MEAT AND FISH DEMAND IN TUNISIA : ECONOMIC AND SOCIO-DEMOGRAPHIC FACTORS EFFECTS

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Abstract

The aim of the paper is to analyze the impact of socio-economic and demographic variables on the demand for meat and fish for Tunisian consumers. This study is one of the first applications in Tunisia with respect to the demand for meat and fish that simultaneously covers two important aspects: the non-imposition of, a priori, a functional form and the use of cross-section data including demographic and socioeconomic variables. The main results show that meat and fish consumption patterns by age, level of income and level of education are relatively different as regards to the economic factors (food expenditure and price). The changes in demographic and economic characteristics are influencing the changes in meat and fish demand.

Keywords: meat and fish demand, food demand systems, synthetic model, economic and socio-demographic factors.

1. INTRODUCTION

Tunisia is a Mediterranean country and has for a long time food culinary traditions near to the "Mediterranean diet". The Tunisian diet was characterized in 2005 by important consumption of cereals (183 kg/person/year), fruits and vegetables (148 kg/person/year) and milk (54 kg/person/year). The consumption of meat, poultry and fish is about 36 kg/person/year accounting for only 5,8% of the total food products consumed in 2005 (National Institute of Statistics, 2005). The structure of the consumption of meat and fish has undergone a significant evolution over the past two decades. Between 1990 and 2005, consumption of poultry and fish grew remarkably respectively by 80% and 32%. Sheep meat consumption increased by 24% and beef has decreased by 21% over the same period. Concerning the expenditures, they have more than doubled for mutton (102%) and poultry (143%) and especially fish (206%). The remarkable increase in fish expenditure reflects the new consumption patterns of the Tunisian consumer. Beef expenditures increased by almost 50% despite the drop in its consumption due to the increase in the price of meat (INS, 2005). These changes reflect the change in food habits of the Tunisian consumer. Since 1990's, food demand has had significant changes related particularly to urbanization process; new lifestyles; industrialization of food sectors; woman work; the emergence of modern retail and increasing health and nutrition concerns. Food habits are changing rapidly with the new sociodemographic characteristics of the Tunisian population. Indeed, age, income level and education level are thus important factors in purchasing decisions in a country where 55% of the population has an age lower than 30 years in 2005 and whose education and income is improving day by day.

The literature on demand analysis of meat and fish is very diverse (Alston and Chalfant, 1991; Capps and Schmitz, 1991; Brester and Wohlgenant, 1993; Gracia and Albisu, 1998; Wilson and al, 2005; Jabarin, 2005; Taljaard and al, 2006). From a methodological point of view, most of the mentioned researches suffer from some stiffness in two ways: On the one hand, they impose a priori a particular functional form for demand equations (Almost Ideal Demand System, Rotterdam, CBS, GADS, etc.), without testing whether an alternative model might better fit the data; on the other hand, these works only consider one dimension of the data (time series). Considering a cross section dimension would substantially improve the precision of the estimates of the parameters of the models, although we must recognize the difficulty of conducting such studies in Tunisia due to the lack of information to build a real cross section at a national level.

In Tunisia, the analysis of the meat and fish consumption was the subject of several studies using national and international statistics data bases (Ben Kaabia and al, 2000; Dhehibi and al, 1999, 2001, 2003). Other studies have examined the consumption of meat and fish in a global framework of food demand (Dhehibi and al, 2003; Laajimi and al, 2003). However, few studies have been based on cross-sections (Abdesslem, 1990; Khaldi and al, 2008) introducing economic factors (price, income) and socio-demographic factors (age, education, residence).

The objective of this study is to determine the impact of socio-economic and demographic variables on the demand for beef, mutton, chicken, turkey and fish for Tunisian consumers using cross section data and different functional forms for food consumer’s models.

The paper is organized as follows: Section 2 develops the empirical model and the estimation procedure. Results and discussion are presented in Section 3. Finally, section 4 outlines the conclusion and policy implications drawn from this study.

2. METHODOLOGICAL FRAMEWORK

2.1. Theoretical Model

Classical demand theory considers the behaviour of an individual consumer who wishes to maximise its utility function, subject to a budget constraint:

$$\text{Max. } u(\mathbf{q}) = u(q_1, q_2, \ldots\ldots, q_n)$$

$$\text{S.a} \qquad \sum_{i=1}^{n} p_i q_i = m \qquad\qquad i=1, \ldots\ldots\ldots,n \qquad (1)$$

Where u is utility; $q_{i,}$ $p_{i,}$ are quantity and price for food i respectively; and m is the total expenditure or income.

The demand equations satisfying (1) have the general form:

$$q_i = f_i(m, p_1 \ldots\ldots\ldots p_n) \qquad (2)$$

Classical demand theory implies several restrictions on (2) which may be expressed in terms of elasticities and these are, in turn, the derivatives of the logarithmic version of (2). The logarithmic differential of (2) is

$$d \ln q_i = \eta_i d \ln m + \sum_{j=1}^{n} \mu_{ij} d \ln p_j \qquad (3)$$

Where η_i is the income elasticity of demand for good i, and μ_{ii} is the uncompensated, own-price elasticity, while the μ_{ij} *(i≠j)* are the cross-price elasticities.

Many early empirical demand studies approximated the demand equations (2) by double-logarithmic specifications with constant elasticities. Whilst demand systems based on this specification could fit the data quite well and yield plausible estimates of the elasticities, they are not well suited to the task of investigating the restrictions of classical demand analysis. Even the adding-up restriction cannot be generally satisfied by the double-logarithmic specification (Deaton and Muellbauer, 1980 and Barten, 1993).

Rotterdam System - ROT

The Rotterdam model was developed by Theil (1965). He replaced μ_{ij} by e_{ij} in the logarithmic differential equation (3), using the compensated price elasticities:

$$d \ln q_i = \eta_i (d \ln m - \sum_{j=1}^{n} w_j d \ln p_j) + \sum_{j=1}^{n} e_{ij} d \ln p_j \qquad (4)$$

Then he multiplied both sides through by w_i to obtain

$$w_i d \ln q_i = b_i (d \ln m - \sum_{j=1}^{n} w_j d \ln p_j) + \sum_{j=1}^{n} s_{ij} d \ln p_j \qquad (5)$$

Next, the marginal shares $b_i = w_i \eta_i$ and the Slutsky coefficients $s_{ij} = w_i e_{ij}$ were treated as constants.

The first term in brackets in (5) can be interpreted as the change in one particular logarithmic measure of real income $d\ln Q$ = $d\ln(m/P)$ where $d\ln P = \sum_{j=1}^{n} w_j d\ln p_j$ is the Divisia price index. There is another equivalent way of calculating the real income term by considering the logarithmic differential of the ith budget share:

$$d\ln w_i = d\ln p_i + d\ln q_i - w_i \ln m \tag{6}$$

Then we multiply both sides through by w_i :

$$w_i d\ln w_i = dw_i = w_i d\ln p_i + w_i d\ln q_i - d\ln m \tag{7}$$

Sum (7) over all i:

$$\sum_{i=1}^{n} dw_i = 0 = \sum_{i=1}^{n} w_i d\ln p_i + \sum_{i=1}^{n} w_i d\ln q_i - d\ln m \tag{8}$$

Therefore,

$$d\ln m - \sum_{i=1}^{n} w_i d\ln p_i = \sum_{i=1}^{n} w_i d\ln q_i = d\ln Q \tag{9}$$

And the real income term $d\ln Q = \sum_{i=1}^{n} w_i d\ln q_i$ is recognised as the Divisia quantity index for the change in real income. With this definition, the Rotterdam model may be rewritten as:

$$w_i d\ln q_i = b_i d\ln Q + \sum_{j=1}^{n} s_{ij} d\ln p_j \tag{10}$$

Almost Ideal Demand System - AIDS

The next model considered in this work is the Almost Ideal Demand (AID) system of Deaton and Muellbauer (1980) which can be written in terms of levels of variables as follows:

$$w_i = d_i + c_i(\ln m - \ln P^*) + \sum_{j=1}^{n} r_{ij} \ln p_j \tag{11}$$

Where

$$\ln P^* = \alpha_0 + \sum_{k=1}^{n} d_k \ln p_k + \tfrac{1}{2}\sum_{k=1}^{n} \sum_{j=1}^{n} r_{kj} \ln p_k \ln p_j \tag{12}$$

An approximation for (12) is provided by Stone’s index:

$$\ln P^* = \sum_{j=1}^{n} w_j \ln p_k \tag{13}$$

Then with (13) substituted into (11), we have the AIDS system in levels:

$$w_i = d_i + c_i(\ln m - \sum_{j=1}^{n} w_j \ln p_j) + \sum_{j=1}^{n} r_{ij} \ln p_j \tag{14}$$

The differential version of (14) can be written as follows; we add a constant γ_i to each equation to represent autonomous trends in demand:

$$dw_i = \gamma_i + c_i d \ln Q + \sum_{j=1}^{n} r_{ij} d \ln p_j \tag{15}$$

This model is very similar on the right-hand side to the Rotterdam model equation (10), although the dependent variables are different. The AIDS model explains the change in the budget share of each good, whilst the Rotterdam model considers the behaviour of only the quantity component, $w_i d\ln q_i$, of the budget share change (the price and total expenditure components are treated as exogenous).

The similarity of the AIDS model (15) and the Rotterdam model (10) causes the coefficients of the two models to be linked in the following ways. If we replace $w_i d\ln q_i$ in (7) by the right-hand side of the Rotterdam model (10), and replace $d\ln m$ by $d \ln Q + \sum_{j=1}^{n} w_j d \ln p_j$, we obtain:

$$dw_i = (b_i - w_i) d \ln Q + \sum_{j=1}^{n} \left(s_{ij} + w_i \delta_{ij} - w_i w_j \right) d \ln p_j \tag{16}$$

Where δ_{ij} =1 if i=j, 0 otherwise.

Equation (16) is identical in form to the AIDS model (15), and this comparison reveals, therefore, that the AIDS and Rotterdam coefficients are linked through the following relationships:

$$c_i = b_i - w_i \tag{17}$$

$$r_{ij} = s_{ij} + w_i \delta_{ij} - w_i w_j \tag{18}$$

The budget shares are variable in both the AID and Rotterdam models. The two systems are comparable, but they differ in what they assume to be constant. The Rotterdam model treats b_i *and* s_{ij} as constant. Equation (17) shows that, in the AIDS parameterisation, it is the differences between the marginal and actual budget shares, b_i and w_i , respectively, which are treated as constant over the sample period. The AIDS price terms, as defined in (18) and assumed to be constant, involve another set of implicit relationships between the s_{ij} and the actual budget shares.

CBS System[1]

Keller and Van Driel (1985) at the Dutch Central Bureau of Statistics (CBS) developed the third system. This model is a blend of elements from the AIDS and Rotterdam systems: it has the AIDS income coefficients c_i and the Rotterdam price coefficients s_{ij} . It is formed by replacing b_i in (10) by c_i+w_i and subtracting $w_i d\ln Q$ from both sides. The CBS system can be written as:

$$w_i(d\ln q_i - d\ln Q) = \gamma_i + c_i d\ln Q + \sum_{j=1}^{n} s_{ij} d\ln p_j \qquad (19)$$

In this case, the dependent variable is the (w_i-weighted) deviation of the log change in q_i from the (w_i-weighted) average log change in the quantities of all n goods. That is, the left-hand side is the weighted change in the volume share, q_i/Q, of the ith product.

NBR System[2]

Neves (1994) developed the fourth system: the NBR model which is another hybrid system because it has the Rotterdam income coefficients and the AIDS price coefficients. If we replace c_i in the AIDS system (15) by b_i-w_i and move $w_i dlnQ$ over to the left-hand side, we obtain the NBR system:

$$dw_i + w_i d\ln Q = \gamma_i + b_i d\ln Q + \sum_{j=1}^{n} r_{ij} d\ln p_j \qquad (20)$$

2.2. Data, price quality issues and estimation procedure

<u>Data</u>

This study is based on data from a survey conducted during the year 2008 among a sample of 504 heads of households distributed equally among all governorates. The survey was conducted in the central city of each governorate in order to have maximum representation of income groups of interviewees.

According to the gender, the sample is composed predominantly of men (90.67%). Moreover, about 92.46% of the interviewed are married. Heads of household assets are 99.60% for males and 46.03% for women. The variable "age" permits to divide the sample into five categories

[1] CBS: Central Bureau Voor de Statistiek, the Dutch name of Statistics Netherlands.

[2] The model was named in the Netherlands Central Bureau of Statistics and the National Bureau of Research where Neves worked when the model was developed.

with prevalence for the age group between 40 and 50 (42.06%). The education level has two dominant levels: high school and the upper level representing respectively 41.67% and 34.13% of the sample. The variable income is distributed among different income classes retained, with the exception of the class of less than 143 $ which is considered as the poorest class corresponding to households whose wage is below the minimum wage required, which represents only 3.17 % of the sample. (Table 1).

Price Quality Issue

Data are collected only for quantities and expenditure of beef, poultry and fish[1]. Prices are not recorded. For this reason, unit values for each product are calculated by dividing expenditure by quantities. These values reflect not only spatial variations caused by supply shocks (i.e., transportation costs, seasonal variations, etc.) but also differences in quality which can be attributed to marketing services among other factors (Cox and Wohlgenant, 1986). In order to calculate prices for each product, unit values must be adjusted before using them in demand analysis (Deaton, 1989). Following Gao et al. (1997), the quality-adjusted price can be defined as the difference between the unit price and the expected price, given its specific quality characteristics[2]. The expected price is calculated by a hedonic price function defined as:

$$P_k = \vartheta_k + \sum_s \iota_s \, K_{ks} + \varepsilon_k \qquad (21)$$

where P_k is the unit value and K_{ks} are variables affecting the consumer choice of qualities, such as income and household characteristics, which are used as proxies for household preferences for unobservable quality characteristics.

Finally and because they reflect systematic supply variations, regional variables have not been included. Nevertheless, their average effects are reflected by the intercept ϑ_k. Finally, the quality-adjusted price is then defined by:

$$P_k^{'} = P_k - \sum_s \hat{\iota}_s \, K_{ks} = \hat{\vartheta}_k + \hat{\varepsilon}_k \qquad (22)$$

[1] This survey considers blue fish (mackerels, sardines) whose price does not exceed 3.5 $/kg.

[2] In the case where unit values do not exist as households, they have been estimated from a regression of the observed unit values of households which actually buy the product on dummy variables reflecting household characteristics such as region and income. Estimated parameters are then used to predict unit values for a specific household.

Estimation Procedure

The Rotterdam, CBS, AIDS, and NBR models are defined in a differential form. In order to arrive to estimable equations they have to be converted to finite changes. However, for estimation we need to work with finite change and follow the usual practice of approximating w_{it}, $dlnp_{it}$ and $dlnq_{it}$ for $\frac{(w_{it}+w_{it-1})}{2}$, $\ln\frac{p_{it}}{p_{i,t-1}}$ and $\ln\frac{q_{it}}{q_{i,t-1}}$, respectively, where subscript t indicates time.

The four empirical models have been estimated using the Full Information Maximum Likelihood (FIML) procedure in the TSP4.4 program. The "fish" equation was deleted to avoid singularity of the variance and covariance matrix of residuals due to the adding-up restriction. Restrictions imposed by economic theory (homogeneity and symmetry) were imposed in each model in order to obtain results consistent with the economic theory.

2.3. Empirical Model

The four competing demand systems (10, 16, 19 and 20) are not nested. To asses and compare the empirical performance of each of the four conditional systems, we employed Barten's (1993) non-nested testing procedure. However, the synthetic model nests all demand systems:

$$\mathrm{w_i}\,\mathrm{dln\,q_i} = (\delta_1 w_i + d_i)\ d\ln Q + \sum_{\mathrm{j=1}}^{\mathrm{n}} \left(e_{ij} - \delta_2 w_i(\delta_{ij} - w_j)\right) d\ln p_j \tag{23}$$

Where; $\mathrm{d_i} = \delta_1 b_i + (1-\delta_1)$; $\mathrm{e_{ij}} = \delta_2\delta_{ij} + (1-\delta_2)s_{ij}$; and δ_1 and δ_2 are additional parameters: 1) when $\delta_1 = \delta_2 = 0$, system (23) reduces to the Rotterdam. When $\delta_1 = 1$ and $\delta_2 = 0$, system (23) reduces to the CBS. When $\delta_1 = \delta_2 = 1$, system (23) reduces to the AIDS and when $\delta_1 = 0$ and $\delta_2 = 1$, system (23) reduces to the NBR.

The theoretical restrictions of adding-up, homogeneity and symmetry, implied by demand theory are satisfied by the following parametric restrictions:

Adding-up : $$\sum_{\mathrm{i=1}}^{\mathrm{k}} d_{\mathrm{i}} = 0, \quad \sum_{\mathrm{i=1}}^{\mathrm{k}} e_{\mathrm{ij}} = 0 \tag{24}$$

Homogeneity : $$\sum_{\mathrm{j=1}}^{\mathrm{k}} e_{ij} = 0 \tag{25}$$

Symmetry : $$e_{\mathrm{ij}} = e_{ji} \tag{26}$$

The negativity condition : $$\sum_{\mathrm{i=1}}^{\mathrm{k}}\sum_{j=1}^{k} \tau_i\ e_{ij}\,\tau_j \leq 0\ ,\ \forall\ \tau \tag{27}$$

Indicating that the matrix E must be negative semi-definite of rank N-1. The negativity condition implies that the eigen-values of E matrix must all be no positive. Since the rank of E is (N-1) therefore, the negative semi-definite condition requires the eigen-values to be one zero and (N-1) negatives.

Since the four systems satisfy the adding-up, homogeneity and symmetry, the second step consists on a comparison between the four competing systems. For comparison, a likelihood ratio test and Barten's (1993) test are used. The Likelihood Ratio Test (LRT) for model selection is:

$$\text{LRT} = -2\,[\,\ln L(\theta^{*}) - \ln L(\theta)] \tag{28}$$

Where θ is the vector of parameter estimates of a restricted model (Rotterdam, CBS, AIDS, and NBR) ; θ* is the vector of parameter estimates of the synthetic model; and L(.) is the log value of the likelihood function (Amemiya, 1985).

Table 2 presents the log values of the likelihood function and the corresponding statistics for model selection. In pair-wise likelihood ratio tests between the synthetic model and the four individual systems, the Rotterdam, differential AIDS, and NBR were firmly rejected by the hybrid model. The CBS system was the only system to not be rejected (at least at the 5 percent level).

To conclude, we have seen that CBS model is the best specification that fit with data aggregated over consumers. Thus, the empirical model has the following expression:

$$w_i(d\ln q_i - d\ln Q) = \gamma_i + c_i d\ln Q + \sum_{j=1}^{n} s_{ij} d\ln p_j \tag{29}$$

Where parameters are explained in the previous sections.

Moreover, applying linear restrictions on the estimated parameters homogeneity and symmetry restrictions are satisfying. The expenditure elasticity of each commodity group (η_i), the uncompensated price elasticities (E_{ij}) and the compensated price elasticities (ε_{ij}) for the CBS model are:

- Total expenditure: $$\eta_i = \frac{c_i}{w_i} + 1 \tag{30}$$

- Uncompensated price elasticities: $$E_{ij} = \frac{s_{ij}}{w_i} - \eta_i w_j \tag{31}$$

- Compensated price elasticities: $\varepsilon_{ij} = \frac{s_{\text{ij}}}{w_i}$ (32)

The negativity condition is $\sum_{\text{i}=1}^{\text{k}} \sum_{j=1}^{k} \tau_i \; s_{ij} \tau_j \leq 0 \;, \; \forall \; \tau$, indicating that the matrix S must be negative semi-definite of rank N-1. The negativity condition implies that the eigen-values of S matrix must all be no positive. Since the rank of S is (N-1) therefore, the negative semi-definite condition requires the eigen-values to be one zero and (N-1) negatives.

In this context, the negativity condition cannot be tested statistically; however, the eigen-values of the parameters matrix can be used to indicate whether, on the average level, this condition holds. The four nonzero eigen-values for the Slutsky coefficient matrix are calculated from the S matrix defined in (27). They have values of 0.042502, - 0.044305, - 0.098204, – 0.19316, respectively. The fifth eigen-value must be equal to 0. Indeed, the negativity condition is confirmed to be satisfied in the CBS model.

3. RESULTS AND DISCUSSION

Own price and expenditure elasticities for beef, mutton, poultry and fish are presented in Table 3. The expenditure has a positive and significant impact on the consumption of meat and fish. Beef and mutton are luxury goods while poultry and fish are necessity goods. All own price elasticities are negative. Nevertheless, the fish has an elasticity price which is superior to one which indicates that the demand for fish is relatively elastic. The periodicity of the consumption of fish seems to explain this expenditure elasticity compared to the other products. Beef and mutton demand is less elastic as shown by the less than one own-price elasticities in spite of the high prices of these products compared to the other. Poultry demand is inelastic to any changes in its price.

Cross price elasticities show substitutions or complementarity relations among meats and fish. Table 4 shows that all price elasticities along the diagonal of the hicksian matrix are negative. Mutton substitutes any type of meat. Beef substitutes mutton, chicken and fish. Chicken substitutes beef and mutton. Fish substitutes also mutton and chicken. Turkey does not substitute any type of meat because it was recently introduced into the culinary practices of the Tunisian consumer. Beef and Mutton are net substitutes because they are considered for a long time as essential in the traditional kitchen.

Tables 5, 6 and 7 show the most interesting results in meat and fish demand analysis: meat and fish expenditure and price elasticities differentiated by education level, age and household income. Expenditure elasticities by education level are superior to one which is considered as a "luxury product" for beef and mutton except for beef for consumers with a high level of education. Poultry and fish are necessary products except turkey bought by illiterate consumers or those having coranic or primary education. The high price of turkey compared to chicken and fish could explain the classification of this type of meat as a luxury product for this type of consumer (Table 5).

Generally, consumers with a high level of education are more concerned by health than those with a low level of education. This result explains the high quantity of fish purchased and poultry with a low level of greases. The less expenditure elasticities of chicken, turkey and especially fish for consumers with high level of education confirm this reality.

Empirical results for own price elasticities of meat and fish by level of education shown that are negative in agreement with the economic theory and lower than one. Almost all of the coefficients reported in the table are intuitively reasonable. The demand for chicken meat is less elastic than the demand of beef and mutton. Nevertheless, it is more elastic than the demand for fish. In this case, the own price elasticities for fish is low compared to the other products. This shows that the Tunisian consumers are insensitive to any changes in the price of fish. Consequently, an increase in the expenditure of fish is not the result of lower prices, but of a rise in the income and probably also because of the interest for the health by consumers.

Expenditure elasticities by age show that beef and mutton are luxury goods except beef for young consumers (age lower than 40 years). Poultry and fish are necessary goods for all types of consumers. Elasticities expenditure for beef and mutton increases with age whereas elasticities expenditure for chicken and fish decrease with age. Age is a major factor in consuming meat and fish as it integrates health dimension. This is confirmed by a high elasticity for mutton meat (1,45) and a low elasticity for fish (0,45) for the Tunisian consumers aged more than 50 years. In fact, oldest consumers decrease the consumption of the mutton meat rich in animal greases and increase the consumption of fish whose benefits are recognized (Table 6).

The own price elasticities by age are in the majority of cases significant. The demand for beef and mutton is elastic to any change in its price for the category of age between 40 and 50 years. For the others age category, this demand is relatively elastic. This variability in demand elasticity confirms the effect of age in beef and mutton consumption. The demand for fish is inelastic for the age category more than 50 years. This confirms that fish consumption is not dependent on its price but on health aspects.

Own price and expenditure elasticities by level of income are showed in Table 7. Empirical results indicate that beef and mutton are luxury goods except beef for consumers with a monthly income between 286 and 714 $. Poultry and fish are necessary goods (Table 7).

The own price elasticities by level of income are not all negative and are positive for two cases. The first case relates to turkey meat belonging to the category of consumers with an income lower than 286$. The second case concerns fish bought by the consumers having an income higher than 714$. That seems to be explained for turkey meat by the volume of purchase which is definitely lower than the volume of purchase of the other products. Indeed, the majority of the purchases of turkey meat do not exceed the half-kilo. Concerning fish which is often consumed in summer, even if its price increases, the consumed quantity increases because the periodicity of this product. Comparing to the other kind of meats (Beef, mutton, poultry), mackerels and sardines have a lower price. Even there is an augmentation in the price it has no effects on its consumption.

The demand for beef and mutton for the consumers with an income higher than 714 $ and the demand for mutton meat for the consumers with an income between 286 and 714 $ are elastic to any changes of the price. Demand elasticity for chicken meat increases with the income. In spite what it seems to be normally observed, consumers having a higher income are more sensitive to any changes in the price of chicken. In other words, they benefit from a reduction in prices of this product to increase the quantity bought.

4. CONCLUSION AND POLICIES IMPLICATIONS

In this paper we have analyzed the consumers habits of food in Tunisia, from the standpoint of the quantities consumed for meat and fish, to changes in traditional economic variables, income and prices, and certain demographic and socioeconomic variables. This research has focused on the estimation of demand systems using cross-section data, thus a synthetic system was selected giving certain restrictions on its parameters. The selection of a functional form a priori would have meant the loss of significant information.

The results in terms of elasticities are comparable with those obtained in other studies, primarily those who have used time series data although there are some differences in the expenditure and price elasticities magnitude. The aggregation of meat and fish and the characteristics of the source of information used were undoubtedly the main drivers of this work by making it difficult to compare results.

In any case, we believe that the strategy used in our research is adequate and provides greater flexibility and consistency in the estimation of demand systems for meat and fish in Tunisia, even though there is some complexity. Thus, to what extent this increased complexity can improve the above result is an open question, which is away from the objective of this research and that every reader should appreciate. In any case, any estimated model should be validated from both the economically and statistically point of view, as we have done in this study.

In this work, we tried to start a certain line of research that will complement both aspects of which had already been treated in the demand literature. Obviously, this research can be improved in the future, both from the methodological and the applied point of view. In the first case, the estimation and comparison in multi-equation systems using panel data is a field that is the subject of theoretical research, especially in regard to the development of specification tests in multivariate version. From the applied point of view, the introduction of variables other than the traditional income, prices and demographic characteristics can be determinants for meat and fish consumption in the Tunisian society. Issues such as diet quality and information about the diet-health are factors that influence the demand for theses products and therefore should be introduced in the future researches.

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Table 1. Socio-demographic statistics of the sample, N=504 (%)

Age (years)	<30	5.16
	30-40	23.21
	40-50	42.06
	50-60	22.62
	>60	6.95
Education Level	Illiterate	3.77
	Coranic school	4.56
	Primary school	15.87
	Secondary school	41.67
	Higher school	34.13
Income (per month)	< 143 $	3.17
	143-286 $	19.25
	286-429 $	24.8
	429-714 $	24.8
	714-1072 $	15.87
	> 1072 $	12.1

Source: Authors' elaboration form survey data (2008).

Table 2. Tests results for the competing demand models and the synthetic system: likelihood ratio test statistics and Goodness of fit

Demand Systems	*Maximised Log Likelihood*	*Likelihood Ratio Test: named demand system v. the 'synthetic' system.*[a]	*Goodness of Fit* R^2
Synthetic System[b]	800.82	-	0.298
ROT	703.76	194.12	0.247
CBS	799.80	2.04	0.289
AIDS	782.75	36.15	0.298
NBR	686.05	229.54	0.237

Notes: [a]. With two degrees of freedom, the critical value at the 5 percent significance level is 5.99. The 1 percent critical value is 9.21.

[b]. The estimates for δ_1 and δ_2 in (23) are 1.06 and 0.16 with standard errors 0.0686 and 0.136, respectively.

Table 3. Expenditure and own price elasticities

Products	*Elasticities*	
	Expenditures	**Prices**
Beef	1,06**	-0,66**
Mutton	1,35**	-0,88**
Chicken	0,73**	-0,39**
Turkey	0,43**	-0,26**
Fish	0,61**	-1,19**

Notes : ** significance at 5% level. * significance at 10% level.

Table 4. Cross price elasticities

Products	*Beef*	*Mutton*	*Chicken*	*Turkey*	*Fish*
Beef	**-0,42****	0,22**	0,17*	0,008	0,027
Mutton	0,14**	**-0,40****	0,09*	0,024	0,28**
Chicken	0,16**	0,14*	**-0,22****	-0,02	0,24**
Turkey	0,07	0,35**	-0,26	**-0,25***	0,25
Fish	0,61**	0,60**	0,01	0,01	**-1,09****

Notes : ** significance at 5% level. * significance at 10% level.

Table 5. Own price and expenditure elasticities by education level of the head of household

Products	*Illeterate, coranic and primary studies*		*Secondary studies*		*higher studies*	
	Expenditures	Prices	Expenditures	Prices	Expenditures	Prices
Beef	1,09**	-0,84**	1,01**	-0,39	0,98**	-0,85**
Mutton	1,33**	-0,85**	1,38**	-0,91**	1,38**	-0,97**
Chicken	0,76**	-0,18*	0,78**	-0,55**	0,68**	-0,44**
Turkey	1,10**	-0,23	0,18	-0,07	0,51*	-0,0083
Fish	0,65**	-0,12*	0,61**	-0,17**	0,52**	-0,11**

Notes : ** significance at 5% level. * significance at 10% level.

Table 6. Own Price and expenditure elasticities by age of household head

Products	*AGE1* *< 40 ans*		*AGE2* *Entre 40 et 50 ans*		*AGE3* *> 50 ans*	
	Expenditures	Prices	Expenditures	Prices	Expenditures	Prices
Beef	0,96**	-0,07	1,04**	-1,27**	1,11**	-0,53*
Mutton	1,29**	-0,64**	1,35**	-1,12**	1,45**	-0,80**
Chicken	0,86**	-0,58**	0,73**	-0,57**	0,65**	-0,04
Turkey	0,51**	-0,28	0,39	-0,32	0,30	-0,28
Fish	0,69**	-0,19**	0,60**	-0,34**	0,45**	-0,05**

Notes : ** significance at 5% level. * significance at 10% level.

Table 7. Own Price and expenditure elasticities by income

Products	*RVN1*		*RVN2*		*RVN3*	
	Expenditures	Prices	Expenditures	Prices	Expenditures	Prices
Beef	1,23**	-0,76**	0,91**	-0,38	1,15**	-1,31**
Mutton	1,21**	-0,61**	1,48**	-1,17**	1,31**	-0,85**
Chicken	0,81**	-0,29*	0,78**	-0,40**	0,52**	-0,52**
Turkey	0,67*	1,48*	0,15	-0,42**	0,31	-0,16
Fish	0,71**	-0,13**	0,45**	-0,00	0,71**	0,09**

Notes : ** significance at 5% level. * significance at 10% level.
RVN1: Monthly income <286 $, RVN2: Monthly income between 286 and 714 $, RVN3: Monthly income > 714 $.