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Abstract

The article investigates the demand for food in Slovenia in the period of 1988–2008 by employing an Almost Ideal Demand System based on Household Budget Survey datasets with own production included. It was established that the demand for food was mostly inelastic, while the responsiveness of households to income and food prices was in general increasing with time. Even though expenditure shares for food did not vary much by income brackets, there were some differences in the elasticities. By taking own production into account, the elasticities of food demand decreased. Overall, Slovenians preserved quite uniform nutritional habits during the transition period; changing to some extent with time, but not much in the structure by disposable income.

JEL classification: C30, D12, P20, Q11.

Keywords: Almost Ideal Demand System, demand for food, elasticities, seemingly unrelated regressions, Slovenia, transition.

1. Introduction

Food has a specific place in the structure of consumption expenditure of households, which is reflected in the share of expenditure for food in total consumption expenditure. Namely, according to the Household Budget Survey (HBS) data, the latter amounted in Slovenia to some 20–35% in the last three decades (SORS, 2012). The awareness of stylized facts about food demand is thus very useful for various policy makers, as it supports choosing the most suitable policy measures related to food standards, and consequently facilitates achieving the nutrient balance. At the same time, a detailed understanding of food demand is crucial for the implementation of sectoral and macroeconomic policies (Sadoulet and de Janvry, 1995).

The volume and structure of the demand for food are related to various determinants. These are primarily economic, but also demographic, social and other (*cf*. Deaton and Muellbauer, 1980b; Edgerton *et al*., 1996; Unnevehr *et al*., 2010). Within the scope of economic determinants of the demand for food, the market price of a given good, consumer's income, and market prices of substitute and complementary goods play the most important roles.

In Slovenia and in other Central and Eastern European Countries (CEECs), comprehensive empirical research related to demand for various goods is quite scarce. We are aware of two studies for Slovenia, where the demand for food was estimated by employing a system of equations; Erjavec and Turk (1998), and Regoršek (2005). Prior to these two studies, the analysis of the demand for food in Slovenia was based on quite rudimentary (partial) single-equation estimation of Engel curves.

Erjavec and Turk (1998) estimated expenditure and price elasticities of the demand for seven commodity groups of food in Slovenia for the years 1988 and 1993. They used a linearized version of the Almost Ideal Demand System (AIDS) model (LA/AIDS model), initially developed by Deaton and Muellbauer (1980a), and HBS data with own production included. The results of the analysis showed that in 1988 and 1993 fruit and dairy products were luxury goods, while most commodity groups exhibited inelastic demand. Additionally, cross-price elasticities were indicating a complementary nature of food products. The level of relative prices and the level of total expenditure turned out to be the most important determinants of food demand in Slovenia. In 1993, the households were more responsive to changes in prices of meat and cereal products, compared to 1988 (Erjavec and Turk, 1998, p. 537).

Regoršek (2005) performed a similar analysis for Slovenia for the year 2001, i.e. she estimated expenditure and price elasticities of the demand for seven commodity groups of food with a LA/AIDS model employing HBS data, this time not including own production. She established, by finding own-price elasticities all being negative and smaller than one in absolute terms, that the responsiveness of households to prices of food products was still relatively low. Within that, the elasticities turned out to be the lowest for meat and fish, and bread and cereals, and the highest for dairy products, and vegetables. By calculating cross-price elasticities, Regoršek (2005) confirmed the complementary nature of food products, whereas the demand for food was influenced the most by prices of bread and cereals, and meat and fish (Regoršek, 2005, p. 65).

Apart from the abovementioned studies for Slovenia, only a few comprehensive studies of food demand systems exist for CEECs. Hossain and Jensen (2000) estimated a LA/AIDS model of food demand for Lithuania, covering the period from 1992 to 1994. Elsner (1999) performed a similar analysis for Russia, based on data for the year

1996. Yu *et al*. (2003) estimated alternative demand systems for several economies, including transition economies. They published elasticities of demand for food for the year 1985, and their projections for the year 2020. Stehrer (2001) reported the results of European Comparison Project (ECP), where an AIDS model was employed to study demand in 52 mainly European countries. The study was based on cross-section data on consumption expenditure and price levels for the year 1996, with several CEECs included. Podkaminer (2004) later employed updated ECP data for the year 1999 in order to assess the demand for food in Europe by the year 2010. Abler (2010) summarized structural changes in the demand for agricultural products in a number of large developing economies. The results reported in his paper were based mainly on AIDS and LA/AIDS models, and included transition economies.

The scarcity of research on food demand for Slovenia and other CEECs, and absence of comprehensive demand models were the main reasons for research that led to the present article. The purpose of this article is thus to investigate the demand for food in Slovenia in the transition (and in part post-transition) period of 1988–2008. This encompasses building a system of demand equations for food products, estimating the parameters of an AIDS model, calculating expenditure and price elasticities of the demand for food, and performing a temporal comparison of the results. Empirical analysis was performed on Slovenian HBS data (SORS, 2012) for the years 1988, 1998 (1997–1999) and 2008 (2007–2009).

The choice of time period used for the analysis, i.e. 1988–2008, was determined by the transition period in Slovenia. Namely, since the late ‘80s, the Republic of Slovenia has gone through intensive processes of economic transformation, characterized by economic liberalisation that resulted in privatisation of companies, elimination of trade barriers, creation of a financial sector, and an overall emphasis on market prices (Mrak *et al*., 2004; *cf*. Berthomieu and Ri, 2009). Dynamic changes in the Slovenian economy during this period have led to gradual changes in both price levels and in relative prices, thus influencing both real income levels and the income distribution.

Advances of the research, presented in this article, compared to the previous studies for Slovenia (and other CEECs), are fourfold. First, we employ the original AIDS model, and not its linearized (approximated) version (LA/AIDS model), thus improving the arrangement of goods bundles within the model and gaining in precision of the results. Second, a non-linear seemingly unrelated regression (SUR) estimator was employed to estimate the parameters, thus gaining in flexibility of the model specification and efficiency of the estimates. Third, all the elasticities, calculated based on the regression coefficients, were equipped with proper significance levels (*p*–values), thus enabling proper statistical inference and robust conclusions. And fourth, we included own production (evaluated at average prices), and for the first time explicitly analyzed its effects on the results.

By employing an AIDS econometric model for Slovenia, we tested for four main hypotheses, and shall give in this article the most important findings. First, the demand for food is mostly inelastic. The largest share of the expenditure for food can be attributed to meat (and fish) products, which exhibit the highest elasticities and can be classified as luxury goods. Second, there are no substantial differences in expenditure shares and elasticities for various commodity groups among the income brackets. Third, the behaviour of consumers with regard to food demand is changing during the transition period, i.e. the responsiveness of households to income and food prices is in

general increasing with time. And fourth, by taking own production into account, the elasticities of food demand decrease for various commodity groups.

The outline of the article is as follows. In Section 2, the AIDS model is briefly described and the calculation of elasticities is presented. In Section 3, the HBS data is presented, with emphasis on the structure of consumption expenditure, and expenditure for food in particular. In Section 4, the results of our analysis are illustrated, partitioned into expenditure elasticities, own-price elasticities, and cross-price elasticities of the demand for food. In the final section, we summarize the main findings of the article.

2. The methodology

Structural changes in the demand for food can be identified based on price and expenditure elasticities of the demand for food. These can be estimated traditionally by employing Engel curves for individual goods (single-equation estimation) or by employing a technically more challenging demand system (multivariate model estimation). Between these two approaches, we opted for the latter.

There exist several algebraic specifications of demand systems, dominated in empirical research by the Linear Expenditure System (LES), developed by Stone (1954), the Rotterdam model, developed separately by Barten (1964) and Theil (1965), the Generalised Leontief model, developed by Diewert (1971), the Translog model, developed by Christensen *et al*. (1975), and the Almost Ideal Demand System (AIDS), developed by Deaton and Muellbauer (1980a). The key differences among the various model specifications are introduced at the level of defining the dependent variable and interpreting the parameters of the estimated model (*cf*. Alston and Chalfant, 1993; Mergos and Mizzi, 1998).

Due to its many advantages, we chose the AIDS model to perform an econometric analysis of the demand for food in Slovenia. As summarized by Buse (1994), the AIDS model is founded on a well-structured analytical framework, adapted for various types of aggregation, suitable for estimation, and allows for testing of standard constraints of the classical theory of demand. It is capable of explaining a large portion of the variability in the shares of consumption expenditure, and is especially suitable for the analysis of food demand (Deaton and Muellbauer, 1980b). Namely, the AIDS model performs best in the case of high substitutability among the analyzed goods, and equally well in cases of low and moderate substitutability as i.e. the Rotterdam model (*cf*. Blanciforti and Green, 1983; Barnett and Seck, 2008; Abler, 2010).

Even though in practice the most commonly used version is the linearized AIDS model (LA/AIDS model), we opted for the more technically demanding original AIDS model. This enables us to improve the arrangement of commodity groups within the model and increase efficiency (precision) of the results (*cf*. Alston *et al*., 1994; Edgerton *et al*., 1996; Barnett and Seck, 2008), as the elasticities are no longer approximations, for the cost of higher technical complexity of econometric estimation.

The AIDS model of Deaton and Muellbauer (1980a) incorporates the PIGLOG (logarithm of price independent generalized linearity) class of consumer preferences, which permits perfect aggregation over consumers. The representation of this class of preferences is obtained by using the cost (expenditure) function $c(u, p)$ that defines the minimum expenditure necessary to attain a level of utility u given prices p:

$$\log c(u, p) = (1-u)\log a(p) + u \log b(p)\,. \qquad (1)$$

The practical application of the PIGLOG class of preferences requires selection of specific functional forms for the functions of prices $a(p)$ and $b(p)$ as linear, homogeneous, concave functions of prices p. Thus, the following functional forms have been proposed (*cf*. Syriopoulos and Sinclair, 1993; Yang and Koo, 1994):

$$\log a(p) = \alpha_0 + \sum_{i=1}^{J} \alpha_i \log p_i + \frac{1}{2} \sum_{i=1}^{J} \sum_{j=1}^{J} \gamma_{ij}^{*} \log p_i \log p_j \tag{2}$$

and

$$\log b(p) = \log a(p) + \beta_0 \prod_{i=1}^{J} p_i^{\beta_i} , \tag{3}$$

where p_j stands for the price of commodity group j, j = 1, ..., J, and α_i, β_i and γ_{ij}^{*} are the parameters. The AIDS cost function becomes:

$$\log c(u, p) = \alpha_0 + \sum_{i=1}^{J} \alpha_i \log p_i + \frac{1}{2} \sum_{i=1}^{J} \sum_{j=1}^{J} \gamma_{ij}^{*} \log p_i \log p_j + u\beta_0 \prod_{i=1}^{J} p_i^{\beta_i} . \tag{4}$$

Since it is a fundamental property of the cost function that its price derivatives are the quantities demanded, q_i, then:

$$\frac{\partial c(u, p)}{\partial p_i} = q_i . \tag{5}$$

Multiplying both sides of expression (5) by $p_i / c(u, p)$ gives, in logarithmic form:

$$\frac{\partial \log c(u, p)}{\partial \log p_i} = \frac{p_i q_i}{c(u, p)} = w_i , \tag{6}$$

where w_i is the share of food expenditure for commodity groups i. Differentiating in $\log p_i$ from expression (4), taking account of expressions (5) and (6), and taking $\gamma_{ij} = \frac{1}{2}\left(\gamma_{ij}^{*} + \gamma_{ji}^{*}\right)$, the AIDS model is obtained, where a system of budget share equations is defined for each of $J - 1$ commodity groups as:

$$w_i = \alpha_i + \sum_{j=1}^{J} \gamma_{ij} \log p_j + \beta_i \log\{x / P\} + \varepsilon_i , \qquad i = 1, ..., J-1 , \tag{7}$$

with x representing the consumption expenditure for all J commodity groups in the system, and ε_i representing an independent and identically distributed (IID) stochastic variable. The aggregate price index P can be further defined as:

$$\log P = \alpha_0 + \sum_{i=1}^{J} \alpha_i \log p_i + \frac{1}{2} \sum_{i=1}^{J} \sum_{j=1}^{J} \gamma_{ij} \log p_i \log p_j \,. \tag{8}$$

We categorize J commodity groups in our demand system, and thus have $J - 1$ demand equations (expenditure share equations), as in the framework of a coherent demand system the $J - 1$ equations identify also the parameters of the J-th commodity group. In our system of food demand there are seven commodity groups, and thus six expenditure share equations. The parameters of the J-th (in our case the seventh) commodity group are obtained by applying the following constraints:

$$\sum_{i=1}^{J} \alpha_i = 1, \qquad \sum_{i=1}^{J} \beta_i = 0, \qquad \gamma_{ij} = \gamma_{ji}, \qquad \sum_{i=1}^{J} \gamma_{ij} = 0 \,. \tag{9}$$

Expression (9) thus represents the theoretical constraints of addition, homogeneity and symmetry, which are introduced into the demand system to assure its integrability, i.e. fulfilment of the adding-up condition $\sum_i w_i = 1$. The addition constraint simply means that a household cannot spend more than its total disposable income. The homogeneity (of degree zero) constraint assures unchanged demand with proportional changes in prices and income. The symmetry constraint, arising from the Slutsky equation, implies that the effect of a unit increase in the price of good j on the demand of good i is equal to the effect of a unit increase in the price of good i on the demand of good j. The addition constraint is fulfilled implicitly by construction of the datasets, while the homogeneity and symmetry constraints need to be imposed explicitly onto the system of demand equations (*cf.* Asche, 1996).

The expenditure share equations for various commodity groups have different dependent variables (shares of expenditure for a given commodity group in the total expenditure for food), but the same set of explanatory variables. Each equation, represented by expression (7), is a valid regression equation that could be estimated separately from the other $J - 1$ equations, thus such a system of equations is known in econometrics as "seemingly unrelated regressions" (SUR). The application of ordinary least squares estimator (OLS) gives consistent, but in general inefficient estimates of regression coefficients. The latter can be attributed to the correlation of disturbances (captured in the stochastic variable u) among the expenditure share equations (Davidson and MacKinnon, 2004, pp. 501–517).

To obtain efficient estimates of the regression coefficients (and thus also of the elasticities), the system of equations (7)–(8) was estimated by applying a SUR-type estimator. In doing so, we tried to remain as general as possible, thus no (limiting) assumptions were imposed on the form of the variance-covariance matrix and on the distribution of the disturbances (StataCorp, 2009, pp. 1239–1243, 1252–1262). Consequently, the iterative feasible generalized nonlinear least squares (iterative FGNLS) estimator was used (a substitutable expression program was written in Stata for this purpose and is available upon request).

Once the regression coefficients α_i, β_i and γ_{ij} are estimated, the expenditure elasticity of the demand for food, $e_{x,i}$, can be obtained by using the following formula (*cf.* Green and Alston, 1990, p. 444; 1991, p. 874):

$$e_{x,i} = 1 + \left(\frac{1}{w_i}\right)\left(\frac{\partial w_i}{\partial \ln x}\right) = 1 + \frac{\beta_i}{w_i}, \tag{10}$$

while the Marshallian or uncompensated own- and cross-price elasticities of the demand for food, e_{ij}^M, can be obtained by applying the following formula:

$$e_{ij}^M = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i}{w_i}\left(\alpha_j + \sum_{k=1}^{J-1}\gamma_{kj} \ln p_k\right), \tag{11}$$

where δ_{ij} denotes the Kronecker delta (being equal to one for $i = j$, and zero otherwise). The elasticities (11) refer to allocations within a given commodity group at unchanged total expenditure for food x and unchanged all other prices $p_k, k \neq j$ (i.e. all prices, except the price of the given commodity group under analysis).

3. The data

For the purpose of our analysis we employ Household Budget Survey (HBS) data, provided by the Statistical Office of the Republic of Slovenia (SORS, 2012) as statistically protected micro datasets for the years 1988, 1998 (1997–1999) and 2008 (2007–2009). Up to 1997, the HBS was conducted in five-year intervals on a relatively large sample of some 3,500 households. In 1997, it was adapted based on Eurostat recommendations and is now conducted on smaller samples continuously, i.e. throughout each year, where the data from each consecutive three years are then combined to some 3,700 households and recalculated to the middle year (the reference year).

In order to prepare a uniform database with all the required variables, several adjustments were necessary. First, the structure of household expenditure needed to be harmonized among the three datasets. Namely, in 1988 the consumables were classified in the HBS according to the former "balance-sheet approach" (*cf.* SORS, 2006), which differs from the Classification of Individual Consumption According to Purpose (COICOP), used by the SORS from 1997 onwards. Thus, we matched the household expenditure in the 1988 dataset with the COICOP that was already applied to the 1998 and 2008 datasets. Second, the structure of available assets of households needed to be harmonized among the three datasets. This was again based on the post-1997 HBS methodology, where the available assets can roughly be decomposed to available money assets, value of own production, and benefits in kind. Problematic observations (households with no expenditure for food, with no available assets etc.) were excluded from the sample at this stage.

Next, the micro data were aggregated to commodity divisions, groups and classes according to COICOP (*cf.* United Nations, 2000), with some modifications. Within the group "01.1 – Food", which is the primary subject of our analysis, commodity classes

"Meat" and "Fish and seafood" were merged due to the low number of households with expenditure in the latter category. Additionally, commodity class "Sugar, jam, honey, chocolate and confectionery" was renamed to "Sugar and confectionery", while commodity class "Food products not elsewhere classified" was eliminated from the analysis, as quantities were not available. We thus obtain seven "commodity groups" of food: (1) bread and cereals, (2) meat, fish and seafood, (3) milk, cheese and eggs, (4) oils and fats, (5) fruit, (6) vegetables, and (7) sugar and confectionery.

Quantities in some commodity groups were adjusted accordingly (to kilograms), such that average prices can be calculated by commodity group and by household. As usual in applying AIDS models, in cases where we were not able to calculate a price for a particular household, the average price was imputed to preserve as many observations as possible in the database. Own production was evaluated using the average prices in order to obtain the value of goods that would have been paid if these goods were purchased. This is a common practice in HBS surveys and in the Statistics on Income and Living Conditions (SILC) survey.

To take into account the effects of household size and composition on consumption, equivalent income was used, i.e. the available assets of households were divided by the number of equivalent adults in the household, where the modified OECD equivalence scale was used (first adult in the household has weight 1, each additional adult has weight 0.5, and each child has weight 0.3). Finally, our database consisted of 2,825 observations in 1988, 3,383 observations in 1998, and 3,206 observations in 2008. Table 1 represents the structure of consumption expenditure in Slovenia in the period 1988–2008 at the top level of COICOP hierarchy.

Table 1. Structure of consumption expenditure in Slovenia, 1988–2008

Commodity group	Expenditure (in %)		
	1988	1998	2008
Food and non-alcoholic beverages	33.83%	27.94%	20.74%
Alcoholic beverages, tobacco and narcotics	3.32%	3.45%	2.91%
Clothing and footwear	10.01%	8.20%	7.22%
Housing, water, electricity, gas and other fuels	13.45%	12.19%	15.76%
Furnishings, household equipment and routine household maintenance	5.80%	6.62%	6.72%
Health	0.88%	1.66%	2.26%
Transport	10.31%	13.09%	13.04%
Communication	0.56%	2.27%	5.62%
Recreation and culture	6.72%	8.05%	9.39%
Education	0.25%	0.58%	0.74%
Restaurants and hotels	4.65%	5.04%	3.57%
Miscellaneous goods and services	10.22%	10.91%	12.03%
Total	100.00%	100.00%	100.00%

Source: SORS (2012); own calculations.

As can be seen from Table 1, consumption expenditure shares were changing in the course of time. On average, the highest shares of consumption expenditure of households in the period 1988–2008 relate to food and non-alcoholic beverages (27.25%), housing, water, electricity, gas and other fuels (13.79%), and transport

(12.24%). Together, these three commodity groups add up on average to more than half (53.28%) of consumption expenditure and roughly half (48.79%) of all expenditure of households. Highest increase in the share of consumption expenditure can be ascribed to communication (5.06 percentage points; from 0.56% in 1988 to 5.62% in 2008), while the highest decrease can be attributed to food and non-alcoholic beverages (13.09 percentage points; from 33.83% in 1988 to 20.74% in 2008). Both can be attributed to economic growth and technical progress, especially in a transition economy like Slovenia. The share of expenditure for essential goods and services, comprised of food and non-alcoholic beverages, clothing and footwear, and housing, water, electricity, gas and other fuels, was continuously decreasing; from 57.29% in 1988, 48.33% in 1998, to mere 43.72% in 2008.

The share of expenditure for food, the primary subject of our analysis, represented on average 24.96% of consumption expenditure and 22.77% of all expenditure of households in the period 1988–2008. The trend in the course of time was decreasing. Namely, expenditure for food amounted in 1988 to roughly one third (31.28%), in 1998 to roughly one quarter (25.38%), and in 2008 to less than one fifth (18.99%) of consumption expenditure of households. Table 2 represents the structure of expenditure for food in Slovenia in the period 1988–2008, classified according to commodity groups that were obtained as described above.

Table 2. Structure of expenditure for food in Slovenia, 1988–2008

Commodity group	Expenditure (in %)		
	1988	1998	2008
Bread and cereals	12.50%	15.26%	16.01%
Meat, fish and seafood	30.13%	30.29%	28.98%
Milk, cheese and eggs	18.40%	17.02%	17.56%
Oils and fats	2.94%	4.89%	4.86%
Fruit	13.42%	9.28%	10.42%
Vegetables	19.75%	17.10%	15.15%
Sugar and confectionery	2.86%	6.16%	7.02%
Total	100.00%	100.00%	100.00%

Source: SORS (2012); own calculations.

As can be seen from Table 2, expenditure shares for food were changing in the course of time in Slovenia as well, not just consumption expenditure shares as a whole. On average, the highest shares of expenditure for food in the period 1988–2008 relate to meat, fish and seafood (29.80%), milk, cheese and eggs (17.62%), and vegetables (17.23%). Together, these three commodity groups add up on average to almost two thirds (65.64%) of expenditure for food of households. Highest increase in the share of expenditure for food can be attributed to sugar and confectionery (4.16 percentage points; from 2.86% in 1988 to 7.02% in 2008), while the highest decrease can be attributed to vegetables (4.60 percentage points; from 19.75% in 1988 to 15.15% in 2008). A trend that is unfortunately in line nowadays with most modern economies. Expenditure shares for food of various commodity groups did not vary much by income brackets (quintiles) in the period 1988–2008 (not shown).

These findings should be relevant for agricultural and nutritionist policy makers, as it has been expected, according to Erjavec and Turk (1998, p. 533), that with higher economic growth a higher share of income is spent for milk and dairy products, fruit,

and vegetables. This does not seem to be the case for Slovenia in the transition (and in part post-transition) period of 1988–2008.

Structure of expenditure for food, presented in Table 2, includes own production that is now being explicitly shown in Table 3. As can be seen from Table 3, own production of food was continuously decreasing in the period 1988–2008; from 23.75% in 1988, 20.93% in 1998, to 14.96% of expenditure for food in 2008. On average, the highest share of own production relates to vegetables (8.68%), while the lowest share relates to sugar and confectionery (negligible 0.03%).

Table 3. Structure of expenditure for food in Slovenia, own production, 1988–2008

Commodity group	Expenditure (in %)		
	1988	1998	2008
Bread and cereals	0.91%	0.63%	0.38%
Meat, fish and seafood	4.22%	4.79%	3.23%
Milk, cheese and eggs	5.28%	2.99%	1.40%
Oils and fats	0.30%	0.33%	0.28%
Fruit	3.77%	2.60%	2.38%
Vegetables	9.26%	9.57%	7.23%
Sugar and confectionery	0.01%	0.02%	0.06%
Total	23.75%	20.93%	14.96%

Source: SORS (2012); own calculations.

Commodity groups with highest expenditure shares also experienced the highest decrease in own production in the period 1988–2008; 1.00 percentage point for meat, fish and seafood, 3.88 percentage points for milk, cheese and eggs, and 2.03 percentage points for vegetables. Most of the decrease occurred in the period 1998–2008, while there was even an increase for some commodity groups in the period 1988–1998. There were also differences in own production by income brackets (quintiles) in the period 1988–2008 (not shown). Namely, households in the first quintile had a substantially higher share of own production in total expenditure for food (29.09% on average), compared to the fifth quintile (11.30% on average).

4. The results

Due to obvious spatial limitations, we report hereinafter the estimated elasticities based on regression coefficients from the system of equations (7)–(8), and not the regression coefficients themselves. Due to the same reason, we report only the elasticities for whole (annual) samples with own production included, even though we also discuss the elasticities for quintiles within each sample and with own production excluded (both the regression coefficients of the estimated models and the elasticities not reported in this article are available upon request).

For each elasticity estimate, we report the corresponding *p*–value, calculated from the regression coefficients' standard errors. As can be seen from the model statistics in Table 4, the value of the (uncentered) multiple regression coefficient for the six share equations and the three analysed years ranged from 0.63 to 0.90.

Table 4. Summary statistics of the iterative FGNLS estimation of the SUR models

Statistic	Commodity group	1988	1998	2008
n		2,825	3,383	3,206
R^2 w_1	Bread and cereals	0.8306	0.8462	0.8174
R^2 w_2	Meat, fish and seafood	0.9009	0.8397	0.8360
R^2 w_3	Milk, cheese and eggs	0.7671	0.7929	0.7894
R^2 w_4	Oils and fats	0.7041	0.6341	0.6941
R^2 w_5	Fruit	0.7790	0.6654	0.7031
R^2 w_6	Vegetables	0.8363	0.7261	0.6952
ln L		27,804	26,997	25,340

Note: Iterative FGNLS estimation refers to iterative feasible generalized nonlinear least squares. The values of the uncentered multiple regression coefficient are reported.

Source: SORS (2012); own calculations.

4.1. Expenditure elasticities of the demand for food

Expenditure elasticities of the demand for food in Slovenia in the period 1988–2008 are given in Table 5. As can be seen from Table 5, the estimated elasticities are all statistically significant and range from 0.57 to 1.28. The most elastic demand was exhibited by commodity groups meat, fish and seafood (0.97–1.28), vegetables (1.04–1.22), and milk, cheese and eggs (0.97–1.24). These goods could therefore, at least in some years, be classified as luxury goods. Expenditure elasticities of the remaining commodity groups did not exceed the value of one in any of the analyzed years (inelastic behaviour of households, indicating normal goods). The least elastic demand was exhibited by commodity groups sugar and confectionery (0.57–0.74), and oils and fats (0.57–0.76).

Table 5. Expenditure elasticities of the demand for food in Slovenia, 1988–2008

Commodity group	Expenditure elasticity		
	1988	1998	2008
Bread and cereals	0.8541	0.6802	0.7959
	(0.000)	(0.000)	(0.000)
Meat, fish and seafood	0.9657	1.2537	1.2842
	(0.001)	(0.000)	(0.000)
Milk, cheese and eggs	1.2361	0.9816	0.9695
	(0.000)	(0.085)	(0.034)
Oils and fats	0.7571	0.6820	0.5716
	(0.000)	(0.000)	(0.000)
Fruit	0.9445	0.7852	0.8253
	(0.001)	(0.000)	(0.000)
Vegetables	1.0370	1.2175	1.1405
	(0.006)	(0.000)	(0.000)
Sugar and confectionery	0.7354	0.5677	0.6214
	(0.000)	(0.000)	(0.000)

Note: The corresponding statistical significance levels (p–values) are given in parentheses.

Source: SORS (2012); own calculations.

The expenditure elasticities were changing in the course of time in Slovenia (see Table 5). Some commodity groups exhibit a continuously increasing trend, like meat, fish and seafood (from 0.97 in 1988 to 1.28 in 2008). Others exhibit a continuously decreasing trend, like milk, cheese and eggs (from 1.24 in 1988 to 0.97 in 2008), or oils and fats (from 0.76 in 1988 to 0.57 in 2008). Most commodity groups do not exhibit a distinct continuous trend, though, but a change from 1988 to 1998 in one direction and a change from 1998 to 2008 in the opposite direction. The overall "direction" of expenditure elasticities for the remaining commodity groups is nevertheless clear; for bread and cereals, fruit, and sugar and confectionery the trend is decreasing, while for vegetables the trend is increasing with time.

Analysis of expenditure elasticities by income brackets (quintiles) reveals for the period 1988–2008 that by advancing to a higher income quintile the expenditure elasticities were slightly decreasing on average for commodity groups bread and cereals, and oils and fats, while they were slightly increasing on average for commodity groups meat, fish and seafood, and vegetables (not shown). The latter seems sensible, as commodity groups meat, fish and seafood, and vegetables were considered luxury goods overall in the time period under analysis. The expenditure elasticity for bread and cereals was quite high for all income quintiles, which could have resulted from an increase in high-quality supply of cereal products domestically and abroad, favoured by consumers with an increasing standard of living (*cf*. Erjavec and Turk, 1998, p. 534).

As established in Section 3, own production represented an important share of expenditure for food in the period 1988–2008, and thus its presence in the market could also affect the demand elasticities. Comparison of results with own production included to results without own production (not shown) revealed that by including own production the expenditure elasticities for meat, fish and seafood, and bread and cereals significantly decreased, while this discrepancy exhibited a "dynamic" that is in line with structure and time development of own production, shown in Table 3. This means, for example, that the decreasing share of own production of meat, fish and seafood was matched by a decreasing difference between the expenditure elasticity without own production and expenditure elasticity with own production included.

International comparisons are extremely cumbersome, even with those few CEECs, for which estimated elasticities from similar models are available. The main reason lies in differences in aggregation to commodity groups. Hossain and Jensen (2000) found the following expenditure elasticities for Lithuania, based on 1992–1994 data: 0.66 for grains, 1.3 for meat (own weighted average), 0.84 for milk, 0.68 for eggs, 1.06 for fruit and vegetables, and 1.21 for sugar and confectionery. Elsner (1999) estimated the following expenditure elasticities for Russia, based on 1996 data: 0.5 for cereals (own weighted average), 0.8 for meat and seafood (own weighted average), 1.07 for milk, 0.91 for oils and fats, 1.05 for fruit, 1.40 for vegetables, and 0.8 for sugar and sweets (own weighted average). Taking into account similar time periods, one can observe comparable values of expenditure elasticities, with differences exhibiting to a large extent discrepancies in the standard of living among the CEECs on one hand, and differences in industry priorities on the other.

4.2. Own-price elasticities of the demand for food

Own-price elasticities of the demand for food in Slovenia in the period 1988–2008 are given in Table 6. As can be seen from Table 6, the estimated elasticities are all

statistically significant and range from –0.32 to –1.07. The most elastic demand was exhibited (as in Section 4.1.) by commodity groups meat, fish and seafood (from –0.65 to –1.07), vegetables (from –0.74 to –0.96), and milk, cheese and eggs (from –0.62 to –0.87). The behaviour of households with respect to prices of goods can thus be considered as inelastic, except for the commodity group meat, fish and seafood that exhibited an elasticity slightly greater than one in 1998 and 2008. The least elastic demand was exhibited by commodity groups oils and fats (from –0.32 to –0.72), and bread and cereals (from –0.36 to –0.75). The latter can be attributed to the essential role of bread in the nutrition of Slovenians (Erjavec and Turk, 1998, p. 534).

Table 6. Own-price elasticities of the demand for food in Slovenia, 1988–2008

Commodity group	Price elasticity		
	1988	1998	2008
Bread and cereals	–0.3630	–0.7512	–0.6990
	(0.000)	(0.000)	(0.000)
Meat, fish and seafood	–0.6498	–1.0563	–1.0726
	(0.000)	(0.021)	(0.036)
Milk, cheese and eggs	–0.6204	–0.7343	–0.8711
	(0.000)	(0.058)	(0.034)
Oils and fats	–0.3164	–0.6151	–0.7212
	(0.000)	(0.000)	(0.000)
Fruit	–0.7417	–0.7522	–0.6740
	(0.000)	(0.000)	(0.000)
Vegetables	–0.7445	–0.9572	–0.8571
	(0.003)	(0.000)	(0.000)
Sugar and confectionery	–0.5562	–0.7641	–0.7776
	(0.000)	(0.000)	(0.000)

Note: The corresponding statistical significance levels (*p*–values) are given in parentheses.

Source: SORS (2012); own calculations.

The own-price elasticities were changing in the course of time in Slovenia (see Table 6). Most commodity groups exhibit a continuously increasing trend in absolute terms, like meat, fish and seafood (from –0.65 in 1988 to –1.07 in 2008), milk, cheese and eggs (from –0.62 in 1988 to –0.87 in 2008), oils and fats (from –0.32 in 1988 to –0.72 in 2008), and sugar and confectionery (from –0.56 in 1988 to –0.78 in 2008). Some commodity groups exhibit a relative idleness (like fruit) or a slight regression after an increasing trend (like bread and cereals, and vegetables). These changes can be attributed to a large extent to changing nutritional habits of the Slovenian population, as it was observed already by Erjavec and Turk (1998) that the attitude towards consumption of meat, fruit and vegetables is gradually changing with time. An additional factor that affects the price elasticities of food demand are economic crises that decrease household income, though the consequences of late-2000s recession are probably not going to be reflected in Slovenia until the post-2008 HBS data.

Analysis of own-price elasticities by income brackets (quintiles) reveals for the period 1988–2008 that by advancing to a higher income quintile the own-price elasticities were slightly decreasing (in absolute terms) on average for commodity group bread and cereals, while they were slightly increasing on average for commodity groups fruit, and vegetables (not shown). In general, there were no major changes in own-price

elasticities by income quintiles, indicating that Slovenians have developed or (better said) preserved quite uniform nutritional habits during the transition period; changing to some extent with time, but not much in the structure by disposable income.

Comparison of results with own production included to results without own production (not shown) revealed that by including own production the own-price elasticities decreased on average (in absolute terms). This is a result of two "forces": (1) a substantial portion of supply being less price-sensitive, and (2) an increased supply of a good in the market imposing a downward pressure on its price. The magnitude of this effect was in line (as in Section 4.1.) with structure and time development of own production, shown in Table 3; in 1988, when the share of own production in the expenditure for food was relatively large, the difference between an elasticity without own production and an elasticity with own production included was relatively high, while by 2008 this difference decreased substantially.

As in the previous section, we will once more attempt to present the most relevant international comparisons. Hossain and Jensen (2000) found the following own-price elasticities for Lithuania, based on 1992–1994 data: –0.44 for grains, –1.2 for meat (own weighted average), –0.59 for milk, –0.94 for eggs, –0.90 for fruit and vegetables, and –0.74 for sugar and confectionery. Elsner (1999) estimated the following own-price elasticities for Russia, based on 1996 data: –0.8 for cereals (own weighted average), –1.1 for meat and seafood (own weighted average), –1.27 for milk, –1.15 for oils and fats, –1.05 for fruit, –1.19 for vegetables, and –1.1 for sugar and sweets (own weighted average). Again, taking into account differences in the standard of living and industry priorities, these elasticities are quite comparable to ours.

4.3. Cross-price elasticities of the demand for food

Cross-price elasticities of the demand for food in Slovenia in the period 1988–2008 are given in Tables 7–9 (all off-diagonal elements). As can be seen from Tables 7–9, the estimated elasticities are mostly statistically significant and range in absolute terms (taking into account only the statistically significant ones) from 0.001 to 0.29. Low values of cross-price elasticities (indicating price-inelastic behaviour of households) were for the most part expected, as some commodity groups are broadly defined and quite heterogeneous. Most estimated elasticities were negative, indicating a complementary nature of the goods under consideration, while only a few were positive, thus indicating that these goods were substitutes.

Table 7. Own- and cross-price elasticities of the demand for food in Slovenia, 1988

Commodity group	Price elasticity						
	Bread and cereals	Meat, fish and seafood	Milk, cheese and eggs	Oils and fats	Fruit	Vegetables	Sugar and confectionery
Bread and cereals	**–0.3630**	–0.1443	–0.1125	–0.0256	–0.0635	–0.1385	–0.0067
	(0.000)	(0.000)	(0.000)	(0.016)	(0.001)	(0.000)	(0.142)
Meat, fish and seafood	–0.0738	**–0.6498**	–0.1301	–0.0274	–0.0443	–0.0429	0.0027
	(0.000)	**(0.000)**	(0.000)	(0.017)	(0.001)	(0.000)	(0.373)
Milk, cheese and eggs	–0.1241	–0.2946	**–0.6204**	–0.0385	–0.0414	–0.0693	–0.0478
	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.326)	(0.156)	(0.000)
Oils and fats	–0.0966	–0.2180	–0.1526	**–0.3164**	–0.0607	0.1356	–0.0484
	(0.016)	(0.000)	(0.000)	**(0.000)**	(0.017)	(0.008)	(0.005)
Fruit	–0.0704	–0.0931	–0.0031	–0.0188	**–0.7417**	–0.0486	0.0312
	(0.001)	(0.001)	(0.327)	(0.017)	**(0.000)**	(0.006)	(0.000)
Vegetables	–0.1105	–0.0869	–0.0279	0.0120	–0.0454	**–0.7445**	–0.0336
	(0.003)	(0.003)	(0.159)	(0.011)	(0.009)	**(0.003)**	(0.003)
Sugar and confectionery	–0.0142	0.0977	–0.2154	–0.0491	0.1744	–0.1726	**–0.5562**
	(0.142)	(0.373)	(0.000)	(0.005)	(0.000)	(0.000)	**(0.000)**

Note: The corresponding statistical significance levels (*p*–values) are given in parentheses. Own-price elasticities are printed in boldface.

Source: SORS (2012); own calculations.

As can be seen from Tables 7–9, there were several complementary relationships between the price and the demand of different commodity groups in the period 1988–2008. First, there was a two-way relationship between commodity groups bread and cereals, and meat, fish and seafood, where those cross-price elasticities that were statistically significant remained relatively stable in the course of time. Then, there were several two-way relationships, where the two cross-price elasticities decreased substantially from 1988 to 1998 and remained low in 2008. These were between commodity groups: (1) bread and cereals, and milk, cheese and eggs, (2) meat, fish and seafood, and milk, cheese and eggs, (3) milk, cheese and eggs, and sugar and confectionery, and (4) bread and cereals, and vegetables. Additionally, there was a two-way relationship between commodity groups bread and cereals, and oils and fats, where the two cross-price elasticities increased from 1988 to 1998. Some of these relationships were found already by Erjavec and Turk (1998) for the years 1988 and 1993.

In general, we can observe that the complementary nature of relationships between various commodity groups of food became weaker after the socioeconomic changes, implemented in the transition period, which can be attributed to less traditionally oriented and much richer supply of food in Slovenia in the last two decades. This happened on one hand due to the processes of economic integration of Slovenia into CEFTA and then the EU, and on the other hand due to globalization of agricultural markets and convergence of agricultural and nutritionist policies within the EU.

Table 8. Own- and cross-price elasticities of the demand for food in Slovenia, 1998

Commodity group	Price elasticity						
	Bread and cereals	Meat, fish and seafood	Milk, cheese and eggs	Oils and fats	Fruit	Vegetables	Sugar and confectionery
Bread and cereals	**–0.7512**	0.0933	–0.0211	–0.0439	0.0088	0.0197	–0.0280
	(0.000)	(0.436)	(0.020)	(0.000)	(0.046)	(0.006)	(0.000)
Meat, fish and seafood	–0.0405	**–1.0563**	–0.0960	0.0005	–0.0473	–0.0239	0.0098
	(0.044)	**(0.021)**	(0.020)	(0.000)	(0.046)	(0.006)	(0.001)
Milk, cheese and eggs	–0.0271	–0.0884	**–0.7343**	–0.0298	–0.0296	–0.0244	–0.0480
	(0.088)	(0.058)	**(0.058)**	(0.059)	(0.071)	(0.112)	(0.058)
Oils and fats	–0.1372	–0.1763	–0.0529	**–0.6151**	–0.0058	0.0040	–0.0513
	(0.000)	(0.035)	(0.001)	**(0.000)**	(0.082)	(0.027)	(0.000)
Fruit	–0.0016	–0.0125	–0.0209	–0.0081	**–0.7522**	–0.0135	0.0236
	(0.046)	(0.011)	(0.009)	(0.082)	**(0.000)**	(0.010)	(0.222)
Vegetables	–0.0644	–0.0313	–0.0645	–0.0250	–0.0474	**–0.9572**	–0.0277
	(0.006)	(0.065)	(0.036)	(0.027)	(0.010)	**(0.000)**	(0.049)
Sugar and confectionery	–0.0522	0.2558	–0.0621	–0.0351	0.0557	0.0343	**–0.7641**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.222)	(0.049)	**(0.000)**

Note: The corresponding statistical significance levels (*p*–values) are given in parentheses. Own-price elasticities are printed in boldface.

Source: SORS (2012); own calculations.

Apart from the above complementary relationships between the price and the demand of different commodity groups, we can also observe a few substitute relationships (see Tables 7–9). First, there was a two-way relationship between commodity groups fruit, and sugar and confectionery, where the two cross-price elasticities were statistically significant only in 1988. Next, there was a two-way relationship between commodity groups vegetables, and oils and fats, where the two cross-price elasticities were also statistically significant only in 1988. Moreover, there was a two-way relationship between commodity groups meat, fish and seafood, and sugar and confectionery, where the two cross-price elasticities were statistically significant only in 1998. Again, with increasing standard of living the cross-relationships grow weaker or even disappear.

Table 9. Own- and cross-price elasticities of the demand for food in Slovenia, 2008

Commodity group	Price elasticity						
	Bread and cereals	Meat, fish and seafood	Milk, cheese and eggs	Oils and fats	Fruit	Vegetables	Sugar and confectionery
Bread and cereals	**–0.6990**	0.0289	–0.0129	–0.0340	–0.0553	–0.0036	–0.0200
	(0.000)	(0.128)	(0.008)	(0.000)	(0.000)	(0.020)	(0.001)
Meat, fish and seafood	–0.0622	**–1.0726**	–0.0396	–0.0155	–0.0442	–0.0363	–0.0138
	(0.013)	**(0.036)**	(0.008)	(0.000)	(0.000)	(0.020)	(0.232)
Milk, cheese and eggs	–0.0395	0.0258	**–0.8711**	0.0113	–0.0270	–0.0397	–0.0293
	(0.041)	(0.300)	**(0.034)**	(0.177)	(0.046)	(0.039)	(0.035)
Oils and fats	–0.0761	0.1141	0.1108	**–0.7212**	0.0373	0.0070	–0.0435
	(0.000)	(0.405)	(0.143)	**(0.000)**	(0.367)	(0.012)	(0.000)
Fruit	–0.0897	0.0102	–0.0202	0.0051	**–0.6740**	–0.0682	0.0115
	(0.000)	(0.094)	(0.013)	(0.367)	**(0.000)**	(0.000)	(0.477)
Vegetables	–0.0590	–0.0277	–0.0760	–0.0254	–0.0797	**–0.8571**	–0.0155
	(0.020)	(0.316)	(0.005)	(0.012)	(0.000)	**(0.000)**	(0.301)
Sugar and confectionery	–0.0176	0.1349	–0.0122	–0.0325	0.0384	0.0452	**–0.7776**
	(0.001)	(0.232)	(0.001)	(0.000)	(0.477)	(0.301)	**(0.000)**

Note: The corresponding statistical significance levels (*p*–values) are given in parentheses. Own-price elasticities are printed in boldface.

Source: SORS (2012); own calculations.

Comparison of results with own production included with results without own production (not shown) revealed that by including own production approximately half of all cross-price elasticities decreased (in absolute terms) in the years 1988, 1998 and 2008. Where statistically significant, this decrease amounted to some 0.005–0.15 percentage points, with an unweighted average of 0.04 percentage points.

5. Conclusion

Even though food is still the most important commodity group in the structure of consumption expenditure of households, the share of expenditure for food was decreasing with time in Slovenia; from roughly one third in 1988 to less than one fifth of consumption expenditure of households in 2008. This raises several issues related to demand for food in Slovenia, of which some were addressed in this article. In particular, we studied the demand for food in the transition (and in part post-transition) period of 1988–2008. For this purpose, we employed an Almost Ideal Demand System based on Household Budget Survey datasets with own production included.

First, it was established that the demand for food was mostly inelastic. This is documented by the relevant expenditure and price elasticities. The largest share of the expenditure for food can be attributed to the commodity group meat, fish and seafood, which also exhibits the highest expenditure elasticities and can be classified into the group of luxury goods in the time period under analysis. This commodity groups was followed, in terms of both expenditure shares and elasticities, by commodity groups milk, cheese and eggs, and vegetables. With increasing disposable income, one can expect that the demand for these goods will thus increase.

Even though expenditure shares for food of various commodity groups did not vary much by income brackets, there were some differences in the elasticities. For example,

by advancing to a higher income quintile the expenditure elasticities were slightly decreasing on average for commodity groups bread and cereals, and oils and fats, while they were slightly increasing for commodity groups meat, fish and seafood, and vegetables. Similarly, the own-price elasticities were slightly decreasing on average (in absolute terms) for commodity group bread and cereals, while they were slightly increasing for commodity groups fruit, and vegetables.

Next, the behaviour of consumers with regard to food demand was changing during the transition period. In terms of expenditure elasticities, some commodity groups exhibit an increasing trend, while others exhibit a decreasing trend. In terms of own-price elasticities, most commodity groups exhibit a continuously increasing trend in absolute terms. In terms of cross-price elasticities, the prevailing complementary nature of relationships between various commodity groups became somewhat weaker after the socioeconomic changes of transition. In general, Slovenians have developed or (better said) preserved quite uniform nutritional habits during the transition period; changing to some extent with time, but not much in the structure by disposable income.

Finally, own production represented an important, though continuously decreasing share of expenditure for food, with differences by income brackets. Own production should thus be included into analysis to avoid biased results. By taking own production into account, the elasticities of food demand decreased for various commodity groups. The magnitude of this effect was in line with structure and time development of own production; when the share of own production in the expenditure for food was large, the difference between an elasticity without own production and an elasticity with own production included was also high, and vice versa.

Some issues remain open for future research. It would be quite useful, though econometrically less manageable, to expand the (loosen) aggregation of food products. As commodity groups that were used in our research are still quite heterogeneous, this would enable a more precise analysis in terms of levels and "dynamic". Additionally, as there are food products of different quality available in the market, the effects of quality on the prices of food should be incorporated into the analysis, as they can influence expenditure allocation and thus expenditure elasticities (*cf.* Stavrev and Kambourov, 1999; Huang and Ling, 2000).

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