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A MODEL OF HOUSEHOLD TYPE SPECIFIC FOOD DEMAND BEHAVIOUR IN HUNGARY

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ABSTRACT

The paper describes a two stage model of Hungarian households' food demand. Demand for the food aggregate is represented by a Working-Leser type single equation model while demand for seven distinct food types is modelled in a complete demand system using the LA/AIDS functional form. Estimation is based on household budget survey data for 1996. Demand elasticities are estimated for average households as well as for specific groups defined by sociodemographic characteristics. Fruit and vegetables are found to be the food types with most elastic demand but in general, differences between elasticities for different products as well as between different sociodemographic groups are relatively small.

JEL: D 12, C 31, C 51
Keywords: food demand, demand modelling, Hungary

ZUSAMMENFASSUNG

Das Papier beschreibt ein Modell der Nahrungsmittelnachfrage ungarischer Privathaushalte. Die Nachfrage nach dem Gesamtaggregat „Nahrungsmittel“ wird durch ein Eingleichungsmodell vom Working-Leser Typ beschrieben während die Verteilung der Nahrungsmittelausgaben auf sieben Nahrungsmitteltypen durch ein vollständiges Nachfragesystem vom Typ LA/AIDS modelliert wird. Die Datengrundlage für Parameterschätzungen entstammt den Haushaltsbudgeterhebungen des Statistischen Zentralamtes aus dem Jahr 1996. Nachfrageelastizitäten wurden sowohl für durchschnittliche Haushalte als auch für spezifische soziodemographische Bevölkerungsgruppen errechnet. Die höchsten Elastizitäten weist die Nachfrage nach Obst und nach Gemüse auf, allerdings sind die Unterschiede zwischen den Elastizitäten für verschiedene Nahrungsmitteltypen und für verschiedene Bevölkerungsgruppen relativ klein.

JEL: D 12, C 31, C 51
Schlüsselwörter: Nahrungsmittel, Nachfragemodell, Ungarn

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LIST OF ABBREVIATIONS

COMECON	Council for Mutual Economic Assistance
HCSO	Hungarian Central Statistical Office
iid	independently identically distributed
LA/AIDS	Linear Approximated Almost Ideal Demand System
NQ	Normalised Quadratic (functional form)
OLS	Ordinary Least Squares
SUR	Seemingly Unrelated Regression

LIST OF SYMBOLS

K	Number of sociodemographic variables considered
M	Number of food types considered
w_F	Share of food expenditure in total expenditure
w_i	Expenditure share of food type *i* in food expenditure
$\alpha, \beta, \gamma, \delta$	Demand function parameters
$\nu, \phi, \lambda, \varphi$	Parameters of Probit function
ε_{ij}	(uncompensated) price elasticity of demand for good *i* with respect to the price of good *j*
η	Elasticity of demand for good *i* with respect to total expenditure
X	Total household expenditure
m	Total food expenditure for a set of M goods
P	Price index
p_j	Price of good *j*
d_k	The *k*-th sociodemographic variable

1 INTRODUCTION[1]

During the transition from a planned to a market economy private households in Hungary have been affected by a considerable increase in unemployment and a deterioration of the social security systems. The average level of real income declined while at the same time the distribution became less equal. In addition relative prices changed. Hungarian households have adjusted their consumption patterns to these developments. Regarding food consumption this has influenced the market potential for the agricultural and food industry as well as the nutritional status of the population. The study described here analyses the consumption behaviour of Hungarian households regarding different types of food in 1996 and thus after the period of the most sudden changes. Specifics of demand behaviour of distinct sociodemographic groups are given special attention. This approach can help to assess group specific welfare impacts of policy decisions regarding direct and indirect taxation, social benefits as well as agricultural and trade policy. With regard to nutrition and health, the food demand of poor households, households with children, and households of pensioners are of particular interest. At the same time aggregate food demand influences the market potential for the produce of the agricultural and the food sector. Consequently, better understanding of food demand provides background information for the design of sectoral policies.

This paper aims at making the methodological approach of the study transparent and to give an overview of empirical results. Section 2 summarises the theoretical and methodological aspects of the approach chosen. In addition the data base is introduced. In section 3 information with respect to group specific consumption structures in Hungary as well as the model results on group specific demand elasticities are presented. Some conclusions and suggestions for possible further research are derived in section 4.

2 A MODEL OF FOOD DEMAND BEHAVIOUR

The applied approach is based on the assumption that the available budget and the market prices of goods have a predominant impact on demand and that these determinants are hence adequate variables to model, explain, and predict demand. The way in which consumers react to changes of their budget and of prices depends on their preferences which in turn reflect the needs and the attitudes of the household members. Preferences of households with similar socio-economic profiles are expected to be more homogeneous than those of households that differ with respect to their composition and living conditions.

To model the consumption behaviour of Hungarian households a two-stage budgeting process is assumed which is in accordance with the neoclassical theory of consumer demand. The first stage represents the allocation of the household budget on broad expenditure groups like food, clothing, housing, etc. It is modelled simply as the decision on the share of food expenditure (in Hungary 34 % on average[2]) as a function of the households' total budget.[3] The second

[1] This paper presents results of research work that was supported by the EU-Commission under PHARE-ACE Project P96-6014-R. I am indebted to Prof. S. Tangermann, University Göttingen, and the project partners for their helpful suggestions concerning the general direction of research, to Mrs. Z. Szabo, HCSO Budapest, for her patient support of my efforts to understand the data source and to Mr. J. Meier, University Göttingen, for his help regarding the data management. Prof. M. Hartmann, Dr. K. Glitsch and Dr. G. Weber (all IAMO, Halle) helped to improve the paper by providing valuable comments on earlier versions.

[2] This food share is higher than indicated in official statistics because in this study those components of total expenditure which are not at the discretion of the households (e.g. taxes and social security contributions) were excluded from consideration.

stage, i.e. the allocation of the food budget on different food types, is modelled using a complete demand system. The food aggregate is grouped into seven food types which are presented here together with their respective shares in the average Hungarian household's food budget in 1996:

- Protein foods (meat, fish, eggs) 32 %
- Dairy products (excl. butter) 11 %
- Fats and oils 6 %
- Staple foods (grain products, potatoes, sugar) 20 %
- Vegetables 6 %
- Fruit 6 %
- Other food (sweets, incl. meals outside home, pre-prepared dishes) 19 %

This grouping was chosen in order to define food types that are relatively homogeneous regarding their function in people's diet. The different types play distinct roles in a balanced nutrition and first conclusions regarding the development of the nutritional status can be derived from changes in the consumption of those food types.[4] To assess what impact price and income changes had on the consumption of these food types in the past, parameters of a demand model are estimated based on price and expenditure data collected in a household survey.

The model aims not only to quantify demand responses of the average Hungarian household but also to identify specific behavioural patterns of different subgroups of the population. Sociodemographic characteristics are selected in a way to distinguish population groups that are assumed to represent a wide range of patterns regarding their food demand behaviour. For example the presence of children in a household or the educational level of the household head are assumed to be factors with considerable impact on the households' preferences for different kinds of food. The way how group specific results are obtained will be explained in the following section. Table 1 shows the characteristics, their indicators, and the (K=17) variables[5] that are used to class the households in the sample with the respective groups.[6]

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3 Due to a lack of price information for non food products it was not possible to model the allocation of the household budget in a complete demand system including distinct non food product aggregates explicitly.

4 The aggregates are not appropriate (and too broad) to allow conclusions regarding the demand for the content of agricultural raw products in the food types. The impact of consumer demand on the market potential for the agricultural sector will have to be studied using different aggregates and appropriate conversion and transmission factors to link agriculture output and the consumer food products.

5 Separate dummy variables were defined for each category of the categorical data, e.g. one 1/0 dummy for "children present" and one for "no children present". See first paragraph of section 2.3.

6 The proportion of households belonging to each group is presented in table A3 in the Appendix. The various classification criteria were applied one by one in this study, i.e. no results for groups defined by more than one criterion (e.g. 'single households' in 'rural areas') are presented.

Table 1: Sociodemographic Characteristics Considered in the Model

Sociodemographic field	Particular characteristic	Definition/type of variables used
Household size and composition	Number of household members	Discrete
	Presence of children under 11	Yes, dummy No, dummy
	Age of household head	Discrete
Social position of household	Main source of income	Manual work, dummy Non-manual work, dummy Pension, dummy Other sources, dummy
	Educational status of household head	Primary school or lower, dummy Secondary or higher, dummy
Dwelling	Ownership type of dwelling	Own property, dummy Dwelling not owned, dummy
	Settlement type	Budapest, dummy Other urban areas, dummy Rural areas, dummy
Household food production	Expenses for factors or inputs for agricultural production	Expenses over 100 Ft, dummy Expenses less than 100 Ft, dummy

For reasons which will be discussed in section 2.3 a separate dummy variable was defined for each category of the categorical data, e.g. one 1/0 dummy for “children present” and one for “no children present”. In these cases the dummy variables exhibit perfect correlation by definition. Between other variables, correlation is high although not perfect. This is all but unexpected considering that e.g. the incidence of household food production is higher in rural households than in urban ones. Implications of correlation among variables for parameter estimation and for the interpretation of group specific demand parameters are treated in sections 2.1 and 3.

2.1 Functional Form

The first stage of budget allocation, the households’ decision on total food expenditure, is modelled by relating the food share (w_F) to the logarithm of total expenditure[7] (X) and the above mentioned sociodemographic variables d_k (k=1...K) (Working-Leser model, WORKING 1943):

$$w_F = \alpha_F + \beta_F \ln X \tag{1}$$

with

$$\alpha_F = \delta_0 + \sum_{k=1}^{K} \delta_k d_k \ . \tag{2}$$

The parameters α_F, β_F, δ_0 and δ_k characterise the households preferences. Sociodemographic variables are included in the model to avoid that their impact will inflate the error term and affect the fit of the model (best case) and to avoid biased parameter estimates which occur if sociodemographic variables and explanatory variables of the model are correlated with each other (worst case). The applied method to introduce the sociodemographic variables into the

7 Figures on total expenditure are considered more reliable than income figures because the former on average exceed the latter considerably in the data set.

demand function is called (linear) demographic translation.[8] This specification is appropriate, if the sociodemographic variables influence only the constant component of the demand function and leave the responsiveness of consumption to income changes unaffected. This hypothesis will have to be tested against more general specifications in the future. The selection of sociodemographic variables is the result of multiple attempts to fit the demand system with different sociodemographic variables. The expenditure elasticity of food demand for the average household is given by

$$\eta_F = 1 + \frac{\beta_F}{w_F}. \quad (3)$$

The presented functional form implies that the elasticity depends on the expenditure share of food. This dependency is utilised to compute expenditure elasticities specific to individual socio-economic groups: their group specific preference structure and hence consumption behaviour leads to group specific expenditure shares. Put the other way round the group specific expenditure shares can be regarded as indicators of group specific consumption behaviour. If elasticities are computed according to (3) using the expenditure share characterising the respective socio-economic group, the result is a group specific elasticity. This approach is appropriate if the functional form and demographic translation are justified, i.e. if price and income parameters are independent of sociodemographic parameters. Largely the same selection of sociodemographic variables is utilised for (a) specifying demand equations and (b) computing household type specific elasticities although these two issues are formally independent decisions.

The second stage of budget allocation, the household's decision among 7 food types, is specified using the linearised form of the Almost Ideal Demand System (LA/AIDS, DEATON and MUELLBAUER 1980a). This functional form combines two desirable properties: (i) second order flexibility and (ii) the ability to represent concave Engel curves, however it lacks the property (iii) of global regularity. The latter is due to the fact that the underlying cost function can be restricted to concavity only locally. This means that the estimated demand functions may be inconsistent with the axioms of rational choice which are crucial in the theoretical framework of the model (see e.g. chapter 1 of DEATON and MUELLBAUER 1980b). The demand system derived from the Normalized Quadratic Expenditure (NQ) function (DIEWERT and WALES 1987) has the properties (i) and (ii), however it implies the problem of linear Engel curves and thus lacks empirical plausibility. This holds especially in the context of Household Budget Survey data, which cover a wide range of income levels. This shortcoming is considered too serious to accept it in a trade off with global regularity. The generalisation of the NQ system with non linear (quadratic) Engel curves NQ-QES (RYAN and WALES 1996) was not applied because global regularity can not be guaranteed for that system (a feature that it has in common with the AIDS). As to the knowledge of the author, no clearly superior (dominant) functional form has been introduced yet.[9] For this reason, the widely used LA/AIDS is considered appropriate for this empirically oriented study. It is simple to estimate and can almost be regarded a "benchmark system" in applied studies. Other forms will be used and compared in further research.

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8 See POLLACK and WALES (1981) for a discussion of this and alternative specifications.

9 For a discussion of the choice of functional forms of demand systems see e.g. ELSNER, 2000 or BROSIG, 2000.

The LA/AIDS demand function for the *i*-th of *M* goods (i.e. food types) has the following form:

$$w_i = \alpha_i + \sum_{j=1}^{M} \gamma_{ij} \ln p_j + \beta_i \ln(m/P) \tag{4}$$

where w_i and p_j denote the budget share and the price of good *i* and *j* (*i,j* = 1...*M*), *m* represents total expenditure for the *M* goods and *P* is the weighted geometric mean of the *M* prices with the budget shares used as weights ("Stone's price index"). Parameters are denoted α_i, β_i and γ_{ij}. Sufficient regularity conditions for the systems can be formulated in terms of linear parameter restrictions

$$\sum_{i}^{M} \alpha_i = 1, \quad \sum_{i}^{M} \beta_i = 0, \quad \sum_{i}^{M} \gamma_{ij} = 0, \quad \sum_{j}^{M} \gamma_{ij} = 0, \quad \gamma_{ij} = \gamma_{ji} \quad \forall i, j \tag{5}$$

and the requirement that the matrix of compensated price effects (Slutsky matrix) is negative semidefinite. The diagonal elements s_{ii} and the off diagonal elements s_{ij} of this matrix are defined as

$$s_{ii} = m \frac{\gamma_{ii} + w_i^2 - w_i}{p_i^2} \quad \text{and} \quad s_{ij} = m \frac{\gamma_{ij} + w_i w_j}{p_i p_j} \tag{6}$$

respectively with the scalar *m* representing total expenditure for goods 1...*M*. The Slutsky matrix takes different values for each set of expenditure shares w_i and prices p_i which implies that its negative semidefiniteness requires a different set of restrictions on the parameters γ_{ij} for every point in the variables space defined by w_i and p_i. This is why for the LA/AIDS, regularity can only be imposed locally, not globally.

Like in the first stage model, sociodemographic variables are introduced to the LA/AIDS equations by linear demographic translation, i.e. the α_i in (4) are substituted by expressions analogous to (2). Expenditure elasticities from LA/AIDS parameters are computed using (3) as in the Working-Leser model. Uncompensated own and cross price elasticities (ε_{ii} and ε_{ji}) are computed as (c.f. GREEN and ALSTON 1990)

$$\varepsilon_{ii} = \frac{\alpha_{ii} - \beta_i w_i}{w_i} - 1 \qquad \text{and} \quad \varepsilon_{ij} = \frac{\alpha_{ij} - \beta_i w_j}{w_i}. \tag{7}$$

Also with respect to food types group specific elasticities are computed by inserting group specific budget shares in (3) and (7). The (group specific) expenditure elasticities from the first stage (elasticity η_{FX} of food demand with respect to total household expenditure) are multiplied by those of the second stage (elasticities η_F of demand for food types i with respect to total food expenditure) to obtain "integrated" elasticities η_X of demand for food types with respect to total expenditure[10]:

$$\eta_{iX} = \eta_{FX} * \eta_{iF} \tag{8}$$

Some further aspects of model specification are closely related to properties of the used data set and to econometric estimation and they will hence be treated in the respective sections.

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[10] Integrated price elasticities (c.f. DEATON 1975: 184) can not be computed because no parameters of price driven substitution between food and non food products were estimated in the first stage model.

2.2 Data Source and Data Processing

Data for 7250 households were collected by the Hungarian Central Statistical Office (HCSO) in the Household Budget Survey 1996. The records contain information on the occupation and income of the household members, as well as on household expenditure and consumption as well as on a wide range of demographic and socio-economic characteristics. Following the practice from pre-transition times in many COMECON countries quantity and value of consumed food commodities were recorded in great detail. The sample was divided in six subgroups. In order to capture seasonal specifics each subgroup kept records of their expenditure during different two-months-sub-periods of the year. In order to make the sample of households representative of the Hungarian population with respect to basic sociodemographic characteristics, HCSO supplies weighting factors which were applied throughout this study.

To meet empirical requirements, the raw data had to be transformed in several ways. This is briefly explained to make the study transparent. However, a thorough discussion of the underlying economic and practical considerations cannot be given here.

- As a substitute for information on (household specific) prices, unit values are computed using data on value and quantities of purchased goods and services.[11]
- The value of self-produced food is added to the expenditure for purchased goods. Unit values of purchased quantities are used to compute the value of self-produced goods. The value of consumed food from own production is hence regarded as part of household expenditure.
- All consumption figures are expressed as annual averages per equivalent adult, weighting children below the age of eleven years with the factor 0.7 and persons below the age of 18 with the factor 0.9.
- Figures on quantity and value for individual food and non-food products are used to construct the aggregates mentioned above. Unit values for the aggregates are computed as weighted averages using household specific expenditure shares as weights.
- Variation of prices (i.e. unit values) between households not only reflects differences between supply conditions in different locations but also differences in the composition of the product aggregates and the quality of each food item in the aggregate. Following COX and WOHLGENANT (1996), quality adjusted prices, prices for a 'standard quality' (or 'standard composition') comparable between households, are used in the demand model. The method rests on the assumption that differences between price averages for different socio-economic groups reflect (and sufficiently represent) differences between qualities typically consumed by these groups. If this 'systematic' component is removed, the remaining variation of prices reflects differences in supply conditions and can hence be used to assess price responsiveness of households in the demand model. The practical procedure is to run linear regressions of the unit values on the sociodemographic variables. The sum of the constant term and the residuals for each household is then interpreted as the household specific quality adjusted unit value.

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[11] A different approach using budget surveys from three different years (pooled cross section and time series data) was tried in an attempt to avoid the problem of simultaneity bias connected with the use of unit values as regressors (see below). Aside from problems concerning consistency of data over years, variation between years turned out not to be sufficient for the estimation of price responses.

- Some households did not consume some of the goods during the surveyed period. In these cases the quality adjusted "average" unit-values (the estimated constants from the mentioned regressions) are imputed to substitute for the non-available unit-values.
- Records containing missing values for sociodemographic characteristics and records containing outliers for per capita consumption or unit values are dropped. Consumption figures (value or quantities) exceeding the mean plus seven standard deviations and unit values exceeding the mean plus five standard deviations are considered outliers.

2.3 Estimation and Inference

Parameters of the first stage model (Engel-model) are estimated by (weighted) OLS assuming independently and identically distributed (iid) error terms. For those groups of 1/0 dummy variables that form a complete set (e.g. 'Budapest'/'Urban'/'Rural' or 'Household with children'/'Household without children'), parameters are restricted to sum up to zero to avoid perfect multicollinearity that results in singularity of the covariance matrix of residuals. This means that the parameters δ_0 and β_F in (1) and (2) (i.e. the demand equation with the sociodemographic terms dropped) describe demand behaviour of the sample average and that the parameters δ_k of the sociodemographic variables describe the effect of the characteristic as compared to the average of all households.[12]

As mentioned above some of the sociodemographic characteristics used as explanatory variables are correlated with each other. Bivariate correlation coefficients computed from the sample are sufficiently low (<0.7) to justify that no in-depth analysis of multicollinearity and possible consequences on inference is considered necessary.

On the second stage of the model, each of the food types "fats", "fruit" and "vegetable" was not consumed during the observed period by a considerable proportion of households (2 %, 3 % and 9 % respectively). In these cases, censoring of the dependent variables, i.e. the budget shares which can not be negative, is in effect. To avoid biased estimates which would result from standard OLS estimation in such cases, LEE's (1978) generalisation of AMEMIYA's (1974) two-step estimator is applied (see also HEIEN and WESSELLS, 1990): In the first step, a probit regression is computed that determines the probability that a given household consumes the good in question. A linear specification is chosen for the probit model, containing those of the exogenous variables from the demand system that were found to be statistically significant and hence relevant for the decision to purchase or not:

$$C_i = \nu_i + \phi_i p_i + \sum_{k=1}^{K} \lambda_{ik} d_k + \varphi_i m \,. \tag{9}$$

C_i denotes a dichotomous variable that takes the value one if the household consumes good i and zero otherwise. Variables p_i, m and d_k are defined as in (2) and (4) and the parameters ν_i, ϕ_i, λ_{ik} and φ_i characterise households' propensity to consume or not. The obtained information on each household's probability to consume, i.e. the inverse Mills ratio[13], is then used as an instrument in the second step which will now be described.

[12] Following SUITS (1984), this is easier interpreted than if one dummy variable from each set is dropped so that the equation describes the behaviour of an arbitrarily chosen *reference household* and the sociodemographic parameters describe the differential effect in comparison with the reference household.

[13] The inverse Mills ratio for each household h is the quotient of the density and cumulative probability functions that are represented by equation (9): $R_{ih} = \varphi\left(\mathbf{p}_h, \mathbf{d}_h, m_h\right) / \Phi\left(\mathbf{p}_h, \mathbf{d}_h, m_h\right)$.

The complete demand model of the allocation of the food budget is estimated using Seemingly Unrelated Regression (SUR) techniques so that contemporaneously correlated errors are accounted for and cross-equation parameter restrictions can be imposed. Parameters of all but one equations are estimated by maximum-likelihood imposing the restrictions (5) and the semidefiniteness-constraint on the Slutsky-matrix for the midpoint of the space spanned by the budget shares w_i.[14] Parameters of the last equation are derived as residuals using the restrictions (5). Restrictions for the parameters of the sociodemographic variables within each set are imposed equation by equation as pointed out in the context of the model's first stage. The Mills ratios for the three concerned food types ("fats", "fruit" and "vegetable") are introduced additively as instruments in the respective equations.

The final objective of the described procedure is to obtain elasticity estimates for the average household and for specific socio-economic groups. These results are gained in a procedure involving at least four steps which have been described above: (i) the price regressions to compute household specific quality adjusted unit values, (ii) the Working-Leser model to estimate parameters of demand for the food aggregate, (iii) the probit model as a means to account for zero consumption and (iv) the LA/AIDS model to estimate parameters of the demand for food types. Validation of the final results from such a multi step procedure is difficult, even if confidence limits of the estimates in each of the involved steps could be relied upon.[15] Given that e.g. the quality adjusted prices and the Mills ratios are not fixed values but estimates with probability distributions the distributions of the final elasticities are complicated functions of the variables involved in the different sub-models. In this study these matters are not pursued thoroughly and only crude overall measures of goodness of fit are presented below.

As discussed above the restriction to achieve concavity in the LA/AIDS can only be imposed locally for a single point in the variable space. In order to check the relevance of the restriction it was tested for all other points in the parameter space spanned by the sample of households. The result is that in 5539 of 6481 cases (85 %) the condition was fulfilled. If the model would be used to simulate consumption under given price-income scenarios, the concavity requirement can be checked at the respective point using the resulting constellation of budget shares. It was checked that estimation without imposition of the concavity restriction yields results that are not consistent with a concave cost function at the point of estimation which implies that the restriction is binding.

3 EMPIRICAL RESULTS

3.1 Measures of Model Fit and Parameter Estimates

The approach described above involved parameter estimations in four different kinds of models. An overall evaluation of the models is given in this section. Concerning the low coefficients of determination in all the models it should be noted that this is not unusual in cross section studies using microdata of households due to a large degree of stochastic variation.

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[14] The module "Constrained Maximum Likelihood" of the GAUSS software package allows to impose inequality restrictions so that the eigenvalues of the Slutsky matrix can be confined to nonpositive values.

[15] In our study where the LA/AIDS estimates have been obtained with inequality restrictions in effect it is not possible to compute confidence limits analytically as long as one does not know exactly which of the restrictions are binding in a particular parameter constellation and which are not (c.f. GOURIEROUX and MONFORT, 1995II: 246f). Inferential results can be obtained in such situation using resampling techniques (c.f. BROSIG, 2000).

The linear regressions of unit values on sociodemographic variables are characterised by *adj.* R^2 values between 0.07 and 0.17 indicating that most of the variation of unit values is not related to socio-economic factors. The fact that 82 percent of estimated parameters are significantly different from zero at the 5 percent level validates the procedure on the other hand. But it remains a critical point in the study that the unit value regressions are considered sufficient to remove quality related price differences (including those due to differences in the composition of the aggregate) and attribute the remaining price variation to different supply conditions.

Regarding the probit models for fats and vegetable, only 30 percent of the regressors (total expenditure, own-prices and sociodemographic variables) had parameters significantly different from zero (5 percent level). This is not surprising given that the proportions of zero observations are small. Nevertheless, the inclusion of the Mills ratios seemed justified also in these cases because their parameters proved to be highly significant in the LA/AIDS model. In the probit regression for fruit, 10 out of 12 regressors had significant parameters.

Estimation of the Engel function had an adjusted R^2 of 0.49 and 10 out of 12 regressors had significant parameters. Results are presented in appendix A1.

In the LA/AIDS a total of 90 parameters were estimated (not including the ones determined by restrictions). As mentioned in footnote 15, t-values can not be interpreted given that inequality restrictions were binding. Estimates and the values of those parameters computed as residuals using the restrictions are presented in table A2 but not discussed here.

3.2 Price- and Expenditure Elasticities for the Average Hungarian Household

Tables 2a and 2b present the elasticities computed from the parameter estimates and the mean budget shares. The figures have an order of magnitude that can be expected for a transition country such as Hungary with a per capita GDP of around 40 percent of EU average at purchasing power parities (OECD 1997). They are comparable with elasticities estimated for Hungary from aggregated time series data by BANSE (1990), BANSE and BROSIG (1998). Food expenditure varies with changes of household budget only with an elasticity of 0.60 so that even those food types with elasticities well above one with respect to food expenditure have integrated expenditure elasticities that qualify them as necessities (see table 2a).

Table 2a: Food Demand Elasticities for the Average Hungarian Household

Elasticity of food consumption with respect to total consumption (Working-Leser Model): 0.60									
	Uncompensated price elasticities and expenditure elasticities from LA/AIDS								Integr: Total Expend.
PROD	Protein foods	Dairy prod.	Fat/oil	Staple-foods	Vege-tables	Fruit	Other food	Food expend.	
Protein foods	**-0.96**	0.02	-0.01	0.04	0.01	0.01	0.06	0.83	0.50
Dairy prod.	0.01	**-0.94**	-0.01	-0.07	0.02	0.04	0.02	0.93	0.56
Fat / oil	-0.08	-0.01	**-0.84**	0.04	-0.01	-0.04	0.00	0.92	0.55
Staple foods	0.03	-0.04	0.01	**-0.92**	-0.03	0.01	-0.02	0.95	0.57
Vegetables	-0.08	-0.01	-0.04	-0.16	**-0.93**	-0.11	0.01	1.33	0.80
Fruit	-0.09	0.03	-0.06	-0.04	-0.12	**-1.02**	0.01	1.30	0.78
Other food	-0.02	-0.02	-0.02	-0.07	0.01	0.01	**-1.10**	1.21	0.72

Source: Own computations based on HCSO household budget survey data.

Table 2b: Compensated Price Elasticities of Demand for the Average Hungarian Household

	Protein foods	Dairy prod.	Fat/oil	Staple-foods	Vege-tables	Fruit	Other food
Protein foods	**-0.70**	0.11	0.04	0.21	0.06	0.06	0.22
Dairy prod.	0.31	**-0.84**	0.06	0.12	0.08	0.09	0.20
Fat / oil	0.22	0.10	**-0.78**	0.23	0.05	0.02	0.17
Staple foods	0.33	0.07	0.07	**-0.73**	0.03	0.06	0.16
Vegetables	0.34	0.14	0.05	0.11	**-0.86**	-0.04	0.26
Fruit	0.32	0.18	0.02	0.22	-0.04	**-0.95**	0.26
Other food	0.37	0.12	0.06	0.17	0.08	0.08	**-0.87**

Source: Own computations based on HCSO household budget survey data.

The relatively high integrated expenditure elasticity values for vegetables (0.80) and fruit (0.78) indicate that an increase in incomes will have pronounced positive effects on the consumption of these food types and may hence lead to more balanced diets. Nutritionists have pointed out that the average Hungarian diet contains too much fats and meat and that the fibre content is not sufficient. The expenditure elasticity of 'other food' (0.72) is in the same range but not easily interpretable given the heterogeneity of the aggregate. Some of its components like meals in restaurants and some kinds of convenience food may find income elastic demand while others (meals in canteens) probably do not. The variance between the expenditure elasticities of different food types is remarkably low. One could have expected the difference between the basic food types fats (0.55) and staple foods ("staple foods", 0.55) and the other, more luxurious food types to be bigger. The same notion applies to uncompensated own price elasticities for the average household which span the small range from -0.84 (fat/oil) to -1.02 (fruit) leaving inhomogenous 'other food' aside. Uncompensated cross price elasticities are considerably smaller in absolute value, in many cases the estimates are probably not significantly different from zero.[16] Many of the compensated cross price elasticities are bigger in absolute terms than the corresponding uncompensated ones. Their positive signs qualify the respective pairs of food types as substitutes. In cases where compensated cross price elasticities are positive but the uncompensated ones are negative it can be calculated that the negative effect of a price increase on the food budget prevents substitution of the respective type by others which would have occurred otherwise. For the only pair of 'alleged' complements (fruit/vegetables) compensated cross price elasticities (both -0.04) are likely not to be significant.

The elasticity estimates can be used to assess impacts of changes in real per capita income and changes in food price constellations on market demand for food types. For nutritional and social issues it is advisable to look at elasticities for distinct population groups.

3.3 Particularities of Different Sociodemographic Groups

Table A3 in the appendix shows – for different sociodemographic groups - shares of food expenditure in total expenditure and shares of the expenditure for food types in total food expenditure. The last column indicates the proportion of the population (i.e. the weighted

[16] The impossibility to check the significance of the estimates when parameters are constrained by inequality restrictions was mentioned above.

sample) that each group represents. Variation of expenditure shares over groups directly carries over to variation in price and expenditure elasticities as determined by (3) and (7). Results on group specific elasticities as presented in table A4 are hence closely related to budget shares presented in table A3. Consumption structures differ significantly between the various groups: Food shares in total expenditure are well above the average of 34 percent for households headed by elderly people and those households with main income from non-labour sources.[17] Households that produce food (farmers or households with subsidiary plots), rural households and those headed by a person without higher education have a relatively high share of food expenditure too. The mentioned household groups are at the same time the ones exhibiting food expenditure that is quite responsive to income changes. Expenditure elasticities are around five percentage points above the average. The lowest food share (and expenditure elasticity) is observed for households headed by white collar workers. More extreme discrepancies could be recognised if groups characterised by more than one variable were selected. For example rural households headed by persons over 60 who have no wage or pension income, allocate more than half of their expenditure on food.

Expenditure elasticities describing the allocation of the food budget on food types (stage two) are much related to the first stage. In most cases, the sociodemographic groups with high/low expenditure elasticities for food as an aggregate show the highest/lowest integrated expenditure elasticities for the most elastic food types ‘fruit’, ‘vegetable’ and ‘other food’. For rural households, households with heads over 60, and those with no work or pension income these elasticities are almost 0.9. This means that changes in income affect consumption of these food types strongest but they can still not be regarded luxuries. This is not surprising for aggregates as broad as the ones considered. Table A3 reveals that some of the sociodemographic distinctions separate groups with significantly differing patterns regarding their choice of food types. These groupings are ‘main source of income’, ‘settlement type’, ‘age’ and ‘education’ of the household head and the distinction between households that do or do not produce food. The multitude of patterns that can be compared with each other prevents comprehensive discussion and only some examples are provided here. Households of blue-collar workers, pensioners and ‘others’ allocate their food budget in similar ways while for white-collar workers ‘other food’ and fruit have higher shares at the cost of meat and staple foods. It is worth noting that the white collar workers’ dietary pattern regarding the traditional luxury good meat is more similar to that one for staple foods than to the one regarding fruit and ‘other food’ (dominated by meals consumed from the catering trade). The integrated expenditure elasticities of these groups differ largely because of the big differences in the expenditure elasticity of food, the ranking of expenditure elasticities does not vary though between the groups. This means that the behavioural differences that are very obvious from the budget shares are only slightly reflected in the elasticities. Only a mathematical explanation can be given here: for goods with large budget shares (protein foods, other food) considerable absolute differences in budget shares in the denominator of (3) affect the expenditure elasticity only slightly. Similar observations can be made regarding the other groupings: households which produce food have significantly higher expenditure shares for meat and staple foods (probably to some extent meat and potatoes they produce themselves) and lower shares for ‘other food’ but also here the pattern of elasticities is similar to the one of non producing households.

Although price elasticities are also functions of budget shares, differences in the share patterns of different groups carry over only very slightly to price elasticities. They differ very little

[17] It is obvious that the classifications according to main income source and age of household head result in groups containing to a considerable degree the same member households.

between the groups. Most probably the limitations of the translation approach become apparent here in which sociodemographic parameters are assumed not to influence price responses but enter elasticity formulas only via group specific budget shares.

4 CONCLUSIONS

A study on food consumption in Hungary was conducted using data on individual households. Sets of demand elasticities for average households were estimated. The results have plausible orders of magnitude. Differences between demand behaviour of specific sociodemographic groups were described using group specific elasticities. Differences between such elasticities are smaller than expected given that budget share patterns differ considerably between groups. It is questionable whether homogeneous elasticity patterns reliably reflect the degree of homogeneity of price and income responses within the Hungarian population or whether the method of estimating group specific elasticities is inappropriate. This method assumes that behavioural differences determine elasticities only via group specific budget shares and not directly via group specific price and income response parameters. To check the appropriateness of this approach is one of the directions that further research will take. Other directions concern further differentiation of food types, other choices for the functional forms and to find ways for statistical validation of the estimates.

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APPENDIX

(All tables present own computations based on HCSO household budget survey data)

Table A1: Results of Estimation of Engel Function

R-square	**0.4924**	**Adj R-sq**	**0.4916**	
Parameter Variable	**Standard Estimate**	**T for H0: Error**	**Parameter = 0**	**Prob > |T|**
INTERCEP	1.715574	0.03015729	56.888	0.0001
LN(EXP)	-0.136441	0.00289793	-47.082	0.0001
HSIZE	-0.010785	0.00112783	-9.563	0.0001
BUD	-0.005450	0.00243470	-2.239	0.0252
URB	-0.008103	0.00164083	-4.938	0.0001
RUR	0.013553			
Man Work	-0.026752	0.00223338	-11.978	0.0001
Non man Work	-0.010439	0.00340324	-3.067	0.0022
PENSION	0.028504	0.00239890	11.882	0.0001
Other source	0.008687	0.00341890	2.541	0.0111
High educ	-0.012658	0.00159524	-7.935	0.0001
Low educ	0.012658			
Agric prod.	-0.018350	0.00149370	-12.285	0.0001
No agric prd	0.018350			
Owned resid	0.005015	0.00235422	2.130	0.0332
Resid not own	-0.005015			

Table A2: Estimated LA/AIDS parameters

Constants, parameters of prices, total food expenditure and Mills ratios

	CONST	PRICE Parameters							EXP	Mills ratios
		PROT	DAIRY	FATS	STAPLE	VEGET	FRUIT	OFOOD		
PROT	0.5307	**-0.0057**	-0.0014	-0.0064	0.0030	0.0013	0.0002	0.0090	-0.0536	-
DAIRY	0.1552	-0.0014	**0.0055**	-0.0010	-0.0092	0.0018	0.0035	0.0008	-0.0075	-
FATS	0.0826	-0.0064	-0.0010	**0.0102**	0.0018	-0.0009	-0.0025	-0.0012	-0.0051	0.031
STAPLE	0.2141	0.0030	-0.0092	0.0018	**0.0147**	-0.0057	0.0010	-0.0056	-0.0096	-
VEGET	-0.0266	0.0013	0.0018	-0.0009	-0.0057	**0.0051**	-0.0056	0.0040	0.0196	0.028
FRUIT	0.0019	0.0002	0.0035	-0.0025	0.0010	-0.0056	**-0.0003**	0.0037	0.0168	-0.015
OFOOD	0.0421	0.0090	0.0008	-0.0012	-0.0056	0.0040	0.0037	**-0.0107**	0.0394	-

Parameters of sociodemographic variables

	Manual work	Non manual work	Pens	Other inc. Source	Househ size	Kids	No Kids	High educ.	Low Educ	Budap	Urban	Rural	Food prod.	No food product
PROT	0.0126	0.0050	-0.0090	-0.0086	0.0002	-0.0157	0.0157	-0.0047	0.0047	-0.0012	-0.0069	0.0081	0.0266	-0.0266
DAIRY	-0.0024	-0.0021	0.0100	-0.0055	-0.0029	0.0068	-0.0068	0.0063	-0.0063	0.0112	-0.0018	-0.0094	-0.0076	0.0076
FATS	-0.0029	-0.0100	0.0086	0.0043	-0.0007	-0.0036	0.0036	-0.0005	0.0005	-0.0038	0.0014	0.0024	0.0001	-0.0001
STAPL	-0.0144	-0.0226	0.0137	0.0233	0.0030	-0.0033	0.0033	-0.0177	0.0177	-0.0250	0.0054	0.0196	0.0007	-0.0007
VEGET	0.0009	-0.0082	0.0029	0.0044	0.0024	-0.0028	0.0028	0.0014	-0.0014	0.0132	-0.0026	-0.0106	0.0011	-0.0011
FRUIT	-0.0001	0.0016	-0.0002	-0.0013	-0.0013	0.0040	-0.0040	0.0044	-0.0044	0.0073	-0.0007	-0.0066	0.0001	-0.0001
OFOOD	-0.0063	-0.0363	0.0260	0.0166	0.0007	-0.0146	0.0146	-0.0108	0.0108	0.0017	-0.0052	0.0035	0.0210	-0.0210

Table A3: Food Share in Total Expenditure, Shares of Food Types in Food Expenditure and Proportion of Household Types in the Sample

	Food share in total expend.	Protein foods	Dairy products	Fats, Oils	Staple-foods	Vege-table	Fruit	Other food	Percent of House-holds
Household size									
single household	36.8	29.8	12.0	7.2	21.3	6.0	5.6	18.2	24.1
2 to 4 members	32.7	32.4	11.0	6.2	19.6	6.0	5.7	19.2	68.5
over 4 members	35.3	32.2	11.2	5.9	21.9	5.0	5.1	18.7	7.4
Children, age of 11									
No	34.8	32.2	11.1	6.7	20.5	6.1	5.5	17.9	76.7
Yes	31.1	30.3	11.7	5.3	19.2	5.2	6.0	22.3	23.3
Age of Head									
under 25	29.2	27.7	12.0	5.8	19.8	5.2	6.4	23.2	2.6
25-60	30.8	32.4	10.8	5.9	19.3	5.7	5.6	20.3	63.2
over 60	39.9	30.9	12.1	7.4	21.7	6.3	5.6	16.1	34.2
Main income source									
Manual work	29.6	32.8	10.8	5.7	19.2	5.6	5.6	20.4	33.4
Non manual work	21.9	29.1	11.9	4.8	15.0	5.6	6.9	26.8	12.5
Pension	39.4	31.7	11.6	7.3	21.8	6.2	5.4	15.9	45.7
Other income source	39.1	31.8	10.7	6.6	22.8	5.6	4.9	17.6	8.4
Educational status									
Up to primary school	37.3	32.8	10.7	6.7	22.0	5.8	5.1	17.1	68.7
Second school or higher	26.5	29.4	12.6	5.7	16.3	6.2	6.8	23.1	31.3
Residence status									
Not owned	32.7	29.2	11.7	6.4	20.0	6.0	5.4	21.2	7.3
Owned	34.0	31.9	11.2	6.4	20.2	5.9	5.6	18.8	92.7
Settlement type									
Budapest	28.2	28.8	13.6	5.8	15.8	7.3	6.9	21.8	17.8
Other urban areas	32.3	30.6	11.6	6.3	19.8	5.9	5.7	20.1	44.8
Rural	38.5	34.5	9.8	6.7	22.6	5.3	4.9	16.2	37.4
Household food production									
No	30.5	29.1	12.5	6.1	18.6	6.1	6.0	21.7	51.7
Yes	37.6	34.6	9.9	6.7	21.9	5.7	5.2	16.0	48.3
All Households	33.9	31.7	11.3	6.4	20.2	5.9	5.6	18.9	100.0

Table A4: Demand Elasticities for Different Socio-economic Groups

Group	(Integrated) Expenditure Elasticities								Uncompensated Own Price Elasticities						
	Food	Protein-foods	Dairy prod.	Fats, oils	Staple-foods	Vege-table	Fruit	Other food	Protein-foods	Dairy prod.	Fats, oils	Staple-foods	Vege-table	Fruit	Other food
Household size															
Single household	0.63	0.52	0.59	0.58	0.60	0.83	0.82	0.77	-0.97	-0.95	-0.85	-0.92	-0.94	-1.02	-1.10
2 to 4 members	0.58	0.49	0.54	0.54	0.56	0.78	0.76	0.70	-0.96	-0.94	-0.83	-0.92	-0.93	-1.02	-1.10
Over 4 members	0.61	0.51	0.57	0.56	0.59	0.86	0.82	0.74	-0.96	-0.94	-0.82	-0.92	-0.92	-1.02	-1.10
Children															
No	0.61	0.51	0.57	0.56	0.58	0.80	0.79	0.74	-0.96	-0.94	-0.84	-0.92	-0.94	-1.02	-1.10
Yes	0.56	0.46	0.53	0.51	0.53	0.77	0.72	0.66	-0.97	-0.95	-0.80	-0.91	-0.92	-1.02	-1.09
Age of Head															
Under 25	0.53	0.43	0.50	0.49	0.51	0.74	0.67	0.62	-0.97	-0.95	-0.82	-0.92	-0.92	-1.02	-1.09
25-60	0.56	0.47	0.52	0.51	0.53	0.75	0.73	0.67	-0.96	-0.94	-0.82	-0.91	-0.93	-1.02	-1.09
Over 60	0.66	0.54	0.62	0.61	0.63	0.86	0.86	0.82	-0.97	-0.95	-0.86	-0.92	-0.94	-1.02	-1.11
Main income source															
Manual work	0.54	0.45	0.50	0.49	0.51	0.73	0.70	0.64	-0.96	-0.94	-0.82	-0.91	-0.93	-1.02	-1.09
Non manual work	0.38	0.31	0.35	0.34	0.35	0.51	0.47	0.43	-0.97	-0.95	-0.78	-0.89	-0.93	-1.02	-1.08
Pension	0.65	0.54	0.61	0.61	0.63	0.86	0.86	0.82	-0.96	-0.95	-0.86	-0.92	-0.94	-1.02	-1.11
Other income source	0.65	0.54	0.61	0.60	0.62	0.88	0.87	0.80	-0.96	-0.94	-0.84	-0.93	-0.93	-1.02	-1.10
Educational status															
Up to primary school	0.63	0.53	0.59	0.59	0.61	0.85	0.84	0.78	-0.96	-0.94	-0.84	-0.92	-0.93	-1.02	-1.10
R higher	0.48	0.40	0.46	0.44	0.46	0.64	0.60	0.57	-0.97	-0.95	-0.82	-0.90	-0.94	-1.02	-1.09
Residence status															
Not owned	0.58	0.48	0.55	0.54	0.55	0.77	0.76	0.69	-0.97	-0.95	-0.84	-0.92	-0.94	-1.02	-1.09
Owned	0.60	0.50	0.56	0.55	0.57	0.80	0.78	0.72	-0.96	-0.94	-0.84	-0.92	-0.93	-1.02	-1.10
Settlement type															
Budapest	0.52	0.42	0.49	0.47	0.49	0.66	0.64	0.61	-0.97	-0.95	-0.82	-0.90	-0.95	-1.02	-1.09
Other urban areas	0.58	0.48	0.54	0.53	0.55	0.77	0.75	0.69	-0.97	-0.95	-0.83	-0.92	-0.93	-1.02	-1.09
Rural	0.65	0.55	0.60	0.60	0.62	0.89	0.87	0.80	-0.96	-0.94	-0.84	-0.93	-0.92	-1.02	-1.11
Own food production															
No	0.55	0.45	0.52	0.51	0.52	0.73	0.71	0.65	-0.97	-0.95	-0.83	-0.91	-0.94	-1.02	-1.09
yes	0.64	0.54	0.59	0.59	0.61	0.86	0.84	0.79	-0.96	-0.94	-0.84	-0.92	-0.93	-1.02	-1.11
All Households	0.60	0.50	0.56	0.55	0.57	0.80	0.78	0.72	-0.96	-0.94	-0.84	-0.92	-0.93	-1.02	-1.10

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