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## Food demand in Slovenia

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### ABSTRACT

The objective of this research is to analyse food consumption patterns in Slovenia. Cross-sectional household data from Household budget survey in year 2001 were used. We estimate expenditure and price elasticities for food demand for households segmented by quartile income levels and for Slovenia total. Food items are divided into the following commodity groups: bread and cereals, meat and fish, dairy products, oils and other fats, fruit, vegetables, confectionary. For a complete demand system analysis, we apply linearly approximated Almost Ideal Demand System (LA/AIDS). Empirical results show positive expenditure elasticities being close to one for all food groups. In general, demands for dairy products and vegetables could be regarded as the most sensitive to food expenditures. Further on, all Marshallian (uncompensated) and Hicksian (compensated) own price elasticities are negative and less than one. Own price elasticities for meat and fish are estimated as the lowest and for vegetables as the highest. With cross price elasticities close to zero the studied commodity groups seem to be unrelated. The negative sign of uncompensated cross price elasticities indicates complementary type of food groups, while substitution relationship of aggregate foods is indicated by mostly positive Hicksian cross price elasticities. According to these expenditure and price elasticities inhabitants of Slovenia seem to be losing consumption characteristics typical for countries in transition. However some unique food habits persist.

**Key words:** food demand / commodity groups / demand system / LA/AIDS / expenditure and price demand elasticities / Household budget survey / income groups

### IZVLEČEK

#### POVPRAŠEVANJE PO HRANI V SLOVENIJI

Namen študije je analiza prehranskih navad prebivalcev Slovenije. Podatke iz Ankete o porabi v gospodinjstvih v letu 2001 smo uporabili za ocenjevanje izdatkovnih in cenovnih elastičnosti povpraševanja po hrani za gospodinjstva v Sloveniji. Gospodinjstva so razdeljena v kvartilne dohodkovne razrede in kot Slovenija skupaj. Prehranske izdelke smo razdelili v naslednje skupine živil: kruh in žita, meso in ribe, mlečni izdelki, olja in druge maščobe, sadje, zelenjava, sladki izdelki. Povpraševanje po hrani je ocenjeno kot sistem enačb povpraševanja z linearno aproksimacijo metode skoraj idealni sistem povpraševanja (LA/AIDS). Ocenjene

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izdatkovne elastičnosti so pozitivne, z vrednostmi blizu 1. V splošnem lahko trdimo, da sta povpraševanje po mlečnih izdelkih ter povpraševanje po zelenjavi najbolj občutljivi na spremembe v izdatkih namenjenih hrani. Nadalje, vse Marshallove (nekompenzirane) in Hicksove (kompenzirane) lastne cenovne elastičnosti so negativne in manjše od 1. Lastne cenovne elastičnosti povpraševanja po mesu in ribah so bile ocenjene kot najnižje, povpraševanja po zelenjavi pa kot najvišje. Omenjene skupine živil so med seboj cenovno nepovezane, saj so križne cenovne elastičnosti blizu vrednosti nič. Večina nekompenziranih križnih cenovnih elastičnosti je negativna, kar nakazuje na komplementarnost proučevanih skupin živil oziroma na substitute, ko govorimo o večinoma pozitivnih Hicksovih križnih cenovnih elastičnostih. Ocenjene izdatkovne in cenovne elastičnosti kažejo, da prebivalci Slovenije izgubljajo prehranske navade značilne za države v tranziciji. Kljub temu nekatere prehranske posebnosti ostajajo.

**Ključne besede:** povpraševanje po hrani / skupine živil / sistem enačb povpraševanja / LA/AIDS / izdatkovne in cenovne elastičnosti povpraševanja / Anketa o porabi v gospodinjstvih / dohodkovni razredi

## INTRODUCTION

When estimating demand for goods and services studies reveal two approaches. Single equation approach specifies demand model directly and does not relay on economic theory of consumer behaviour which recognises the importance of income and prices. For example, Engel curves the most frequently used method ignores price influence. Given the doubts for results of such approach, empirical work has been directed towards the estimation of complete demand systems derived from consumer theory. Modern studies calculate responsiveness of individual consumer behaviour to prices faced by households and to the income they earn (Blanciforti *et al.*, 1986).

Until 90s all food demand studies in Slovenia applied single equations approach, more precisely Engel curves method (Frankovič, 1958 (cited in Kranjec, 1981); Verk, 1969; Kranjec, 1981; Kebrič, 1981; Šumi, 1986; Regoršek, 2002). Erjavec and Turk (1998) carried out the first study which estimated the effect of income and prices on food demand in Slovenia simultaneously. They estimated Slovene food demand functions as a system and Slovene food demand elasticities in years 1988 and 1993.

Our study updates earlier food demand studies for Slovenia in two ways. First and fore most, we present recent estimates of Slovene income and price elasticities for seven food commodity aggregates. Secondly, this study estimates food demand as a system of equations. We apply LA/AIDS method. While time-series data on demand for food categories and their prices are not available in Slovenia we use individual household data from Household budget survey 2001.

## MODEL

Deaton and Muellbauer introduced Almost Ideal Demand System (AIDS) model in 1980. The model is derived from a flexible expenditure function that is extremely useful for estimating a demand system with many desirable properties. Aggregation restriction (Muellbauer, 1975) and simple parametric restrictions are automatically satisfied, homogeneity and symmetry can be imposed. Its functional form is consistent with known household budget data. Owing to its simplicity, the Linear

Approximate Almost Ideal Demand System (LA/AIDS) model is very popular for empirical studies (Deaton and Muellbauer, 1980 and 1980a; Phlips, 1990; Alston *et al.*, 1994; Peterson and Cotterill, 1998). Its estimation is much simpler because linear estimation procedures can be used. LA/AIDS demand functions have the form:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln(x/P^*) \quad [1]$$

where  $\alpha_i, \beta_i, \gamma_{ij}$  are parameters,  $w_i$  is budget share of good  $i$  ( $i=1,2,\dots,n$ ),  $p_j$  is price of good  $j$  ( $j=1,2,\dots,n$ ) and  $x$  denotes total expenditure.  $P^*$  is Stone's price index defined as:

$$\ln P^* = \sum_j w_j \ln p_j \quad [2]$$

On the parameters of LA/AIDS model the following restrictions can be imposed (Jehle and Reny, 2001):

1. Adding-up implies the following parameters' restrictions

$$\sum_{i=1}^n \alpha_i = 1 \quad \sum_{i=1}^n \beta_i = 0 \quad \sum_{i=1}^n \gamma_{ij} = 0. \text{ Hence it follows that } \sum w_i = 1 \text{ as it is clear from [1].}$$

2. Homogeneity requires that  $\sum_{i=1}^n \gamma_{ij} = 0$ .
3. Symmetry is satisfied if  $\gamma_{ij} = \gamma_{ji}$  for any two goods  $i$  and  $j$ .
4. Negativity is not automatically introduced, but by estimating all the compensated own-price elasticities one can test for their negativity.

According to Green and Alston (1990), elasticities in LA/AIDS model can be expressed as  $\eta_i = 1 + \beta_i/w_i$  for income elasticity and  $e_i = -\delta_{ij} + \gamma_{ij}/w_i - \beta_i(w_j/w_i)$  for uncompensated (Marshallian) price elasticity where  $\delta_{ij} = 1$  if  $i = j$  and  $\delta_{ij} = 0$  if  $i \neq j$ . A total price change effect is a sum of price effect and income effect which together affect on quantity demanded. When we are interested only in income effect of a price change assuming price effect is constant, compensated (Hicksian) price elasticities should be calculated. In LA/AIDS model that are as  $e_{ij}^* = e_{ij} + w_j \eta_i$  (Hahn, 1994).

In LA/AIDS model parameter  $\beta_i$  determines the effect of a change in expenditure on the budget share of good  $i$  and whether this good is a luxury, necessity or inferior good. For a luxury  $\beta_i > 0$ , expenditure elasticity is larger than unity ( $\eta_i > 1$ ) indicating  $w_i$  increases when total expenditures are rising ( $x$ ). For a necessary good  $\beta_i < 0$ , expenditure elasticity lies between zero and unity ( $0 < \eta_i < 1$ ) meaning  $w_i$  decreases when  $x$  increases. And for an inferior good  $\beta_i < -1$ , with expenditure elasticity smaller than zero ( $\eta_i < 0$ ). In addition, it is possible to examine all complementary and

substitutive relations between pairs of goods by estimating compensated and uncompensated cross price elasticities (Varian, 1992).

## **DATA**

Slovenian Household budget survey conducted annually by Statistical Office of the Republic of Slovenia was main data source for this study. First similar survey was conducted in 1983 and since 1997 this survey is harmonized with Eurostat's standards. It is a sample survey. To obtain more accurate estimates household data from three consecutive yearly surveys are combined in one sample. Implicitly, all value data have to be deflacionated, namely to the middle year which is quoted as a reference year when interpreting results. We used Household budget survey data with reference year in year 2001. It was carried out in years 2000, 2001 and 2002 and covered 4986 households, of that 3816 households responded (Statistical yearbook of the Republic of Slovenia 2004).

Among others, survey gathers data on total food expenditure, quantity and value of specific food items consumed by a household. Food items are aggregated into the following 7 composite food categories: bread and cereals, meat and fish, dairy products, oils and other fats, fruit, vegetables and confectionary. Aggregation across food commodities revealed households which reported no consumption of particular food group(s). For such households average quantity consumed and average expenditure of non consumed aggregated food categories are used in LA/AIDS estimation. Since the household survey does not report price data, unit values as price indicators for aggregated food groups are calculated across households. They are derived as weighted average of each food item consumed and its quantity in the food group the item belongs to. Weights represent relative consumption share of each food item in total consumption of its aggregated food group.

Households are classified into quartile income groups (borders of each income group are the same as quartile borders) according to the value of average annual disposable income per household member. All entry data for further food demand analysis are calculated per household member.

## **RESULTS**

LA/AIDS model [1] is estimated for five household samples: four quartile income groups and all households in Slovenia (hereafter, Slovenia total). Models are estimated as a system of linear equations, using the systems linear regression (SYSLIN) procedure in SAS computer programs (Zellner, 1962). The parametric constraints of homogeneity and symmetry conditions across the equations are imposed. To avoid singularity derived from adding-up constraint in the variance-covariance matrix one equation ("confectionary" in our case) is deleted from direct estimation in each demand system. The parameters' estimates of confectionary equation are derived using homogeneity, symmetry and adding-up conditions. The share of estimated demand coefficients, which  $p$ -value is less than 0.1 varies, according to the model, between 70% and 81%.

However, of interest to researchers and policy makers is knowledge concerning elasticities of demand for food. According to the value of expenditure elasticities, selected food groups can be classified as inferior goods ( $\eta_i < 0$ ), necessities ( $0 < \eta_i < 1$ ) and luxuries ( $\eta_i > 1$ ). It should be noted that food group indicated as luxury/necessity/inferior good is regarded as luxury/necessity/inferior commodity according to total food expenditure and not according to total household expenditures. It can be seen from Table 1 that all expenditure elasticities are of expected sign and close to 1. Values in parentheses are  $p$ -values testing  $H_0 : \eta_i = 1$ . Demand for dairy products and demand for vegetables could be regarded as the most expenditure elastic, statistically significant at 5 percent level. All other food groups are fairly sensitive to food expenditure changes. Estimates of expenditure elasticities segmented by income groups show that demand for bread and cereals which expenditures represent about 20% of total food expenditures could also be regarded as very elastic for low income households yet it is not statistically significant. Households in the second and the fourth income group treat this food group as necessity but again this cannot be statistically proven. Fruit demand is similarly unusual with relatively high expenditure elasticities for high income households but are not statistically significant.

Table 1. Expenditure elasticities of aggregated food groups,  $\eta_i$ , and expenditure shares of aggregated food groups in total food expenditures,  $w_i$ , (in %), four quartile income groups of households in Slovenia and Slovenia total, 2001.

Preglednica 1. Izdatkovne elastičnosti agregatnih skupin živil,  $\eta_i$ , in deleži izdatkov agregatnih skupin živil v skupnih izdatkih za hrano,  $w_i$ , (v %), štiri kvartilni dohodkovni razredi gospodinjstev v Sloveniji in Slovenija skupaj, 2001.

i	1 <sup>st</sup> (low) income households		2 <sup>nd</sup> income households		3 <sup>rd</sup> income households		4 <sup>th</sup> (high) income households		Slovenia total	
	$w_i$	$\eta_i$	$w_i$	$\eta_i$	$w_i$	$\eta_i$	$w_i$	$\eta_i$	$w_i$	$\eta_i$
1	20.4	1.026 (0.2098)	18.2	0.994 (0.4198)	17.5	0.929 (0.0100)	16.4	0.966 (0.4426)	18.1	0.961 (0.0041)
2	26.4	0.924 (0.0099)	30.5	0.938 (0.0153)	29.9	0.930 (0.0109)	29.2	0.968 (0.1291)	29.0	0.952 (0.0005)
3	21.5	1.093 (0.0046)	21.8	1.141 ( $<0.0001$ )	22.0	1.170 ( $<0.0001$ )	23.6	1.063 (0.0173)	22.2	1.121 ( $<0.0001$ )
4	5.4	0.729 ( $<0.0001$ )	5.2	0.670 ( $<0.0001$ )	5.1	0.677 ( $<0.0001$ )	5.0	0.726 ( $<0.0001$ )	5.2	0.708 ( $<0.0001$ )
5	8.4	0.897 (0.0240)	8.1	0.841 (0.0005)	8.5	1.023 (0.3204)	9.2	1.004 (0.4653)	8.6	0.967 (0.0830)
6	9.9	1.234 ( $<0.0001$ )	9.3	1.226 ( $<0.0001$ )	9.8	1.141 (0.0038)	9.7	1.150 (0.0005)	9.7	1.180 ( $<0.0001$ )
7	8.0	0.939	6.8	0.976	7.2	0.953	6.8	0.912	7.2	0.927

Legend

i: food group  
1: Bread and cereals  
2: Meat and fish  
3: Dairy products

4: Oils and other fats  
5: Fruit  
6: Vegetables  
7: Confectionary

According to the Table 2 all uncompensated own price elasticities ( $e_{ii}$ ) are negative and less than 1. Demand for bread and cereals and demand for meat and fish seem to be the least sensitive to its own price changes. On the other hand, households tend to respond very rapidly to price changes in dairy products and vegetables when demanding them. Uncompensated own price elasticities do not vary systematically across income groups.

Hicksian own price elasticity estimates ( $e_{ii}^*$ ) in Table 2 have similar trend and as derived from theory also have smaller values as Marshallian ones. The estimates of compensated own price elasticities for bread and cereals, dairy products and especially for meat and fish are noticeably smaller than uncompensated. This indicates that income effect of their price change on their own quantity demanded is highly important when purchasing these food groups (Figures 1-5). Demand for meat and fish is almost inelastic to its own price changes. It is unusual that the lowest income households increase their purchases of meat and fish when these prices rise (positive sign of Hicksian own price elasticity). And again, own price elasticity for vegetables is the highest regardless of constant price effect of its price change.

Table 2. Uncompensated,  $e_{ii}$ , and compensated,  $e_{ii}^*$ , own price elasticities for aggregated food groups, four quartile income groups of households in Slovenia and Slovenia total, 2001.

Preglednica 2. Nekompenzirane,  $e_{ii}$ , in kompenzirane,  $e_{ii}^*$ , lastne cenovne elastičnosti agregatnih skupin živil, štirje kvartilni dohodkovni razredi gospodinjstev v Sloveniji in Slovenija skupaj, 2001.

i	1 <sup>st</sup> (low) income households		2 <sup>nd</sup> income households		3 <sup>rd</sup> income households		4 <sup>th</sup> (high) income households		Slovenia total	
	$e_{ii}$	$e_{ii}^*$	$e_{ii}$	$e_{ii}^*$	$e_{ii}$	$e_{ii}^*$	$e_{ii}$	$e_{ii}^*$	$e_{ii}$	$e_{ii}^*$
1	-0.539	-0.330	-0.479	-0.291	-0.467	-0.287	-0.438	-0.269	-0.474	-0.299
2	-0.206	0.038	-0.374	-0.092	-0.340	-0.064	-0.397	-0.128	-0.332	-0.056
3	-0.842	-0.607	-0.821	-0.583	-0.817	-0.576	-0.766	-0.508	-0.814	-0.565
4	-0.596	-0.556	-0.630	-0.592	-0.512	-0.475	-0.539	-0.502	-0.570	-0.534
5	-0.579	-0.503	-0.508	-0.436	-0.578	-0.502	-0.412	-0.329	-0.520	-0.437
6	-0.901	-0.779	-0.924	-0.809	-0.785	-0.664	-0.794	-0.674	-0.852	-0.737
7	-0.596	-0.521	-0.645	-0.581	-0.535	-0.468	-0.551	-0.487	-0.576	-0.509

Legend

i: food group	4: Oils and other fats
1: Bread and cereals	5: Fruit
2: Meat and fish	6: Vegetables
3: Dairy products	7: Confectionary

Our study contains uncompensated and compensated cross and own price elasticities although only the latter are presented in this paper (Table 2). With cross price elasticities close to zero most of the food groups seem to be unrelated. Uncompensated cross price elasticities are mostly negative indicating complementary type of food groups. Hicksian cross price elasticities have mostly positive sign suggesting substitution relationship of aggregated foods.

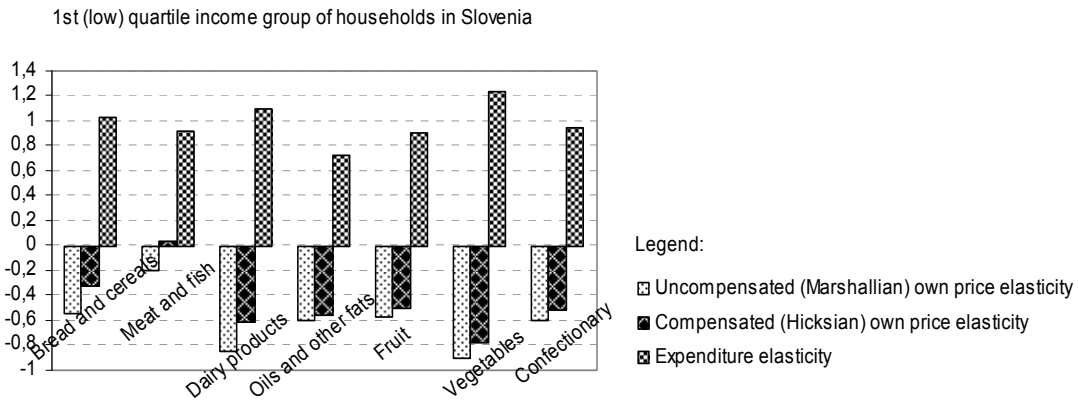


Figure 1. Uncompensated,  $e_{ii}$ , and compensated,  $e_{ii}^*$ , own price elasticities and expenditure elasticities,  $\eta_i$ , for aggregated food groups, 1<sup>st</sup> (low) quartile income group of households in Slovenia, 2001.

Slika 1. Nekompenzirane,  $e_{ii}$ , in kompenzirane,  $e_{ii}^*$ , lastne cenovne elastičnosti in izdatkovne elastičnosti,  $\eta_i$ , agregatnih skupin živil, prvi (nižji) kvartilni dohodkovni razred gospodinjstev v Sloveniji, 2001.

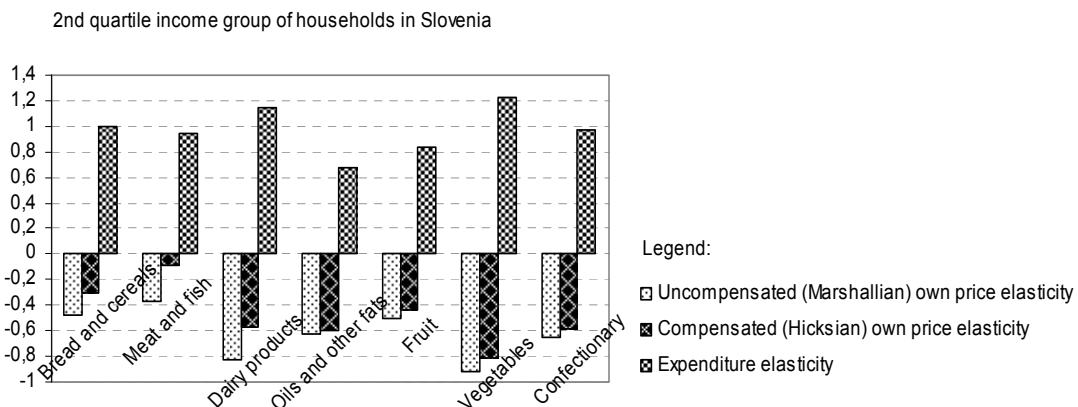


Figure 2. Uncompensated,  $e_{ii}$ , and compensated,  $e_{ii}^*$ , own price elasticities and expenditure elasticities,  $\eta_i$ , for aggregated food groups, 2nd quartile income group of households in Slovenia, 2001.

Slika 2. Nekompenzirane,  $e_{ii}$ , in kompenzirane,  $e_{ii}^*$ , lastne cenovne elastičnosti in izdatkovne elastičnosti,  $\eta_i$ , agregatnih skupin živil, drugi kvartilni dohodkovni razred gospodinjstev v Sloveniji, 2001.

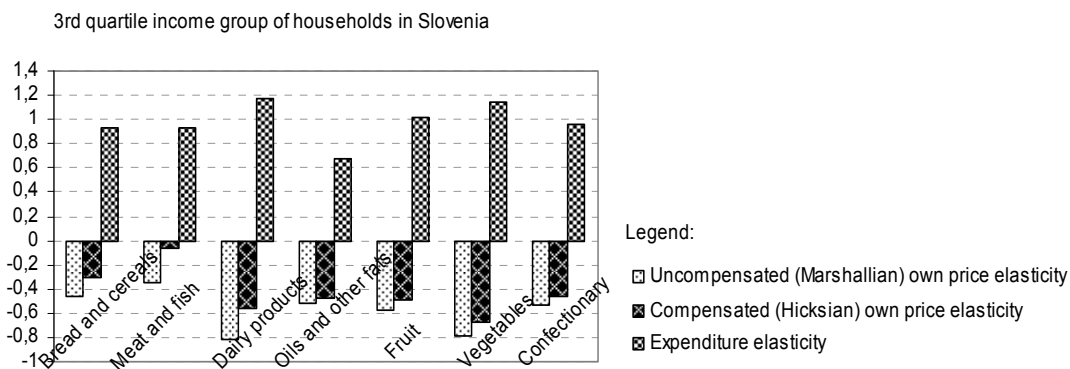


Figure 3. Uncompensated,  $e_{ii}$ , and compensated,  $e_{ii}^*$ , own price elasticities and expenditure elasticities,  $\eta_i$ , for aggregated food groups, 3rd quartile income group of households in Slovenia, 2001.

Slika 3. Nekompenzirane,  $e_{ii}$ , in kompenzirane,  $e_{ii}^*$ , lastne cenovne elastičnosti in izdatkovne elastičnosti,  $\eta_i$ , agregatnih skupin živil, tretji kvartilni dohodkovni razred gospodinjstev v Sloveniji, 2001.

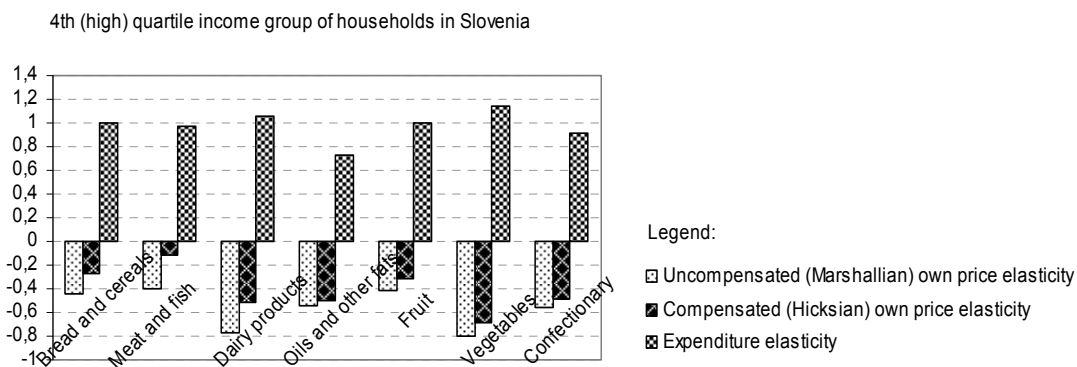


Figure 4. Uncompensated,  $e_{ii}$ , and compensated,  $e_{ii}^*$ , own price elasticities and expenditure elasticities,  $\eta_i$ , for aggregated food groups, 4<sup>th</sup> (high) quartile income group of households in Slovenia, 2001.

Slika 4. Nekompenzirane,  $e_{ii}$ , in kompenzirane,  $e_{ii}^*$ , lastne cenovne elastičnosti in izdatkovne elastičnosti,  $\eta_i$ , agregatnih skupin živil, četrti (višji) kvartilni dohodkovni razred gospodinjstev v Sloveniji, 2001.



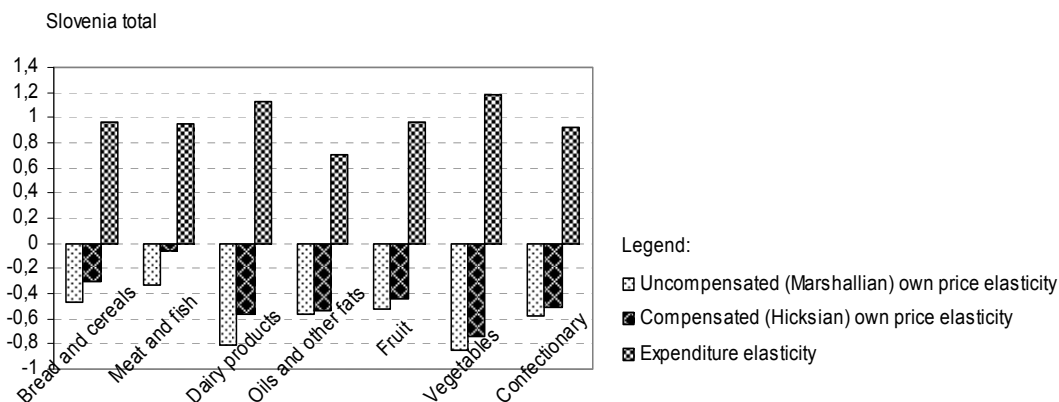


Figure 5. Uncompensated,  $e_{ii}$ , and compensated,  $e_{ii}^*$ , own price elasticities and expenditure elasticities,  $\eta_i$ , for aggregated food groups, Slovenia total, 2001.

Slika 5. Nekompenzirane,  $e_{ii}$ , in kompenzirane,  $e_{ii}^*$ , lastne cenovne elastičnosti in izdatkovne elastičnosti,  $\eta_i$ , agregatnih skupin živil, Slovenija skupaj, 2001.

## CONCLUSION

In this study we modelled food demand in Slovenia as a system of equations using LA/AIDS method (Deaton and Muellbauer, 1980). To investigate consumer purchasing habits in Slovenia we estimated demand elasticities for four quartile income groups of households and for all households (Slovenia total) in year 2001.

Our results confirm findings (Huang and Lin, 2000; Conforti et al., 2000; Erjavec and Turk; 1998) that items in bread and cereals group are treated as a normal good, which is relatively insensitive to its own price changes. A characteristic typical for lower income countries (Katchova and Chern, 2004) still appeared in post-transition Slovenia that is, the lowest income households in Slovenia treat these items as luxury goods. Remaining groups of households regard this food group as a normal good. However, both conclusions cannot be statistically proven. These findings could be explained with rising trend in consumption of bread and cereals (Duffy, 2001) or with a shift in consumption of different items within this food group (Abdulah et. al., 1999).

Decreasing food elasticity of meat and fish demand in Slovenia since 1988 is an obvious example of consumption patterns' changes from ones distinctive of transition countries (Erjavec and Turk, 1998; Stavrev and Kambourov, 1999) towards ones typical of developed countries (Duffy, 2001; Ledezma et al., 2002; Huang and Lin, 2000). This weak responsiveness to food expenditures and its own price changes is mainly due to constant (Duffy, 2001; Ledezma et al., 2002; Huang and Lin, 2000) or, in our case, decreasing (Volk, 2004) share of meat consumption.

Since 1988 consumers in Slovenia have been increasing purchases of dairy products when their income has been increasing. This country specific consumption pattern,

which is similar to that in France, might be explained with relatively high demand share of dairy products (Ledezma et al., 2002). On the other hand, own price elasticities have been rising ever since. Consumption shifts within this food group might have caused this trend (Huang and Lin, 2000) but only further analysis could confirm that.

Characteristics in fruit demand and vegetables demand have drastically changed in 2001 compared to Slovenia's transition period (Erjavec and Turk, 1998) as well as compared to other countries (Ledezma et al., 2002; Huang and Lin, 2000; Katchova and Chern, 2004; Abdulah et al., 1999). In 2001 fruit was treated as normal good and vegetable as luxury good. Ledezma et al. (2002) explained this peculiarity from supply side point of view: most of the fruit is imported, whereas vegetables are produced domestically. On the contrary, in 2001 demand for vegetables was more sensitive to its own price changes than demand for fruit which is again just the opposite to findings of countries concerned (Ledezma et al., 2002; Huang and Lin, 2000; Katchova and Chern, 2004; Abdulah et al., 1999). From Slovene transition period own price elasticities for fruit have dropped even further in 2001, while vegetables' own price elasticities have grown noticeably. This outcome might be explained with the assumption that share of home produced vegetables in Slovenia is higher than home production of fruit. Nevertheless, consumption of fruit in Slovenia has been rising quicker than consumption of vegetables (Volk, 2004) implying that consumption habits in demands of fruit and vegetables in Slovenia are changing.

Knowledge of demand elasticities and their trends gives us an overview of consumption habits of a certain population. This is an important information for policy makers (food policy), researchers (sector analysis) and companies (pricing policy, marketing actions) so reliable food demand parameters are fundamental for further analysis. Applying LA/AIDS method enabled us to gain more reliable food demand parameters than those obtained with Engel curves method as it was a long Slovenian experience in the past. Nevertheless, there are still some limitations of this study. As all (ex) countries in transition Slovenia lacks of appropriate data. In our case price data for seven food groups had to be calculated across households. Broad span of these values indicated that quality of food is important but was ignored in the study. This implies that price elasticities would probably be different when quality impact would have been excluded (Stavrev and Kambourov, 1999). Another disadvantage that rises from data shortage is a choice of alternative method. LA/AIDS model has been constantly improving but recent models claim for time series data (e.g. dynamic AIDS) or more disaggregated data (e.g. quadratic AIDS), which are not available in Slovenia yet. Further food demand analysis applying disaggregated data of food group would be interesting as it could reveal if changes within each group really imply higher demand elasticities as it is usually the case in developed countries. Factors such as consumer's age, field of occupation, number of children, etc. proved to be more important than income (expenditure) level and prices when demanding different food items (Conforti et al., 2000). Since Slovene household budget survey does contain non economic factors further analysis should study their impact on food demand in Slovenia.

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