Food Demand and Consumption Patterns in the New EU Member States: The Case of Slovakia[1]

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Abstract

We estimate a food demand system for Slovakia using a recent Household Budget Survey data collected by the Slovak statistical office covering the period 2004 – 2010. The Quadratic Almost Ideal Demand System (QUAIDS) augmented with demographic, regional and expenditure controls is employed based on preliminary non-parametric Engel curve analysis. Results indicate that demand for dairy products and fruits and vegetables is expenditure and own-price elastic indicating that such goods are perceived as luxuries. On the other hand, commodity bundles such as cereals, meat and fish and other food are found to be normal goods with positive budget elasticity smaller than one and price inelastic demand. Rural and low-income households appear more expenditure and, especially, price sensitive compared with the urban and high-income ones. Overall the food consumption patterns changed and food security situation improved in Slovakia between 2004 and 2010.

Keywords: *elasticity, food demand, QUAIDS, Slovakia*

JEL Classification: D12, I12, O52, Q18

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1. Introduction

Food supply and demand in Europe have been importantly influenced by the Common Agricultural Policy (CAP), which is driven by the European Union's (EU) commitment to support long-term food supply and meet the European and growing world food demand (EC, 2010). As a result of CAP reforms and rising incomes the share of European household expenditure on food has been steadily declining over the years. However, international food prices have recently risen and are likely to remain high primarily because of the escalating cost of inputs and surging world demand. In 2005, a year after the accession of the first wave of new member states from Central and Eastern Europe (CEE), food expenditure in the EU was between 10% and 35% of total household consumption budget, with the smallest shares in the EU-15 (old member states) and the largest in the CEE's new member states (EEA, 2005). Consequently, the price index for food in the EU rose by almost 20% between 2005 and 2012 (Eurostat, 2012). Rising and volatile food prices have led to increased concerns about food security. High food prices increase the income of farmers (who are relatively poor in most developed countries) but increase the cost of food for consumers and create serious difficulties, especially for vulnerable, low-income households (Swinnen and Squicciarini, 2012).

As a large number of vulnerable households in the EU are located in the new member states of the CEE, this paper aims to shed light on some aspects of the food security situation in CEE countries, represented by Slovak households. Moreover, malnutrition as a result of inadequate food intake or unbalanced diet exists to a considerable degree in both developed countries and developing or transition countries. Therefore, a study of household food consumption patterns along with food security situation in the CEE country is timely.[2]

We follow Banks, Blundel and Lewbel (1997) and employ the Quadratic Almost Ideal Demand System (QUAIDS) augmented with demographic and other household controls to examine the food expenditure patterns across income groups and types of region. The main contribution of the paper is the combination of using extended QUAIDS methodology and household longitudinal data from Slovakia. Compared to other demand systems, QUAIDS is more appropriate since it allows for non-linearity in the Engel curves which is important when analysing a disaggregate food demand system as evident from our preliminary

[2] In Europe, about 5% of the overall population is at risk of malnutrition, and among vulnerable groups – the poor, the elderly, and the sick – this percentage is even higher (Reisch, Eberle and Lorek, 2013). In the NMS malnutrition and general poverty is the highest; for instance, in 2011, poverty rate ranged between 20% in Slovakia and 40% in Romania as poverty rates considerably differed between urban and rural areas and across income groups.

non-parametric analysis. Using household (micro) data is important because managing food security requires not only understanding how policies influence the availability of food and income at national level but also how individual households can cope with income and price shocks.

Our analysis of the Slovak Household Budget Survey data suggests that food demand patterns have changed along with improvement in the food security situation since 2004. However, food commodities important for healthy diet such as meat and fish, dairy products or fruits and vegetables still have relatively high expenditure and own-price elasticities. There also is important heterogeneity in sensitivity to income and price shocks across subsamples of rural and urban and low- and high-income households that need to be taken into account by policy-makers.

Our study is organized in the following fashion. Second section offers a brief overview of the previous food demand studies. Section 3 describes the applied QUAIDS methodology. Household Budget Survey data and the main variables entering our model are presented in section 4 along with their summary statistics. We present and discuss the results in section 5 while the concluding remarks and policy implications are discussed in last section.

2. Previous Studies

Food demand has been actively researched for over a century both in developed and developing countries as the focus has usually been on how income and prices influence food expenditure and consumption patterns. Policy makers dealing with food security issues are often interested in studies that examine the response of households to price and income changes. While predominantly food demand analyses have been concerned with situations in developing countries, there are also several food demand studies employing household data from developed European countries (e.g., Molina, 1994 for Spain; Banks, Blundel and Lewbel, 1996; 1997 for the UK; Moro and Sckokai, 2000 for Italy; Abdulai, 2002 for Switzerland). However, food demand responses in the former socialist countries, now new member states of the EU, have not been widely studied with micro data.

An exception is the study of Janda, McCluskey and Rausser (2000) that evaluates the Czech food imports during the transition process applying Almost Ideal Demand System (AIDS). Similarly, Janda, Mikolášek and Netuka (2009) estimate AIDS using Czech Household Budget Survey data focusing on food and alcoholic beverages. More recently the impact of price and income shocks on demand patterns of Czech households have been studied by Janský (2014) or Dybczak, Tóth and Vonka (2014). Authors use estimated elasticities for the simulations of impact of value added tax and regulated price changes on consumer demand. Although there have been conductedseveral food demand studies in Slovakia based on the aggregated time series data (see, e.g. Hupková, Bielik and Turčeková, 2009 and Zentková and Hošková, 2009). These studies have applied single equation ad hoc models. Some aspects of food demand have been studied also in Hungary, for example by Szigeti and Podruzsik (2011).

3. Methodology: Quadratic Almost Ideal Demand System

Several demand systems have been commonly used for modelling the allocation of total expenditures among commodities given certain budget. These include the Linear Expenditure System (LES) (Stone, 1954), the Rotterdam model (Barten, 1964), the Indirect Translog System (ITS) (Christensen, Jorgenson and Lau, 1975), and the AIDS (Deaton and Muellbauer, 1980). LES is unable to describe demand behaviour consistent with the Engel's law, which stipulates that as income increases a good can change from normal to inferior one. The Rotterdam model is consistent with demand theory, however, since it is not derived from specific utility or expenditure function, the model is inconsistent with utility maximising behaviour. ITS has the advantage of a flexible functional form but poses a major estimation problem due to relatively large number of independent parameters. AIDS satisfies the restrictions of demand theory and its estimation is less complicated than other models.

Based on non-parametric analysis of consumer expenditure patterns Banks, Blundel and Lewbel (1996; 1997) show that the correct approximation of Engel curves requires a higher order logarithmic term of expenditure and propose QUAIDS which nests AIDS and also satisfies the restrictions of demand theory.[3] QUAIDS thus allows as income increases a good to change its status from normal to inferior. Household preferences follow the indirect utility function:

$$\ln V = \left\{ \left[\frac{\ln m - \ln a(\mathrm{p})}{b(\mathrm{p})} \right]^{-1} + \lambda(\mathrm{p}) \right\}^{-1} \tag{1}$$

[3] Because usually data on food demand are presented as aggregates across commodities, the commodity group Engel curve will depend on the income levels at which commodities in the group enter the budget, and Jackson (1984) shows that the expenditure share on the group need not be monotonic. This suggests that flexible functional forms (Blaylock and Smallwood, 1982), such as QUAIDS can be an important tool for analysing commodity group Engel curves, and in demand analysis generally.

where

the term [ln$m$ – ln$a$(p)]/b(p)	– the indirect utility function of the PIGLOG[4] demand system,
m	– household income,
a(p), b(p) and λ(p)	– functions of the vector of prices p.

To ensure the homogeneity property of the indirect utility function, it is required that a(p) is homogenous of degree one in p, and b(p) and λ(p) are homogenous of degree zero in p. The price index ln$a$(p) has the usual translog form

$$\ln a(\mathrm{p}) = \alpha_0 + \sum_j \alpha_j \ln p_j + \frac{1}{2}\sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j \tag{2}$$

b(p) is the Cobb-Douglas price aggregator defined as

$$b(p) = \Pi_i \; p_i^{\beta_i} \tag{3}$$

and λ(p) is defined as

$$\lambda(\mathrm{p}) = \sum_i \lambda_i \ln p_i \text{ where } \sum_i \lambda_i = 0 \tag{4}$$

By applying Roy's identity to the indirect utility function (1), the budget shares in the QUAIDS are derived as

$$\omega_i = \alpha_i + \sum\nolimits_j \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(\mathrm{p})}\right] + \frac{\lambda_i}{b(\mathrm{p})}\left\{\ln\left[\frac{m}{a(\mathrm{p})}\right]\right\}^2 \tag{5}$$

For theoretical consistency and to reduce the number of parameters to be estimated adding-up, homogeneity and symmetry restrictions are commonly imposed. The fact that $\sum_i \omega_i = 1$, called the adding-up condition, requires that $\sum_i \alpha_i = 1$, $\sum_i \beta_i = 0$, $\sum_i \lambda_i = 0$ and $\sum_i \gamma_{ij} = 0 \,\forall j$. Moreover, since demand functions are homogeneous of degree zero in (p, m) $\sum_i \gamma_{ij} = 0 \,\forall j$. Slutsky symmetry implies that $\gamma_{ij} = \gamma_{ji} \forall i \neq j$. These conditions are trivially satisfied for a model with n goods when the estimation is carried out on a subset of n – 1 independent equations. The parameters of the dropped equation are then computed from the restrictions and the estimated parameters of the n – 1 expenditure shares.

Majority of previous studies extend the system with demographic variables following Pollak and Wales (1981) where the demographic effects shift the intercept α_i in equation (5). However, we follow the scaling approach introduced

[4] Demand with expenditure shares that are linear in log total expenditure alone have been referred to as Price-Independent Generalised Logarithmic (PIGLOG) by Muellbauer (1976).

by Ray (1983) which has been implemented by Poi (2012) into QUAIDS. This approach has the advantage of having strong theoretical foundations and generating expenditure share equations that closely mimic their counterparts without demographics. For each household the expenditure function e (p, z, u), underlying the budget shares is written as the expenditure function of a reference household e^R (p, u), scaled by the function m_0 (p, z, u) = $\bar{m}_0(\text{z})\varphi(\text{p, z}, u)$ to account for the household characteristics where z represents a vector of s characteristics and u is direct utility. The first term of m_0, $\bar{m}_0(\text{z})$, measures the increase in a household's expenditures as a function of z, not controlling for any differences in consumption patterns. The second term $\varphi(\text{p, z}, u)$ controls for differences in relative prices and the actual goods consumed; a household with two adults and two infants will consume different goods than one comprising four adults.

Furthermore, we extend the vector z with a food expenditure control the rationale for which is the following. In estimating a food demand system the implicit assumption is that the consumer's utility maximisation decision can be decomposed into two separate stages wherein the first stage, the allocation of total expenditure between food and other commodity groups (housing, transport, entertainment, etc.) is decided.[5] In the second stage, the food expenditure is allocated among different food commodity bundles. The price and expenditure elasticities obtained from such a two-stage budgeting process are conditional or partial elasticities in the sense that a second-stage conditional demand system is estimated. To obtain unconditional elasticity estimates correction for the first stage budgeting decision is needed. Therefore, besides standard demographic variables, the share of food expenditure in the net disposable income is also added to the vector z.

The budget share equation (5) augmented with demographic effects becomes:

$$\omega_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + (\beta_i + \eta'_i \text{z}) \ln\left[\frac{m}{\bar{m}_0(\text{z}) a(\text{p})}\right] + \frac{\lambda_i}{b(\text{p}) c(\text{p, z})}\left\{\ln\left[\frac{m}{\bar{m}_0(\text{z}) a(\text{p})}\right]\right\}^2 \quad (6)$$

where $c(\text{p, z}) = \prod_j p_j^{\eta'_j \text{z}}$, η'_j represents the j^{th} column of parameter matrix η.

The adding-up condition requires that $\sum_j \eta_{sj} = 0 \forall s$.

Similar to Banks, Blundel and Lewbel (1997) the expenditure and price elasticities are obtained by partially differentiating equation (6) with respect to ln$m$ and lnp_j respectively:

[5] This separability assumption of food expenditure decision from other expenditure is motivated by Maslow's (1943) hierarchy of needs theory.

$$\mu_i \equiv \frac{\partial \omega_i}{\partial \ln m} = \beta_i + \eta'_i \mathrm{z} + \frac{2\lambda_i}{b(\mathrm{p})c(\mathrm{p},\ \mathrm{z})} \ln\left[\frac{m}{\overline{m}_0(\mathrm{z})a(\mathrm{p})}\right] \text{ and} \tag{7}$$

$$\mu_{ij} \equiv \frac{\partial \omega_i}{\partial \ln p_j} = \gamma_{ij} - \mu_i \left(\alpha_j + \sum_k \gamma_{jk} \ln p_k\right) - \frac{\lambda_i (\beta_j + \eta'_j \mathrm{z})}{b(\mathrm{p})c(\mathrm{p},\ \mathrm{z})} \left\{\ln\left[\frac{m}{\overline{m}_0(\mathrm{z})a(\mathrm{p})}\right]\right\}^2 \tag{8}$$

Then the expenditure and the uncompensated price elasticities are computed as $e_i = \mu_i / \omega_i + 1$ and $e_{ij}^u = \mu_{ij} / \omega_i - \delta_{ij}$ respectively; δ_{ij} represents Kronecker delta taking value 1 if $i = j$ and 0 otherwise. Using the Slutsky equation, we can finally compute compensated price elasticities: $e_{ij}^c = e_{ij}^u + e_i \omega_j$.

4. Data: Slovak Household Budget Survey

We apply QUAIDS to Slovak Household Budget Survey (HBS) data. The HBS data is commonly used for social policy and the standard of living analysis, for defining consumer price index weights, and for estimating household consumption in the national accounts. Our dataset consists of seven annual rounds, from 2004 to 2010. The survey provides detailed information on household incomes and expenditures on food and non-food goods and services. The data also contain detailed information on quantities consumed by each household, its location and size as well as individual household member characteristics such as age, education, occupation, and marital status. Each of our annual samples contains approximately between 4500 and 6000 households, however, the samples do not form a (real) panel as surveyed households are randomly selected from the population each round.

The information on food consumption is collected on a one-month recall basis. We aggregate food commodities consumed into five food groups: cereals, meat and fish, dairy products and eggs, fruits and vegetables, and other food products.[6] The other food products group comprises of food commodities such as fats, oils, condiments, and sugar. As economic theory does not provide any guidance on the number or composition of aggregated food groups, the construction of the food groups used in this analysis was influenced partially by past studies of the European food sector and by a classification reflecting the similarity (substitutability) of food items from a consumer's viewpoint. A major advantage to our food-grouping scheme is that it reduces the total number of parameters in the model and avoids the problem with zero consumption, thus making the demand system estimation simple.

[6] See Appendix A, Table A1 for the aggregation procedure.

Since prices were not provided by HBS, implicit prices for individual food commodities were derived from the purchased quantity and expenditure data. Price indices for the aggregated food commodity groups were computed using the geometric mean with expenditure shares as weights (e.g., as in Abdulai, 2002). Each price obtained is effectively a value to quantity ratio, which is called ‘unit value’ by Deaton (1989).The price calculated this way is household specific, representing household purchase decisions. Thus, the variation in food-group prices is due to differences in the composition of items (goods) consumed in each commodity group and variation in prices of each good across households. The latter could be due to quality differences, seasonal effects, and regional market conditions.

Cox and Wohlgenant (1986) argue that failure to adequately specify cross--sectional price effects could result in biased and misleading demand elasticities. This is because traditional Engel analysis may be inappropriate if prices are not constant in the cross section. In addition, prices in cross-sectional data are generally assumed to reflect quality effects which should be corrected for prior to estimation (Deaton, 1989).[7] Specifically, price-income relationships are caused by differences in marketing services purchased; higher income households purchase more marketing services and, hence, pay higher average prices for commodities. Larger families generally pay lower average prices because of economies of size in purchasing and in household production-consumption activities. Cox and Wohlgenant (1986) propose a regression-based procedure for quality adjusting cross-sectional prices which is applied by several follow-up papers (notably, Park et al., 1996).

We follow the Cox and Wohlgenant’s (1986) approach and quality adjust aggregate commodity prices in our data. However, instead of estimating regression residuals and then adding them up to regional price means we calculate median prices for narrowly defined sample segments whereby controlling for regional (supply), time (quarterly), and household characteristics variation. We define household segments by four quartiles of household net disposable income and size, as well as we control for presence of children in the household. The regional segments are formed by the eight main Slovak regions each divided into rural and urban component. Our approach has at least two advantages; it complies with the traditional Engel analysis where quality adjusted prices are constant within narrowly defined segments and avoids problems of estimated negative household prices.[8]

[7] It is noteworthy that most of the food products are relatively more homogenous than other consumer goods. As it has been pointed out by an anonymous referee, the prices of very tradable food products are also often driven by agricultural commodity prices on the world markets.

Table 1 reports summary statistics for the variables used in the QUAIDS estimations. It is evident that between 2004 and 2010 there was a significant change in incomes and prices in Slovakia. Incomes doubled as well as the prices of the cereals and other food products groups while prices of meat and fish, diary, and fruits and vegetables increased more modestly which is reflected in the less than doubled total food expenditure.

T a b l e 1

Definition of Variables and Summary Statistics

		2004			2010	
Variable	**Definition**	**Mean**	**SD**		**Mean**	**SD**
foodexp	Household food expenditure(Euro)	91.66	47.57		116.95	58.95
foodratio	Ratio of food expenditure and net income	0.24	0.13		0.19	0.12
$p_{cereals}$	Price of cereals (Euro)	0.81	0.15		2.22	0.22
p_{meat}	Price of meat and fish (Euro)	2.46	0.28		3.85	0.29
p_{dairy}	Price of dairy products (Euro)	1.30	0.28		2.78	0.35
p_{fruits}	Price of fruit and vegetables (Euro)	0.72	0.18		1.06	0.20
p_{other}	Price of other food (Euro)	2.01	0.50		3.05	0.71
$w_{cereals}$	Expenditure share on cereals	0.20	0.07		0.20	0.07
w_{meat}	Expenditure share on meat and fish	0.30	0.11		0.29	0.10
w_{dairy}	Expenditure share on dairy products	0.19	0.07		0.18	0.07
w_{fruits}	Expenditure share on fruits and vegetables	0.12	0.07		0.15	0.07
w_{other}	Expenditure share on other food	0.19	0.07		0.17	0.06
N_adults	Number of adults (above age 18)	2.22	0.97		2.44	0.82
N_children	Number of children (below age 16)	0.54	0.86		0.46	0.80
age_HH	Age of the household head	50.87	14.98		52.18	14.41
edu_HH	Education of the household head: categorical scale from primary (0) to higher (3) education	1.99	0.52		2.03	0.49
gender_HH	Gender of the household head; 1 if male	0.68	0.47		0.68	0.47
urban	1 if urban household and 0 otherwise	0.62	0.49		0.55	0.50

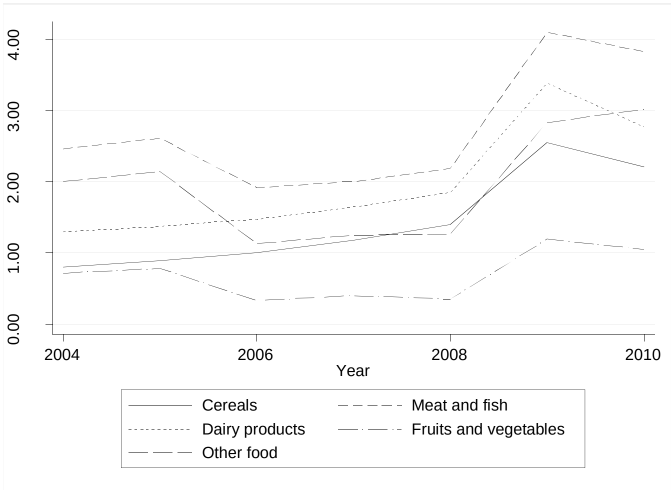
Note: SD is standard deviation. All monetary values prior to the Euro adoption in 2009 were converted to Euro currency using the corresponding exchange rate as given by the National Bank of Slovakia. According to the NUTS III level there are eight regions in Slovakia, Bratislava, Trnava, Trenčín, Nitra, Žilina, Banská Bystrica, Prešov, and Košice which are approximately equally represented in the survey.

Source: Household Budget Survey, Statistical Office of the SR; authors' calculations.

Moreover, detailed evolution of the food price indices of aggregated food groups is depicted in Figure 1. The household consumption patterns do not appear to have changed substantially over the period as evident from food expenditure shares, which have remained quite stable as only the fruits, and vegetables expenditure share shows a more significant increase. Detailed examination of the data suggests that the quantities consumed remained relatively stable too; the tendency for substitution of low-fat milk for whole milk is noteworthy though. This fact taken together with the noticeable increase in the fruits and vegetables expenditure share seems to indicate a shift of Slovak consumers towards a healthier diet.

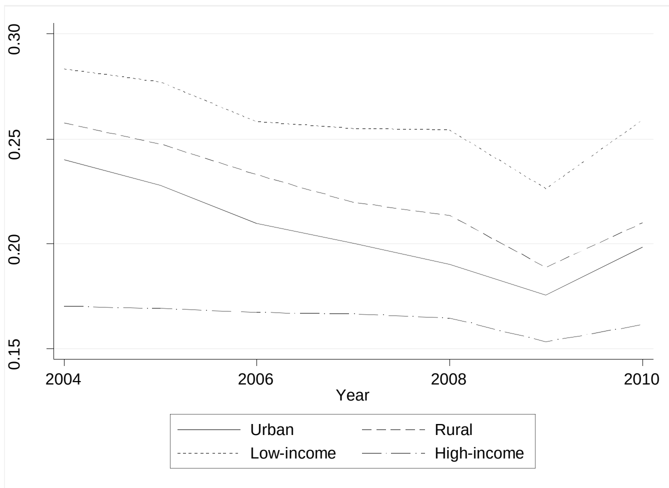
[8] Following Cox and Wohlgenant (1986) and Park et al. (1996) we estimated alternative quality adjusted prices; the QUAIDS results with these prices are similar to the results reported based on median prices at narrowly defined segments.

F i g u r e 1
Evolution of Food Price Indices



Source: Household Budget Survey, Statistical Office of the SR; authors' calculations.

F i g u r e 2
Ratio of Household Food Expenditure and Net Income



Source: Household Budget Survey, Statistical Office of the SR; authors' calculations.

In terms of food security there is further evidence of improvement indicating the potentially important driving force – the rise of incomes. Figure 2 shows that the share of food expenditure in net income has been steadily declining since the Slovakia's accession to the EU in 2004. For the low-income subsample (here defined as households with income below the median) the ratio has dropped from 28% down to 23% in 2009 when the Euro was adopted, consequently followed by a modest hike in 2010. The trend for the high-income subsample (defined as households with income above the median) is similar but the levels are quite different – the drop is from 17% to 15%, which is comparable with EU-15 levels. There are also differences between rural (21% in 2010) and urban (20% in 2010) household food expenditure shares but these differences are less pronounced compared to the income-based subsamples while the declining trend is stronger confirming that the improvement in food security situation as indicated by the food expenditure share is a nationwide trend.

5. Results and Discussion

We start our econometric analysis by first estimating the Engel curves for the five food groups comparing years 2004 and 2010 using a non-parametric Kernel regression as in Banks, Blundel and Lewbel (1997). The shapes of the Engel curves are consistent with the theory. An increase in income is associated with a monotonic decline in the share of expenditure on cereals while there is a positive relationship between increase in income and the expenditure share of meat and fish.

However, the patterns of the Engel curves for dairy products and other food products appear non-linear with inverted-U shape. The Engel curve for fruits and vegetables seems to be decreasing and non-linear. As it has been pointed out by Dybczak, Tóth and Vonka (2010) the results of such an Engel curve analysis are purely descriptive and results should be considered with caution since the price and non-income effects such as demographic and regional variables are not considered. Nevertheless, this preliminary analysis shows that our choice of QUAIDS model for estimating food demand behaviour in Slovakia is justified.

We estimated QUAIDS with Stata software using the code developed by Poi (2008; 2012). We performed estimations on the pooled cross-sections with time trend in order to maximise the number of observations and the efficiency of estimates (see, e.g., Dybczak, Tóth and Vonka, 2014 or Janský et al., 2014). Furthermore, we estimated QUAIDS models year by year to see the dynamics of the computed demand elasticities.[9]

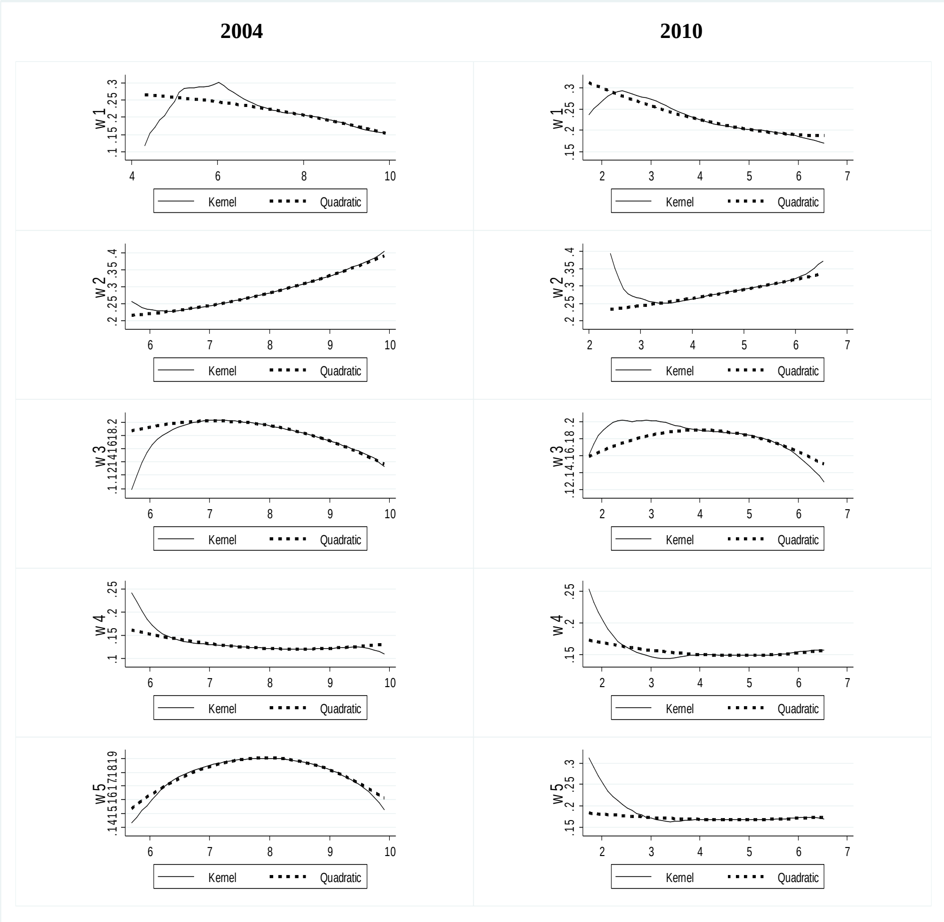
In estimated pooled cross-sections samples large majority of own and cross--price coefficients and linear expenditure coefficients are statistically significant at conventional levels. The majority of the quadratic expenditure terms are also significant at 5% or better. Taken together the estimated expenditure parameters

[9]Estimated parameters of the QUAIDS model on the pooled cross-sections are presented in Appendix B, Table B1. Because of the space constraint, we do not report the full tables. They can be obtained from authors upon a request.

suggest that dairy products and fruits and vegetables are luxury products. The demographic and regional control variables are generally significant and have the expected effects. For example, household size has a positive effect on the expenditure share of cereals and negative effect on the share of meat and fish. The effect of the expenditure ratio control is also highly significant in most equations and samples as it is, for example, positive in the cereals equations and negative in the meat and fish equations.[10]

F i g u r e 3

Engel Curves for Aggregated Food Groups



Note: Variables w1, w2, w3, w4, w5 represent budget shares of cereals, meat and fish, dairy products, fruits and vegetables, and other food. Kernel fit is plotted by solid line while Quadratic fit is given by dashed line.

Source: Household Budget Survey, Statistical Office of the SR; authors' calculations.

[10] To formally test the validity of QUAIDS, we performed specification tests comparing restricted models with linear Engel curves for all food groups and the alternative models with quadratic Engel curves. The results of the tests are listed in Appendix C, Table C1.

Table 2 reports compensated and uncompensated price elasticities and expenditure elasticities calculated from the QUAIDS parameters estimated for the pooled cross-sections. The expenditure elasticities of all food groups are positive as the largest in magnitude are the elasticities of fruits and vegetables (1.15) and dairy products (1.11). Both compensated and uncompensated own-price elasticities are negative and thus consistent with demand theory. While all compensated own-price elasticities are smaller than unity in absolute value, the uncompensated own-price elasticities of meat and fish and fruits and vegetables are greater than unity revealing elastic demand for those commodities. This finding is consistent with our results for expenditure elasticities and the effects of demographic variables and expenditure ratio. All compensated cross-price elasticities are positive albeit relatively small in magnitude suggesting that the respective food groups are substitutes, thus, confirming that our food group classification is appropriate.

Table 2

Estimated Food Demand Elasticities

	Cereals	Meats	Dairy	Fruits & vegs	Other food
			Budget elasticities		
	0.795	**0.915**	**1.105**	**1.152**	**0.985**
	(0.005)	(0.006)	(0.008)	(0.006)	(0.006)
			Compensated price elasticities		
Cereals	**–0.883**	0.238	0.143	0.306	0.196
	(0.010)	(0.009)	(0.009)	(0.009)	(0.008)
Meats	0.256	**–0.855**	0.056	0.333	0.211
	(0.009)	(0.016)	(0.011)	(0.012)	(0.011)
Dairy	0.208	0.076	**–0.689**	0.310	0.096
	(0.013)	(0.015)	(0.019)	(0.015)	(0.013)
Fruits & vegs	0.207	0.209	0.145	**–0.690**	0.129
	(0.006)	(0.007)	(0.007)	(0.011)	(0.007)
Other food	0.219	0.219	0.074	0.212	**–0.724**
	(0.009)	(0.011)	(0.010)	(0.012)	(0.014)
			Uncompensated price elasticities		
Cereals	**–1.042**	0.090	0.033	0.070	0.053
	(0.010)	(0.009)	(0.009)	(0.009)	(0.008)
Meats	0.072	**–1.025**	–0.070	0.062	0.047
	(0.010)	(0.016)	(0.011)	(0.012)	(0.011)
Dairy	–0.014	–0.131	**–0.842**	–0.017	–0.102
	(0.013)	(0.015)	(0.020)	(0.015)	(0.013)
Fruits & vegs	–0.024	–0.006	–0.014	**–1.031**	–0.078
	(0.006)	(0.008)	(0.007)	(0.011)	(0.007)
Other food	0.022	0.036	–0.062	–0.079	**–0.901**
	(0.009)	(0.011)	(0.010)	(0.012)	(0.014)

Note: In bold are reported the budget, uncompensated and compensated own price elasticities.

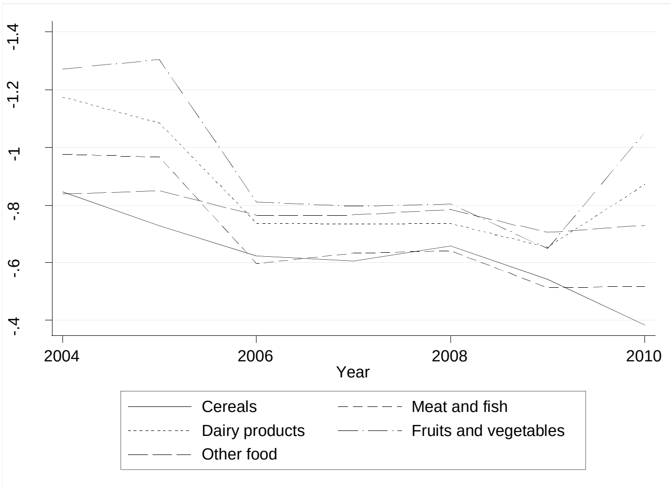
Source: Household Budget Survey, Statistical Office of the SR; authors' calculations.

The fact that the signs of several (eleven out of twenty) compensated price elasticities are different from the signs of the uncompensated elasticities suggests that income effects are important in consumer demand decisions. The overall effect of price changes on demand responses is most relevant for capturing food security and aggregate welfare effects.

Therefore, in Figure 4 we present the evolution of the compensated own-price elasticities for the five food groups over time. The general impression from Figure 4 is that since 2004 the own-price elasticities have declined for all food commodity groups. This observation suggests that Slovak households have become less prone to food price shocks over the period of analysis. However, there is a pronounced hike in household price sensitivity around 2009 – 2010 – the period when Slovakia experienced effects from the global economic crisis and also food crisis.

F i g u r e 4

Compensated Own-price Elasticities



Source: Household Budget Survey, Statistical Office of the SR; authors' calculations.

Results from the analysis by different household subsamples further demonstrate considerable heterogeneity in demand responses to price and income changes.[11] Generally, we can observe higher sensitivity and volatility of responses in the rural and low-income household subsamples throughout the 2004 – 2010 period. There is a substantial hike in the price sensitivity of meat and fish

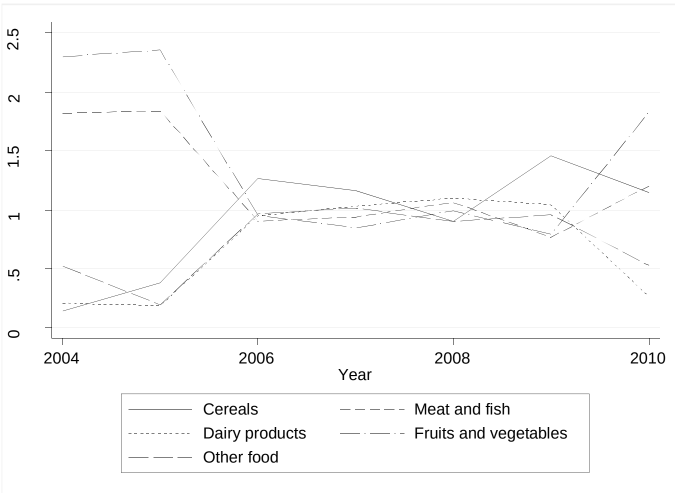
[11] The full tables containing calculated compensated and uncompensated price and expenditure elasticities for rural and urban and low-income and high-income households can be seen in Rizov et al. (2014).

demand of low-income households since 2008, the beginning of the economic crisis. High-income households have experienced increased price sensitivity of their fruits and vegetables and meat and fish demand after 2009 period while urban household experienced similar effects on their demand for dairy products, fruits and vegetables and other food products.

To summarize, an important result of our demand analysis is the observed reduction in price and expenditure elasticities over the period of analysis. Noteworthy is also the observed convergence of the five food group expenditure elasticities at relatively lower level as depicted in Figure 5. This suggests reduction in the relative income constraints on food consumption and diet composition choices.

F i g u r e 5

Expenditure Elasticities



Source: Household Budget Survey, Statistical Office of the SR; authors' calculations.

Conclusion

We analyse the food demand patterns of Slovak households since the accession of Slovakia to the EU in 2004. Our study is one of the few food demand analysis for the CEE countries using QUAIDS, extended with household characteristics, regional and expenditure controls. The longitudinal household budget survey data employed covering a seven year period allow us to reveal changes in demand behaviour over time as well as cast light on some aspects of the food security situation at micro level. In terms of food security a noteworthy nationwide trend is the continuous reduction in the food expenditure and income ratio. By 2010 the food expenditure ratio has dropped to about 15% for households with incomes above the population mean – a level comparable with demand patterns in the richer EU-15 countries. The ratio is still quite high though, at about 23%, for households with income below the mean.

The results show that Slovak households are price and income responsive. All five food groups analysed have positive expenditure elasticities as their magnitudes suggest that fruits and vegetables and dairy product are luxuries for some groups of households. In line with demand theory, all own price elasticities are negative while majority of the cross-price elasticities are positive albeit smaller in magnitude suggesting that even though the commodities from the five food groups are substitutes the substitution possibilities might be quite limited.

Our findings are consistent with studies from other developed countries where food security and access to food do not present a significant challenge. For example, Michalek and Keyzer (1992), Abdulai (2002), and Chern et al. (2003) find that for the majority of population food demand is price and income inelastic and food is perceived as necessity rather than luxury. Considering the fact that in Slovakia average expenditure elasticities for all food groups surpass in magnitude the own-price elasticities, policy tools for enhancing income-generating activities might be more effective compared to policies that are targeted at price reductions. Hence, in order to improve the household diet, especially to increase consumption of fruits and vegetables, income-oriented policies might be appropriate.

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Appendix A

Table A1

Aggregation Procedure

Food group	**Food item**
Cereals	Rice; Bread; Pasta products; Pastry-cook products; Sandwiches; Other cereal products
Meat and fish	Fresh, chilled or frozen meat of bovine animals; Fresh, chilled or frozen meat of swine; Fresh, chilled or frozen meat of sheep and goat; Fresh, chilled or frozen meat of poultry; Dried, salted or smoked meat and edible meat offal; Other preserved or processed meat and meat preparations; Other fresh, chilled or frozen edible meat; Fresh, chilled or frozen fish; Fresh, chilled or frozen seafood; Dried, smoked or salted fish and seafood; Other preserved or processed fish and seafood and fish and seafood preparations
Dairy products	Whole milk; Low fat milk; Preserved milk; Yoghurt; Cheese and curd; Other milk products; Eggs
Fruits and vegetables	Citrus fruits (fresh, chilled or frozen); Bananas (fresh, chilled or frozen); Apples (fresh, chilled or frozen); Pears (fresh, chilled or frozen); Stone fruits (fresh, chilled or frozen); Berries (fresh, chilled or frozen); Other fresh, chilled or frozen fruits; Dried fruit; Preserved fruit and fruit based products; Leaf and stem vegetables (fresh, chilled or frozen); Cabbages (fresh, chilled or frozen); Vegetables cultivated for their fruit (fresh, chilled or frozen); Root crops, non-starchy bulbs and mushrooms (fresh, chilled or frozen); Dried vegetables; Other preserved or processed vegetables; Potatoes
Other food	Butter; Margarine and other vegetable fats; Olive oil; Edible oils; Other edible animal fats; Sugar; Jams, marmalades; Chocolate; Confectionery products; Edible ices and ice cream; Other sugar products; Sauces, condiments; Salt, spices and culinary herbs; Baby food, dietary preparations, baker's yeast and other food preparations

Note: All food items have been converted to kilograms.

Source: Household Budget Survey, Statistical Office of the SR; own processing.

Appendix B

Table B1

Estimated Parameters of the QUAIDS Model, Pooled Sample

Parameter	Cereals	Meat & fish	Dairy	Fruits & vegs.	Other food
α	0.152***	0.087***	0.184***	0.434***	0.144***
	(0.009)	(0.015)	(0.011)	(0.017)	(0.010)
β	2.429***	–2.204***	0.834***	1.142***	–2.200***
	(0.238)	(0.202)	(0.147)	(0.214)	(0.210)
γ_1	–0.013***	0.010***	0.000	0.000	0.003**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
γ_2		–0.004	–0.016***	0.003	0.007***
		(0.003)	(0.002)	(0.002)	(0.002)
γ_3			0.024***	0.003	–0.012***
			(0.003)	(0.002)	(0.002)
γ_4				0.009***	–0.016***
				(0.004)	(0.002)
γ_5					0.017***
					(0.002)
λ	0.008***	–0.004***	–0.001	–0.002***	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\eta_{foodratio}$	–0.003	0.017***	0.000	–0.019***	0.005***
	(0.002)	(0.002)	(0.001)	(0.003)	(0.001)
$\eta_{N\_children}$	–0.005***	–0.005***	0.003***	0.008***	0.000***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
η_{N_adults}	–0.003***	0.001***	0.002***	–0.001*	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{age_HH}	0.000***	0.000***	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{gender_HH}	0.001***	–0.001***	–0.003***	0.004***	–0.001***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
η_{edu_HH}	0.000**	–0.001***	0.000***	0.001***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{urban}	0.014***	0.000	–0.013***	–0.007***	0.006***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
η_{trend}	–0.001***	0.001***	0.000***	–0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	31 872				
Log-likelihood	170 175.32				

Note: Robust standard errors are presented in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: Household Budget Survey, Statistical Office of the SR; authors' calculations.

Appendix C

QUAIDS Specification Tests

To formally test the significance of the quadratic expenditure term and the set of demographic variables and time trend, we perform Wald tests on the estimated parameters. Results of the tests are presented in Table C1, where we list the values of the χ^2 statistics and the corresponding p-values. First we test whether the quadratic expenditure term, captured by the parameter lambda, plays statistically significant role in determining the food expenditure patterns. Since the values of the χ^2 statistics are quite high, with p-values below the conventional level of 0.05 in the surveyed pooled sample, we reject the null hypothesis about lambdas being jointly equal to zero. Quadratic expenditure terms are highly significant and the selection of QUAIDS is appropriate (compared to the standard linear AIDS).

Second we test the null hypothesis for the set of demographic controls – share of food expenditure in total income, number of children, number of adults, age, gender and education of the household's head, urban dummy, and time trend – that the particular demographic variable does not play statistically significant role in determining the food expenditure patterns. If this is the case and the null hypothesis is true, the elements of the row of the η matrix along with the corresponding element of the ρ vector would jointly be equal to zero for the particular demographic variable. The high values of χ^2 statistics and corresponding p-values lower than the 0.05 significance level; indicate that all demographic controls and time trend have significant impact on food expenditures.

Table C1

Wald Tests on the Quadratic Expenditure Term and Demographic Variables

Variable	χ^2 (k)	p-value
λ	139.95	0.00
foodratio	120.76	0.00
N_children	208.24	0.00
N_adults	277.91	0.00
age_HH	166.59	0.00
gender_HH	134.37	0.00
edu_HH	187.57	0.00
urban	1034.81	0.00
trend	6469.92	0.00

Source: Household Budget Survey, Statistical Office of the SR; authors' calculations.