are the *t* ratios.

Furthermore, the cross price elasticity with respect to poultry is negative implying a complemantarity. Other cross-price elasticities are of expected sign. The income elasticity is also positive and about unity; that is when there is one per cent increase in income, demand for meat also increases by one per cent.

In beef equations, all coefficients except the price index and price of poultry are significantly different from zero at 5% level of significance. All of the coefficients except the coefficient of price index have the expected signs .

In poultry equation, the coefficients of beef and poultry price and income have the correct signs. However, the coefficient of the mutton price is insignificant and is negative indicating a complementarity. The income and price index coefficients are significant.

When the joint significance of the coefficients are tested,it can be seen that in all equations the computed F ratios are greater than the critical $F^{0.05}_{6,125}=2.17$, that is all equations are jointly significant.

The test statistic for the restrictions is $X^{2}_{3}=11.49$ is smaller than the critical value implying the acceptance of the symmetry restriction.

4.4.3 Model 3: Homogeneity and Symmetry Restrictions Imposed

After testing for homogeneity and symmetry restrictions individually, it is possible to test both restrictions simultaneously. The estimates of the coefficients of the model is given in Table 3.

When the signs of the coefficients are analyzed, it can be seen that in mutton equation, all of the coefficients have the correct signs. In beef equation the coefficient of poultry price is negative. In poultry equation only the mutton price and income coefficients have the correct signs.

When the individual significances of each coefficient, are analyzed, it can be seen that in mutton and beef equations all of the coefficients except that of price index and price of poultry are significant. In poultry equation only income coefficient is significant.

If the joint significance of the coefficients are to be analyzed, it can be seen that in equations the computed F ratios are greater than the critical $F^{0.05}_{6,125}=2.17$. Therefore, all equations are wholly significant at 5% level of significance.

On the other hand, the test statistic for the restrictions is $X^{2}_{6}=40.2$ which is greater than the critical value. Therefore, the homogeneity and symmetry restrictions are rejected, implying that there may be other factors other than utility maximization for the explanation of the aggregate demand.

When the significance of the price index coefficient is analyzed, it can be seen that it is not significantly different from zero at 5% level of significance in all of the equations.The percentage changes in income and price index coefficients tend to move together.This may lead to possible multicollinearity problems. In order to avoid this problem, the model is reestimated without the price index variable. The regression results of the model is given in Table 4.

TABLE 3: REGRESSION RESULTS WITH HOMOGENEITY and SYMMETRY RESTRICTIONS IMPOSED.

independent var. / depen var.	cons.	prices of mutton	prices of beef	prices of poultry	price index	income	R^2	F
MUTTON	-9.02 (-5.8)	-3.40 (-6.43)	1.05 (2.9)	0.36 (1.42)	0.89 (1.83)	1.09 (10.6)	0.486	19.73
BEEF	-2.44 (-2.14)	1.05 (2.9)	-1.77 (-4.3)	-0.32 (-1.49)	0.37 (1.07)	0.67 (8.87)	0.370	12.2
POULT.	-1.42 (-1.73)	0.36 (1.42)	-0.32 (-1.5)	-0.23 (-1.07)	-0.38 (-1.63)	0.58 (10.5)	0.528	23.26

Notes: CHI-SQUARE(3)=40.2033
Values in the parenthesis are the *t* ratios.

TABLE 4: REGRESSION RESULTS WITH HOMOGENEITY and SYMMETRY RESTRICTIONS IMPOSED and PRICE INDEX VARIABLE DROPPED.

independent var. / depen var.	cons.	prices of mutton	prices of beef	prices of poultry	income	R^2	F
MUTTON	-8.57 (-4.83)	-5.56 (-6.56)	3.37 (4.39)	1.26 (2.22)	1.039 (9.63)	0.51	26.97
BEEF	-3.99 (-3.22)	0.061 (0.104)	-1.157 (-2.15)	0.64 (1.63)	0.697 (9.20)	0.43	19.3
POULT.	-1.39 (-1.49)	-0.841 (-1.89)	0.38 (0.94)	-0.19 (-0.64)	0.607 (10.74)	0.539	29.46

Notes: CHI-SQUARE(6)=49.50
Values in the parenthesis are the *t* ratios.

If the regression results are analyzed, it can be seen that in mutton and beef equations all of the coefficients are significant and they all have the correct signs. In poultry equation only the coefficients of income and mutton price are significant.

In order to test for the joint significance of the coefficients, the respective F are computed, shown in Table 4, and compared with the the critical value of $F^{0.05}_{5,125}=2.17$,it can be seen that , they are greater than the critical value. Therefore all of the equations are significant.

When the restrictions are tested,it can be seen that since the computed $X^2_6=49.5$ is greater than the critical value, the restrictions are rejected.

When the data of consumptions of mutton, poultry and beef are analyzed,it can be seen that until 1985 the consumption levels are somewhat stationary. However, in 1985 there is a peak in the consumption levels in most of the provinces. This may be due to changes in consumption behaviours. Until early 1980s, mutton and beef are consumed in general. Poultry is consumed in rural areas. But in early 1980s , packed chickens introduced to the market and poultry consumption increased. Therefore, a structural change is expected between these two periods. In order to test for the structural change, Chow Test is utilised.Two regressions are run, one for the time period 1979-1984; the other for the time period 1985-1989.These are the unrestricted regressions. The restricted regression is run for the time period 1979-1989.

The coefficient estimates of the regression equation for the first time period is given in Table 5. As it can be seen from the table all of the coefficients of the mutton and beef equations have the correct signs. In mutton equation all of the coefficients are significant. In beef equation only the coefficients of mutton and beef price are not significant.In poultry equation, the mutton price coefficient is negative indicating a complementarity between mutton and poultry.

When the restrictions are tested, it can be see that both restrictions are rejected at 10% level of significance. The computed X^2_6 =24.125 is smaller than the critical X^2_6=22.45.

The coefficient estimates of the regression equations for the time period 1985-1989 are given in Table 6. As it can be seen from the table only the coefficient of poultry price has the wrong sign and it is the only insignificant coefficient in mutton equation. In beef equation all of the coefficients have the correct signs. Only the coefficient of income is significantly different from zero. In poultry equation, the coefficient of mutton price is negative and only the income coefficient is significant.

When the restrictions are tested, it can be seen that the computed X^2_6=49.46 which is greater than the critical X^2_6=22.45 implying that the restrictions are rejected.

The restricted regression estimates of the Chow Test are given in Table 4 and explained in section 4.3.3.

TABLE 5: REGRESSION RESULTS FOR THE TIME PERIOD 1979-1984

independent var. / depen. var.	cons.	prices of mutton	beef	poultry	income	R^2	RSS
MUTTON	-13.03 (-4.78)	-5.62 (-4.27)	2.16 (1.95)	2.48 (2.77)	1.27 (6.97)	0.49	97.06
BEEF	-5.99 (-3.33)	0.14 (0.165)	-1.50 (-2.06)	0.73 (1.24)	0.84 (6.96)	0.47	42.23
POULT.	-2.41 (-1.97)	-1.07 (-1.81)	1.79 (1.60)	-0.25 (-0.63)	0.62 (7.59)	0.61	19.59

Notes: CHI-SQUARE(6)=24.125
Values in the parenthesis are the *t* ratios.

TABLE 6: REGRESSION RESULTS FOR THE TIME PERIOD 1985-1989

independent var. / depen. var.	cons.	prices of mutton	beef	poultry	income	R^2	RSS
MUTTON	-3.88 (-1.68)	-5.97 (-5.77)	5.21 (5.28)	-0.17 (-0.24)	0.803 (6.47)	0.61	50.13
BEEF	-3.92 (-2.20)	0.183 (0.229)	-0.714 (-0.93)	-0.465 (-0.85)	0.556 (5.79)	0.429	29.99
POULT.	-1.10 (-0.72)	-0.29 (-0.42)	0.08 (0.12)	-0.314 (-0.68)	0.54 (6.71)	0.49	21.69

Notes: CHI-SQUARE(6)=49.46
Values in the parenthesis are the *t* ratios.

The Chow Tests for each equation are performed in Table 7.As it can be seen from the table, the computed F ratio of the mutton equation exceeds the critical value is $F^{0.25}_{5,109}=1.35$. Therefore, it can be seen that there is a structural change between these two periods in mutton equation. However, the computed F ratios of poultry and beef equations are smaller than the critical F ratio implying that there is no structural change for the beef and poultry equations.

TABLE 7: CHOW TEST					
equation	URSS	RRSS	DF	F	$F^{0.25}_{5,109}$
MUTTON	147.19	156.52	109	1.40	1.35
BEEF	72.22	76.48	109	1.29	1.35
POULTRY	41.20	42.94	109	0.91	1.35

4.CONCLUSION

This study investigates the structure of the Turkish Meat Demand and tests for any structural change between the periods (1979-1984) and (1985-1989) due to changes in consumer behaviuor.

In the first part of the study, three demand functions are estimated for the meat items mutton, beef and poultry. Since the classical demand theory requires any demand function to satisfy the homogeneity and symmetry restrictions, they are imposed in the demand equations. In the first model, only the homogeneity restriction is imposed and tested. But, it is found that the demand equations do not satisfy the homogeneity restriction. In the second model, only symmetry restriction is imposed and tested it is found that the symmetry restriction is accepted. That is the demand functions satisfy the symmetry restriction. In the third model, both of the restrictions are imposed together. However, the demand functions failed to satisfy both of the restrictions.

In each model individual and joint significances and the signs of the coefficients are examined.It is found that, the coefficient of the price index variable in each equation is insignificant. Furthermore the inclusion of the income and price index variables together may lead to some multicollinearity problems. Therefore, the price index variable is excluded and the model is reestimated with symmetry and homogeneity restrictions imposed.

In the reestimated model, all income and own price elasticities have the correct signs and they are significantly different from zero, that is the income elasticities are positive indicating that meat is a normal good. Own price elasticities are negative indicating that when there is an increase in the price of meat item, its quantity demanded will fall. When the signs of the cross price elasticities are examined,it is found surprisingly that there is a complementarity between mutton and poultry.

It is found that the income elasticity of mutton is greater than the other two elasticities implying that demand for mutton is more sensitive to changes in income than demands for beef and poultry. If there is an increase in consumers' income, the increase in mutton demand will be greater than the increase in demands for poultry and beef. Furthermore, the own price elasticity of mutton is the highest when compared to other own price elasticities. Similarly, in beef and poultry equations also the own price elasticities are higher than the cross price elasticities. Therefore, it can be seen that the demand for each meat item is affected mostly by income and its own price.

So, if government wants to increase meat consumption, an incresae in incomes of the consumers will strongly be reflected by increased demand for meat items. One per cent increase in income causes approximately one per centin mutton demand; the increases in beef and poultry demands are 0.67% and 0.58% , respectively.

In the second part of the study, a test for structural change in demand equations is conducted, between the two time periods. It is found that there is a structural change between these two periods for mutton equation. But there is not any structural change for the beef and poultry equations. That is the assumption about changes in consumer preferences reflected in the mutton equation.

It is found that the demand equations of the Turkish meat market satisfy only the symmetry restriction. Since homogeneity and symmetry restrictions are necessary for the utility maximization , the demand equations were expected to satisfy both of the restrictions. However, rejection of the homogeneity restriction should not be interpreted as individual demand theory is empirically irrelevant when used for the explanation of aggregate demand. There may be a number of reasons for rejection of the restrictions such as absence of dynamic elements, adjustment lags.

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