FOODSECURE
FOR POLICIES THAT MATTER

Food and nutrition security in the European Union: Overview and case studies

Lara Cockx
Nathalie Francken
Hannah Pieters

FOODSECURE Working paper no. 31
March 2015

INTERDISCIPLINARY RESEARCH PROJECT
TO EXPLORE THE FUTURE OF GLOBAL
FOOD AND NUTRITION SECURITY

Deliverable 2.5 Food security in the European Union: Overview and case study

Analysis of drivers of food and nutrition security in the EU - Summary

Food and nutrition security in the EU: Overview		
Food and nutrition Status	Availability	**Fruits and vegetables** are **insufficiently available** in several NMS.
	Access	There is **large heterogeneity** within the EU with regards to the **share of food expenditures** in the household budget.
	Utilization	The main food and nutrition security challenge in the EU is the double burden of malnutrition, the prevalence of both **undernutrition** and rising **overweight and obesity**. **Micronutrient deficiencies** are widespread.
Stability	Vulnerability	The large share of food expenditures in the household budget in some NMS signals economic vulnerability. The **poor**, **ethnic minorities** and the **elderly** are particularly vulnerable groups within the EU. The NMS are home to some of the most vulnerable households. There is large heterogeneity between and within NMS.
	Resilience	There are large differences in social protection policies.
Case studies : Romania and Slovakia		
The analysis of food demand and diet diversity underlines the importance of **policies targeted at the generation of incomes** as well as **rural development**. The large heterogeneity between different subsamples of households calls for well-**targeted** policies.		

Food and nutrition security in the European Union: Overview and case studies

Lara Cockx[1,a], Nathalie Francken [a,b], Hannah Pieters [a]

With contribution of

Cecilia Alexandri [c], Andrej Cupak [c], Lucian Luca [d] , Bianca Păuna [e], Jan Pokrivcak [c], Marian Rizov [f]

[a] LICOS - Centre for Institutions and Economic Performance, University of Leuven, Belgium.

[b] IOB – Institute for Development Policy and Management, University of Antwerp, Belgium.

[c] Slovak University of Agriculture, Nitra, Slovakia.

[d] Institute of Agricultural Economics, Bucharest, Romania.

[e] INCE - Macroeconomic Modelling Center, Bucharest, Romania.

[f] Middlesex University Business School, London, United Kingdom.

The authors thank the external reviewer Alan Mathews for his constructive comments.

[1] Corresponding author: lara.cockx@kuleuven.be

The research leading to these results has received funding from the European Union's Seventh Framework programme FP7 under Grant Agreement n°290693 FOODSECURE - Exploring the Future of Global Food and Nutrition Security. The views expressed are the sole responsibility of the authors and do not necessarily reflect the views of the European Commission.

Executive summary

Food appears to be abundantly available in the European Union and the region is surpassed only by North America on the Global Food Security Index (EIU, 2014). Problems with regards to food and nutrition security are however, by no means eradicated, with for example an estimated 7.2 and 4.6 per cent of the population suffering from chronic calorie deficiency in Bulgaria and Slovakia respectively (IFPRI, 2014). Moreover, an unbalanced diet is cause for concern even when total energy intake is adequate.

The first chapter of this paper sets out to give a broad overview of food and nutrition security in the Union. As will become abundantly clear, the situation in the New Member States (NMS) merits particular attention. To this end, the first part of this chapter reviews the different dimensions of food and nutrition security at EU level with a particular focus on the determinants of food and nutrition security in the NMS as compared to the EU15 countries. Today, the double burden of malnutrition; the prevalence of both undernutrition and overweight and obesity, seems to represent the main food and nutrition security challenge for the EU. Hidden hunger or micronutrient deficiencies are widespread and overweight and obesity (especially in children) are increasing at an alarming rate. In line with expectations, the analysis further reveals that while there have been improvements, the EU15 continues to outperform the NMS with regards to several dimensions of food and nutrition security. One particular concern is that diets in the NMS have remained relatively monotonous. Moreover, the large share of food expenditure in total household budget in the NMS impedes access to food and signals economic vulnerability.

We address vulnerability in more detail and provide a brief overview of vulnerable groups throughout the entire EU in the second part. Food and nutrition security problems are found to mostly affect people in lower socioeconomic groups and other vulnerable population groups. This urges policy makers to pay particular attention to the poor but also women and children, ethnic minorities and the elderly.

The third part of this chapter zooms in on country-level differences in terms of food and nutrition security in the NMS. In general, we note that data on important food security indicators are lacking for several NMS and that there exists large heterogeneity across countries. The analysis further reveals that the prevalence of chronic calorie deficiency and child malnutrition in some NMS, though decreasing over time, remains cause for concern. Similarly, while the share of food in the household budget has been declining, it is still exceedingly high in several

NMS and Romania in particular. Moreover, the availability of fruits and vegetables is deemed insufficient in several NMS, with the situation being especially problematic in Bulgaria.

The second chapter of this paper is devoted to the discussion of the in depth case studies of the food and nutrition security situation of Slovakia and Romania elaborated by Alexandri et al. (2014) and Rizov et al. (2014) respectively (see Appendix E and F). These case studies were selected because of the availability of longitudinal household data that is required for the analysis of households' sensitivity to income and price shocks. Moreover, while Slovakia can be argued to represent part of the upper bound for the situation in the NMS, food and nutrition security has been a permanent concern in Romania, that is home to some of the most vulnerable households in the EU. The food demand analysis reveals that households in this New Member State continue to be very sensitive to food price and income shocks. For the most part this can be attributed to low income levels and the associated large share of food expenditures in the household budget, especially in rural areas. Households in rural areas also exhibit lower levels of diet diversity and the situation for Roma households is particularly worrisome. The findings presented for Slovakia on the other hand, are more consistent with studies from other developed countries, where food security does not present a significant challenge and households tend to perceive the majority of food products as a necessity rather than a luxury. The data also reveal a noteworthy declining trend in the proportion of income spent on food as well as the expenditure and price elasticities for several food product groups that are particularly important for a healthy diet. The analysis however, indicates that fruit and vegetables and meat and fish are still considered as luxury products for some groups of households. More generally, the study reveals that the demand sensitivity of low-income and rural household is considerably higher. Results further indicate that income has a strong positive effect on diet diversity, while uncertainty has a negative impact, which is particularly strong in vulnerable, low income and rural consumer subsamples. Both case studies point to the importance of income-oriented policies for improving both the quantity and quality of food consumption. Moreover, the large discrepancy between urban and rural households calls for policies directed at rural development. More generally, the considerable heterogeneity across different subsamples underlines the importance of targeting policies to vulnerable groups.

Table of Contents

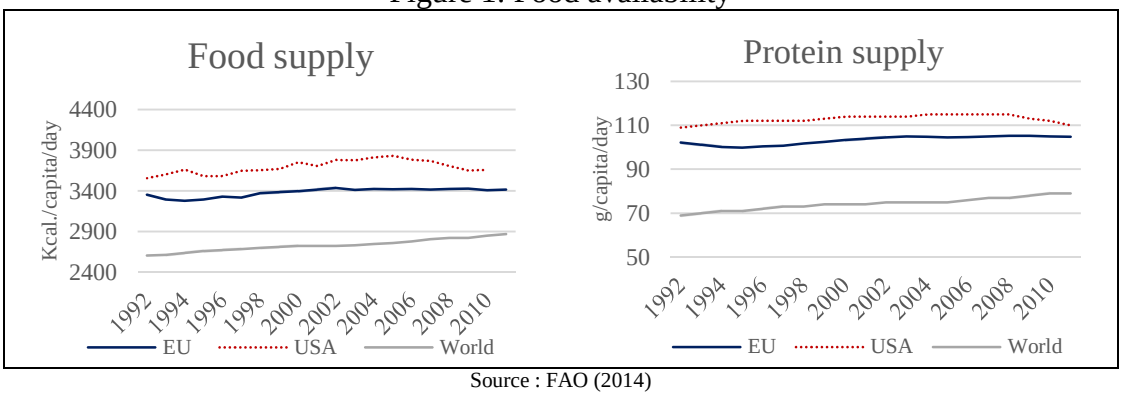
1. Food and nutrition security in the European Union

1.1 An overview

In line with the framework established by Pieters, Guariso and Vandeplas (2013), we review food and nutrition security at the EU level by looking at the **food and nutrition status**, determined by ***availability***, ***access*** and ***utilization***, as well as its **stability**. In this chapter we pay particular attention to the New Member States (NMS) as compared to the EU15 countries.

Availability refers to the extent to which food is within reach of EU households and is largely determined by the food supply and demand. Figure 1 demonstrates that the overall per capita food and protein supply is more than sufficient and that the EU as a whole is surpassed only by one other region in terms of available calories and grams per capita per day; the United States.

Figure 1: Food availability



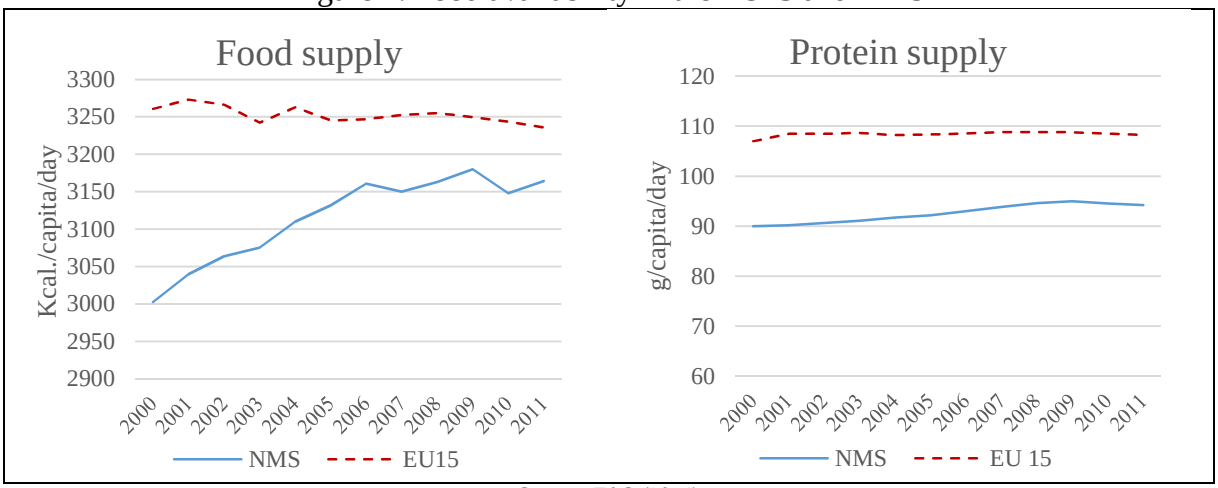
Source : FAO (2014)

Food supply is determined by both domestic food production and trade. The former in turn depends on EU agriculture, governed by the Common Agricultural Policy (CAP), for which food security is now considered to be the top priority by EU citizens (EC, 2010a). Food security arguments are in fact commonly used as an argument in favor of maintaining a strong CAP. Another important macro-driver of food production is climate change. While Europe has a largely temperate climate that is less sensitive to the adverse effects of climate change, the increased threat from pests and diseases as well as the occurrence of extreme weather events in the southern Member States is likely to affect EU agricultural productivity. The greatest impact from climate change will however, most likely be transmitted through the second determinant of food supply; trade. As the EU is still the largest agricultural importer[2] in the world, supply will unavoidably be affected by food price spikes abroad, which are set to become more frequent (EIU, 2014).

[2] The EU is not a net importer. The agricultural trade surplus in 2013 amounted to €18.6 billion (EC, 2014).

While severe food shortages plagued several war-torn European countries in the aftermath of World War 2, since the creation of the EU overall food availability has never been a core issue for the food and nutrition security situation. There is however, considerable regional variation. Though they are catching up, Figure 2 clearly indicates that food supply is on average still lower in the NMS. Moreover, the difference in average protein supply is more persistent.

Figure 2: Food availability in the EU15 and NMS



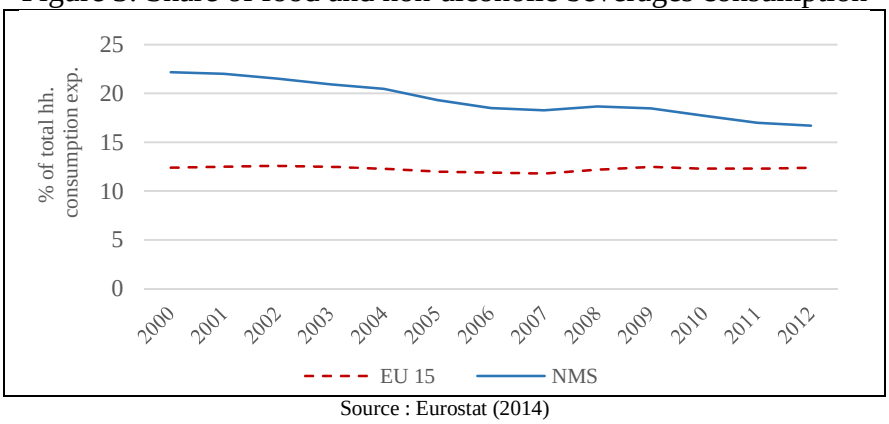
Source : FAO (2014)

According to the 2009 European Health and Nutrition Report, the availability of specific food products tends to be lower in the North and East region of the EU. Data from the FAO Food Balance Sheets for example indicate that the supply of fruit is lower in the North, Central and East. A similar South-North gradient is observed with regards to the availability of vegetables. The Central and East region also show a lower supply of several other food products. Data from the Data Food Networking (DAFNE) initiative confirm the existence of a deficit in the availability of fruit and vegetables in Central and Eastern Europe (Elmadfa, 2009). This lower availability of fruit and vegetables may have important consequences. Pomerleau et al. (2005) for example argue that the burden of cardiovascular disease and cancer attributable to low fruit and vegetable intake is particularly large in the NMS.

The general picture of food availability masks a great deal of variation. There has for example been particular attention for the existence of “food deserts” in the EU, a term used to describe areas in affluent countries where healthy food is not available (Cummins and Macintyre, 1999; Shaw, 2006). It is important to note, that the data on per capita supply by no means reflect the amount of food actually consumed by EU citizens, as availability is not a sufficient condition for ***access*** to food. The latter is largely determined by the cost of food and household income. The cost of food in the EU is however, relatively low and the impact of food price volatility is largely mitigated due to the low average share of food expenses in the household budget.

There is however, considerable heterogeneity. Even though the share of food consumption in total household expenditure has been declining steadily over the years, it remains considerably higher in the lower-income NMS (see Figure 3).

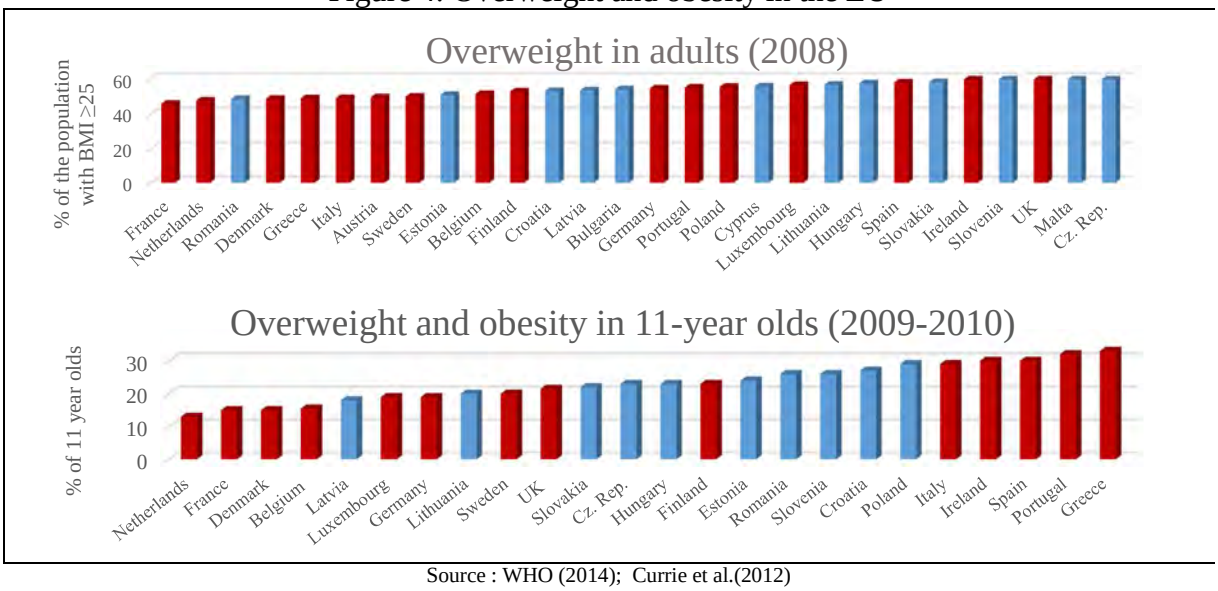
Figure 3: Share of food and non-alcoholic beverages consumption



Source : Eurostat (2014)

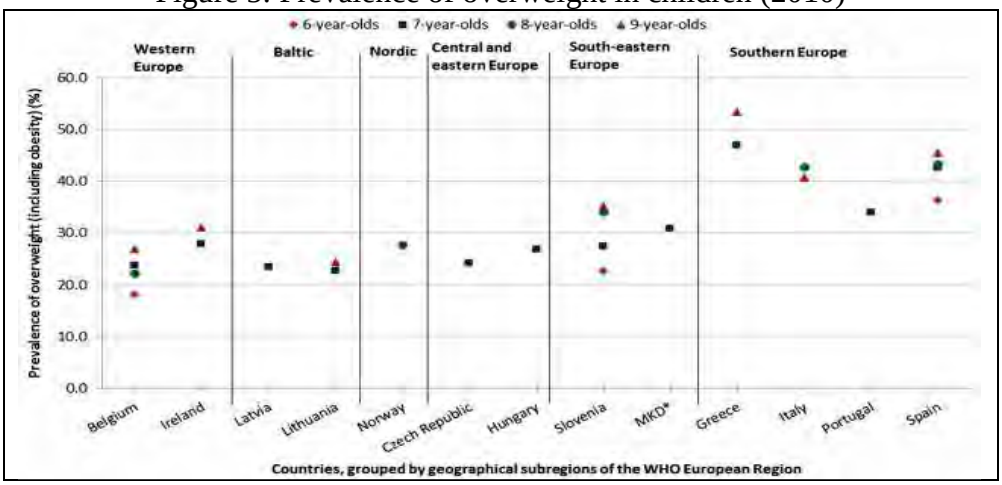
With regards to food ***utilization***, the EU, appears to be plagued by the double burden of malnutrition. While less pronounced than in North America, overweight and obesity now pose one of the most serious public health challenges in the EU (see Figure 4), as they are estimated to cause 9-12 % and 16-20% of deaths in the EU15 countries and the NMS respectively (WHO, 2014). Overweight and obesity are found to mostly affect people in lower socioeconomic groups, which in turn contributes to a widening of health and other inequalities (WHO, 2013). Another particular concern is the high level of overweight and obesity in children, with around 1 in 3 children in the EU aged 6-9 years old overweight or obese in 2010. Figure 5 indicates that the problem of childhood obesity is particularly severe in Southern Europe. Possible explanations for the apparent north–south gradient remain unclear (Wijnhoven et al., 2014).

Figure 4: Overweight and obesity in the EU



Source : WHO (2014); Currie et al.(2012)

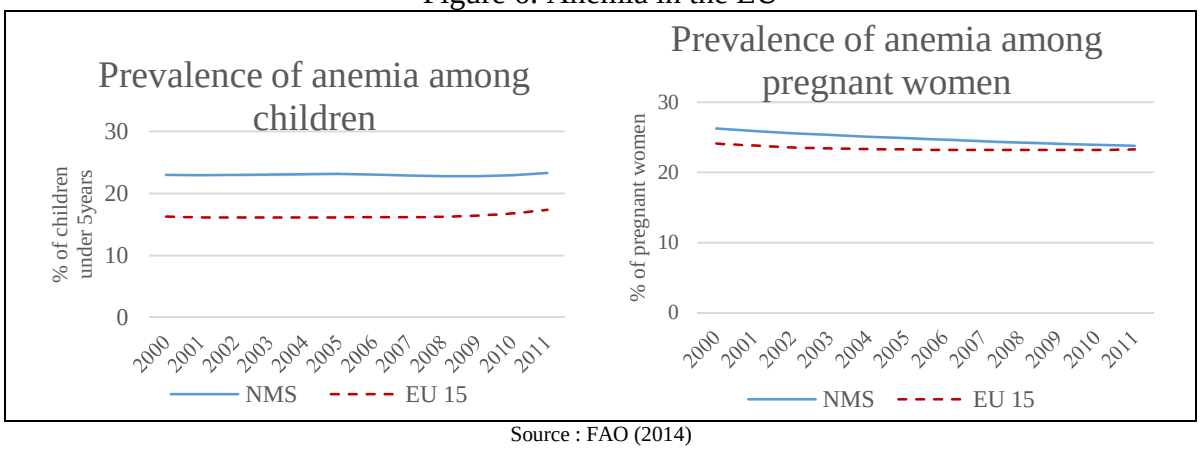
Figure 5: Prevalence of overweight in children (2010)



Source: Wijnhoven et al. (2014)

At the same time micronutrient deficiencies are not uncommon. Roman Viñas et al. (2011) report high prevalence of inadequate intakes of vitamin C, vitamin D, and folate, Calcium, Selenium and Iodine in the EU. Mensink et al. (2013) confirm these concerns with regards to vitamin D, Iodine and Selenium. While socioeconomic conditions and income in particular have been found to be the most important predictors of diet quality (Darmon and Drewnowski, 2008), Novakovic et al. (2010) find that with exception of calcium, the available evidence shows no difference in micronutrient intake or status in Central and Eastern Europe as compared to other, more affluent, European regions. Europe is reported to have the world's lowest proportion of children affected by iron deficiency (WHO, 2008), the NMS however, continue to have higher prevalence of anemia among children. The difference in the prevalence of anemia among pregnant women has become negligible over time (see Figure 6).

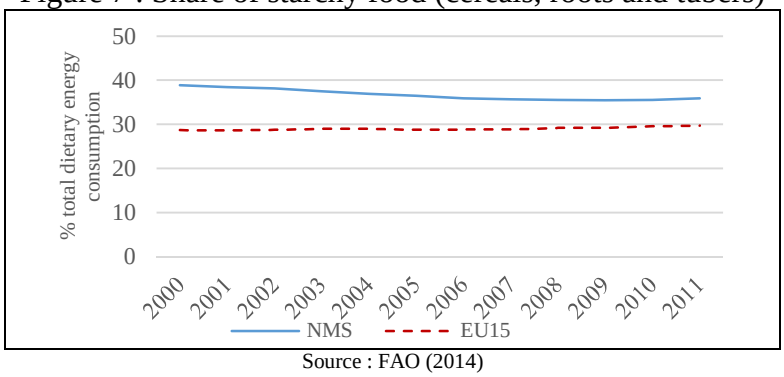
Figure 6: Anemia in the EU



Source : FAO (2014)

Diets in the transition region have been argued to be particularly monotonous, with the majority of energy coming from the consumption of starch and cereals (Swinnen and Van Herck, 2011). Although there is sign of improvement, Figure 6 demonstrates that the share of starchy foods in total dietary energy consumption on average remains larger in the NMS.

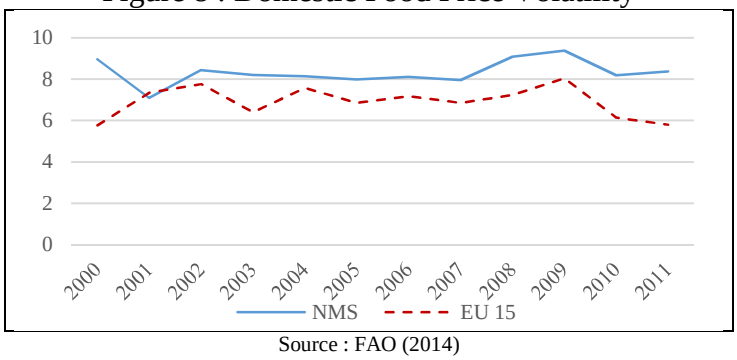
Figure 7 : Share of starchy food (cereals, roots and tubers)



Source : FAO (2014)

We now turn to the second major dimension of food and nutrition security, the **stability** of the food and nutrition status. The stability of the food and nutrition status is related to the likelihood of the occurrence of negative shocks, which is in turn impacted heavily by macro-level drivers, with food prices representing the main transmission channel. While consumer prices for food recorded extraordinary inflation rates in 2008 in light of the world food price crisis, food price inflation has since then been subdued in most Member States. Swinnen et al. (Forthcoming) find that consumer food prices increased only slightly with real food prices just 5 per cent higher in 2012 than in 2005. There are however notable exceptions among the NMS (EIU, 2014), as is to some extent reflected in the higher FAO Domestic Food Price Volatility Index[3], depicted in Figure 8. Moreover, it is expected that the NMS will experience the strongest impact from climate change on domestic consumer prices, as the market conditions allow for intermediaries to pass through the burden (Oxfam, 2013).

Figure 8 : Domestic Food Price Volatility



Source : FAO (2014)

Finally, even though recently the volatility of domestic agricultural production is deemed relatively high, as a result of large swings in production in Eastern Europe, it has been noted that Europe in general has a very stable food security environment. With regards to macro-level drivers of ***vulnerability*** and ***resilience***, we further note that there exist large disparities among Member States with regards to social policies that will protect poorer households.

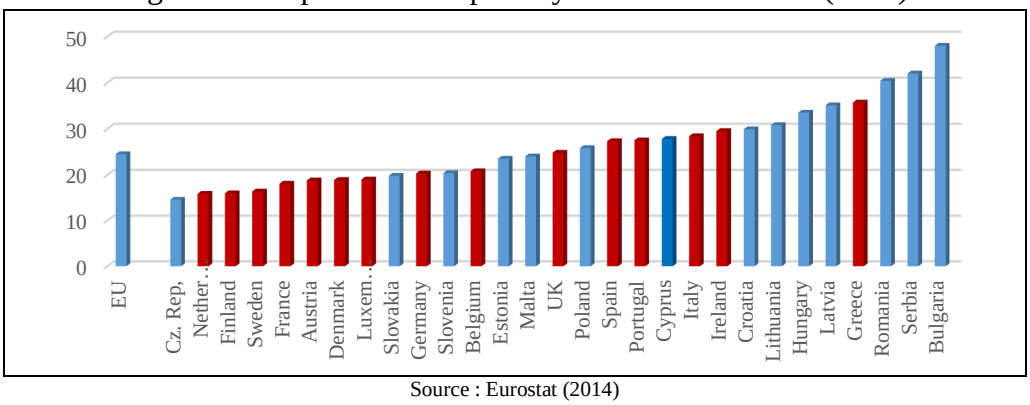
[3] Domestic Food Price Volatility is a measure of variation of the Domestic Food Price Level Index. It has been computed as the standard deviation of the deviations from the trend over the previous five years (FAO, 2013).

1.2 Vulnerable groups

Besides regional differences, there are large disparities in terms of food and nutrition security between and within EU countries. Already in 1986, the World Bank stated that "*the hungry are the poor, mostly women, children, ethnic minorities and the elderly*".

The poorest still face difficulties in obtaining access to food of sufficient quantity and quality to ensure a safe and nutritious diet. Darmon and Drewnowski (2008) note that energy-dense and nutrient-poor diets are cheap and more consumed by those with limited means. This is reflected in the tendency for low-income EU households to have unbalanced diets resulting in both under- and overnutrition (Elmadfa, 2009). Similarly, the WHO argues that poverty in the EU is associated with the consumption of foods of poor nutritional quality (WHO, 2008). Moreover, the food and nutrition status of the poor is most likely less stable. Temporary negative shocks can be expected to make access to food more difficult for Europe's poorest, who spend larger parts of their income on food (EIU, 2014). We note however, that detailed data on the share of the budget spent on food according to income category are not widely available. According to the 2012 estimates on the proportion of the population at risk of poverty or social exclusion represented in Figure 9, there is significant variation across EU members. The NMS, clearly fare worse, with the notable exception of the Czech Republic.

Figure 9 : People at risk of poverty or social exclusion (2013)



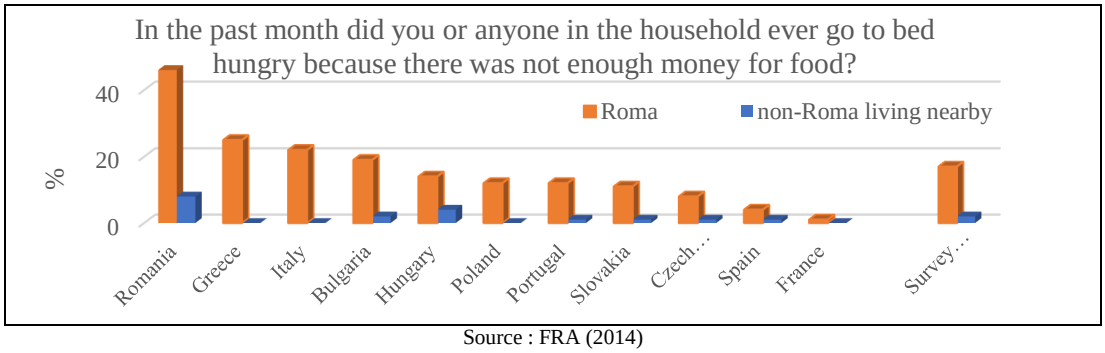
Source : Eurostat (2014)

Gender inequalities in control of assets will affect women's access to food. Moreover, women and pregnant women in particular, are more vulnerable to malnutrition as they for example require more iron and protein (FAO, 2012). The same reasoning applies to young children, as they are growing rapidly and need foods rich in energy and nutrients.

Ethnic minorities are considered a vulnerable group as they are socially excluded and have fewer opportunities to generate the necessary income to have access to sufficient and nutritious food. Vitamin D deficiency has for example been found to be particularly prevalent among immigrants from the Middle East and Asia in the United Kingdom and Norway (Lips, 2007).

Zajc et al. (2006) assessed the nutritional status of the Bayash, a Roma population in Eastern Croatia and find that underweight is much more prevalent, especially for women. Surprisingly, the authors note that the prevalence of overweight is considerably lower, but the proportion of the Roma population with obesity is approximately equal. The authors suggest that the overall nutritional status of the Bayash Roma population is unsatisfactory and appears to be the product of unhealthy dietary habits and socio-economic deprivation. Studies in the Czech Republic (Dejmek et al. 2002) and Slovakia (Ginter et al., 2001) show significantly decreased levels of vitamin C and other antioxidants and vitamins as well as higher levels of inadequate nutrition in Roma minority groups. Data from the 2011 Fundamental Rights Agency (FRA) Roma pilot survey, conducted in 11 Member States, reveal the particularly worrisome food and nutrition security situation of this ethnic minority (see Figure 10).

Figure 10 : Food security of the Roma population in different MS



Source : FRA (2014)

Finally, the elderly have been argued to represent a particularly vulnerable group because of their health status and factors such as financial restrictions and social isolation (Brownie, 2006). Sieber (2006) estimates that the prevalence of malnutrition for elderly in most EU Member States lies between 5 and 20 per cent, with the percentage increasing rapidly in the hospitalized elderly (19-65%) and in those living in care homes (29-74%). The European Parliament (2008) therefore called on Member States to improve the quantity and quality of food in hospitals and care homes.

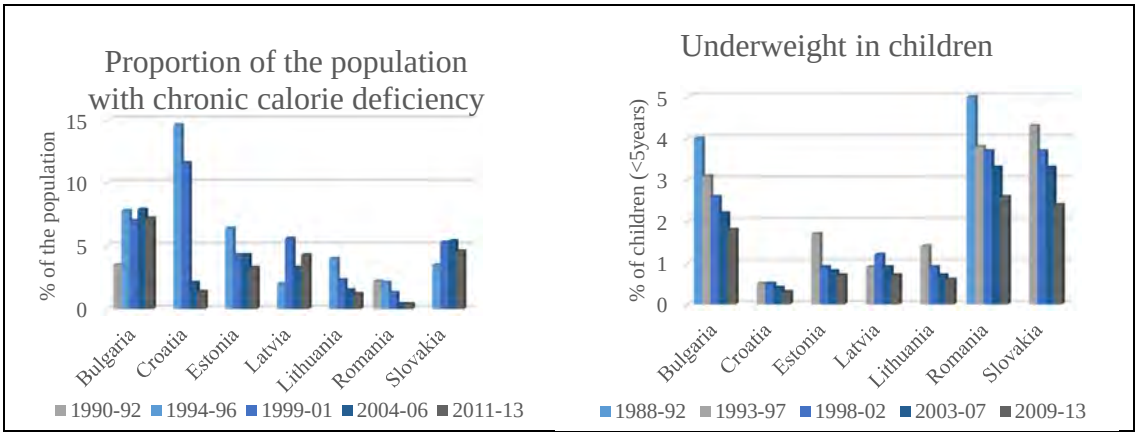
1.3 Food and nutrition security in the New Member States

Throughout the first part of this chapter, it became clear that the food and nutrition security situation in the NMS merits particular attention. We will now shift the focus of our review to the national level and limit our attention to the countries that acceded to the Union after 2004.

The prevalence of chronic calorie deficiency remains high in Bulgaria and Slovakia (Figure 11). Romania and Slovakia are faced with a considerable proportion of underweight children.

Wijnhoven et al. (2014) find elevated values for thinness in children in Lithuania and Slovenia. A number of NMS however, appear to have made significant progress over time. We note that information on the prevalence of malnutrition and underweight is unavailable for several NMS.

Figure 11 : Food security in the NMS

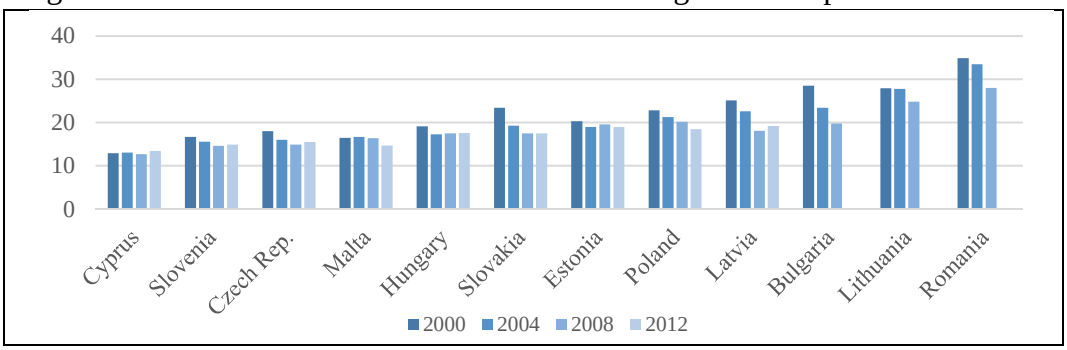


Source : IFPRI (2014)

Data from the FAO Food Balance Sheets reveal that there is some heterogeneity with regards to the ***availability*** of food within the NMS. Compared to the aggregate EU level and even the NMS average, the food supply expressed in available kilocalories per capita per day is relatively lower in Croatia, Slovakia and Bulgaria. The latter scored extremely low on the 2014 Global Food Security Index (GFSI) dimension of availability, mainly because of inadequate investment in agricultural research and development (R&D), high volatility in production and a high proportion of food loss. While Romania, has shown great improvement in terms of food supply per capita, food availability is still deemed problematic because of low public expenditure on agricultural R&D, production volatility and inadequate infrastructure (EIU, 2014). According to the most recent estimates, Bulgaria, Latvia, Czech Republic, Slovakia; Lithuania, Poland and Slovenia fail to meet the FAO/WHO recommendation of 600g/capita/day supply of fruits and vegetables. The situation is again especially problematic in Bulgaria that is not even meeting half of the daily supply requirement (PHEIAC, 2013).

Figure 12 shows that there are considerable differences within the NMS with respect to the share of food and non-alcoholic beverage consumption. Households in Romania are estimated to spend nearly half their budget on food (EIU, 2014). This will have important implications for both food ***access***, as it determines the relative cost of food and the ***vulnerability*** of households because shocks are harder to mitigate. Unfortunately, recent data on food expenditure are lacking for Romania and Lithuania, while precisely those countries had the highest shares of food expenditure in total household consumption spending in the past. There are no data available for Croatia.

Figure 12 : Share of food and non-alcoholic beverages consumption in the NMS



Source : Eurostat (2014)

With regards to ***utilization***, we note that diets are particularly monotonous in Romania, Bulgaria and Poland, with starchy foods still contributing over 40 per cent of total dietary energy intake. Iron deficiency in children is widespread in all NMS except for Malta and Cyprus. Novakovic et al. (2010) find that the mean calcium intake in Estonia, Hungary and Lithuania are below average nutrient requirement. Mild iodine deficiency was reported for children and adolescents from Estonia, Hungary, Latvia and Lithuania.

2. Food and nutrition security in Romania and Slovakia

As the previous chapter demonstrated, several New Member States of the European Union still face considerable problems with regards to undernutrition and malnutrition. Moreover these Member States are home to some of the most vulnerable households in the European Union. Surprisingly, food demand in middle-income transition countries has rarely been investigated on the basis of micro data. This chapter sets out to analyze food demand patterns and the determinants of food diversity in Romania and Slovakia based on data from their respective national Household Budget Surveys (HBS). Among the NMS, Slovakia represents an interesting case study as the economy continues to perform well and the country reported to have the lowest inequality in the entire Union (Eurostat, 2013). Romania on the other hand is a Member State with particularly vulnerable population groups as poverty rates remain high and food prices continuously increase.

The analysis of the food security situation in Romania and Slovakia will consist of an examination of food access through an estimation of the food demand system and an investigation into the determinants of the demand for food diversity, which is related to diet quality and the dimension of utilization. Information on households' responses to price and income changes is of the utmost importance for policy makers dealing with food and nutrition security issues. There is an association between food access and diet diversity at household level. The magnitude of this association increases with improving the food access; for example, Jackson (1984) shows that diet diversity measured as the number of food commodities consumed increase with income and expenditure and Hoddinott and Johannes (2002) demonstrate a link between the mean level of caloric availability and diet diversity.

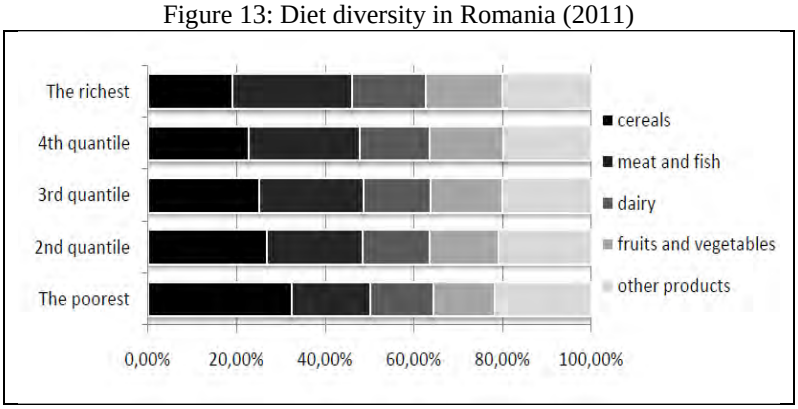
2.1 Romania

2.1.1 Food and nutrition security in Romania: an overview

Even though Romania is one of the countries with the largest agricultural land areas in Europe, thus having significant agricultural resources, food security has been a permanent concern. Domestic agricultural production has been highly volatile due to the fragmented farm structure, inadequate irrigation systems, obsolete production technologies and insufficient funding for the agricultural sector. Moreover, while Romania experienced high rates of economic growth after its accession in 2004, incomes continue to lag behind.

When the country was hit by a sharp recession in 2009, the subsequent economic recovery in 2011 was not sufficient to offset the increasing trend in poverty rates. According to the most recent data 31.5 per cent of the population is living on less than 5 dollar a day (World Bank, 2014) and no less than 41.7 per cent was at risk of poverty or social exclusion in 2012 (Eurostat, 2014). Romania is further characterized by large discrepancies between urban and rural areas, with rural poverty rates estimated to be at least three times larger. At the same time food prices continue to rise and the share of food expenditure in the household budget, an important indicator of access to food, is exceedingly high, with shares of 40.9% and 51.9% in urban and rural areas respectively. After a decade of improvements, the share of food expenditures has actually increased since 2010. Moreover, rural households are still largely dependent on their own food production and are faced with poor access to improved water sources and sanitary sewage facilities, which has been linked to the high incidence of gastro-intestinal infections (Samwel and Gabizon, 2009). Finally, while there have been some improvements in both the quality and quantity of food consumption during the period of economic growth, diets have remained monotonous, especially for low-income households that gain nutrients mostly from grains as can be derived from Figure 13.

Figure 13: Diet diversity in Romania (2011)

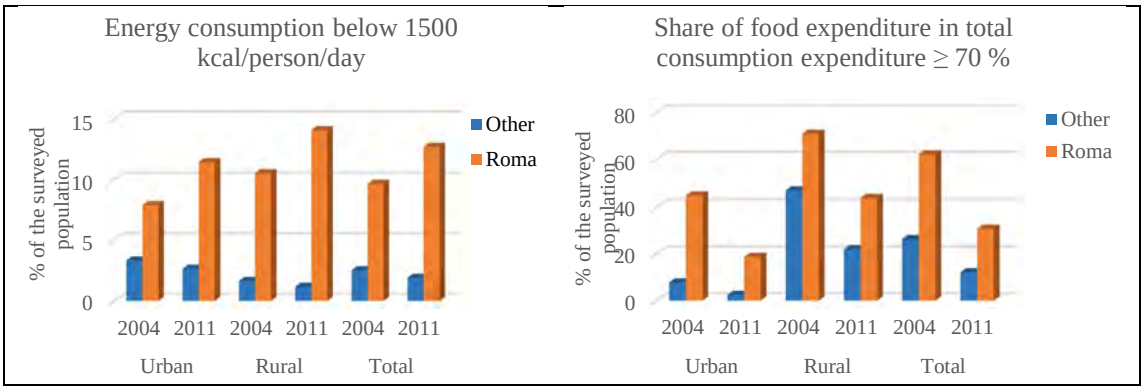


Source : Alexandri et al. (2014)

A particular concern in Romania, is the food and nutrition security situation of the Roma population. According to the 2011 National Census, 3.3 per cent of the total population belongs to the Roma minority group. The Council of Europe however, estimated that this particular ethnic minority accounted for 8.32 per cent (EC, 2010b) of the population in Romania. The Roma population in Romania faces several important challenges that affect their food and nutrition security, including low educational levels and limited employment opportunities culminating in low incomes. Data from the 2011 HBS summarized in Figure 14, reveal a large discrepancy between the Roma and non-Roma population with regards to total energy consumption and the share of food expenditure in total consumption expenditure.

The proportion of the Roma population consuming less than 1500 kilocalories, and thus severely undernourished[4], remains worryingly high, especially in rural areas. It appears that the situation has even deteriorated over time. While the share of food expenditure in total household expenditure has decreased significantly, the proportion of the Roma population spending more than 70 per cent of their budget on food is cause for concern, as it signals high vulnerability.

Figure 14 : Food security indicators for the Roma population



Source : Alexandri et al. (2014)

Roma households appear to face difficulties with regards to other dimensions of food and nutrition security as well. In particular they are reported to have low levels of diet diversity. As can be seen in Table 1, despite some improvements, on average the Roma households fail to meet the daily recommended intake[5] (DRI) of several important macronutrients.

Table 1 : Daily macronutrient intake

	All			*Roma*			*DRI*
	2004	2007	2011	2004	2007	2011	
Proteins (g/day)	98	98	99	85	89	89	95
Lipids (g/day)	103	102	104	85	89	88	95
Carbohydrates (g/day)	376	357	348	355	342	328	400

Source : Alexandri et al. (2014)

2.1.2 Food demand

Food demand patterns in Romania were analyzed based on data from the Romanian HBS for the first quarter of 2011, covering 9360 households[6]. The survey provides detailed information on household characteristics, incomes, expenditures, and actual food consumption. Food commodities are aggregated in the following categories; cereals, meat and fish, dairy products and eggs, fruits, vegetables, sweets, alcohol and other food products. Households with zero expenditure for at least one of the food groups were dropped from the sample.

[4] IFPRI(2014) defines undernourishment as chronic calorie deficiency, with consumption of less than 1800 kilocalories a day, the minimum most people need to live a healthy, productive life.
[5] Daily recommended intake of the selected macronutrients (computed as an arithmetic average of daily recommended intake for adult men and women).
[6] The response rate is around 80%.

Implicit prices or "unit values" (Deaton, 1989) are in turn derived from the data on expenditure and purchased quantities. Table 2 summarizes the main descriptive statistics.

Table 2 : Food expenditures

Expenditure share	*Obs*	*Mean (%)*	*Std. Dev.*	*Min (%)*	*Max (%)*
Cereals	4450	21.25	9.44	0	64.82
Meat	4450	24.64	9.31	1.10	66.50
Milk	4450	16.68	6.95	0.83	51.49
Fruits	4450	6.87	3.78	0.18	31.52
Vegetables	4450	10.39	5.66	0.20	46.29
Sweets	4450	6.58	4.15	0.25	30.06
Alcohol	4450	6.31	4.47	0.10	54.43
Other	4450	7.30	4.01	0	37.16

Source : Alexandri et al. (2014)

In line with Greene (1997) the food demand system in Romania was estimated using the Linear Approximation Almost Ideal Demand System (LA/AIDS) model. While AIDS satisfies the restrictions of demand theory, it is less complicated than other models. The analysis (see Appendix A) reveals that food demand patterns differ for urban and rural households, with the latter having larger shares of cereals, fruits, sweets and alcohol. For the urban households the gender and education level of the head of the households significantly affect food demand. Other characteristics such as the size of the household, the presence of young children were also found to be important in explaining variation in food demand patterns.

We now turn to food expenditure and price elasticities, as they measure the sensitivity of households to market shocks and provide insight into the vulnerability of their food and nutrition security status. Food expenditure elasticities for the different food product categories are reported in Table 3. We note that several of the reported elasticities exceed the value of one, indicating that these food products, including several items that are usually considered as basic necessities, are perceived as luxury items in Romania.

Table 3 : Food expenditure elasticities

	Total	*Urban*	*Rural*
Cereals	0.917	0.781	1.005
Meat	0.991	0.951	1.100
Milk	1.109	1.090	1.137
Fruit	1.079	1.117	1.052
Vegetables	1.121	1.172	1.069
Sweets	1.070	1.188	0.922
Alcohol	0.810	0.958	0.761

Source : Alexandri et al. (2014)

All uncompensated or Marshallian[7] own-price elasticities calculated on the basis of purchased food products (see Table 4), are negative and thus consistent with demand theory.

[7] While the uncompensated/Marshallian demand function holds income constant, for the compensated/Hicksian demand, utility is held constant.

Demand appears to be inelastic for meat and fruit. Compared to rural households, urban households seem less sensitive to price changes in cereals, milk, vegetables and alcohol.

Table 4 : Uncompensated own-price elasticities

	Total	*Urban*	*Rural*
Cereals	-1.296	-0.937	-1.577
Meat	-0.672	-0.692	-0.629
Milk	-1.237	-1.209	-1.291
Fruit	-0.733	-0.750	-0.702
Vegetables	-1.066	-0.932	-1.165
Sweets	-1.068	-1.071	-1.050
Alcohol	-1.178	-1.171	-1.189

Source : Alexandri et al. (2014)

2.1.3 Food diversity

As mentioned above, diets have remained particularly monotonous in Romania. A very straightforward way to measure food diversity is counting the number of food items consumed (CM), but there are alternative measures such as the Berry Index (Berry, 1971), which has gained popularity in the literature (e.g., Thiele and Weiss, 2003; Drescher and Goddard, 2011; Hertzfeld et al., 2014). The Berry Index (BI) is calculated using the following formula:

$$BI = 1 - \sum \omega_i^2$$

where ω_i is the budget share of the ith food commodity

It thus follows that this measure is also a function of food prices, income (expenditure), and household characteristics. To ensure the normality of the index, the transformed Berry Index (TBI) is calculated as follows:

$$TBI = \ln\left[\frac{BI}{(1-BI)}\right].$$

It is useful to consider both measures, as an increase in CM would indicate that a household introduces new food commodities to its diet. However, the BI and TBI provide information to what extent the new commodities and, possibly, other commodities are purchased in sufficiently larger amounts to affect the distribution of consumption shares. Descriptive statistics based on the data from the HBS for the first and third quarter of 2011 are summarized in Table 5.

Table 5 : Diet diversity

	Obs	Mean	Std. Dev.	Min	Max
First quarter					
CM	7843	22.50	9.82	1	60
BI	7843	0.89	0.08	0	0.97
TBI	7835	2.22	0.61	-1.18	3.53
Third quarter					
CM	7724	24.41	10.29	2	62
BI	7724	0.89	0.08	0	0.97
TBI	7715	2.24	0.63	-15.94	3.52

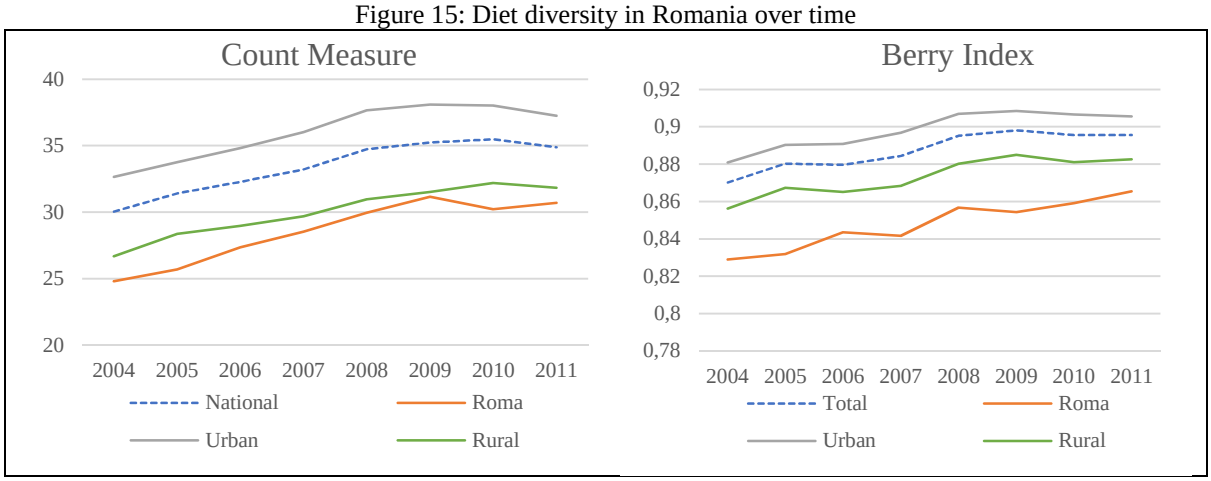
Source : Alexandri et al. (2014)

Diet diversity, measured by the Count Measure and the Transformed Berry Index, is subsequently regressed on household income and other household characteristics (see Appendix B). The highly significant coefficient for the logarithm of household income indicates that food diversity is income elastic. The gender, and occupational status of the head of the household play an important role, as female headed households have significantly higher levels of food diversity and self-employment in agriculture decreases diversity.

Blisard et al. (2003) argue that better-educated consumers may be more aware of the importance of healthy eating and therefore spend money on more diverse and balanced diets. Moon et al. (2002) found empirical evidence to support the argument. The empirical evidence on this relationship is however still mixed (Moon et al., 2002; Thiele and Weiss, 2003).The results from the Romanian data, show limited support for this hypothesized effect. The level of education of the head of household is significantly positive only for the regression on the TBI in the urban subsample. The results further indicate a significantly positive effect for the presence of young children. Interestingly, the size of the household is on average associated with higher count measures, but lower values of the TBI. Thiele and Weiss (2003) argue that reconciling the effects of household size on diet diversity, measured by count and share-based measures, is complicated as the two measures reveal different aspects of a consumption pattern.

Figure 15 shows the evolution of diet diversity in Romania over time. We note that both indicators have improved significantly since 2004. The gap between the urban and rural population is however, maintained. Rural households' large reliance on self-consumption could explain part of this discrepancy. Figure 15 further demonstrates the particularly worrisome situation of the Roma population.

Figure 15: Diet diversity in Romania over time



Source : Alexandri et al. (2014)

2.1.4 Policy implications

Alexandri et al. (2014) note that as income elasticities are higher than price elasticities for most product groups and households' food demand therefore appears to be relatively more sensitive to changes in income, interventions for improving food and nutrition security focusing on income-generating activities could be particularly effective in Romania. The analysis of food diversity also underlines the importance of income as a determinant of diet quality.

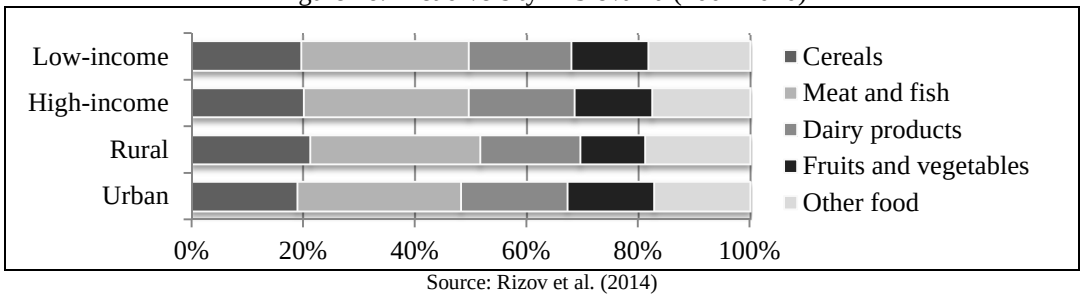
Given the large discrepancy between urban and rural areas, particular attention should be paid to policies targeting at rural development. Cupak et al. (2014) argue that the EU rural development policies in Romania have led to an improvement of the quality and diversity of diets. The authors further point to the success of direct interventions such as schemes for milk and fruit consumption support in schools in rural areas and argue that interventions focusing school children are important for meeting immediate nutrition needs as well as improving nutrition knowledge.

2.2 Slovakia

2.2.1 Food and nutrition security in Slovakia: an overview

Slovakia has been experiencing high growth rates and recovered swiftly from the global financial crisis. Income levels are much higher compared to Romania, which is reflected in the lower share of food expenses in total household consumption expenditure, estimated at 17.5% for 2012. According to the latest Eurostat estimates, among the NMS only the Czech Republic has a lower proportion of the population at risk of poverty or social exclusion. Moreover, as mentioned above, inequality is particularly low. This clearly reduces households' vulnerability to price shocks and improves their access to food. The country however, still faces some food and nutrition security problems, with an estimated 4.6 % of the population facing chronic calorie deficiency and 2.4 % of children underweight. As can be derived from Figure 16, diets have remained, rather monotonous.

Figure 16: Diet diversity in Slovakia (2004-2010)



Source: Rizov et al. (2014)

Other food and nutrition security problems for Slovakia signaled in the 2014 Food Security Index country report include poor agricultural infrastructure, volatile agricultural production and low protein quality and micronutrient availability (EIU, 2014).

2.2.2 Food demand

Food demand patterns were analyzed based on data from HBS in Slovakia, annually covering between 4500 and 6000 households, for the period from 2004 to 2010. We note that as households were selected randomly each year, these samples don't form a "real" panel dataset and the households were not followed from one year to the next. Similar to the previously discussed Romanian HBS, the Slovakian surveys provide detailed information on household characteristics, incomes, expenditures, and actual food consumption. Implicit prices or "unit values" (Deaton, 1989) were again derived from the data on expenditure and purchased quantities. Food commodities were aggregated in the following categories; cereals, meat and fish, dairy products and eggs, fruits and vegetables and other food products.

The main descriptive statistics for the analysis are summarized in Table 6. As food expenditure shares remained relatively stable, household consumption patterns in Slovakia don't appear to have changed substantially over time. Further examination shows little alterations in quantities consumed as well. A noticeable increase in the share of expenditure on fruits and vegetables and the substitution of low-fat milk for whole milk however, indicate some modest improvements in diet quality. Moreover, the share of food expenditure in net income has been declining, despite a small hike in 2010, since Slovakia's accession to the EU. The rising income levels can easily be considered the main driving force behind this positive evolution.

Table 6: Descriptive statistics on food expenditures

	2004		2010	
	Mean	Std.Dev.	Mean	Std.Dev.
Total monthly household food expenditure(€)	91.66	47.57	116.95	58.95
Net monthly household real income (€)	449.93	317.51	715.74	420.32
Ratio of food expenditure and net income	0.24	0.13	0.19	0.12
Expenditure share on cereals	0.20	0.07	0.20	0.07
Expenditure share on meat and fish	0.30	0.11	0.29	0.10
Expenditure share on dairy products	0.19	0.07	0.18	0.07
Expenditure share on fruits and vegetables	0.12	0.07	0.15	0.07
Expenditure share on other food	0.19	0.07	0.17	0.06

Source : Rizov et al. (2014)

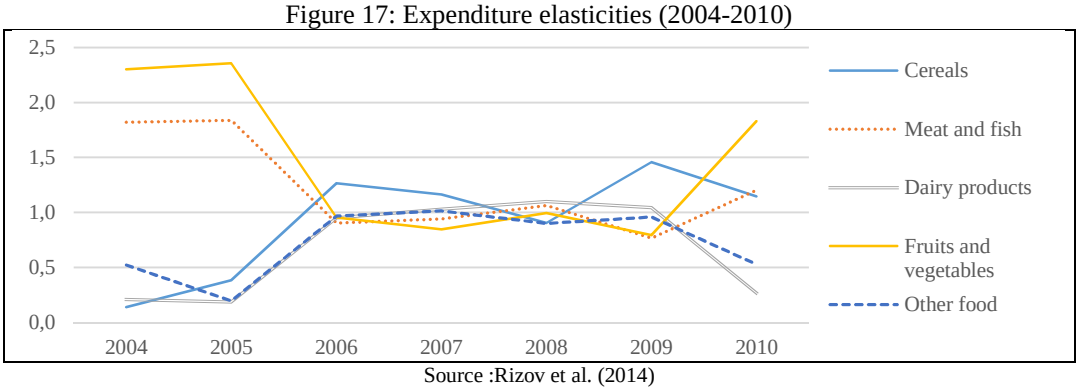
In line with Banks et al. (1997) the Quadratic Almost Ideal Demand System (QUAIDS), which allows for non-linearity in the Engel curves, augmented with demographic and regional controls was employed to analyze food expenditure patterns across income groups and regions.

The estimation of the Engel curves for the five food groups (see Appendix C, Figure C1), indicate that while an increase in income is associated with a monotonic decline in the share of expenditure on cereals, there is a positive relationship between income and the expenditure share of meat and fish. These items are therefore perceived as luxury products. The Engel curves for dairy products and fruits and vegetables appear non-linear with an inverted-U-shape.

The expenditure parameters estimated with QUAIDS (see Appendix C, Table C1), suggest that meat and fish, and for the rural households in early rounds also fruits and vegetables, are luxury products. The demographic and regional controls 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 expenditure elasticities of all food groups are positive. Despite an overall decline over time, the elasticities for fruits and vegetables and meat and fish are the largest in magnitude. The expenditure elasticity for cereals and other food products on the other hand have actually increased over time, with a pronounced hike in 2009 (see Figure 17).

Figure 17: Expenditure elasticities (2004-2010)

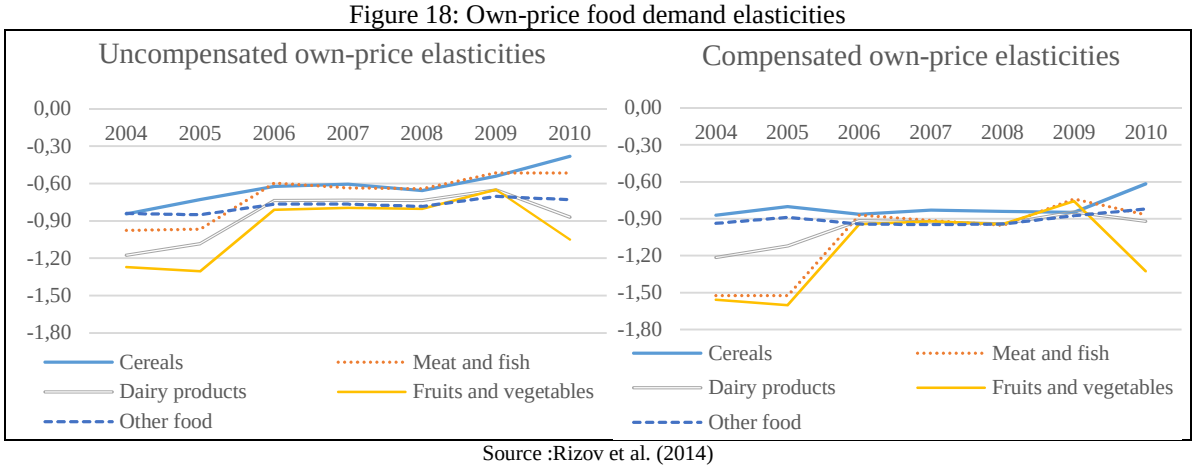


Source :Rizov et al. (2014)

All compensated or Hicksian and uncompensated or Marshallian own-price elasticities are negative and thus consistent with economic theory. While the 7-year averaged compensated own-price elasticities (see Appendix C, Table C1) are smaller than unity in absolute value, the uncompensated own-price elasticities of fruits and vegetables and meat and fish exceed one and therefore indicate an elastic demand. The fact that the signs of several compensated and uncompensated cross-price elasticities are different suggests that income effects are important in consumer demand decisions.

Figure 18 represents the evolution of own-price elasticities over time. While in general, there appears to be a declining trend, there is a pronounced hike in household price sensitivity around 2009-2010 in the aftermath of the global economic crisis. The results also indicate that rural and low-income households are more price sensitive.

Figure 18: Own-price food demand elasticities



Source :Rizov et al. (2014)

2.2.3 Food diversity

Next, diet diversity demand functions in Slovakia are investigated. Two of the previously discussed diversity measures - the count measure (CM) and the Transformed Berry Index (TBI) - are analyzed by the means of both ordinary least squares regressions and quantile regressions. The estimation results show a significant positive effect of income on diet diversity, with income having a stronger effect at lower quantiles of the diet diversity distribution. Food prices are also found to have a significant effect on diet diversity in several cases, however the direction of the effects is difficult to interpret (Thiele and Weiss; 2003).

The analysis of diet diversity is linked to decision making under uncertainty. To distinguish the effect of uncertainty, the equation includes a measure of the household risk premium. The latter is not directly measured in the survey, but based upon the information on the compensated price elasticities obtained from the QUAIDS analysis. As price elasticities capture the sensitivity of households to price and income shocks, they proxy the household risk premium by capturing both the household risk aversion and the variance of expected income. The results indicate that there is a significantly negative effect of the risk premium on diet diversity. Interestingly, the effects decline across quantiles for the CM specification and increase for the TBI specification. According to Rizov et al. (2014) this suggests that at the lower end of the diet diversity distribution households are more likely to reduce the number of commodities consumed rather than rebalance quantities consumed.

There is limited support for the hypothesized effect of education. The coefficient is significant only in the TBI specification, with the effect being stronger at the highest quintiles of the diet diversity distribution. In line with the previously mentioned results for the demand for food diversity in Romania, the size of the household has opposite effects depending on the measure.

The effect is again significantly positive in the CM specification and significantly negative in the TBI specification. Single households are found to have less diverse consumption patterns and the presence of children has a significantly positive effect on diet diversity measured by TBI. The latter effect is the strongest at the lower quantiles. The results further reveal significant time and regional effects. Diet diversity is higher compared to the reference 2004 year and lower in other regions compared to the capital city; Bratislava. There is also some indication of seasonality, as diet diversity generally appears to be lower in the winter. Finally, the results also confirm the existence of a divide between urban and rural areas, with the latter consuming a less diverse diet.

Rizov et al. (2014) note that the findings presented for Slovakia are consistent with studies from other developed countries, where food security does not present a significant challenge. Households tend to perceive food as a necessity rather than a luxury (Michalek and Keyzer, 1992; Abdulai, 2002; Chern et al., 2003) and diet diversity exhibits a positive relationship with income (Thiele and Weiss, 2003; Drescher and Goddard, 2011).

2.2.4 Policy implications

The analysis of food demand in Slovakia reveals that average expenditure elasticities for all food groups surpass own-price elasticities in magnitude. This seems to imply that Slovakian households' food demand is more sensitive to changes in income as compared to prices, leading Rizov et al. (2014) to conclude that policy tools for enhancing income might prove to be more effective compared to policies that are targeted at price reduction. The authors additionally mention, that income oriented policies could be particularly suitable for increasing the consumption of fruits and vegetables and more generally improve diet diversity. Rizov et al. (2014) however, further stress that coping with food and nutrition security problems in the NMS requires a combination of a wide array of government policies, including infrastructure building, social policies, agricultural policies, fiscal policies and even anti-discriminatory policies.

Additionally, these findings point to the need for well-targeted policies, as the food and nutrition security problems are particularly acute for marginalized and vulnerable groups including ethnic minorities, elderly people, single mothers and the rural population in general. With regards to the large discrepancy between urban and rural food security, Rizov et al. (2014) note particular attention should be paid to policies directed at rural development and improvement of food supply chains.

3. Conclusion

Throughout this paper it became clear that the double burden of malnutrition, the prevalence of both undernutrition and rising overweight and obesity poses a severe challenge. With 1 in 3 children in the EU aged 6 to 9 years old overweight or obese as well as the persistent prevalence of chronic calorie deficiency in some of the New Member States and inadequate micronutrient intakes, food and nutrition security problems are by no means eradicated in the European Union

The previously mentioned food and nutrition security problems are found to mostly affect people in lower socioeconomic groups and other vulnerable population groups. This urges policy makers to pay particular attention to the poor but also women and children, ethnic minorities and the elderly. Moreover, the New Member States are home to some of the most vulnerable households in the European Union. Food and nutrition security interventions are therefore especially important in these countries. Surprisingly however, there has been little investigation into the determinants of food and nutrition security in this particular setting.

The in depth case study of Romania, demonstrates that households in this New Member State continue to be very sensitive to food price and income shocks. Expenditure and price elasticities of demand exceed unity for the majority of the food product groups, even for items generally considered as commodities. The situation is particularly worrisome for rural households, to a large extent due to their lower income and reliance on self-consumption. Households in rural areas also exhibit lower levels of diet diversity, which is assumed to be associated with the quality of diets.

The findings presented for Slovakia are more consistent with studies from other developed countries, where food security does not present a significant challenge and households tend to perceive the majority of food products as a necessity rather than a luxury. The Slovak longitudinal HBS data also reveal a noteworthy declining trend in the proportion of income spent on food as well as the expenditure and price elasticities for several food product groups that are particularly important for healthy diet. The analysis of food demand diet diversity in Slovakia again underlines the role of income in improving food and nutrition security, along with need for particular attention to rural areas.

Sources

Abdulai, A.2002. Household demand for food in Switzerland: A Quadratic Almost Ideal Demand System. *Swiss Journal of Economics and Statistics* 138(1): 1-18.

Alexandri, C., Pauna, B., Luca, L. 2014. Food security and vulnerable households in Romania. FoodSecure Working Paper.

Banks, J., Blundel, R., Lewbel, A.1996. Tax reform and welfare measurement: Do we need demand system estimation? *Economic Journal* 10(6): 1227-1185.

Blisard, N., Variyam, J., Cromartie, J. 2003. Food Expenditures by U.S. Households: Looking Ahead to 2020.*Agricultural Economics Report No. 821*.Washington, DC: U.S. Department of Agriculture, ERS.

Brownie, S.2006. Why are elderly individuals at risk of nutritional deficiency?. *International Journal of Nursing Practice* 12(2): 110-118.

Chern, W., Ishibashi, K., Taniguchi, K., Tokoyama, Y.2003.Analysis of the food consumption of Japanese households. *FAO Economic and Social Development Paper 152*, Food and Agriculture Organization of the United Nations, Rome

Cummins, S., & Macintyre, S. 1999. The location of food stores in urban areas: a case study in Glasgow. *British Food Journal* 101(7): 545-553.

Cupak, A., Pokrivcak, J., Rizov, M., Alexandri, C., Luca, L. 2014. Economic Development and Food Demand in Central and Eastern European Countries: The Case of Romania. Paper prepared for the 142nd EAAE Seminar, May 29-30, 2014 Budapest, Hungary.

Currie, C. et al. 2012. Social determinants of health and well-being among young people. Copenhagen: World Health Organization Regional Office for Europe.

Darmon, N., & Drewnowski, A. 2008. Does social class predict diet quality?. *The American journal of clinical nutrition* 87(5): 1107-1117.

Deaton, A., Muellbauer, J. 1980. An almost ideal demand system. *American Economic Review* 70(3): 312-336.

Dejmek, J., Ginter, E., Solansky, I., Podrazilová, K., Stávková, Z., Benes, I., & Srám, R. J. 2002. Vitamin C, E and A levels in maternal and fetal blood for Czech and Gypsy ethnic groups in the Czech Republic. *International Journal for Vitamin and Nutrition Research* 72(3), 183-190.

Drescher, L., Goddard, E. 2011. Heterogeneous demand for food diversity: A quantile regression analysis. *GEWISOLA Paper*, September, Halle, Germany

Economist Intelligence Unit (EIU). 2014. Food security in focus: Europe 2014.

Elmadfa, I. (Ed.). 2009. European nutrition and health report 2009 (Vol. 62). Karger Medical and Scientific Publishers.

European Commission (EC). 2010a. The Reform of the CAP Towards 2020. *Consultation document for impact assessment*.

European Commission (EC). 2010b. An EU Framework for National Roma Integration Strategies up to 2020. Communication from the Commission to the European parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

European Commission (EC). 2014. Agricultural trade in 2013: EU gains in commodity exports. MAP 2014-1.

European Parliament. 2008. Resolution of 25 September 2008 on the White Paper on nutrition, overweight and obesity-related health issues (2007/2285(INI)).

Eurostat. 2013. Gini coefficient of equivalised disposable income. Available at http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ilc_di12&lang=en (Accessed December, 2013).

Eurostat. 2014. Database. Available at <http://ec.europa.eu/eurostat/data/database> (Accessed October, 2014).

Food and Agriculture Organization of the United Nations (FAO). 2012. Gender and nutrition. Available at < http://www.fao.org/docrep/012/al184e/al184e00.pdf> (Accessed October, 2014)

Food and Agriculture Organization of the United Nations (FAO). 2014. Browse data. Available at < http://faostat3.fao.org/browse/FB/*/E > (Accessed October, 2014).

Fundamental Rights Agency. 2011. Results from the 2011 Roma Survey. Available at < http://fra.europa.eu/en/publications-and-resources/data-and-maps/survey-data-explorer-results-2011-roma-survey> (Accessed October, 2014)

Ginter, E., Krajcovicova-Kudlackova, M., Kacala, O., Kovacic, V., & Valachovicova, M. 2001. Health status of Romanies (Gypsies) in the Slovak Republic and in the neighboring countries. *Bratislavské Lekárske Listy* 102(10): 479-484.

Greene, W.H., 1997. Econometric Analysis, 3rd Edition. Prentice Hall, Englewood Cliffs, NJ.

Herzfeld, T., Huffman, S., Rizov, M. 2014.The dynamics of food, alcohol and cigarette consumption in Russia during transition. *Economics and Human Biology* 13: 128-143.

International Food Policy Research Institute. 2014. Global Hunger Index.

Lips, P.2007. Vitamin D status and nutrition in Europe and Asia. *The Journal of steroid biochemistry and molecular biology* 103(3): 620-625.

Mensink, G. B. M., Fletcher, R., Gurinovic, M., Huybrechts, I., Lafay, L., Serra-Majem, L., ... & Stephen, A. M. 2013. Mapping low intake of micronutrients across Europe. *British Journal of Nutrition* 110(04): 755-773.

Michalek, J., Keyzer, M., 1992. Estimation of a two-stage LES-AIDS consumer demand system for eight EC countries. *European Review of Agricultural Economics* 19(2): 137-163.

Moon, W., Florkowski, W.J., Beuchat, L.R., Resurreccion, A.V., Paraskova, P., Jordanov, J., Chinnan, M.S. 2002. Demand for food variety in an emerging market economy. *Applied Economics* 34(5): 573-581.

Novaković, R., Cavelaars, A. E., Bekkering, G. E., Roman-Vinas, B., Ngo, J., Gurinović, M., ... & de Groot, L. C. 2013. Micronutrient intake and status in Central and Eastern Europe compared with other European countries, results from the EURRECA network. *Public Health Nutrition* 16(05): 824-840.

Oxfam. 2013. Impacts of climate change on European food security: A growing concern for Europe. Presentation by Céline Charvériat, Director of Advocacy and Campaigns, Oxfam International

Public Health Evaluation and Impact Assessment Consortium (PHEIAC). 2013. Evaluation of the implementation of the Strategy for Europe on Nutrition, Overweight and Obesity related health issues – Annexes to the final report.

Pieters, H., Guariso, A., & Vandeplas, A. 2013. Conceptual framework for the analysis of the determinants of food and nutrition security (No. 13). LEI Wageningen UR.

Pomerleau, J., Lock, K., & McKee, M. 2006. The burden of cardiovascular disease and cancer attributable to low fruit and vegetable intake in the European Union: differences between old and new Member States. *Public Health Nutrition* 9(05): 575-583.

Rizov, M., Cupak, A., Pokrivcak, J. 2014. Food security and household consumption patterns in Slovakia. FoodSecure Working Paper

Roman Vinas, B., Ribas Barba, L., Ngo, J., Gurinovic, M., Novakovic, R., Cavelaars, A., ... & Serra Majem, L. 2011. Projected prevalence of inadequate nutrient intakes in Europe. *Annals of Nutrition and Metabolism* 59(2-4): 84-95.

Samwel, M., & Gabizon, S. 2009. Improving school sanitation in a sustainable way for a better health of school children in the EECCA and in the new EU member states. *Desalination* 248(1), 384-391.

Shaw, H. J. 2006. Food deserts: towards the development of a classification. *Geografiska Annaler: Series B, Human Geography* 88(2): 231-247.

Sieber, C.C. 2006. Nutritional screening tools – how does the MNA compare? Proceedings of the session held in Chicago May 2-3, 2006. *The Journal of Nutrition, Health and Aging* 10(6): 488-494.

Swinnen, J., & Van Herck, K. 2011. Food security and the transition region. *FAO Working paper series*.

Swinnen, J., Knops, L. and K. van Herck. Forthcoming. Food Price Volatility and EU Policies. in Pinstrup-Andersen, P. (ed.), *Food Price Policy in an Era of Market Instability. A Political Economy Analysis*, Oxford: Oxford University Press, forthcoming.

Thiele, S., Weiss, C.2003. Consumer demand for food diversity: Evidence for Germany. *Food Policy* 28: 99-115.

Wijnhoven et al. 2014. WHO European Childhood Obesity Surveillance Initiative: body mass index and level of overweight among 6–9-year-old children from school year 2007/2008 to school year 2009/2010. *BMC Public Health* 14(806)

World Bank.1986. Poverty and Hunger – Issues and Options for Food Security in Developing Countries. Washington, DC: International Bank for Reconstruction and Development.

World Bank. 2014. World Development Indicators. Available at < http://data.worldbank.org/data-catalog/world-development-indicators> (Accessed October, 2014)

World Health Organization (WHO). 2007. The challenge of obesity in the WHO European Region and the strategies for response. WHO Regional office for Europe.

World Health Organization (WHO). 2008. Worldwide prevalence of anemia 1993-2005 WHO Global Database on Anemia. Edited by Bruno de Benoist, Erin McLean, Ines Egli and Mary Cogswell

World Health organization (WHO). 2013. Country profiles on nutrition, physical activity and obesity in the 53 WHO European Region member States.

World Health Organization (WHO). 2014. Obesity and inequities: Guidance for addressing inequities in overweight and obesity. WHO Regional Office for Europe. Edited by Francesco Branca, Haik Nikogosian and Tim Lobstein

Zajc et al. 2006. Body Mass Index and Nutritional Status of the Bayash Roma from Eastern Croatia. *Collegium Antropologicum* 30(4): 315-319.

Zahrnt, V. 2011. Food security and the EU'S Common Agricultural Policy: Facts against fears. ECIPE, Bruxelles.

Appendix

A. The influence of the demographic characteristics on food demand in Romania

Table A1. Results for urban sample

	Cereals	Meat	Milk	Fruits	Vegetables	Sweets	Alcohol
Month (January is the omitted)							
February	-0.0113*	0.0168*	-0.0001	-0.0038*	0.0095*	-0.0057*	-0.0028
March	-0.0001	0.0070	-0.0090*	-0.0084*	0.0186*	-0.0026	-0.0032
Rural area	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
1st household member is female	-0.0044	-0.0108*	0.0063	0.0025	0.0025	0.0065*	-0.0052*
Education of the first household member							
primary school	0.5115*	0.1799*	0.1646*	-0.0828*	0.0724*	-0.0385	0.1045*
secondary school	0.5165*	0.1918*	0.1674*	-0.0782*	0.0553*	-0.039*	0.0972*
vocational education	0.5008*	0.2023*	0.1729*	-0.0721*	0.0521*	-0.0383*	0.0963*
10 classes	0.5124*	0.1982*	0.1614*	-0.0666*	0.0474*	-0.0381	0.1002*
high school education	0.4942*	0.1999*	0.1777*	-0.0691*	0.0522*	-0.039*	0.0961*
foreman education	0.4933*	0.1933*	0.1812*	-0.0652*	0.0506	-0.0368	0.0925*
short term college education	0.5003*	0.1900*	0.1811*	-0.0738*	0.0512	-0.0343	0.0943*
long term college education	0.4852*	0.2050*	0.1879*	-0.0663*	0.0464	-0.0398*	0.0960*
Doctoral education	0.4392*	0.3008*	0.2317*	-0.0865*	-0.0143	-0.0852*	0.1247*
Number of Household members	0.0209*	0.0061*	-0.0089*	-0.0036*	-0.0067*	-0.0030*	-0.0022*
Number of babies in the household							
1 baby	-0.0205*	-0.0121	0.0434*	0.0030	-0.0033	-0.0084	0.0000
Number of children in the household							
1 child	-0.0006	-0.0165*	0.0163*	0.0041*	-0.0062	0.0085*	-0.0028
2 children	0.0085	-0.0254*	0.0152*	0.0057	-0.0053	0.0107*	-0.0086*
3 children	0.0002	-0.0688*	0.0112	0.0074	0.0346*	0.0307*	-0.0111
4 children	-0.0149	-0.0785*	0.0814*	-0.0071	0.0077	0.0214	-0.0052
5 children	-0.0821*	-0.0275	0.0693*	0.0127	0.0226	0.0326	-0.0271
The age of the first household member	0.0000	0.0002	0.0002	0.0000	0.0000	-0.0002*	-0.0001
The age of the second household member	-0.0003*	-0.0002	0.0003	0.0002*	0.0000	0.0000	-0.0001
Education of the second household member							
primary school	0.0402*	-0.0204	-0.0185	-0.0079	0.0089	0.0083	0.0010
secondary school	0.0433*	-0.0301	-0.0202	-0.0029	0.0083	0.0072	-0.0007
vocational education	0.0341*	-0.0222	-0.0105	-0.0059	0.0056	0.0053	0.0001
10 classes	0.0444*	-0.0449*	-0.0172	-0.0054	0.0122	0.0085	0.0015
high school education	0.0260	-0.0160	-0.0179	-0.0025	0.0073	0.0085	-0.0013
foreman education	0.0183	0.0028	-0.0164	-0.0106	0.0065	0.0042	0.0051
short term college education	0.0115	0.0080	-0.0315	-0.0005	-0.0001*	0.0063	0.0009
long term college education	0.0173	-0.0152	-0.0270*	0.0009	0.0033	0.0154	0.0060
Doctoral education	0.0172	-0.3668*	0.0441	0.0541	0.1264*	0.0538	0.0322

Table A2. Results for rural sample

	Cereals	Meat	Milk	Fruits	Vegetables	Sweets	Alcohol
Month (omitted is January)							
February	-0.0047	0.0284*	-0.0118*	-0.0008	0.0073*	-0.0055	-0.0040
March	0.0009	0.0283*	-0.0221*	-0.0010*	0.0125*	-0.0047	-0.0017
Rural area	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
1st household member is female	0.0098	-0.0100	0.0031	-0.0004	0.0069	-0.0021	-0.0056
Education of the first household member							
primary school	0.0554	-0.0278	0.0001	-0.0017	-0.0092	0.0147	-0.0363
secondary school	0.0757	-0.0391	-0.0079	0.0015	-0.0122	0.0133	-0.0321
vocational education	0.0730	-0.0436	-0.0090	0.0076	-0.0190	0.0147	-0.0271
10 classes	0.0808	-0.0340	-0.0031	-0.0031	-0.0119	0.0052	-0.0379
high school education	0.0551	-0.0304	0.0038	0.0074	-0.0165	0.0125	-0.0366
foreman education	0.0285	-0.0133	0.0109	0.0071	-0.0056	0.0070	-0.0349
short term college education	-0.0160	0.0453	0.0026	-0.0021	-0.0191	-0.0045	-0.0174
long term college education	0.0207	-0.0172	0.0121	0.0187	-0.0006	-0.0060	-0.0340
Doctoral education	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
Number of household members	0.0097*	-0.0016	-0.0106*	-0.0004	-0.0041*	0.0017	0.0023
Number of babies in the household							
1 baby	-0.0406*	0.0182	0.0286*	0.0071	0.0002	-0.0129*	-0.0002
2 babies	0.1267	-0.0708	-0.0372	0.0496	0.0049	-0.0236	-0.0276
Number of children in the household							
1 child	0.0150	-0.0225*	0.0029	0.0093*	-0.0038	0.0080*	-0.0055
2 children	0.0343*	-0.0322*	0.0030	0.0051	0.0026	0.0011	-0.0125*
3 children	0.0551*	-0.0759*	0.0299*	0.0027	-0.0011	0.0066	-0.0090
4 children	0.0598	-0.0564	-0.0044	-0.0047	0.0118	0.0281	-0.0277
5 children	-0.0165	-0.0167	0.1011*	-0.0079	0.0253	-0.0370	-0.0305
The age of the first household member	0.0001	0.0002	-0.0001	0.0000	-0.0002	0.0000	-0.0001
The age of the second household member	-0.0001	-0.0005	0.0002	0.0001	0.0002	-0.0001	0.0001
Education of the second household member							
primary school	0.0322	-0.0076	-0.0221	0.0114	0.0248	-0.0167	-0.0026
secondary school	0.0231	-0.0010	-0.0153	0.0019	0.0271	-0.0156	-0.0012
vocational education	0.0302	0.0016	-0.0198	-0.0003	0.0300	-0.0232	-0.0007*
10 classes	0.0256	-0.0221	-0.0215	0.0105	0.0447*	-0.0131	-0.0088*
high school education	0.0188	-0.0114	-0.0043	0.0065	0.0221	-0.0160	0.0004
foreman education	0.0088	-0.0079	-0.0189	0.0172	0.0432*	-0.0275	0.0077
short term college education	0.0432	-0.0571	-0.0027	0.0194	0.0222	-0.0202	0.0069
long term college education	-0.0074	-0.0068	0.0036	0.0144	0.0204	-0.0147	0.0095

Table A3. Results for total sample

	Cereals	Meat	Milk	Fruits	Vegetables	Sweets	Alcohol
Month (omitted is January)							
February	-0.0097*	0.022*	-0.0052*	-0.0026	0.0088*	-0.0053*	-0.0037*
March	-0.0013	0.0156*	-0.0136*	-0.0086*	0.0168*	-0.0032	-0.0031
Rural area	0.0402*	-0.0342*	-0.0218*	0.0044*	-0.0142*	0.0092*	0.0084*
1st household member is female	0.0023	-0.012*	0.006	0.0011	0.0035	0.0034	-0.0051*
Education of the first household member							
primary school	0.0911*	-0.0134	-0.0169	-0.0040	-0.0178	0.0087	-0.0464*
secondary school	0.1021*	-0.0132	-0.0184	-0.0017	-0.0259	0.0071	-0.0462*
vocational education	0.0915*	-0.0107	-0.0147	0.0043	-0.0307	0.0084	-0.0441*
10 classes	0.1043*	-0.0116	-0.0161	0.0024	-0.0278	0.0018	-0.0477*
high school education	0.0842*	-0.0063	-0.0081	0.0056	-0.0301	0.0058	-0.0476*
foreman education	0.0796*	-0.0124	-0.0026	0.0092	-0.0300	0.0078	-0.0496*
short term college education	0.0752	-0.0026	-0.0084	0.0018	-0.0284	0.0097	-0.0467*
long term college education	0.0703	-0.0013	-0.0001	0.0101	-0.0326	0.0049	-0.0463*
Doctoral education	0.0568	0.0834	0.0458	-0.0157	-0.1063*	-0.0426	-0.0189
Number of Household members	0.0143*	0.0029	-0.0097*	-0.0019*	-0.0051*	-0.0008	0.0002
Number of babies in the household							
1 baby	-0.0254*	0.0005	0.0383*	0.0043	-0.0059	-0.0104*	0.0000
2 babies	0.1307	-0.0663	-0.0300	0.0420	0.0020	-0.0275	-0.0271
Number children							
1 child	0.0050	-0.0192*	0.0117*	0.0059*	-0.0043	0.0082*	-0.0037
2 children	0.0193*	-0.0307*	0.0118*	0.0055	0.0008	0.0061	-0.0106*
3 children	0.0297*	-0.0668*	0.0233*	0.0058	0.0072	0.0154*	-0.0086
4 children	0.0288	-0.0584*	0.0424*	-0.0055	0.0132	0.0176	-0.0215
5 children	-0.0449	-0.0077	*0.0787	0.0004	0.0194	-0.0020	-0.032*
The age of the first household member	0.0000	0.0001	0.0001	0.0000	-0.0001	-0.0001	-0.0001
The age of the second household member	-0.0004*	-0.0003	0.0003*	0.0002	0.0001	0.0000	0.0000
Education of the second household member							
primary school	0.0303	-0.0152	-0.0205	0.0008	0.0171	0.0029	0.0002
secondary school	0.0308*	-0.0156	-0.0181	-0.0026	0.0168	0.0017	-0.0004
vocational education	0.0291	-0.0108	-0.0133	-0.0042	0.0166	-0.0037	-0.0009
10 classes	0.0290	-0.0340*	-0.0202	0.0022	0.0302*	0.0037	-0.0041
high school education	0.0191	-0.0094	-0.0138	0.0008	0.0149	0.0012	-0.0021
foreman education	0.0064	0.0105	-0.0150	-0.0037	0.0183	-0.0046	0.0039
short term college education	0.0147	-0.0034	-0.0216	0.0043	0.0091	-0.0032	0.0031
long term college education	0.0126	-0.0120	-0.0208	0.0044	0.0112	0.0072	0.0054
doctoral education	0.0104	-0.3420*	0.0464	0.0648	.1375*	0.0399	0.0256

B. The influence of demographic characteristics on diet diversity in Romania

Table B1. Results regression of the count measure (CM)

CM	**First quarter**		**Third quarter**	
Number of obs	7816		7712	
F(111, 7704)	68.02		80.33	
Prob > F	0		0	
R-squared	0.4949		0.5282	
Adj R-squared	0.4877		0.5217	
Root MSE	0.3627		0.33099	
	Coef	**Prob**	**Coef**	**Prob**
Logarithm of the income variable	**0.2146028**	0.00	**0.1545835**	0.00
Second month of the quarter	**0.034758**	0.00	-0.016765	0.07
Third month of the quarter	**0.0402922**	0.00	**-0.049323**	0.00
Female	**0.0694881**	0.00	**0.0277885**	0.01
Urban Households	0.0210242	0.91	**0.2424988**	0.04
Education level of the rural household head, omitted category is no education				
Primary school	-0.02085	0.72	**-0.125979**	0.01
Secondary school	0.0445853	0.44	-0.074055	0.10
Vocational education	0.0628792	0.28	-0.050153	0.28
First two years of high school	-0.044295	0.51	-0.05282	0.35
High school	0.1038931	0.09	0.0122738	0.80
Post high school schooling	0.0751407	0.29	0.001783	0.98
Short term university degree	-0.049674	0.60	0.0428629	0.58
University degree	0.1132328	0.14	-0.068843	0.27
Doctoral studies	-0.430562	0.24	(dropped)	
Education level of the urban households, omitted category is no education				
Primary school	0.322466	0.09	0.1138331	0.35
Secondary school	0.3061443	0.11	0.1524385	0.21
Vocational education	0.3150608	0.10	0.1571704	0.19
First two years of high school	0.3486687	0.08	0.155783	0.25
High school	0.262235	0.17	0.1111491	0.36
Post high school schooling	0.3045114	0.12	0.1188861	0.35
Short term university degree	**0.4090966**	0.05	0.07975	0.57
University degree	0.2240449	0.26	0.1617001	0.21
Doctoral studies	0.6389457	0.14	0.0624542	0.71
Occupational status of the household head, omitted category is wage earner				
Patron	0.1154808	0.16	-0.070168	0.35
Self-employed in non-agricultural activities	0.0214165	0.38	0.008113	0.72
Member in a non-agriculture coop	0.1985292	0.28	0.1575916	0.50
Self-employed in agricultural activities	**-0.041645**	0.04	**-0.102833**	0.00
Member in an agriculture coop	-0.003058	0.99	0.0918494	0.63
Unemployed	-0.013193	0.57	0.0106291	0.69
Pensioner	0.0285006	0.10	0.0218476	0.16
Pupil	**-0.285331**	0.02	-0.417898	0.21
Student	**-0.321905**	0.00	0.0065028	0.94
Housewife	-0.047966	0.38	-0.080185	0.17
Dependent (old person, pre-school child, handicapped person, etc.)	-0.10111	0.08	0.0011414	0.98

The age of the household head, omitted category is less than 30 years				
between 30 and 39	**0.0666624**	0.02	0.0360162	0.19
between 40 and 49	0.0280752	0.33	**0.0540383**	0.05
between 50 and 59	0.021192	0.47	**0.0856898**	0.00
over 60	-0.002463	0.93	**0.0580932**	0.03
Number of household members, omitted category is one member				
2 members	**0.0548548**	0.00	**0.0656865**	0.00
3 members	0.0371104	0.06	**0.0478313**	0.01
4 members	0.0289203	0.24	**0.0553757**	0.02
5 members	0.0488784	0.15	0.051412	0.10
6 members	0.0626092	0.19	-0.023567	0.58
7 members	-0.026001	0.73	-0.085232	0.17
Number of children, omitted category is no child				
1 child	**0.1311985**	0.00	**0.1012279**	0.00
2 children	**0.1701286**	0.00	**0.1261402**	0.00
3 children	**0.2670834**	0.00	**0.1018566**	0.02
4 children	0.1573811	0.08	0.0916415	0.19
5 children	**0.2424217**	0.04	0.1959654	0.09
County, omitted category is Alba				
Arad	0.0577438	0.148	0.0130593	0.73
Arges	**0.1013149**	0.011	**0.0911093**	0.02
Bacau	**0.1177945**	0.003	**0.1779014**	0.00
Bihor	**0.1334746**	0	**0.1562161**	0.00
Bistrita Nasaud	**0.1895041**	0	**0.1270221**	0.00
Botosani	**-0.126441**	0.002	-0.055566	0.13
Brasov	**0.240077**	0	**0.3081753**	0.00
Braila	**0.2355008**	0	**0.2477146**	0.00
Buzau	**0.2434773**	0	**0.2067226**	0.00
Caras-Severin	**0.1817836**	0	**0.1641759**	0.00
Cluj	0.0215582	0.564	**0.1486317**	0.00
Constanta	0.0552041	0.158	**0.0680111**	0.06
Covasna	0.0891715	0.048	**0.0999097**	0.02
Dambovita	**0.1957554**	0	**0.1717504**	0.00
Dolj	0.0170813	0.651	0.0354142	0.31
Galati	**-0.08699**	0.032	**-0.112968**	0.00
Gorj	**-0.09561**	0.029	-0.067236	0.09
Harghita	0.0732631	0.096	**0.0890933**	0.03
Hunedoara	**0.2863026**	0	**0.2755097**	0.00
Ialomita	**0.1455479**	0.001	**0.1543747**	0.00
Iasi	**0.1896386**	0	**0.1838793**	0.00
Ilfov	**0.3352543**	0	**0.3877576**	0.00
Maramures	0.0544874	0.193	0.0458566	0.24
Mehedinti	**-0.349624**	0	**-0.27044**	0.00
Mures	-0.009335	0.81	**0.1114253**	0.00
Neamt	0.0534392	0.198	0.0523792	0.16
Olt	**-0.159189**	0	**-0.161465**	0.00
Prahova	**0.3026486**	0	**0.296984**	0.00
Satu Mare	**-0.135117**	0.001	**-0.128185**	0.00

Salaj	0.0099932	0.826	0.0534873	0.21
Sibiu	0.0396855	0.32	**0.1447894**	0.00
Suceava	**0.2711369**	0	**0.297357**	0.00
Teleorman	**-0.15262**	0	**-0.195329**	0.00
Timis	**0.1567613**	0	**0.111286**	0.00
Tulcea	0.0487451	0.297	0.0325151	0.46
Vaslui	0.0043093	0.918	**0.1262921**	0.00
Valcea	**-0.260136**	0	**-0.202837**	0.00
Vrancea	-0.043002	0.305	-0.041975	0.28
Bucharest, s1	**0.1312925**	0.017	**0.1101229**	0.03
Bucharest, s2	**0.1887638**	0	**0.2146962**	0.00
Bucharest, s3	**0.160922**	0.001	0.0534364	0.24
Bucharest, s4	**0.2468093**	0	**0.2356455**	0.00
Bucharest, s4	**0.2358195**	0	**0.2455388**	0.00
Bucharest, s6	**0.2034264**	0	**0.1739992**	0.00
Calarasi	0.0459015	0.29	**0.0855209**	0.03
Giurgiu	**0.1347938**	0.002	**0.1173276**	0.01
Constant	**1.075336**	0	**1.653595**	0.00

Table B2. Results regression on the Transformed Berry Index (TBI)

TBI	**First quarter**		**Third quarter**	
Number of obs	7808		7703	
F(111, 7704)	47.7		43	
Prob > F	0		0	
R-squared	0.4076		0.375	
Adj R-squared	0.399		0.3663	
Root MSE	0.46941		0.49867	
	Coef	**Prob**	**Coef**	**Prob**
Logarithm of income	**0.234934**	0.00	**0.177076**	0.00
Second month of the quarter	**0.081059**	0.00	-0.01609	0.25
Third month of the quarter	**0.049938**	0.00	**-0.03105**	0.03
Female	**0.068747**	0.00	**0.059661**	0.00
Urban household	-0.15106	0.54	0.061493	0.73
Education level of the rural household head, omitted category is no education				
Primary school	-0.06234	0.40	**-0.1459**	0.03
Secondary school	-0.05021	0.50	-0.10929	0.11
Vocational education	-0.03973	0.60	-0.07686	0.27
First two years of high school	-0.09088	0.30	-0.04797	0.57
High school	0.039272	0.61	-0.01239	0.87
Post high school schooling	0.008172	0.93	-0.00077	0.99
Short term university degree	0.005787	0.96	0.005808	0.96
University degree	0.156606	0.11	-0.0088	0.93
Doctoral studies	-0.12009	0.80	(dropped)	
Education level of the urban households, omitted category is no education				
Primary school	0.475731	0.06	0.312615	0.09
Secondary school	**0.53855**	0.03	**0.365309**	0.05
Vocational education	**0.573263**	0.02	**0.393096**	0.03
First two years of high school	**0.539452**	0.04	0.351024	0.08
High school	**0.497585**	0.05	**0.363892**	0.05
Post high school schooling	**0.516825**	0.04	0.312697	0.11
Short term university degree	0.494392	0.07	0.386228	0.07
University degree	0.385081	0.13	0.336982	0.08
Doctoral studies	0.567561	0.32	0.108451	0.67
Occupational status of the household head, omitted category is wage earner				
Patron	0.232364	0.03	-0.01063	0.93
Self-employed in non-agricultural activities	-0.01598	0.61	0.010921	0.75
Member in a non-agriculture coop	0.162339	0.49	0.047104	0.89
Self-employed in agricultural activities	-0.02329	0.37	**-0.11597**	0.00
Member in an agriculture coop	-0.09906	0.77	-0.07418	0.80
Unemployed	-0.0412	0.17	-0.02565	0.52
Pensioner	0.035886	0.11	-0.00929	0.69
Pupil	**-0.38204**	0.02	-0.59915	0.23
Student	**-0.34258**	0.00	0.136427	0.26
Housewife	**-0.14902**	0.03	**-0.18188**	0.04
Dependent (old person, pre-school child, handicapped person, etc.)	-0.04948	0.52	-0.06018	0.42
The age of the household head, omitted category is less than 30 years				

between 30 and 39	0.053812	0.16	0.051509	0.22
between 40 and 49	-0.00039	0.99	0.060224	0.14
between 50 and 59	-0.00828	0.83	**0.104699**	0.01
over 60	-0.04141	0.26	**0.099179**	0.01
Number of household members, omitted category is one member				
2 members	**-0.10233**	0.00	**-0.03313**	0.07
3 members	**-0.22185**	0.00	**-0.14897**	0.00
4 members	**-0.29489**	0.00	**-0.24723**	0.00
5 members	**-0.33321**	0.00	**-0.3394**	0.00
6 members	**-0.40882**	0.00	**-0.37277**	0.00
7 members	**-0.58347**	0.00	**-0.55075**	0.00
Number of children, omitted category is no child				
1 child	**0.146454**	0.00	**0.123154**	0.00
2 children	**0.193642**	0.00	**0.185923**	0.00
3 children	**0.282483**	0.00	**0.156182**	0.01
4 children	**0.338271**	0.00	0.075343	0.47
5 children	**0.388104**	0.01	**0.495866**	0.00
County, omitted category is Alba				
Arad	**0.165858**	0	0.062297	0.27
Arges	0.054178	0.29	-0.05875	0.30
Bacau	**0.332162**	0	**0.306825**	0.00
Bihor	**0.266073**	0	**0.282282**	0.00
Bistrita Nasaud	**0.173195**	0	0.013586	0.83
Botosani	0.083837	0.11	**0.107336**	0.05
Brasov	**0.288045**	0	**0.293513**	0.00
Braila	**0.380932**	0	**0.315654**	0.00
Buzau	**0.321964**	0	**0.189064**	0.00
Caras-Severin	**0.233873**	0	**0.218831**	0.00
Cluj	-0.08739	0.07	**0.09982**	0.05
Constanta	**0.114265**	0.02	-0.00517	0.92
Covasna	0.093961	0.11	0.075734	0.22
Dambovita	**0.147829**	0	0.038129	0.49
Dolj	**0.170133**	0	0.100619	0.06
Galati	**-0.14144**	0.01	**-0.18361**	0.00
Gorj	-0.10872	0.06	**-0.13669**	0.02
Harghita	0.058356	0.31	-0.0499	0.41
Hunedoara	**0.262106**	0	**0.278451**	0.00
Ialomita	**0.24962**	0	**0.190858**	0.00
Iasi	**0.325117**	0	**0.23678**	0.00
Ilfov	**0.478951**	0	**0.425804**	0.00
Maramures	0.096954	0.07	-0.00538	0.93
Mehedinti	**-0.2433**	0	**-0.22271**	0.00
Mures	0.00325	0.95	**0.102945**	0.05
Neamt	**0.16821**	0	**0.116638**	0.04
Olt	-0.05381	0.31	**-0.12932**	0.02
Prahova	**0.303305**	0	**0.276877**	0.00
Satu Mare	**-0.13255**	0.02	**-0.26702**	0.00
Salaj	0.029865	0.61	0.091961	0.15

Sibiu	0.052334	0.31	0.106053	0.06
Suceava	**0.433883**	0	**0.364577**	0.00
Teleorman	**-0.18834**	0	**-0.29055**	0.00
Timis	0.081765	0.09	-0.00237	0.96
Tulcea	**0.135762**	0.03	0.011024	0.87
Vaslui	0.086875	0.11	**0.123401**	0.04
Valcea	**-0.3434**	0	**-0.32846**	0.00
Vrancea	0.03135	0.56	-0.02265	0.70
Bucharest, s1	**0.220799**	0	0.105575	0.16
Bucharest, s2	**0.243482**	0	**0.209337**	0.00
Bucharest, s3	**0.237548**	0	0.061155	0.37
Bucharest, s4	**0.354457**	0	**0.273891**	0.00
Bucharest, s4	**0.417674**	0	**0.318353**	0.00
Bucharest, s6	**0.383846**	0	**0.187436**	0.00
Calarasi	-0.06042	0.28	-0.01855	0.76
Giurgiu	**0.15741**	0.01	0.046455	0.46
Constant	**0.307566**	0.01	**0.729125**	0.00

C. Food demand in Slovakia

Figure C1 Engel curves for aggregated food groups

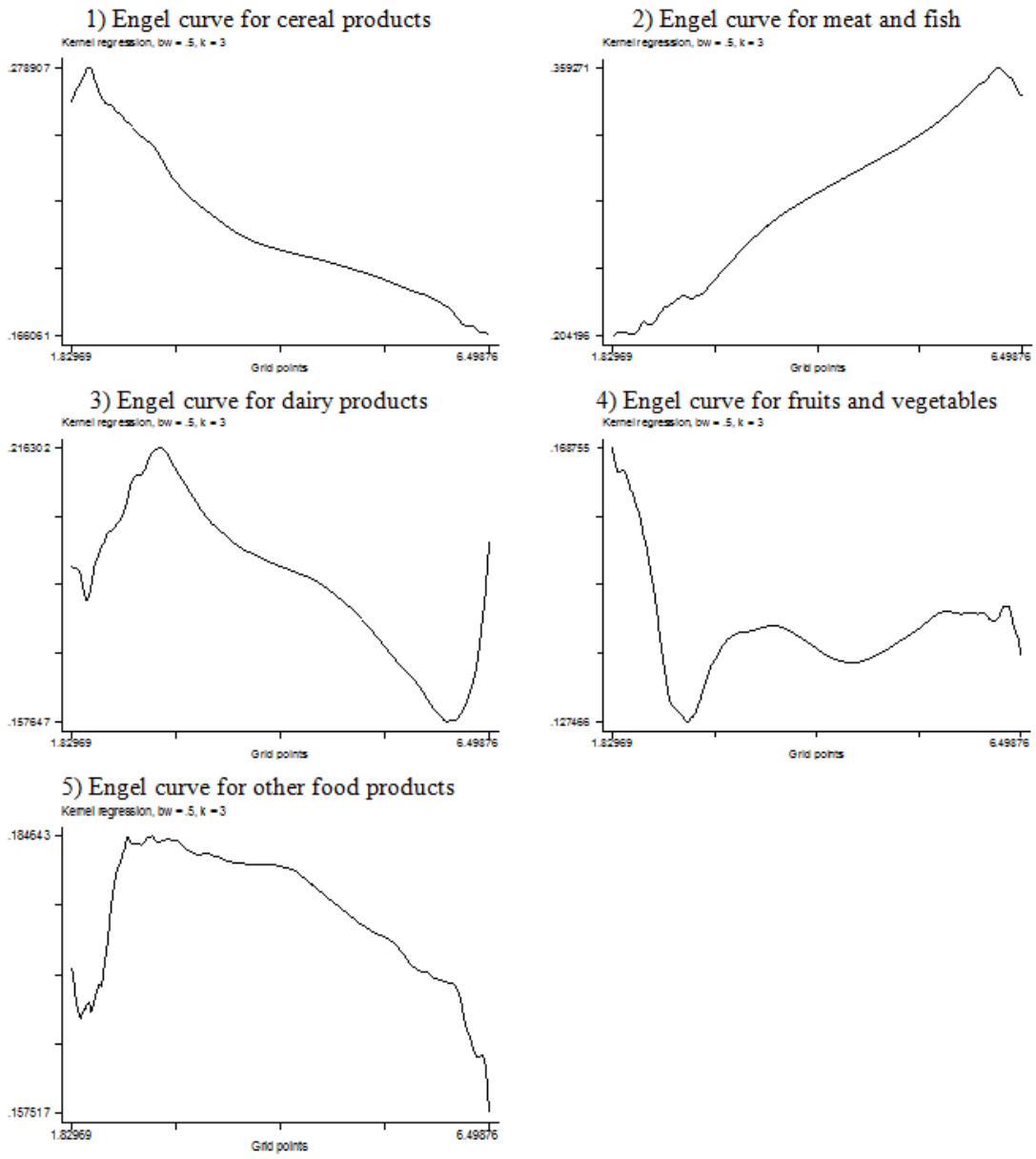


Table C1 Average food demand elasticities, 2004-2010

	C	MF	DP	FV	OF	
	Compensated price elasticities					Expenditure
C	**-0.61**	0.27	0.13	0.13	0.10	**0.92**
MF	0.21	**-0.69**	0.22	0.08	0.19	**1.22**
DP	0.08	0.40	**-0.86**	0.23	0.15	**0.68**
FV	0.30	0.04	0.35	**-0.96**	0.27	**1.44**
OF	0.05	0.39	0.12	0.22	**-0.78**	**0.73**
	Uncompensated price elasticities					
C	**-0.81**	-0.01	-0.04	0.00	-0.06	
MF	-0.04	**-1.06**	-0.01	-0.09	-0.04	
DP	-0.06	0.20	**-0.98**	0.13	0.03	
FV	0.01	-0.39	0.08	**-1.15**	0.01	
OF	-0.09	0.17	-0.02	0.12	**-0.91**	

Note: C denotes cereals; MF- meat and fish; DP- dairy products; FV- fruits and vegetables; OF- other food. In bold are reported the expenditure, uncompensated and compensated own price elasticities.

Table C2 QUAIDS estimated parameters

Parameter	2004	2005	2006	2007	2008	2009	2010
Alpha							
α_1	-0.292***	-0.241**	0.108***	0.096***	-0.032	0.214***	0.114
	(0.102)	(0.120)	(0.035)	(0.022)	(0.072)	(0.074)	(0.101)
α_2	0.986***	1.184***	0.408***	0.406***	0.514***	0.370***	0.614***
	(0.141)	(0.180)	(0.033)	(0.029)	(0.092)	(0.053)	(0.159)
α_3	-0.147*	-0.328***	0.121***	0.134***	0.174***	0.104***	-0.208*
	(0.086)	(0.120)	(0.014)	(0.019)	(0.065)	(0.028)	(0.117)
α_4	0.421***	0.585***	0.181***	0.188***	0.236***	0.155***	0.471***
	(0.083)	(0.112)	(0.014)	(0.022)	(0.060)	(0.029)	(0.109)
α_5	0.032	-0.201*	0.182***	0.176***	0.108*	0.157***	0.008
	(0.086)	(0.109)	(0.014)	(0.016)	(0.064)	(0.026)	(0.091)
Beta							
β_1	-0.119***	-0.106***	0.002	-0.006	-0.031*	0.039	0.001
	(0.039)	(0.033)	(0.013)	(0.008)	(0.017)	(0.024)	(0.029)
β_2	0.157***	0.198***	-0.002	0.000	0.027	-0.030*	0.047
	(0.055)	(0.049)	(0.012)	(0.010)	(0.023)	(0.017)	(0.046)
β_3	-0.092***	-0.122***	-0.014**	-0.001	0.011	-0.003	-0.094***
	(0.032)	(0.033)	(0.006)	(0.007)	(0.017)	(0.009)	(0.033)
β_4	0.105***	0.135***	0.011**	0.000	0.009	-0.008	0.094***
	(0.029)	(0.027)	(0.005)	(0.008)	(0.016)	(0.010)	(0.030)
β_5	-0.050	-0.105***	0.003	0.007	-0.016	0.001	-0.048*
	(0.032)	(0.029)	(0.005)	(0.006)	(0.017)	(0.009)	(0.026)
Gamma							
γ_{11}	0.101***	0.078***	0.032***	0.036***	0.033***	0.057***	0.081***
	(0.031)	(0.025)	(0.002)	(0.002)	(0.004)	(0.007)	(0.010)
γ_{12}	-0.094**	-0.092**	-0.016***	-0.014***	-0.018***	-0.024***	-0.032***
	(0.039)	(0.039)	(0.002)	(0.002)	(0.004)	(0.005)	(0.010)
γ_{13}	0.041**	0.050**	-0.006***	-0.008***	-0.005**	-0.012***	-0.021*
	(0.019)	(0.020)	(0.002)	(0.001)	(0.002)	(0.003)	(0.011)
γ_{14}	-0.043**	-0.043**	-0.007***	-0.009***	-0.007***	-0.017***	-0.007
	(0.019)	(0.022)	(0.001)	(0.001)	(0.002)	(0.003)	(0.009)
γ_{15}	-0.005	0.007	-0.003**	-0.004***	-0.002	-0.003	-0.022***
	(0.014)	(0.018)	(0.001)	(0.001)	(0.002)	(0.002)	(0.006)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table C2 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
γ_{22}	0.134**	0.177**	0.027***	0.018***	0.024***	0.052***	0.077***
	(0.062)	(0.078)	(0.003)	(0.003)	(0.005)	(0.005)	(0.021)
γ_{32}	-0.051*	-0.088**	-0.007***	-0.005***	-0.006**	-0.012***	-0.029
	(0.030)	(0.042)	(0.002)	(0.002)	(0.002)	(0.003)	(0.020)
γ_{42}	0.045**	0.081***	-0.001	0.003**	0.002	-0.006**	0.009
	(0.022)	(0.030)	(0.001)	(0.001)	(0.002)	(0.003)	(0.015)
γ_{52}	-0.034	-0.079**	-0.003**	-0.002	-0.002	-0.009***	-0.024**
	(0.023)	(0.037)	(0.001)	(0.001)	(0.003)	(0.002)	(0.012)
γ_{33}	-0.004	0.039	0.015***	0.015***	0.014***	0.029***	0.048**
	(0.020)	(0.030)	(0.002	(0.002)	(0.002)	(0.003)	(0.022)
γ_{43}	-0.015	-0.045**	0.002	0.000	-0.001	-0.002	-0.014
	(0.014)	(0.022)	(0.001)	(0.001)	(0.001)	(0.002)	(0.016)
γ_{53}	0.029***	0.043**	-0.003***	-0.002	-0.002	-0.003*	0.016
	(0.011)	(0.018)	(0.001)	(0.001)	(0.002)	(0.002)	(0.010)
γ_{44}	0.018	0.039	0.007***	0.008***	0.008***	0.030***	0.014
	(0.018)	(0.026)	(0.001)	(0.002)	(0.001)	(0.003)	(0.017)
γ_{54}	-0.004	-0.031	-0.001	-0.002**	-0.001	-0.005***	-0.002
	(0.012)	(0.019)	(0.001)	(0.001)	(0.001)	(0.002)	(0.010)
γ_{55}	0.014	0.060**	0.010***	0.010***	0.008***	0.021***	0.033***
	(0.012)	(0.024)	(0.001)	(0.001)	(0.002)	(0.002)	(0.010)
Lambda							
λ_1	-0.006	-0.004*	0.004***	0.003***	0.001	0.007***	0.003
	(0.004)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
λ_2	0.009*	0.010**	-0.003***	-0.003***	-0.001	-0.006***	0.000
	(0.005)	(0.004)	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)
λ_3	-0.007**	-0.006**	0.000	0.001**	0.002	0.002*	-0.005**
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
λ_4	0.008***	0.008***	-0.001*	-0.002***	-0.001	-0.002**	0.005**
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
λ_5	-0.005*	-0.008***	0.000	0.001	-0.001	0.000	-0.004**
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Eta							
$\eta_{foodratio1}$	-0.007**	0.001	-0.001	0.002	-0.001	-0.003	0.000
	(0.003)	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)	(0.001)
$\eta_{foodratio2}$	-0.003	-0.005**	-0.016***	-0.017***	-0.010***	-0.005	-0.002
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.006)	(0.001)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table C2 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
$\eta_{foodratio3}$	0.009***	0.004***	0.013***	0.009***	0.006***	0.005*	0.000
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)
$\eta_{foodratio4}$	0.000	0.000	-0.001	0.003	0.004**	0.003	0.000
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)
$\eta_{foodratio5}$	0.001	0.000	0.005**	0.003	0.001	0.000	0.001
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
$\eta_{n\_children1}$	-0.005***	-0.003***	-0.003***	-0.002***	-0.001***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_children2}$	0.006***	0.005***	0.005***	0.005***	0.002***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
$\eta_{n\_children3}$	-0.002***	-0.002***	-0.003***	-0.003***	-0.002***	-0.003***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_children4}$	0.001***	0.001***	0.002***	0.001***	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_children5}$	-0.001***	-0.001***	-0.001***	-0.001**	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults1}$	-0.005***	-0.002***	-0.001***	0.000**	0.000	-0.002***	-0.002***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults2}$	0.003***	0.000	-0.002***	-0.002***	-0.001***	0.001	0.001**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults3}$	0.000	0.000	0.001***	0.001***	0.001***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults4}$	0.002***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults5}$	0.000	0.000	0.000	0.000	0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{age_HH1}	0.000	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{age_HH2}	0.000	0.000*	0.000	0.000	0.000***	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{age_HH3}	0.000	0.000***	0.000**	0.000*	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table C2 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
η_{age_HH4}	0.000	0.000	0.000	0.000	0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{age_HH5}	0.000***	0.000***	0.000***	0.000***	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{gender1}$	-0.001	0.003***	-0.003***	-0.001***	0.001	-0.001**	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
$\eta_{gender2}$	0.005***	-0.001	0.006***	0.005***	0.002***	0.006***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\eta_{gender3}$	-0.002***	0.001**	-0.002***	-0.002***	-0.001**	-0.002***	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
$\eta_{gender4}$	-0.001***	-0.002***	-0.001	-0.001***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{gender5}$	-0.001***	-0.001*	0.000	-0.001**	0.000	-0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
η_{edu1}	0.000	0.002***	0.001	0.001***	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000	(0.000)	(0.000
η_{edu2}	0.004***	0.002**	0.004***	0.003***	0.001***	0.000**	0.001***
	(0.001)	(0.001)	(0.001)	(0.001	(0.000)	(0.000)	(0.000)
η_{edu3}	-0.002***	-0.002***	-0.002***	-0.002***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
η_{edu4}	-0.002***	-0.002***	-0.002***	-0.002***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
η_{edu5}	0.000	0.000	-0.001*	0.000	0.000	0.000***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
η_{urban1}	0.007***	0.004***	0.008***	0.010***	0.008***	0.002***	0.005***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)
η_{urban2}	-0.003***	-0.002**	-0.004**	-0.007***	-0.006**	0.001	-0.002**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)
η_{urban3}	-0.002***	-0.001**	0.001	0.003***	0.003**	-0.001	0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
η_{urban4}	-0.005***	-0.004***	-0.008***	-0.010***	-0.007***	-0.005***	-0.006***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.000	(0.001)
η_{urban5}	0.003***	0.003***	0.003***	0.003***	0.002***	0.002***	0.003***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001	(0.000)	(0.000)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table C2 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
η_{Q21}	0.000	-0.001	0.000	0.000	0.000	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
η_{Q22}	0.001	0.002*	0.001	0.002***	0.000	0.003***	0.002**
	0.001	0.001	0.001	0.001	0.001	0.001	0.001
η_{Q23}	0.001***	0.001	0.002***	0.002***	0.001***	0.001**	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
η_{Q24}	-0.001	-0.002***	-0.002***	-0.002***	-0.001***	-0.001***	-0.003***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q25}	-0.002***	0.001*	-0.001	-0.002***	0.000	-0.003***	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q31}	0.000	0.000	0.001	0.000	0.000	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001
η_{Q32}	0.001	0.003***	0.001	0.000	-0.001	0.002	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001	(0.001	(0.001)
η_{Q33}	0.002***	0.002***	0.003***	0.002***	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
η_{Q34}	-0.001	-0.003***	-0.002***	0.000	0.001**	0.000	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q35}	-0.002***	-0.002***	-0.003***	-0.002***	-0.002***	-0.004***	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q41}	-0.002**	0.001	0.000	-0.001*	0.000	0.002**	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
η_{Q42}	0.001	0.001	-0.001	0.001	-0.002***	-0.003**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
η_{Q43}	0.002***	0.002***	0.004***	0.002***	0.002***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
η_{Q44}	0.002***	-0.003***	-0.001*	0.000	0.001***	0.000	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q45}	-0.003***	-0.001**	-0.002***	-0.002***	-0.001***	-0.002***	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
$\rho_{foodratio}$	-0.004	-0.108	-0.434***	-0.926***	-5.278	0.045	0.026
	(0.144)	(0.548)	(0.067)	(0.229)	(4.216)	(0.454)	(0.276)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table C2 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
$\rho_{n\_children}$	-0.058***	-0.276	-0.084***	-0.144***	0.216	-0.130***	-0.185***
	(0.015)	(0.176)	(0.026)	(0.035)	(0.262	(0.032)	(0.055)
ρ_{n_adults}	-0.073***	-0.138	-0.044**	-0.045	0.275	-0.076**	-0.008
	(0.013)	(0.095)	(0.017)	(0.033)	(0.306)	(0.040)	(0.056)
ρ_{age_HH}	0.000	0.017	0.009***	0.014**	0.079	0.008	0.009
	(0.001)	(0.015)	(0.003)	(0.006)	(0.060)	(0.005)	(0.006)
ρ_{gender}	-0.060***	0.646	-0.295***	-0.111**	1.339	-0.292***	-0.036
	(0.032)	(0.632)	(0.073)	(0.050	(1.143)	(0.069)	(0.083)
ρ_{edu}	-0.042***	0.300	-0.063	-0.069	-0.146	0.032	0.007
	(0.014)	(0.308)	(0.061)	(0.049)	(0.135)	(0.020)	(0.014)
ρ_{urban}	0.073**	0.063	0.652**	2.688**	18.372	0.036	0.568**
	(0.037)	(0.160)	(0.256)	(1.311)	(,)	(0.077)	(0.239)
ρ_{Q2}	-0.024	-0.257	-0.053	-0.162	-0.320	-0.220**	-0.113
	(0.051)	(0.225)	(0.082)	(0.100)	(0.634)	(0.093)	(0.108)
ρ_{Q3}	-0.001	-0.106	0.008	-0.096	0.486	-0.134	-0.018
	(0.051)	(0.202)	(0.091)	(0.089)	(0.752)	(0.106)	(0.122)
ρ_{Q4}	-0.127	-0.034	-0.053	-0.189**	0.054	0.094	-0.179
	(0.042)	(0.210)	(0.071)	(0.095)	(0.662)	(0.128)	(0.109)
N	4520	4644	4651	4671	4681	4678	6078

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

D. Food diversity in Slovakia

Table D1 Determinants of food diversity: pooled sample, 2004-2010

	ln(CM)				TBI			
Variable	OLS	Q(0.1)	Q(0.5)	Q(0.9)	OLS	Q(0.1)	Q(0.5)	Q(0.9)
ln(income)	0.03***	0.05***	0.04***	0.03***	0.06***	0.09***	0.06***	0.04***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
$ln(p_{cereals})$	-0.12***	-0.18***	-0.10***	-0.05***	-0.01	-0.02	0.00	0.03**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
$ln(p_{meat})$	0.02***	0.03***	0.01	0.00	-0.06***	-0.05***	-0.06***	-0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$ln(p_{dairy})$	-0.04***	-0.02*	-0.05***	-0.04***	0.06***	0.07***	0.05***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
$ln(p_{fruits})$	0.10***	0.14***	0.09***	0.05***	0.04***	0.06**	0.03**	0.03**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)
$ln(p_{other})$	0.08***	0.12***	0.07***	0.04***	0.02***	0.03**	0.01*	0.01
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
rp	-0.12***	-0.12***	-0.11***	-0.10***	-0.13***	-0.11***	-0.15***	-0.16***
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
2005	0.04***	0.04***	0.05***	0.03***	0.04***	0.04***	0.03***	0.04***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
2006	0.33***	0.34***	0.32***	0.28***	0.29***	0.28***	0.32***	0.36***
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)
2007	0.34***	0.35***	0.33***	0.28***	0.29***	0.28***	0.32***	0.35***
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)
2008	0.35***	0.37***	0.33***	0.28***	0.28***	0.27***	0.30***	0.33***
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)
2009	0.33***	0.32***	0.33***	0.30***	0.29***	0.27***	0.32***	0.35***
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.04)	(0.02)	(0.02)
2010	0.28***	0.29***	0.28***	0.25***	0.25***	0.23***	0.28***	0.32***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)
qy2	0.01***	0.02***	0.01***	0.01**	0.03***	0.03***	0.03***	0.02***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
qy3	0.03***	0.04***	0.02***	0.02***	0.02***	0.02*	0.01**	0.01*
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
qy4	0.01**	0.01	0.01**	0.01	0.01**	0.02**	0.02***	0.01*
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
TT	0.01	0.05***	-0.01	-0.02***	-0.02***	0.01	-0.02***	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)

Note: Note: Robust (bootstrapped) standard errors are presented in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

Reference category for the season dummy set is the winter (qy_1).

Table D2 Determinants of food diversity: pooled sample, 2004-2010, continued

	ln(CM)				TBI			
Variable	OLS	Q(0.1)	Q(0.5)	Q(0.9)	OLS	Q(0.1)	Q(0.5)	Q(0.9)
TN	0.03***	0.09***	0.01**	-0.02***	0.00	0.04***	0.00	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
NR	0.01**	0.06***	0.00	-0.03***	-0.05***	-0.01	-0.05***	-0.07***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
BB	0.00	0.04***	-0.01**	-0.03***	-0.02***	0.02	-0.02**	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
PO	0.00	0.05***	-0.01**	-0.04***	-0.03***	0.02	-0.03***	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
ZA	0.02***	0.07***	0.01**	-0.01***	0.01	0.05***	0.01	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
KE	0.02***	0.06***	0.01**	-0.02***	-0.03***	0.01	-0.03***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
urban	0.03***	0.05***	0.04***	0.02***	0.09***	0.12***	0.08***	0.06***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
edu	0.00	0.01	0.00	0.01**	0.02***	0.02*	0.02***	0.02***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
hh_size	0.01***	0.01**	0.01***	0.00**	-0.02***	-0.02***	-0.02***	-0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
single	-0.04***	-0.07***	-0.02***	-0.01***	-0.02***	-0.05***	-0.01	0.00
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
child	0.01**	0.01	0.01	0.00	0.03***	0.04***	0.02***	0.02***
	(0.00)	(0.01)	(0.000	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
cons	2.87***	2.40***	2.92***	3.25***	1.90***	1.28***	1.94***	2.38***
	(0.02)	(0.04)	(0.02)	(0.02)	(0.03)	(0.06)	(0.03)	(0.03)
N	33243	33243	33243	33243	33243	33243	33243	33243
(Pseudo)R^2	0.08	0.06	0.04	0.03	0.07	0.04	0.04	0.04

Note: Note: Robust (bootstrapped) standard errors are presented in parentheses, * p<0.05, ** p<0.01, *** p<0.001. Reference category for the season dummy set is the winter (qy_1).

Figure D1 Effects of selected variables across quantiles, CM specification

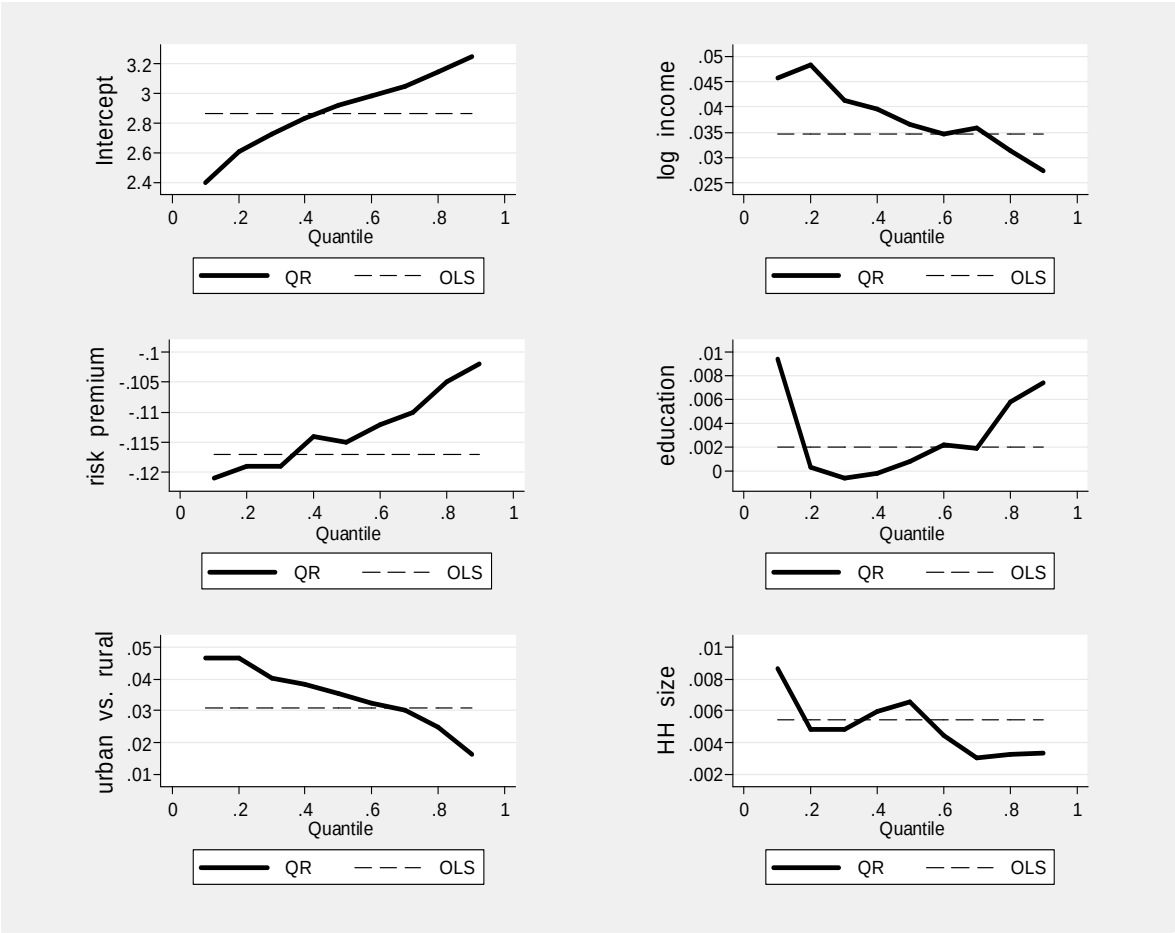
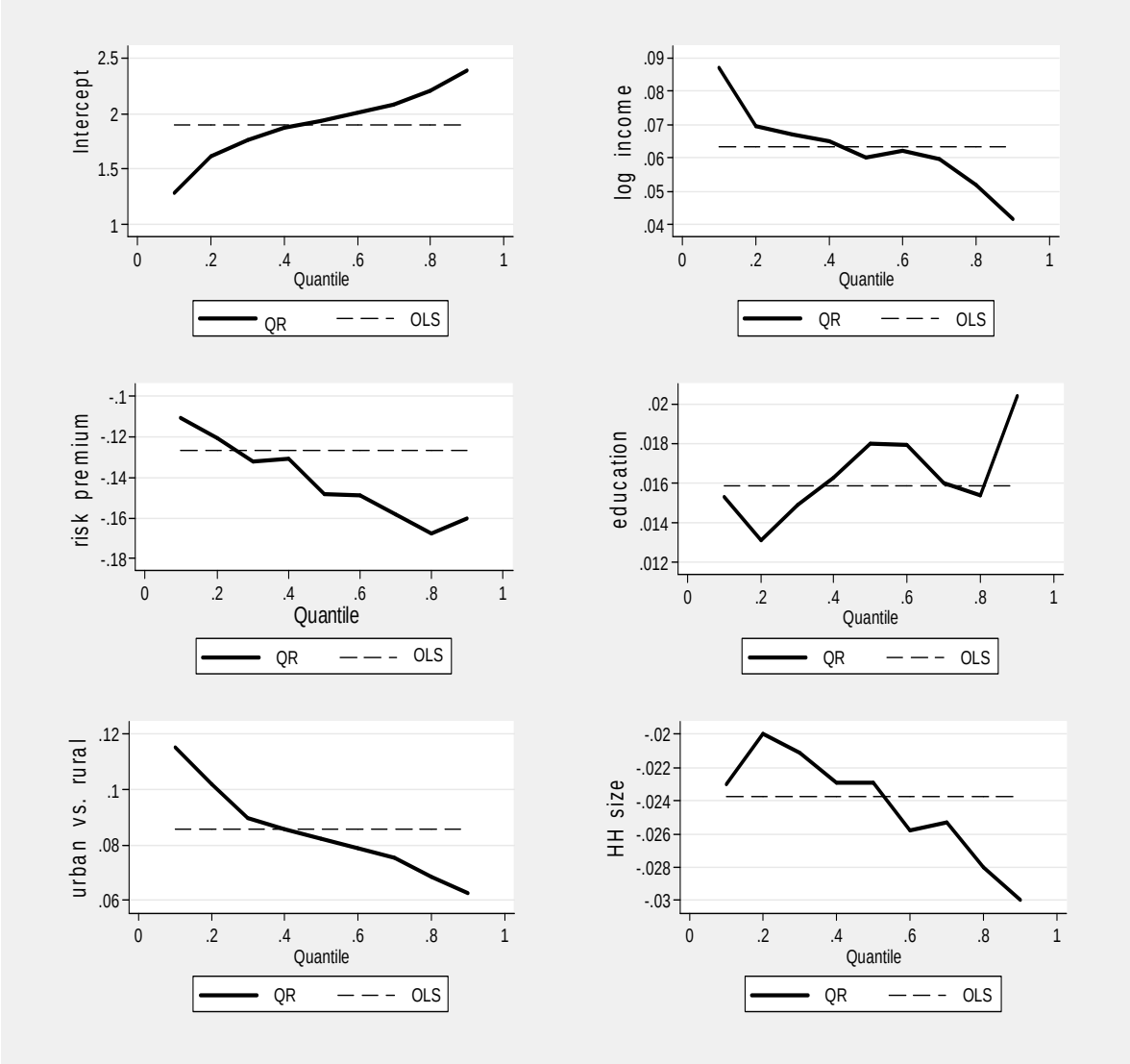


Figure D2 Effects of selected variables across quantiles, TBI specification



Food security and vulnerable households in Romania

Cecilia Alexandri[a], Bianca Păuna[b], Lucian Luca[a]

with contribution of:

Andrej Cupak[c], Cristian Kevorchian[a]

[a]*Institute of Agricultural Economics, Bucharest, Romania*

[b] *INCE Macroeconomic Modelling Center, Bucharest, Romania*

[c]*Slovak University of Agriculture, Nitra*

December 2014

1. Introduction

In Romania, the food security concerns have always been present due to the low incomes and strong poverty incidence that persisted in certain regions of Romania, even in the economic growth context of the period 2001-2008. The population's food situation in Romania does not exclude the food insecurity risks for persons on households with low incomes, mainly in the context in which in the year 2010 household incomes were affected by the wage cuts (by 25%) of employees from the state budget. The relative poverty rate in Romania, at a high level compared to other EU Member States, increased to 22.2% in the year 2011, after a gradual decrease from 2006 until 2010. The economic growth resuming in 2011 did not succeed in counteracting the effects of wage cuts, the relative poverty rate continuing to increase in the year 2012 as well (Table 1).

Table 1. Key-indicators of the socio-economic context in Romania in the period 2010-2012

Indicators	*m.u.*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Real GDP growth	% (compared to previous year)	8.5	4.2	7.9	6.3	7.3	-6.6	-1.1	2.3	0.6
Relative poverty rate	% (under 60% of the median cash incomes)	:	:	:	24.8	23.4	22.4	21.1	22.2	22.6
Indices of real earnings	% (2004=100)	100.0	114.3	124.6	143.0	166.5	163.9	158.0	155.0	156.5
Average real pension indices of state social insurance pensioners	% (2004=100)	100.0	108.1	118.0	145.0	194.5	217.9	212.7	202.6	202.7

Source: NIS, Tempo online

Romania's vulnerability with regard to food insecurity (and poverty, in general) is given by the differences in the standards of living between the urban and rural areas. Even though the food insecurity risk is partially diminished by subsistence farming, this modality to reach a social equilibrium in the rural area lowers the opportunity to bridge up the development gap between the urban and the rural areas.

The relative poverty rate by residence areas highlights this gap: for instance, in the year 2008 (the last year for which these data are available) the poverty rate was 22.4% at national level, 9.1% in the urban area and 38.6% in the rural area (INS, 2009). In the calculation of the relative poverty rate the value of self-consumption on the household is not included, but including it, although makes Romania comes closer to the EU average, only reduces the rural – urban gap from 4:1 to 3:1. As regards the share of food expenditures in total consumption expenditures of households (indicator that includes the value of self-consumption), the urban – rural gap accounts for about one-tenth of total consumption expenditures, i.e. 40.9% in the urban area and 51.9% in the rural area, in the year 2011. The gap expressed in percentage is quite large if we take into consideration the fact that the absolute value of consumption expenditures is by one quarter lower in the rural area compared to the urban area.

With regard to the food consumption expenditures of Romanian households (NIS, 2012), in the year 2011 the food consumption expenditures accounted for 44.9% of total consumption expenditures

per total households. This share increased by 0.8 percent compared to 2010, marking the end of the continuous diminution in the last decade (Table 2).

Table 2. Structure of consumption expenditures per total households in Romania (% of total consumption expenditures)

	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
Food consumption	49.6	47.2	45.4	45.0	44.3	44.2	44.1	44.9
Non-food commodities	27.6	28.8	29.7	30.3	31.5	31.0	30.7	30.1
Payment of services	22.8	24.0	24.9	24.7	24.2	24.8	25.2	25.0

Source: (NIS, 2012)

The economic growth in the period 2004-2008 was reflected in the population's incomes and consumptions, leading to the relative diminution of the food consumption expenditures, namely the diminution of their share in total expenditures, according to the evolution pattern of the developed countries.

The analysis of the distribution of food expenditures by categories of households, according to the household head's occupational status, reveals that there is a great discrepancy as regards the share of food consumption, between the households of employees (by about 40%) and the households of farmers (by about 60%).

There are also significant differences between the households in the urban area and those from the rural area: thus, the structure of expenditures in the urban area is more balanced, with a greater share allocated to services. The differences between the food consumption share between the rural households (51.9% of total consumption expenditures) and the urban households (40.9%) are favoured by the fact that in the rural area almost half (45.4%) of food consumption expenditures are represented by the value of self-consumption, which represents only 20.0% in the urban area.

Comparing the shares of food consumption expenditures by categories of households, it can be noticed that there are great differences depending on the household size, number of children under 18 years of age, the income size and the household head's training level (Table 3). The food vulnerability of households increases with the number of members in household and decreases with the increase of incomes.

Table 3. Share of food consumption expenditures in total consumption expenditures of households in Romania, according to household characteristics in the year 2011

	Low share (%)	*High share (%)*
According to household size	With 1 person	With 6 persons and over
	45.8	53.0
According to the number of children under 18 years	Without children	With 4 children and over
	44.0	63.9
According to income size	From decile 10	From decile 1
	34.9	53.5
According to household head's training level	Higher education	Primary education
	32.8	65.7

Source: (NIS, 2012)

Comparing the data of the year 2011 (INS, 2013), separately by the two residence areas, referring to the consumption of important foodstuffs, the self-produced food inclusively (Table 4) and those referring to the expenditures for the purchase of these foodstuffs, self-produced food exclusively (Table 5), certain characteristics of self-consumption can be identified versus the bought food. In the case of bread, the consumption is higher in the rural area, and the expenditures for buying it are approximately equal to those in the urban area, which may signify that if the price is lower in the rural area, self-consumption is not necessarily higher. In the case of fresh meat, the expenditures in the rural area are about half of those in the urban area, which means that self-consumption is important, as long as the gap between the quantity consumed in the rural area is greater than that in the urban area, and the purchases are half of the value of those from urban area. At the same time, in the case of fruit and vegetables, self-consumption in the rural area seems to be high, of we compare total consumption to purchases, with the mention that in the urban area fruit consumption is higher than in the rural area. While in the case of sugar there are no great differences between the two residence areas, in the case of alcohol it seem that self-consumption is important.

Table 4. Consumption of certain foodstuffs in the year 2011 (monthly averages per person)

Products	*m.u.*	*Total*	*Urban*	*Rural*
Bread and bread products	kg	8.565	8.098	9.134
Fresh meat	kg	3.079	3.246	2.876
Milk	l	5.962	5.595	6.409
Fruit	kg	3.399	3.925	2.758
Vegetables and canned vegetables	kg	7.597	7.923	7.199
Sugar	kg	0.741	0.755	0.724
Alcohol	l	2.188	1.817	2.64

Source: NIS, Tempo online (HBS)

Table 5. Expenditures for the purchase of certain foodstuffs in the year 2011 (monthly averages per person)

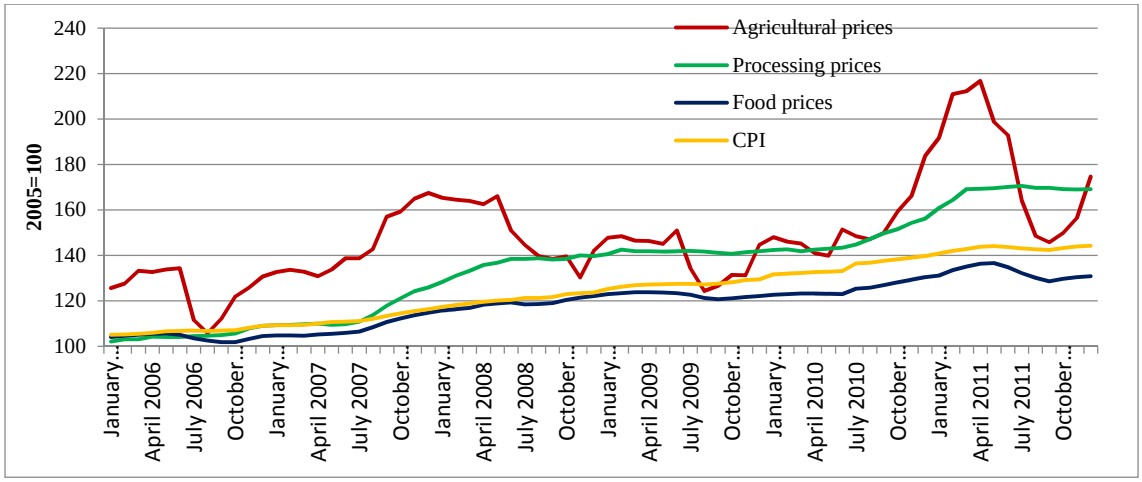
Products	*m.u.*	*Total*	*Urban*	*Rural*
Bread and bread products	RON	28.83	28.91	28.74
Fresh meat	RON	25.58	33.56	15.9
Milk	RON	12.73	17.05	7.48
Fruit	RON	10.1	13.37	6.14
Vegetables and canned vegetables	RON	12.06	16.78	6.34
Sugar	RON	3.67	3.61	3.75
Alcohol	RON	5.48	5.88	4.98

Source: NIS, Tempo online (HBS)

Food prices experienced almost a permanent increase in the investigated period, being influenced both by the evolutions of domestic agricultural prices and the evolutions on the European and regional markets.

The domestic agricultural production and crop production, in particular, experienced high volatility in the investigated period, which was also transmitted to the level of agricultural prices (Figure 1). Agricultural production instability in Romania is determined by the highly fragmented farm structure, irrigation system insufficiency, obsolete production technologies applied on certain farms and insufficient funding of the agricultural sector. Price volatility was attenuated on the different stage of the chains, so that the final consumer food prices experienced a slow growth, up by 30% in December 2011 compared to the 2005 prices, below the CPI growth (+44%).

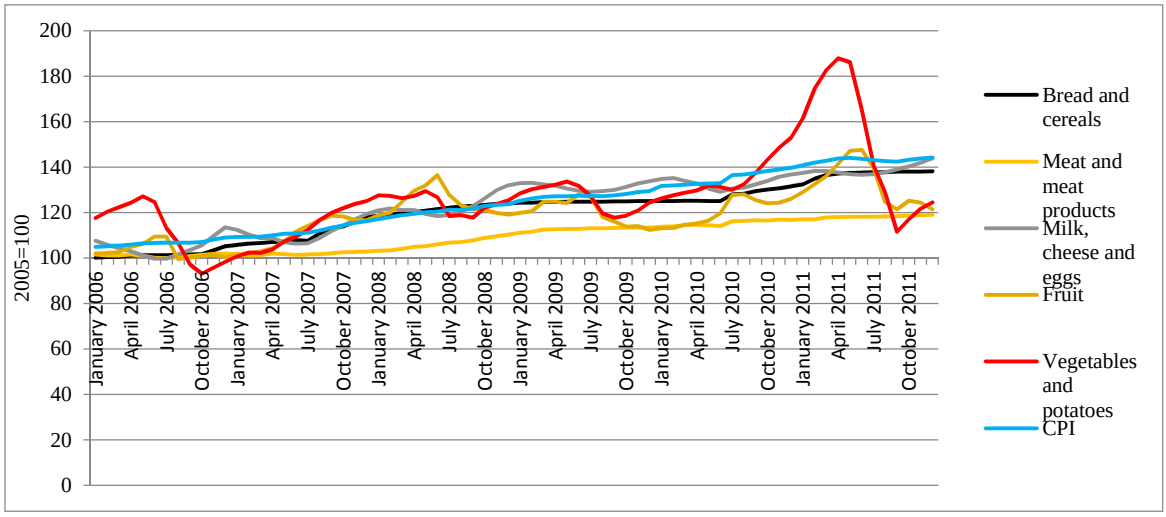
Figure 1. Monthly price indices on the agri-food chains in Romania (2005=100)



Source: NIS, Tempo online (HBS)

If we examine the consumer price evolution for the main groups of foodstuffs (Figure 2), we can notice that the most volatile prices are found in the groups vegetables and potatoes and fruit, due to the seasonality of domestic production and to the significant share of imports in consumption. One aspect is worth mentioning, i.e. the group meat and meat products had the lowest growth index among the investigated foodstuffs (+19% in December 2011 compared to the year 2005), below CPI end even below the consumer prices for foods (+30%). This can explain the fact that price elasticity for meat and meat products is lower than that for cereals, vegetables, fruit or dairy products (see subchapter 4.1)

Figure 2. Monthly consumer price indices for the main foodstuffs (2005=100)



Source: NIS, Tempo online (HBS)

2. Methodology

2.1. Food demand system

An estimation of the food demand system in Romania is done on the basis of an AIDS (Almost Ideal Demand System) model, in order to analyze the statistical data referring to the food expenditures on the household, collected by the National Institute for Statistics through the Household Budget Survey (HBS) of the 1st quarter of the year 2011.

The approach uses the AIDS methodology developed by Deaton and Muellbauer (1980). The main property that makes the use of AIDS very attractive is that the model gives a first order approximation to all demand systems derived from an utility maximizing behaviour. A very important property that explains the attractiveness of the model is the ease of estimation, the functional form of the model is linear, and therefore very easy to estimate (Tiffin et al., 2014).

The functional form of the AIDS model is of the following form:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(X/P)$$

where:

$$\log P = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2} \sum_j \sum_k \gamma_{kj} \log p_k \log p_j$$

The notation is the standard one: w_k are the budget share of the k food group in the total expenditure for food (X); p_k is the aggregate price for the k food group and X is the total food expenditure.

The construction of the log P is the only empirical problem that arises when estimating the AIDS model. This issue is dealt easily by using the hypothesis that prices are highly correlated in which case the following approximation can be used:

$$\log P \cong \sum_k w_k \log p_k$$

When the above approximation is used, the model is named linear approximation AIDS model, or LA/AIDS model (Green, 1990). The properties of the demand system require that the coefficients of the equations satisfy the following properties:

$$\sum_{i=1}^{n} \alpha_i = 1 ; \sum_{i=1}^{n} \gamma_{ij} = 0; \sum_{i=1}^{n} \beta_i = 0 ; \sum_{j=1}^{n} \gamma_{ij} = 0 ; \gamma_{ij} = \gamma_{ji}$$

The ease of testing the restrictions imposed by the theory on the AIDS demand system is another property that makes its use very attractive to researchers. Since our goal was to estimate price and expenditure elasticities of various group of foods, we circumvent the issue by discarding from the estimation one of the commodity group, since the coefficients can be easily deduced from the properties of the demand system.

The coefficients from the demand system can easily computed if one employed some approximations. The uncompensated price elasticity of demand is:

$$\varepsilon_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i}{w_i} w_j$$

The compensated price elasticity of demand is:

$$\varepsilon_{ij}^{*} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} + w_j$$

The expenditure elasticity of demand is:

$$\varepsilon_i = 1 + \frac{\beta_i}{w_i}$$

2.2. Diversity measures

Romania has some particularities in terms of consumption when compared to other similar countries. Almost half of the population live in rural areas, and a large percentage of them are self-employed in subsistence agriculture. Besides the obvious poverty aspects of this occupation, it means that a large share of the households' food consumption is not transacted on the market but is produced in-house. The effect of self-consumption on diversity is not very easy to assess, households might use the additional resources[8] available to them for buying other food products (ambiguous effect on diversity), but they could equally buy non-food products (diversity decreases). On the other hand the diversity of the food products available at a reasonable price in the autumn is by far larger than the diversity of foods available in the winter[9]. Therefore, because of that we should observe a larger diversity of products in the summer/autumn sample. This is why we are interested to see how do the determinants of diversity vary during winter and autumn, and in order to do so, we estimated

[8] There is additional income in the household due to the fact that a larger share of foods is produced by the household in the summer/autumn in comparison to the winter when households have only products that can be stored, and the rest they need to buy.

[9] New technologies in agricultural production and storing have greatly increase the diversity of foods available during the winter months and decrease their prices, but there is still a premium that consumers have to pay when they want to purchase autumn products in winter and early spring.

the same diversity function both in winter sample (first quarter of 2011) and late summer, early autumn sample (the third quarter of 2011).

We have looked at two measures of diversity first the count measure (CM), in which the number of food products consumed by the household are added. The second diversity measure is the Berry Index which is constructed by adding the square of the share of expenditure for all food products.

$$BI = 1 - \sum_{i=1}^{n} \frac{x_i}{X}$$

where: x_i is the expenditure on the i product and X is the total food expenditure.

The two measures are very dissimilar, while CM can take values from 0 to 100[10], the BI can take values from 0 to 1[11]. Typically the dependent variable is the logarithm of the count measure, and a transformed Berry Index (TBI) is used as the dependant variable in the regression. The TBI is computed from the BI as follows:

$$TBI = \ln(\frac{BI}{1 - BI})$$

3. Data

The structure and evolution of households' food consumption and food expenditures in Romania is best described by data collected by the National Institute of Statistics (NIS) through the Household Budget Survey. The Household Budget Survey (HBS) is a statistical research, conducted annually by NIS providing necessary information for social policy and the standard of living analysis, for defining consumer price index weights and for estimating household consumption in the national accounts.

HBS is organized as a quarterly survey on a sample of 9360 dwellings, distributed into independent monthly sub-samples of 3120 dwellings each (NIS, 2012). HBS contains sections with detailed information on the following:

- Household's location and territory (county), residence area (rural, urban) and the period of data collection (month and year);
- Indicators on the household's composition, including the socio-demographic indicators on the household members, number of members, number of dependent persons (children), age, educational level, vocational training, ethnic group, occupational status, etc.;
- Balance of foodstuffs and beverages consumed per each household containing consumptions by origin sources (bought, from own production, from stocks, loans);
- Balance of a household's incomes mainly containing the entries in cash and the incomes in kind, expressed in value terms (cash entries from salaries, pensions, social services, sale of farm products, from other activities, etc.);
- Balance of households expenditures containing both the cash expenses and the expenses in kind, expressed in value terms.

[10] The number of food items which is recorded in the Romanian Integrated Household Survey

[11] The maxim value is 1-1/100 when the household consumes equal shares of all foods, which is close to 1 when there are a sufficient number of goods.

3.1. Data for AIDS

The data base used is the Household Budget Survey from the first quarter of 2011. In the data set we have information with respect to the household composition and characteristics of the members (age, education, labour market status, etc.), the household income, total expenditure as well as food expenditure on different food groups. Since there are over 100 records of different categories of foods in the survey, we aggregated them in eight broad groups as follows:

1. Bread, cereals and pasta (Cereals);
2. Meat and meat products, fish and sea food (Meat);
3. Milk, dairy products (Milk);
4. Fruits and fruit derivatives (Fruits);
5. Vegetables and vegetable derivatives (Vegetables);
6. Sweets and non-alcoholic beverages (Sweets);
7. Adult goods, as coffee and alcoholic beverages (Alcohol);
8. Other.

Table 6 presents the values of these shares (dependent variables in the AIDS) for total sample.

Table 6. The statistics of the food expenditure shares

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Expenditure share on cereals	4450	0.212415	0.094384	0	0.648234
Expenditure share on meat	4450	0.246379	0.09314	0.010829	0.664996
Expenditure share on milk	4450	0.166817	0.069475	0.008333	0.514861
Expenditure share on fruits	4450	0.068715	0.037832	0.001786	0.315169
Expenditure share on vegetables	4450	0.103852	0.05659	0.001989	0.462895
Expenditure share on sweets	4450	0.065779	0.041545	0.002584	0.300585
Expenditure share on alcohol	4450	0.063058	0.044674	0.001012	0.54428
Expenditure share on others	4450	0.072985	0.04011	0	0.371585

Source: Authors' computations

We have estimated seven demand functions, since the eight demand's coefficients can be obtained easily from the other seven demand functions.

The custom of buying in bulk, in order to built winter stocks, or in order to obtain a better price is not yet extinct, and can create problems if one wants to have an accurate measure of the precise household consumption of a certain food group. In addition to this, some rural households have members which are agricultural workers therefore they grow part of their food intake on their land. The data records both the quantity purchase, the expenses for each food category in the month of the interview, as well as the household consumption (self-consumption inclusively).

The self-consumption issue, i.e. the modality in which it can be included in the analysis of the consumption demand of self-produced food, presupposes a difficult decision, as in an economy like

that of Romania, self-consumption plays an important role, mainly in rural areas. Not taking into consideration the self-consumption leads to a higher accuracy of data (prices and bought foodstuffs). Furthermore, if we consider the modality of data registration in the HBS, from the available data (corresponding to a quarter of the year) it is impossible to separate the previously bought products and those that are self-produced. The primary interest to estimate the food demand elasticities led to the decision to limit the analysis to the purchased foodstuffs, for which a price could be calculated. This option probably induces certain distortions in estimating a complete system of food demand.

To understand the significance of the problem here is some information. There are some 280,000 records of food consumption for all households. In 100,000 cases, the purchased quantity is equal to the household consumption, in 140,000 the purchased quantity is lower than the household consumption, and in 40,000 the purchased quantity is higher than the household consumption. One should expect this behaviour, but they should even out, there should be an approximately equal number of records with consumption above the quantity purchased, and quantity purchased above the household consumption. The fact that this is not happening tells us that a significant part of household still have stocks of products. Because of that, one has to decide on the issue regarding what information to use, either the quantity purchased or the quantity consumed, leaving aside for the moment the issue that for the quantity consumed we might not have the correct price.

Since we are interested in computing the elasticities, we opted for using the household expenditure in the specific month, since for that information we had the correct prices.

The price index for each food group was computed by dividing the group expenditure by the group quantity, and the aggregate price of food (in log form) was computed as a weighted sum of the index of prices for each group (in log form), where the weights were the average share of food expenditure for each group.

3.2. Data for food diversity

We use the Household Budget Survey for two quarters of the 2011. The survey contains detailed information regarding the composition of the household like the age of the members, education level, occupational status, etc. as well as information regarding the consumption and income in the month of the interview. The survey records approximately 100 records for food expenditure, and this is the information that is used for computing the diversity measures described above. Table 7 presents the values of the CM, BI and TBI for the two samples.

Table 7. The statistics of the CM, BI and TBI

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
First quarter					
CM	7843	22.50249	9.816804	1	60
BI	7843	0.88761	0.079188	0	0.97157
TBI	7835	2.2217	0.607214	-1.17966	3.531456
Third quarter					
CM	7724	24.41196	10.29228	2	62

BI	7724	0.889837	0.07757	0	0.971117
TBI	7715	2.236487	0.626178	-15.9424	3.515186

Source: Authors' computations

The diversity measures employed do not appear to be very different in the two analyzed samples. In the summer, households consume on average two more food products in comparison to the winter, according to the CM measures. The differences measured by BI and TBI are not so large. The fact that the average food diversity measures do not appear to be very different in the two quarters does not mean that the determinants of food diversity are similar in the winter and in the autumn sample. In order to test that we had run the estimation for the two different samples .

4. Estimation and results

4.1. Food demand

The estimated model is the LA/AIDS demand system presented earlier, in which the dependent variables are the share of the food groups (presented earlier) in the total food expenditure, and the explanatory variables are some demographic and human capital characteristics of the household, together with the log of the price indices for each food category and the log of food expenditure divided by the aggregated price. The demographic variables included are the family composition, in terms of household members, number of babies and of children, the age and the education level of the first two household members. Since the rural dummy was significant, we have estimated the demand functions for urban and rural households as well. The results are presented in the Appendix A to this paper.

As mentioned before, the place of residence is significant and in terms of the demand (expressed as share in total food expenditure) for the specific food groups, the rural households have larger share of cereals, fruits, sweets and alcohol, in comparison to the urban households. Note that the monetary value of the specific expenditure of the urban household might be larger, but if you express them as shares they become larger, due to the low income level of the rural households.

If the household head is female, than there is a reduced demand for meat and alcohol and increased demand for sweets in the urban population sample in comparison to the case when the household head is male. This effect is not present in the rural sample.

In the urban sample, a more educated household head is associated with reduced shares for cereals and fruit groups, increased shares for meat, milk, and alcohol groups. The number of household members is an important determinant of the household demand, larger urban households demand more cereals, and meat (at a lesser extend) at the expense of the other food, while larger rural household demand more cereals, and less milk and vegetables.

The presence of babies in the household decreases the share of cereals and increases the share for milk in both the rural and the urban households, which is an expected result, while the presence of children decreases meat, and increases milk.

The age of both the household head and the second person in the household do not seem to influence significantly the share for food groups, and neither the education level of the second household member, with the exception of the urban household, cereals share.

The coefficients of the log of price groups and the log of food expenditure were used in order to compute price and expenditure elasticities. The elasticities estimate the measure in which the price differences influence the choice of the similar households.

The price and expenditures elasticities are presented, calculated for the total sample, and by residence areas for the 1st quarter of 2011. Although both the compensated and non-compensated price elasticities were calculated, only the non-compensated elasticities are presented (that generally have higher values than the compensated ones). The non-compensated elasticities take into consideration both effects generated by a change in prices, i.e. the income effect and the substitution effect.

Table 8. Estimated expenditure elasticities

	Total sample	*Urban area*	*Rural area*
Cereals	0.917	0.781	1.005
Meat	0.991	0.951	1.100
Milk	1.109	1.090	1.137
Fruit	1.079	1.117	1.052
Vegetables	1.121	1.172	1.069
Sweets	1.070	1.188	0.922
Alcohol	0.810	0.958	0.761

Source: Authors' computations

The expenditure elasticities for the total sample (Table 8) have positive values, which means that the defined groups represent normal products, for which an increase of food expenditures leads to an increase of demand. The fact that the expenditure elasticities are greater than 1 in the case of milk, fruit, vegetables and sweets indicates their perception as luxury goods. The presence of fruit and vegetables among these could be explained by the specificity of fruit consumption in the 1st quarter of the year (more citrus and less fruit from domestic production). The groups of products bread, meat and alcohol appear as necessity goods, with elasticities less than one, but close to 1.

The values of elasticities calculated for the urban area are closer to the elsticities in other (more developed) countries (Rizov et al., 2014). Thus, the expenditure elasticity of the cereal group is lower (its value is under that of the alcohol group), even though the milk, fruit, vegetables and sweets groups are perceived as being from the luxury goods category.

The demand elasticities in the rural area, calculated for the 1st quarter of the year 2011, suggests that the interaction with self-consumption can be important even for the households that bought products from each group defined for the analysis. The situation is different from that in the urban area in the first place because, besides the groups sweets and alcohol, all the other groups are considered luxury goods (the cereal group inclusively, where bread prevails).

Price elasticities for the total sample

The own price elasticities of the analyzed groups of products (Table 9), found on the elasticity matrix diagonal, measure the percentage of demand modification as a result of the 1% modification of the respective group price (the values are negative because the price modification results in a modification of demanded quantity in the opposite direction). Except for the groups meat and fruit, for which the demand appears more inelastic, all the other groups have an elasticity greater than one (in module), which would mean that the demanded quantity is modified by a percentage higher than the price. The result suggests a strong preference for products of the groups meat and fruit. A special situation is represented by the price elasticity greater than one for cereals, which could be explained by the great differences between the food habits from the rural and urban areas (possible substitution of buying bread by the preparation of polenta obtained from the self-produced maize flour, in the rural area).

The cross price elasticities (values that are not on the elasticity matrix diagonal) measure the modification of the demanded quantity for a group of foodstuffs if the price of another group is modified by 1%. The negative sign indicates that the considered group has complementary groups, and the positive sign indicates that it has substituent groups. For instance, in the case of meat, the cross price elasticities are negative for most groups (except for milk and fruit).

Table 9. Uncompensated price elasticities for the total sample

Group	*Cereals*	*Meat*	*Milk*	*Fruit*	*Vegetables*	*Sweets*	*Alcohol*
Cereals	**-1.296**	-0.077	-0.003	0.360	0.085	0.525	0.224
Meat	-0.222	**-0.672**	-0.013	0.011	-0.283	0.001	0.074
Milk	0.002	0.041	**-1.237**	0.057	0.069	0.051	0.136
Fruit	-0.045	0.009	-0.054	**-0.733**	-0.038	0.117	0.003
Vegetables	0.046	-0.104	-0.040	0.039	**-1.066**	0.170	0.129
Sweets	-0.001	-0.027	-0.013	0.011	0.014	**-1.068**	0.074
Alcohol	-0.011	-0.003	0.044	0.039	0.042	0.012	**-1.178**

Source: Authors' computations

Price elasticities in the urban area

Estimated own price elasticities (Table 10) are less than one for the cereals, meat, fruit and vegetables groups, which suggests that the urban households are less vulnerable to changes in prices compared to the rural households, which represents a plus from the food security point of view. The fact that the milk group has an elastic demand can be explained by the seasonal variations in the milk and dairy price (with significant price increases in winter time).

It is interesting that the group fruit find substituents in each of the other groups, which is a situation similar to that for the total sample probably as a result of the specific fruit consumption in the 1st quarter of the year.

Table 10. Uncompensated price elasticities in the urban area

Group	*Cereals*	*Meat*	*Milk*	*Fruit*	*Vegetables*	*Sweets*	*Alcohol*
Cereals	**-0.937**	-0.144	-0.022	0.252	-0.051	0.348	-0.033
Meat	-0.223	**-0.692**	-0.004	0.041	-0.300	0.040	0.016
Milk	-0.042	0.051	**-1.209**	0.089	0.074	0.028	0.184
Fruit	-0.028	-0.016	-0.021	**-0.750**	-0.081	0.102	0.066
Vegetables	-0.021	-0.081	-0.040	0.093	**-0.932**	0.148	0.074
Sweets	-0.001	-0.022	-0.011	0.004	0.011	**-1.071**	0.061
Alcohol	-0.019	-0.008	0.033	0.057	0.034	0.030	**-1.171**

Source: Authors' computations

Price elasticities in the rural area

The own price elasticities less than one for meat and fruit (Table 11) indicate an inelastic demand for these products, probably because the traditional food consumption pattern implies a higher consumption of meat in winter time, and the availability of fruit specific to the cold season (citrus from import) make people eat these products, as a result of the expansion of the urban food consumption pattern.

Examining the cross price elasticities, it can be noticed that the alcohol group is complementary with the groups meat and fruit, for the rural households.

Table 11. Uncompensated price elasticities in the rural area

Group	*Cereals*	*Meat*	*Milk*	*Fruit*	*Vegetables*	*Sweets*	*Alcohol*
Cereals	**-1.577**	0.114	0.030	0.461	0.172	0.672	0.243
Meat	-0.222	**-0.629**	-0.039	-0.023	-0.270	0.010	-0.017
Milk	0.003	0.053	**-1.291**	0.048	0.095	0.076	0.106
Fruit	-0.081	0.083	-0.129	**-0.702**	0.015	0.130	-0.055
Vegetables	0.071	-0.124	-0.038	-0.007	**-1.165**	0.149	0.107
Sweets	0.014	-0.027	-0.035	0.026	-0.027	**-1.050**	0.081
Alcohol	-0.003	0.014	0.065	-0.003	0.053	-0.011	**-1.189**

Source: Authors' computations

4.2. Diet diversity

The equations estimated have as dependent variable the count measure (CM) and the transformed Berry Index (TBI), the explanatory variables used being: the logarithm of the household income, in

order to assess the elasticity of the diversity with respect to income, information regarding the household composition, the characteristics of the household head, and information regarding the zone of residence were included also. The household composition variables are the number of household members and the number of children. The household characteristics that were included in the equation were age, education, occupational status. In terms of residence, we have included a dummy for the urban households, the county of residence. In addition, the education of the household head was interacted with the zone of residence (urban/rural) in order to assess whether educated/un-educated urban households made different choices in terms of diversity in comparison to educated/un-educated rural households. In the specification tried we have include information regarding the characteristics of the second household member, but they did not seem to have an effect on food diversity

The results for CM, presented in Table B1 from Appendix B, indicate that there are some important differences in the food diversity of the first quarter in comparison to the third quarter. There is some indication of the fact that the diversity in the third quarter is higher because the constant in the regression is significant higher in the summer data in comparison to the winter one (1.65 in comparison to 1.08). On the other hand, the diversity is more elastic with respect to income in winter than in summer (0.21 in comparison to 0.15). This means that an equal increase in income would bring an larger increase in diversity in the winter months. A female household head is associated to higher diversity, but the effect is stronger in the first quarter. In summer months the urban households have higher food diversity than rural households, but probably due to self-consumption of agricultural production. If the household head is self-employed in agriculture than there are some effects on food diversity which is lower in this case, again the effect is more pronounced in the third quarter. The other occupation status do not appear to have significant effects on the count measure of diversity. The age of the household head has a larger influence in the third quarter, older households appear to favour a more diverse food diet. Larger households, especially households with children have larger number of foods items purchased, probably due to the fact that they have to take into consideration the different tastes of the household members.

The results for TBI, presented in Table B2 from Appendix B , are not very different from the results of the count measure. The income elasticity is somewhat larger 0.23 in the first quarter and 0.17 in the third quarter, but the same difference between the influence of income from one quarter to the other can be observed. A female household head has a positive influence on the TBI measure as well as the CM. The education level in the case of the urban households is important in the determination of TBI diversity. It appears no education for the household heads means less diversity. There is no indication that more educated household head means more diversity, but there are certain levels of education that seems to be associated with higher TBI diversity (vocational education). The occupational status of the household head is important as well. Self employment in agriculture decreases diversity in the third quarter only, and housewives are associated with lower diversity of food. Household composition greatly affects the TBI diversity, the increase in the number of members decreases diversity (with the CM the effect was in reverse) but if the members are children, they increase diversity (similar to the CM measure).

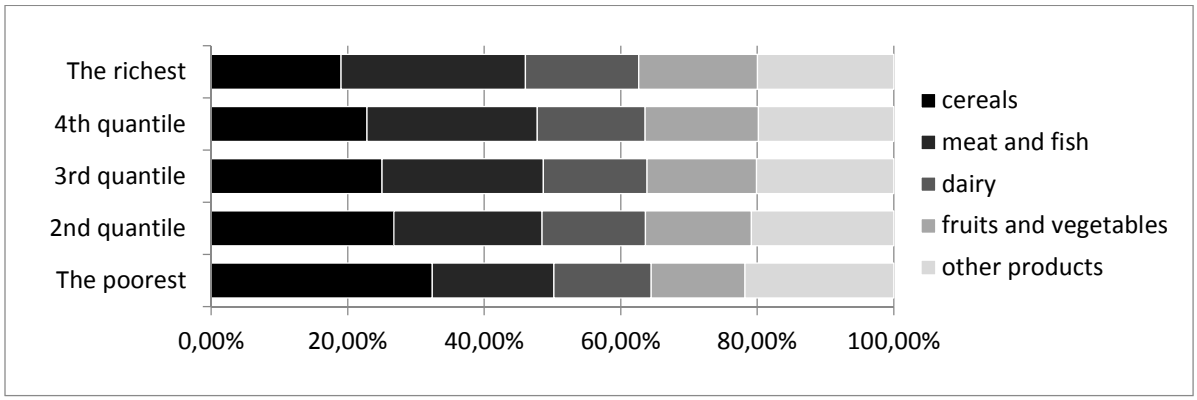
5. Vulnerable households

5.1. Low income households

The food demand in Romania is strongly influenced by high share of self-consumption, especially in rural areas, as shown in a recent study (Cupak et al., 2014) that estimated an AIDS for five aggregated groups (cereals and bread, meat and fish, dairy products and eggs, fruits and vegetables, and other product) for years 2004, 2007 and 2011 for a "representative" low income household (1st quintile of the income distribution) residing in rural area.

Estimated expenditure elasticties are higher than 1 for 4 out of 5 food groups meaning that meat and fish, dairy products, fruits and vegetables and other food products are perceived as luxury goods by low income, rural households. On the other hand, cereal products are considered to be rather a necessity. The matter of high expenditure elasticities of the key food products such as meat, fruits and vegetables indicates a limitation of the high quality nutrition intake and thus low income, rural households are forced to switch towards a monotonous food consumption gaining nutrients mostly from grains (as presented in Figure 3).

Figure 3. Composition of food consumption in Romania by income groups

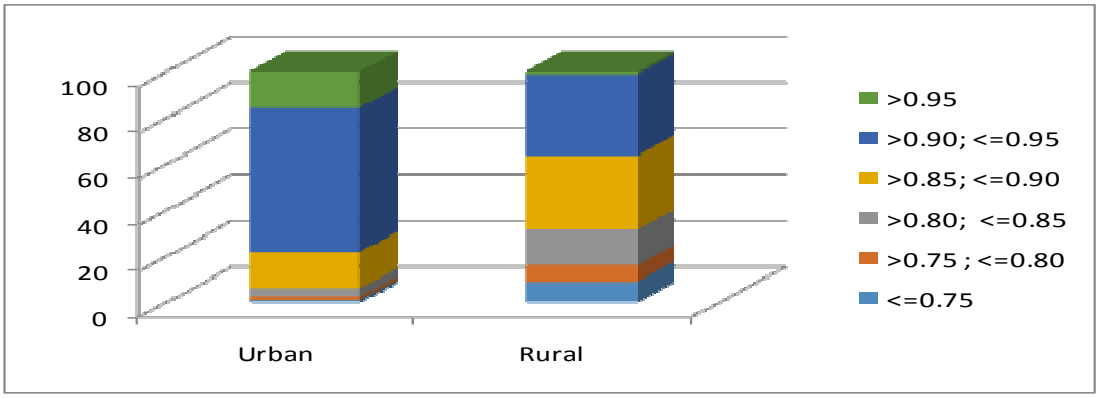


Source: (Cupak et al., 2014)

Low income, rural household in Romania are most price sensitive towards dairy products (with compensated own-price elasticities higher than 1, in module) meaning a price elastic demand. Demand for the other 4 food groups seems to be price inelastic. The evaluations of demand system and the calculated elasticities reveal the consumption behaviour of the poorest households in the rural area, where poverty is higher than in urban areas. The choices of rural households as regards the food bought can be significantly influenced by the fact that they practically operate in a subsistence economy, where the cash incomes are extremely low and that they generally buy what they cannot produce on their own household or certain luxury goods for special occasions. If we investigate consumption on rural households, by types of products, we can notice the highest shares (more than 50% of food consumption comes from self-consumption) in milk, cheese, eggs, vegetables, and we also notice that the dairy product group also has the highest elasticity. Practically, this leads us to the conclusion that for the groups of products with a high share of self-consumption, the products that are bought are perceived as luxury goods rather than products for meeting the basic needs for food.

Low income at household level make as an important part of foodstuffs to be produced in their own household, and the consumption of bought dietary food to be at a lower level, as was already mentioned. This aspect is noticeable in Romania, where the rural households have a much lower dietary diversity compared to the urban households (Figure 4).

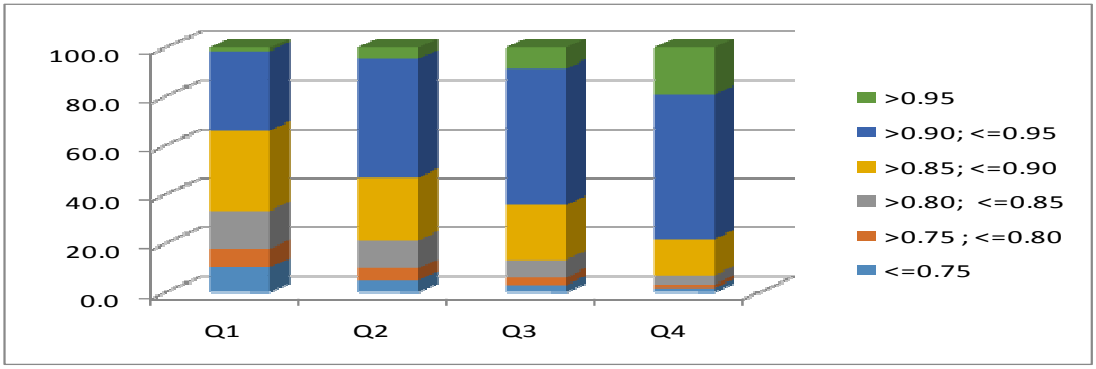
Figure 4. Distribution (%) of urban and rural households by Berry Index, in the first quarter of 2011



Source: Contributors' computations

It is important to mention that the households that have a high dietary diversity, measured with Berry index, for which the index values are higher than 0.90, account for 68% of the urban households and only 36% of the rural households. The rural households have a moderate dietary diversity, most of them (47%) being in the interval (0.80, 0.90) for the Berry Index. The higher food diversity in the case of urban households in comparison with rural households represents an indirect effect of income disparities between households from urban and rural areas. Thus, in 2011, according to the Budget Household Survey (NIS, 2012), urban households had total and cash income higher with 23%, and respectively by 73% compared to rural households. In addition to the income factor, other factors that influence consumer behaviour and diversity of dietary could be considered including some demographic factors that were already mentioned. In addition, the access to food retail systems and to the transport infrastructure may also influence the behaviour of the consumers from different residence areas.

Figure 5. Distribution (%) of households by Berry Index and income quartiles, in the first quarter of 2011



Source: Contributors' computations

In this context, our results relative to households' food diet diversity in relation to disposable income fully confirm the economic theory, i.e. a direct link between income growth and diversity of diets. Figure 5 shows that the households from first income quartile is characterized by a medium to low dietary diversity with only 34% of these to have a high diversity, for which the Berry Index is higher than 0.90. In fourth income quintile, more than 78% of households have a high dietary diversity

(BI>0.90), and 20% have a very high diversity, for which the Berry Index is higher than 0.95. At the same time, the number of households that fall into the high food diversity category increases with incomes, which indicates a consistent statistical relation between income and dietary diversity.

The processing of primary data from the Household Budget Survey in the first and third quarters of the year 2011 reveals an extremely high level of food insecurity self-evaluated by each household in sample, by the answer to the question „Owing to the lack of financial resources, was your household unable to pay for sufficient food products to ensure an acceptable level of food?". Thus, in the first quarter, about 40% of households considered that they were unable to pay for the necessary foodstuffs (this share was down in the third quarter, to reach 37%), the share of rural household being larger than the urban household share, as it results from the data presented in Table 11.

Table 11. Share of households self-evaluated as food insecure in the year 2011, by residence area

	First quarter	*Third quarter*
Total sample	39.9%	37.1%
Rural sample	43.0%	40.0%
Urban sample	37.0%	34.3%

Source: Authors' computations

The high share of households that evaluate themselves as being vulnerable from the food security perspective imposes a more comprehensive investigation of the objective nutrition situation on these households and of the causes that generate food insecurity. The quite small differences between rural and urban households that are self-evaluated as vulnerable suggest that a subjective perception may exist at household level. This finding implies the need to initiate certain systematic research studies meant to identify the vulnerable persons/households, which should be followed by the introduction of national programs for fighting against food insecurity.

5.2. Roma households

One of the population segments featuring vulnerability from the food security point of view is the Roma minority. Among the national minorities from Romania, the Roma people are the second minority population as percentage share; in the year 2011, on the occasion of the Population's Census, 619 thousand people self-declared that they are Roma people, i.e. 3.25% of the country's population. In reality it is considered that this number is much higher, and a survey conducted nationwide by the Research Institute for the Quality of Life estimated the number of Roma people at 1.5 million (UNDP, 2012). Most Roma people live in the countryside (64.1%). The Roma people are a young population, 66.8% of these being under 30 years of age in the year 2002, compared to the majority population (the Romanians), where only 40.6% were under 30 years old. However, life expectancy at birth for the Roma children is significantly lower.

The Roma population is facing serious economic problems generated by poverty and social exclusion. The differences between the majority population and the Roma population, with regard to poverty level and social disparities, are presented in Table 12.

Table 12. Romania - Poverty rate and inequality in the year 2011

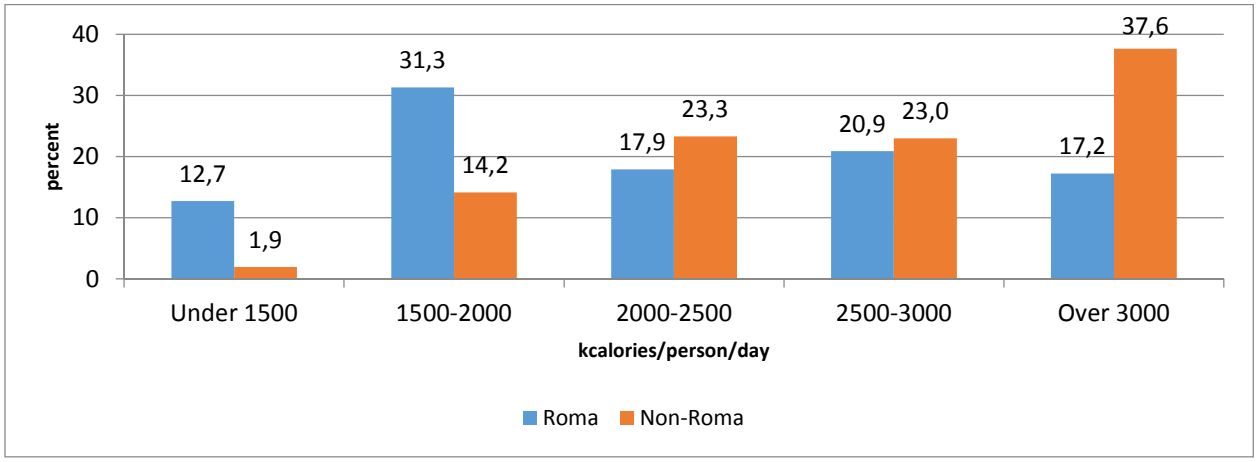
	Roma households	*Non-Roma households*
Absolute poverty rate at PPP $ 4.30 (related to incomes)[1]	54%	13%
Gini coefficient (inequality)	0.46	0.34
Ratio of incomes between the poorest people (Q1) and the richest people (Q5)	13.49	6.96

Source: (UNDP, 2012); [1)] Purchasing power parity of 4.30 US$/day

Besides the significant income discrepancies between the Roma population and the majority population, there is also a strong social polarization inside the Roma community, if we have in view the ratio of incomes between the poorest Roma people (Q1) and the richest Roma people. The handicaps of the Roma community stem from several causes, but the most important one is considered to be the extremely low educational level that limits the employment opportunities on the labour market and the incomes implicitly. For instance, if we refer to the population category 25-64 years, 61% of the Roma people have no schooling or they have not completed primary school and 0% have post-high school education.

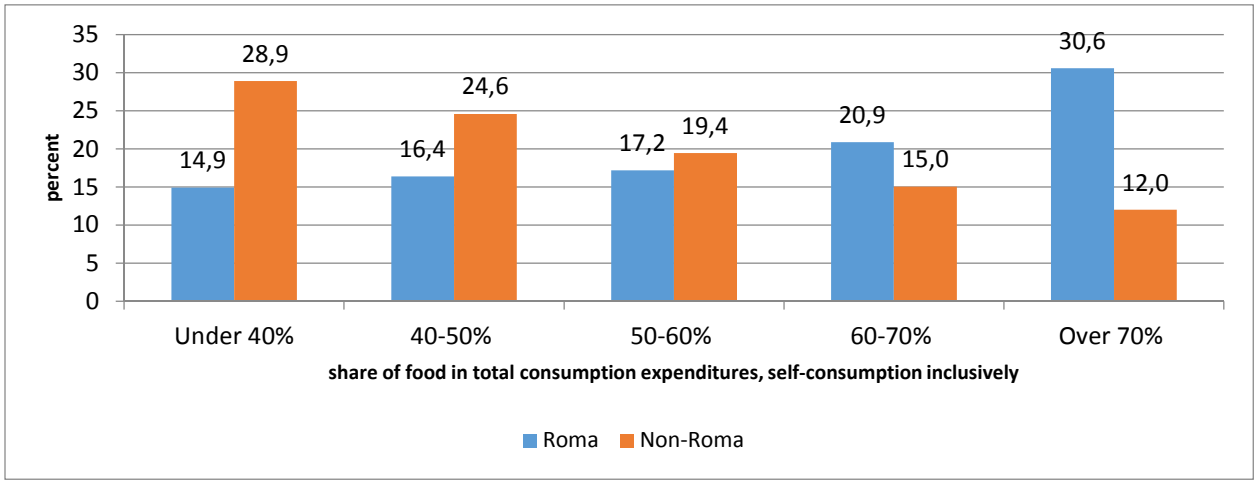
Information on the demographic indicators, household incomes, expenditures and consumption is also found in the Household Budget Survey (HBS) for Romania, although the Roma households represent only 1.8% of sample. The HBS data also permit the approximation of the vulnerability level from the food security standpoint for the Roma households. In the case of these households, the food consumption expressed in calories is under the minimum nutritional requirements defined by FAO (about 2000 kcal/person/day) for almost half of the registered cases (Figure xx).

Figure 6. Distribution of households by the food intake expressed in calories in the 1st quarter of the year 2011, for certain population groups



Source: Authors' computations

Figure 7. Distribution of households by the share of food expenditures in total consumption expenditures in the 1st quarter of the year 2011, for certain population categories

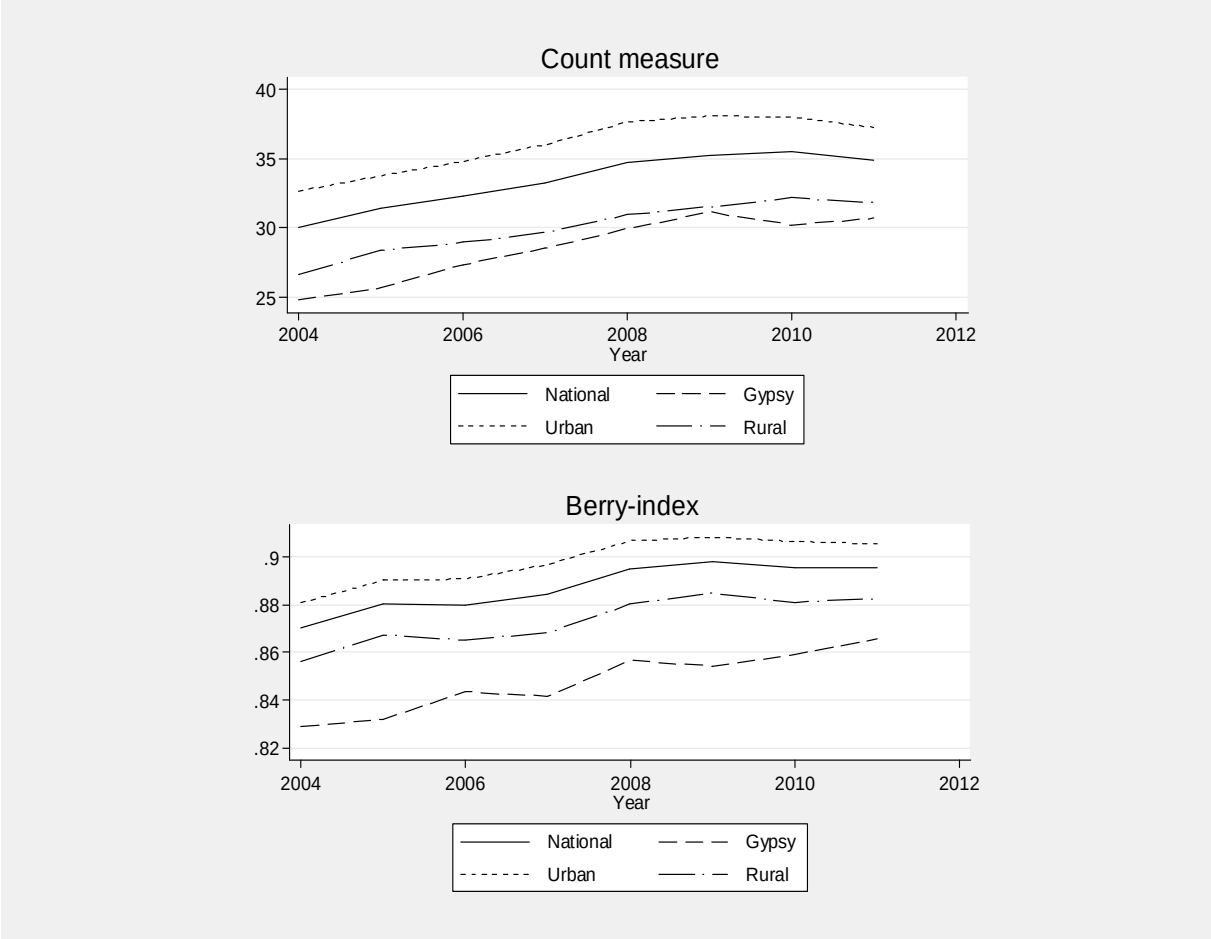


Source: Authors' computations

The economic vulnerability of the Roma households is indicated by the excessively high share of food consumption expenditures in total consumption expenditures. Almost half of Roma households spend on food more than 50% of total consumption expenditures, and a large part even more than 60% (Figure 7).

The situation of Roma households is more difficult than the other households, even from the perspective of food diversity. Although there were improvements in the last decade, along with other household (Figure 8), the gap is maintained.

Figure 8. Evolution of the food diversity measures by household type (2004- 2011)



Source: Contributors' computations

Also from the nutritional point of view, Roma people are disadvantaged compared to total sample (Table 13).

Table 13. Average daily intake of the selected macronutrients (adult equivalents)

Full sample				
Macronutrient	*2004*	*2007*	*2011*	*DRI*[1]
Proteins (g/day)	98	98	99	95
Lipids (g/day)	103	102	104	95
Carbohydrates (g/day)	376	357	348	400
Calories (kcal)	2954	2877	2855	2750
Roma subsample				
Macronutrient	*2004*	*2007*	*2011*	*DRI*
Proteins (g/day)	85	89	89	95
Lipids (g/day)	85	89	88	95
Carbohydrates (g/day)	355	342	328	400

Calories (kcal)	2613	2641	2600	2750

Source: HBS of Romania; contributors' calculations. Notes: 1- Daily recommended intake of the selected macronutrients (computed as an arithmetic average of daily recommended intake for adult men and women).

6. Conclusions

In Romania, food demand features high elasticity in relation to income. In most investigated products, the elasticity of food expenditures in relation to income has values larger than one, which means that the food commodity market still has a significant growth potential. At the same time, with the increase of incomes in the rural area, self-consumption role is expected to decrease and food purchases are expected to increase. The food consumption from the self-produced food on the households is part of the survival strategies of very poor households.

Food demand elasticity in relation to incomes is higher than the demand elasticity in relation to prices for most investigated products and that is why we think that the interventions for improving food security should target incomes in the first place.

The investigation of food demand and the estimation of elasticity coefficients provide useful information on the consumption behaviour of different population categories in relation to incomes and food prices. The food demand system parameters are determined for the households from the urban and rural areas. The expenditure elasticities are higher in the rural area than in the urban area mainly due to the rural population's lower cash incomes.

A characteristic of the demand system in Romania is that expenditure elasticites for products which traditionally are considered as basic food like: bread, meat or milk have large values (larger than one), which suggests that they are perceived as luxury products by the population. An explanation of this issue is the low income level and the large share of food expenditure in total expenditure due to the poverty level of the rural households. Another explanation which is relevant to the rural households steams from the importance of the self-consumption, i.e. of its important contribution to meeting household food consumption, a situation facilitated by the existence of fragmented holdings.

The choices of rural households as regards the food bought can be significantly influenced by the fact that they practically operate in a subsistence economy, where the cash incomes are extremely low and that they generally buy what they cannot produce on their own household or certain luxury goods for special occasions. If we investigate consumption on rural households, by types of products we can notice the highest shares (more than 50% of food consumption comes from self-consumption) in milk, cheese, eggs, vegetables, and we also notice that the dairy product group also has the highest elasticity. Practically, this leads us to the conclusion that for the groups of products with a high share of self-consumption, the products that are bought are perceived as luxury goods rather than products for meeting the basic needs for food.

The investigation of the food diversity in different socio-economic and demographic categories of the population is important for the identification of vulnerable categories and for the nutrition programs. Low income, which has a negative influence to food diversity demand induce a negative influence in food commodity markets. The residence area is also important for the household diet, as the rural households have a less diversified food diet, due to lower incomes and to the high share of self-produced food and subsistence economy.

References

Cupak, A., Pokrivcak, J., Rizov, M., Alexandri, C., Luca, L., 2014. *Economic Development and Food Demand in Central and Eastern European Countries: The Case of Romania*, paper prepared for presentation for the 142nd EAAE Seminar, Budapest

Deaton,A., Muellbauer, J., 1980. An almost ideal demand system. *American Economic Review* 70 (3), 418-336

FAO, 2013. *The state of food and agriculture 2012*, FAO, Rome

Green, R. and Alton, J.M., 1990. Elasticities in AIDS Models, *American Journal of Agricultural Economics*, May 1990, 442-445

NIS, 2012. *Co-ordinates of living standard in Romania. Population income and consumption. The year 2011*, National Institute of Statistics, Bucharest

Tiffin, R., Balcombe, K., Salois M., Kehlbacher, A., 2011. *Estimating Food and Drink Elasticities*, University of Reading

Rizov, M., Cupak, A., Pokrivcak, J., 2014. *Food demand patterns in the new EU member states: The case of Slovakia*, Paper presented at the EAAE 2014 Congress, Ljubljana

UNDP, 2012. *Economia socială şi comunităţile de romi – provocări şi oportunităţi*, UNDP,Bucureşti

Appendix A. The influence of the demographic characteristics over the food demand

Table A1. Results for urban sample

	Cereals	Meat	Milk	Fruits	Vegetables	Sweets	Alcohol
Month (January is the omitted)							
February	-0.0113*	0.0168*	-0.0001	-0.0038*	0.0095*	-0.0057*	-0.0028
March	-0.0001	0.0070	-0.0090*	-0.0084*	0.0186*	-0.0026	-0.0032
Rural area	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
1st household member is female	-0.0044	-0.0108*	0.0063	0.0025	0.0025	0.0065*	-0.0052*
Education of the first household member							
primary school	0.5115*	0.1799*	0.1646*	-0.0828*	0.0724*	-0.0385	0.1045*
secondary school	0.5165*	0.1918*	0.1674*	-0.0782*	0.0553*	-0.039*	0.0972*
vocational education	0.5008*	0.2023*	0.1729*	-0.0721*	0.0521*	-0.0383*	0.0963*
10 classes	0.5124*	0.1982*	0.1614*	-0.0666*	0.0474*	-0.0381	0.1002*
high school education	0.4942*	0.1999*	0.1777*	-0.0691*	0.0522*	-0.039*	0.0961*
foreman education	0.4933*	0.1933*	0.1812*	-0.0652*	0.0506	-0.0368	0.0925*
short term college education	0.5003*	0.1900*	0.1811*	-0.0738*	0.0512	-0.0343	0.0943*
long term college education	0.4852*	0.2050*	0.1879*	-0.0663*	0.0464	-0.0398*	0.0960*
Doctoral education	0.4392*	0.3008*	0.2317*	-0.0865*	-0.0143	-0.0852*	0.1247*
Number of Household members	0.0209*	0.0061*	-0.0089*	-0.0036*	-0.0067*	-0.0030*	-0.0022*
Number of babies in the household							
1 baby	-0.0205*	-0.0121	0.0434*	0.0030	-0.0033	-0.0084	0.0000
Number of children in the household							
1 child	-0.0006	-0.0165*	0.0163*	0.0041*	-0.0062	0.0085*	-0.0028
2 children	0.0085	-0.0254*	0.0152*	0.0057	-0.0053	0.0107*	-0.0086*
3 children	0.0002	-0.0688*	0.0112	0.0074	0.0346*	0.0307*	-0.0111
4 children	-0.0149	-0.0785*	0.0814*	-0.0071	0.0077	0.0214	-0.0052
5 children	-0.0821*	-0.0275	0.0693*	0.0127	0.0226	0.0326	-0.0271
The age of the first household member	0.0000	0.0002	0.0002	0.0000	0.0000	-0.0002*	-0.0001
The age of the second household member	-0.0003*	-0.0002	0.0003	0.0002*	0.0000	0.0000	-0.0001
Education of the second household member							
primary school	0.0402*	-0.0204	-0.0185	-0.0079	0.0089	0.0083	0.0010
secondary school	0.0433*	-0.0301	-0.0202	-0.0029	0.0083	0.0072	-0.0007
vocational education	0.0341*	-0.0222	-0.0105	-0.0059	0.0056	0.0053	0.0001
10 classes	0.0444*	-0.0449*	-0.0172	-0.0054	0.0122	0.0085	0.0015
high school education	0.0260	-0.0160	-0.0179	-0.0025	0.0073	0.0085	-0.0013
foreman education	0.0183	0.0028	-0.0164	-0.0106	0.0065	0.0042	0.0051
short term college education	0.0115	0.0080	-0.0315	-0.0005	-0.0001*	0.0063	0.0009
long term college education	0.0173	-0.0152	-0.0270*	0.0009	0.0033	0.0154	0.0060
Doctoral education	0.0172	-0.3668*	0.0441	0.0541	0.1264*	0.0538	0.0322

Table A2. Results for rural sample

	Cereals	Meat	Milk	Fruits	Vegetables	Sweets	Alcohol
Month (omitted is January)							

	Cereals	Meat	Milk	Fruits	Vegetables	Sweets	Alcohol
February	-0.0047	0.0284*	-0.0118*	-0.0008	0.0073*	-0.0055	-0.0040
March	0.0009	0.0283*	-0.0221*	-0.0010*	0.0125*	-0.0047	-0.0017
Rural area	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
1st household member is female	0.0098	-0.0100	0.0031	-0.0004	0.0069	-0.0021	-0.0056
Education of the first household member							
primary school	0.0554	-0.0278	0.0001	-0.0017	-0.0092	0.0147	-0.0363
secondary school	0.0757	-0.0391	-0.0079	0.0015	-0.0122	0.0133	-0.0321
vocational education	0.0730	-0.0436	-0.0090	0.0076	-0.0190	0.0147	-0.0271
10 classes	0.0808	-0.0340	-0.0031	-0.0031	-0.0119	0.0052	-0.0379
high school education	0.0551	-0.0304	0.0038	0.0074	-0.0165	0.0125	-0.0366
foreman education	0.0285	-0.0133	0.0109	0.0071	-0.0056	0.0070	-0.0349
short term college education	-0.0160	0.0453	0.0026	-0.0021	-0.0191	-0.0045	-0.0174
long term college education	0.0207	-0.0172	0.0121	0.0187	-0.0006	-0.0060	-0.0340
Doctoral education	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
Number of household members	0.0097*	-0.0016	-0.0106*	-0.0004	-0.0041*	0.0017	0.0023
Number of babies in the household							
1 baby	-0.0406*	0.0182	0.0286*	0.0071	0.0002	-0.0129*	-0.0002
2 babies	0.1267	-0.0708	-0.0372	0.0496	0.0049	-0.0236	-0.0276
Number of children in the household							
1 child	0.0150	-0.0225*	0.0029	0.0093*	-0.0038	0.0080*	-0.0055
2 children	0.0343*	-0.0322*	0.0030	0.0051	0.0026	0.0011	-0.0125*
3 children	0.0551*	-0.0759*	0.0299*	0.0027	-0.0011	0.0066	-0.0090
4 children	0.0598	-0.0564	-0.0044	-0.0047	0.0118	0.0281	-0.0277
5 children	-0.0165	-0.0167	0.1011*	-0.0079	0.0253	-0.0370	-0.0305
The age of the first household member	0.0001	0.0002	-0.0001	0.0000	-0.0002	0.0000	-0.0001
The age of the second household member	-0.0001	-0.0005	0.0002	0.0001	0.0002	-0.0001	0.0001
Education of the second household member							
primary school	0.0322	-0.0076	-0.0221	0.0114	0.0248	-0.0167	-0.0026
secondary school	0.0231	-0.0010	-0.0153	0.0019	0.0271	-0.0156	-0.0012
vocational education	0.0302	0.0016	-0.0198	-0.0003	0.0300	-0.0232	-0.0007*
10 classes	0.0256	-0.0221	-0.0215	0.0105	0.0447*	-0.0131	-0.0088*
high school education	0.0188	-0.0114	-0.0043	0.0065	0.0221	-0.0160	0.0004
foreman education	0.0088	-0.0079	-0.0189	0.0172	0.0432*	-0.0275	0.0077
short term college education	0.0432	-0.0571	-0.0027	0.0194	0.0222	-0.0202	0.0069
long term college education	-0.0074	-0.0068	0.0036	0.0144	0.0204	-0.0147	0.0095

Table A3. Results for total sample

	Cereals	Meat	Milk	Fruits	Vegetables	Sweets	Alcohol
Month (omitted is January)							
February	-0.0097*	0.022*	-0.0052*	-0.0026	0.0088*	-0.0053*	-0.0037*
March	-0.0013	0.0156*	-0.0136*	-0.0086*	0.0168*	-0.0032	-0.0031
Rural area	0.0402*	-0.0342*	-0.0218*	0.0044*	-0.0142*	0.0092*	0.0084*

	Cereals	Meat	Milk	Fruits	Vegetables	Sweets	Alcohol
1st household member is female	0.0023	-0.012*	0.006	0.0011	0.0035	0.0034	-0.0051*
Education of the first household member							
primary school	0.0911*	-0.0134	-0.0169	-0.0040	-0.0178	0.0087	-0.0464*
secondary school	0.1021*	-0.0132	-0.0184	-0.0017	-0.0259	0.0071	-0.0462*
vocational education	0.0915*	-0.0107	-0.0147	0.0043	-0.0307	0.0084	-0.0441*
10 classes	0.1043*	-0.0116	-0.0161	0.0024	-0.0278	0.0018	-0.0477*
high school education	0.0842*	-0.0063	-0.0081	0.0056	-0.0301	0.0058	-0.0476*
foreman education	0.0796*	-0.0124	-0.0026	0.0092	-0.0300	0.0078	-0.0496*
short term college education	0.0752	-0.0026	-0.0084	0.0018	-0.0284	0.0097	-0.0467*
long term college education	0.0703	-0.0013	-0.0001	0.0101	-0.0326	0.0049	-0.0463*
Doctoral education	0.0568	0.0834	0.0458	-0.0157	-0.1063*	-0.0426	-0.0189
Number of Household members	0.0143*	0.0029	-0.0097*	-0.0019*	-0.0051*	-0.0008	0.0002
Number of babies in the household							
1 baby	-0.0254*	0.0005	0.0383*	0.0043	-0.0059	-0.0104*	0.0000
2 babies	0.1307	-0.0663	-0.0300	0.0420	0.0020	-0.0275	-0.0271
Number children							
1 child	0.0050	-0.0192*	0.0117*	0.0059*	-0.0043	0.0082*	-0.0037
2 children	0.0193*	-0.0307*	0.0118*	0.0055	0.0008	0.0061	-0.0106*
3 children	0.0297*	-0.0668*	0.0233*	0.0058	0.0072	0.0154*	-0.0086
4 children	0.0288	-0.0584*	0.0424*	-0.0055	0.0132	0.0176	-0.0215
5 children	-0.0449	-0.0077	*0.0787	0.0004	0.0194	-0.0020	-0.032*
The age of the first household member	0.0000	0.0001	0.0001	0.0000	-0.0001	-0.0001	-0.0001
The age of the second household member	-0.0004*	-0.0003	0.0003*	0.0002	0.0001	0.0000	0.0000
Education of the second household member							
primary school	0.0303	-0.0152	-0.0205	0.0008	0.0171	0.0029	0.0002
secondary school	0.0308*	-0.0156	-0.0181	-0.0026	0.0168	0.0017	-0.0004
vocational education	0.0291	-0.0108	-0.0133	-0.0042	0.0166	-0.0037	-0.0009
10 classes	0.0290	-0.0340*	-0.0202	0.0022	0.0302*	0.0037	-0.0041
high school education	0.0191	-0.0094	-0.0138	0.0008	0.0149	0.0012	-0.0021
foreman education	0.0064	0.0105	-0.0150	-0.0037	0.0183	-0.0046	0.0039
short term college education	0.0147	-0.0034	-0.0216	0.0043	0.0091	-0.0032	0.0031
long term college education	0.0126	-0.0120	-0.0208	0.0044	0.0112	0.0072	0.0054
doctoral education	0.0104	-0.3420*	0.0464	0.0648	.1375*	0.0399	0.0256

Appendix B. The influence of the demographic characteristics over diet diversity

Table B1. The estimation regression of the count measure (CM) of diversity

CM	First quarter		Third quarter	
Number of obs	7816		7712	
F(111, 7704)	68.02		80.33	
Prob > F	0		0	
R-squared	0.4949		0.5282	
Adj R-squared	0.4877		0.5217	
Root MSE	0.3627		0.33099	
	Coef	**Prob**	**Coef**	**Prob**
Logarithm of the income variable	**0.2146028**	0.00	**0.1545835**	0.00
Second month of the quarter	**0.034758**	0.00	-0.016765	0.07
Third month of the quarter	**0.0402922**	0.00	**-0.049323**	0.00
Female	**0.0694881**	0.00	**0.0277885**	0.01
Urban Households	0.0210242	0.91	**0.2424988**	0.04
Education level of the rural household head, omitted category is no education				
Primary school	-0.02085	0.72	**-0.125979**	0.01
Secondary school	0.0445853	0.44	-0.074055	0.10
Vocational education	0.0628792	0.28	-0.050153	0.28
First two years of high school	-0.044295	0.51	-0.05282	0.35
High school	0.1038931	0.09	0.0122738	0.80
Post high school schooling	0.0751407	0.29	0.001783	0.98
Short term university degree	-0.049674	0.60	0.0428629	0.58
University degree	0.1132328	0.14	-0.068843	0.27
Doctoral studies	-0.430562	0.24	(dropped)	
Education level of the urban households, omitted category is no education				
Primary school	0.322466	0.09	0.1138331	0.35
Secondary school	0.3061443	0.11	0.1524385	0.21
Vocational education	0.3150608	0.10	0.1571704	0.19
First two years of high school	0.3486687	0.08	0.155783	0.25
High school	0.262235	0.17	0.1111491	0.36
Post high school schooling	0.3045114	0.12	0.1188861	0.35
Short term university degree	**0.4090966**	0.05	0.07975	0.57
University degree	0.2240449	0.26	0.1617001	0.21
Doctoral studies	0.6389457	0.14	0.0624542	0.71
Occupational status of the household head, omitted category is wage earner				
Patron	0.1154808	0.16	-0.070168	0.35
Self-employed in non-agricultural activities	0.0214165	0.38	0.008113	0.72
Member in a non-agriculture coop	0.1985292	0.28	0.1575916	0.50
Self-employed in agricultural activities	**-0.041645**	0.04	**-0.102833**	0.00
Member in an agriculture coop	-0.003058	0.99	0.0918494	0.63
Unemployed	-0.013193	0.57	0.0106291	0.69
Pensioner	0.0285006	0.10	0.0218476	0.16
Pupil	**-0.285331**	0.02	-0.417898	0.21
Student	**-0.321905**	0.00	0.0065028	0.94
Housewife	-0.047966	0.38	-0.080185	0.17

Dependent (old person, pre-school child, handicapped person, etc.)	-0.10111	0.08	0.0011414	0.98
The age of the household head, omitted category is less than 30 years				
between 30 and 39	**0.0666624**	0.02	0.0360162	0.19
between 40 and 49	0.0280752	0.33	**0.0540383**	0.05
between 50 and 59	0.021192	0.47	**0.0856898**	0.00
over 60	-0.002463	0.93	**0.0580932**	0.03
Number of household members, omitted category is one member				
2 members	**0.0548548**	0.00	**0.0656865**	0.00
3 members	0.0371104	0.06	**0.0478313**	0.01
4 members	0.0289203	0.24	**0.0553757**	0.02
5 members	0.0488784	0.15	0.051412	0.10
6 members	0.0626092	0.19	-0.023567	0.58
7 members	-0.026001	0.73	-0.085232	0.17
Number of children, omitted category is no child				
1 child	**0.1311985**	0.00	**0.1012279**	0.00
2 children	**0.1701286**	0.00	**0.1261402**	0.00
3 children	**0.2670834**	0.00	**0.1018566**	0.02
4 children	0.1573811	0.08	0.0916415	0.19
5 children	**0.2424217**	0.04	0.1959654	0.09
County, omitted category is Alba				
Arad	0.0577438	0.148	0.0130593	0.73
Arges	**0.1013149**	0.011	**0.0911093**	0.02
Bacau	**0.1177945**	0.003	**0.1779014**	0.00
Bihor	**0.1334746**	0	**0.1562161**	0.00
Bistrita Nasaud	**0.1895041**	0	**0.1270221**	0.00
Botosani	**-0.126441**	0.002	-0.055566	0.13
Brasov	**0.240077**	0	**0.3081753**	0.00
Braila	**0.2355008**	0	**0.2477146**	0.00
Buzau	**0.2434773**	0	**0.2067226**	0.00
Caras-Severin	**0.1817836**	0	**0.1641759**	0.00
Cluj	0.0215582	0.564	**0.1486317**	0.00
Constanta	0.0552041	0.158	**0.0680111**	0.06
Covasna	0.0891715	0.048	**0.0999097**	0.02
Dambovita	**0.1957554**	0	**0.1717504**	0.00
Dolj	0.0170813	0.651	0.0354142	0.31
Galati	**-0.08699**	0.032	**-0.112968**	0.00
Gorj	**-0.09561**	0.029	-0.067236	0.09
Harghita	0.0732631	0.096	**0.0890933**	0.03
Hunedoara	**0.2863026**	0	**0.2755097**	0.00
Ialomita	**0.1455479**	0.001	**0.1543747**	0.00
Iasi	**0.1896386**	0	**0.1838793**	0.00
Ilfov	**0.3352543**	0	**0.3877576**	0.00
Maramures	0.0544874	0.193	0.0458566	0.24
Mehedinti	**-0.349624**	0	**-0.27044**	0.00
Mures	-0.009335	0.81	**0.1114253**	0.00
Neamt	0.0534392	0.198	0.0523792	0.16
Olt	**-0.159189**	0	**-0.161465**	0.00
Prahova	**0.3026486**	0	**0.296984**	0.00

Satu Mare	**-0.135117**	0.001	**-0.128185**	0.00
Salaj	0.0099932	0.826	0.0534873	0.21
Sibiu	0.0396855	0.32	**0.1447894**	0.00
Suceava	**0.2711369**	0	**0.297357**	0.00
Teleorman	**-0.15262**	0	**-0.195329**	0.00
Timis	**0.1567613**	0	**0.111286**	0.00
Tulcea	0.0487451	0.297	0.0325151	0.46
Vaslui	0.0043093	0.918	**0.1262921**	0.00
Valcea	**-0.260136**	0	**-0.202837**	0.00
Vrancea	-0.043002	0.305	-0.041975	0.28
Bucharest, s1	**0.1312925**	0.017	**0.1101229**	0.03
Bucharest, s2	**0.1887638**	0	**0.2146962**	0.00
Bucharest, s3	**0.160922**	0.001	0.0534364	0.24
Bucharest, s4	**0.2468093**	0	**0.2356455**	0.00
Bucharest, s4	**0.2358195**	0	**0.2455388**	0.00
Bucharest, s6	**0.2034264**	0	**0.1739992**	0.00
Calarasi	0.0459015	0.29	**0.0855209**	0.03
Giurgiu	**0.1347938**	0.002	**0.1173276**	0.01
Constant	**1.075336**	0	**1.653595**	0.00

Table B2. The estimation regression of the TBI measure of diversity

TBI	First quarter		Third quarter	
Number of obs	7808		7703	
F(111, 7704)	47.7		43	
Prob > F	0		0	
R-squared	0.4076		0.375	
Adj R-squared	0.399		0.3663	
Root MSE	0.46941		0.49867	
	Coef	**Prob**	**Coef**	**Prob**
Logarithm of income	**0.234934**	0.00	**0.177076**	0.00
Second month of the quarter	**0.081059**	0.00	-0.01609	0.25
Third month of the quarter	**0.049938**	0.00	**-0.03105**	0.03
Female	**0.068747**	0.00	**0.059661**	0.00
Urban household	-0.15106	0.54	0.061493	0.73
Education level of the rural household head, omitted category is no education				
Primary school	-0.06234	0.40	**-0.1459**	0.03
Secondary school	-0.05021	0.50	-0.10929	0.11
Vocational education	-0.03973	0.60	-0.07686	0.27
First two years of high school	-0.09088	0.30	-0.04797	0.57
High school	0.039272	0.61	-0.01239	0.87
Post high school schooling	0.008172	0.93	-0.00077	0.99
Short term university degree	0.005787	0.96	0.005808	0.96
University degree	0.156606	0.11	-0.0088	0.93
Doctoral studies	-0.12009	0.80	(dropped)	
Education level of the urban households, omitted category is no education				
Primary school	0.475731	0.06	0.312615	0.09
Secondary school	**0.53855**	0.03	**0.365309**	0.05
Vocational education	**0.573263**	0.02	**0.393096**	0.03
First two years of high school	**0.539452**	0.04	0.351024	0.08
High school	**0.497585**	0.05	**0.363892**	0.05
Post high school schooling	**0.516825**	0.04	0.312697	0.11
Short term university degree	0.494392	0.07	0.386228	0.07
University degree	0.385081	0.13	0.336982	0.08
Doctoral studies	0.567561	0.32	0.108451	0.67
Occupational status of the household head, omitted category is wage earner				
Patron	0.232364	0.03	-0.01063	0.93
Self-employed in non-agricultural activities	-0.01598	0.61	0.010921	0.75
Member in a non-agriculture coop	0.162339	0.49	0.047104	0.89
Self-employed in agricultural activities	-0.02329	0.37	**-0.11597**	0.00
Member in an agriculture coop	-0.09906	0.77	-0.07418	0.80
Unemployed	-0.0412	0.17	-0.02565	0.52
Pensioner	0.035886	0.11	-0.00929	0.69
Pupil	**-0.38204**	0.02	-0.59915	0.23
Student	**-0.34258**	0.00	0.136427	0.26
Housewife	**-0.14902**	0.03	**-0.18188**	0.04
Dependent (old person, pre-school child, handicapped person, etc.)	-0.04948	0.52	-0.06018	0.42
The age of the household head, omitted category is less than 30 years				

between 30 and 39	0.053812	0.16	0.051509	0.22
between 40 and 49	-0.00039	0.99	0.060224	0.14
between 50 and 59	-0.00828	0.83	**0.104699**	0.01
over 60	-0.04141	0.26	**0.099179**	0.01
Number of household members, omitted category is one member				
2 members	**-0.10233**	0.00	**-0.03313**	0.07
3 members	**-0.22185**	0.00	**-0.14897**	0.00
4 members	**-0.29489**	0.00	**-0.24723**	0.00
5 members	**-0.33321**	0.00	**-0.3394**	0.00
6 members	**-0.40882**	0.00	**-0.37277**	0.00
7 members	**-0.58347**	0.00	**-0.55075**	0.00
Number of children, omitted category is no child				
1 child	**0.146454**	0.00	**0.123154**	0.00
2 children	**0.193642**	0.00	**0.185923**	0.00
3 children	**0.282483**	0.00	**0.156182**	0.01
4 children	**0.338271**	0.00	0.075343	0.47
5 children	**0.388104**	0.01	**0.495866**	0.00
County, omitted category is Alba				
Arad	**0.165858**	0	0.062297	0.27
Arges	0.054178	0.29	-0.05875	0.30
Bacau	**0.332162**	0	**0.306825**	0.00
Bihor	**0.266073**	0	**0.282282**	0.00
Bistrita Nasaud	**0.173195**	0	0.013586	0.83
Botosani	0.083837	0.11	**0.107336**	0.05
Brasov	**0.288045**	0	**0.293513**	0.00
Braila	**0.380932**	0	**0.315654**	0.00
Buzau	**0.321964**	0	**0.189064**	0.00
Caras-Severin	**0.233873**	0	**0.218831**	0.00
Cluj	-0.08739	0.07	**0.09982**	0.05
Constanta	**0.114265**	0.02	-0.00517	0.92
Covasna	0.093961	0.11	0.075734	0.22
Dambovita	**0.147829**	0	0.038129	0.49
Dolj	**0.170133**	0	0.100619	0.06
Galati	**-0.14144**	0.01	**-0.18361**	0.00
Gorj	-0.10872	0.06	**-0.13669**	0.02
Harghita	0.058356	0.31	-0.0499	0.41
Hunedoara	**0.262106**	0	**0.278451**	0.00
Ialomita	**0.24962**	0	**0.190858**	0.00
Iasi	**0.325117**	0	**0.23678**	0.00
Ilfov	**0.478951**	0	**0.425804**	0.00
Maramures	0.096954	0.07	-0.00538	0.93
Mehedinti	**-0.2433**	0	**-0.22271**	0.00
Mures	0.00325	0.95	**0.102945**	0.05
Neamt	**0.16821**	0	**0.116638**	0.04
Olt	-0.05381	0.31	**-0.12932**	0.02
Prahova	**0.303305**	0	**0.276877**	0.00
Satu Mare	**-0.13255**	0.02	**-0.26702**	0.00
Salaj	0.029865	0.61	0.091961	0.15

Sibiu	0.052334	0.31	0.106053	0.06
Suceava	**0.433883**	0	**0.364577**	0.00
Teleorman	**-0.18834**	0	**-0.29055**	0.00
Timis	0.081765	0.09	-0.00237	0.96
Tulcea	**0.135762**	0.03	0.011024	0.87
Vaslui	0.086875	0.11	**0.123401**	0.04
Valcea	**-0.3434**	0	**-0.32846**	0.00
Vrancea	0.03135	0.56	-0.02265	0.70
Bucharest, s1	**0.220799**	0	0.105575	0.16
Bucharest, s2	**0.243482**	0	**0.209337**	0.00
Bucharest, s3	**0.237548**	0	0.061155	0.37
Bucharest, s4	**0.354457**	0	**0.273891**	0.00
Bucharest, s4	**0.417674**	0	**0.318353**	0.00
Bucharest, s6	**0.383846**	0	**0.187436**	0.00
Calarasi	-0.06042	0.28	-0.01855	0.76
Giurgiu	**0.15741**	0.01	0.046455	0.46
Constant	**0.307566**	0.01	**0.729125**	0.00

Food security and household consumption patterns in Slovakia

Version, November 2014

Marian Rizov[a], Andrej Cupak[b], Jan Pokrivcak[b]

[a]*Middlesex University Business School, London*

[b]*Slovak University of Agriculture, Nitra*

Abstract

We investigate the food security situation of Slovak households in terms of both access to food and quality of the diet consumed by estimating food demand system and diet diversity demand models using household budget survey data over the period 2004-2010. In most samples demand for meat and fish and fruits and vegetables is expenditure and own-price elastic. On average all five food groups investigated are found to be normal goods. Rural and low-income households appear more expenditure and price sensitive compared to the urban and high-income ones. Results from quantile regressions indicate that income has a positive while uncertainty has a negatively effect on the diversity of the diet as the effects are stronger in more vulnerable, low income and rural consumer subsamples. Overall the food security situation in Slovakia appears to have improved over time, since the country's EU accession.

Key words: Food security, demand, QUAIDS, elasticity, diet diversity, Slovakia

JEL codes: D12, I12, O52, Q18

1.Introduction

Food security is an important dimension of household well-being. Therefore, 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 household 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 et al., 1996; 1997 for the UK; Moro and Sckokai, 2000 for Italy; Abdulai, 2002 for Switzerland). However, food demand responses in the middle-income former socialist countries, now new member states of the European Union (EU), have not been widely studied with micro data.[12] As under-nutrition and malnutrition exist to a considerable degree in both developed countries and developing and transition countries a study of the food security situation in the EU new member states (NMS) is timely.[13]

Food supply and demand in Europe have been importantly influenced by the Common Agricultural Policy (CAP), which is driven by the EU's commitment to support long-term food supply and meet the European and growing world food demand (European Commission, 2010). As a result of CAP 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 NMS, food expenditure in the EU was between 10% and 35% of total household consumption budget, with the smallest shares in the EU-15 and the largest in the NMS (EEA, 2005). Consequently, the price index for food in the EU rose by almost 20% between 2005 and 2012 (Eurostat, 2012). Rising food prices create serious difficulties, especially for vulnerable, low-income households that spend a substantial proportion of their income on food.

[12] Exceptions are studies by Janda et al. (2009) who estimate a complete demand system using Czech household budget survey data and Moon et al. (2002) who study the demand for food variety in Bulgaria; there are also a few partial demand analysis on selected food groups (e.g., Hupkova et al., 2009 and Zetkova and Hoskova, 2009 for Slovakia; Szigeti and Podruzsik, 2011 for Hungary).

[13] 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 et al., 2013). In the NMS malnutrition and general poverty is the highest; for instance, in 2011, poverty rate ranged between20% in Slovakia and 40% in Romania as poverty rates considerably differ between urban and rural areas and across income groups.

Because a large number of vulnerable households are located in the NMSs, this paper aims at shedding light on the food security situation of households in Slovakia, a middle-income east European NMS with well performing economy, and the lowest income inequality in the EU (Eurostat, 2013); thus findings from Slovakia can be considered a upper bound of the indicators for the food security situation in the NMS. Documenting and understanding food security outcomes is useful for several reasons: to identify the food-insecure, characterize the nature of their insecurity (seasonal versus chronic), monitor changes in their circumstances, and assess the impact of potential interventions. According to USAID (1992) there are two main dimensions to the definition of food security: access (conditional on availability) and utilization (whether a population will be able to derive sufficient and balanced nutrition during a given period).

As a first stage of our analytical framework we follow Banks et al. (1997) and employ the Quadratic Almost Ideal Demand System (QUAIDS) augmented with demographic and other controls to examine the household food demand patterns, and thus availability and access to food, across income groups and types of region. An important 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 are commonly the case when analysing aggregate commodity food demand system at household level. The fact that we use 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. Furthermore, as a second stage of our framework we analyse household diet diversity demand functions, which provide information on food utilisation. We apply both OLS and quantile regressions, thus capturing the heterogeneity in behaviour across subsamples.

Our analysis of Slovak household demand patterns suggests that food security situation has improved since Slovakia's EU accession. However, food commodities important for healthy diet such as meat and fish and fruits and vegetables remain expenditure and own-price elastic. In terms of diet diversity, economic uncertainty importantly impacts, especially, low income households. 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. The rest of the paper consists of methodology, data, and results sections and a conclusion.

2. Methodology

Within the food security analysis framework, there is an association between food access and diet diversity at household level. The magnitude of the association increases with improving the food access; for example, Jackson (1984) shows that diet diversity measured as the number of food commodities consumed increase with income and expenditure and Hoddinott and Johannes (2002) demonstrate a link between the mean level of caloric availability and diet diversity. Therefore, our analysis of food security proceeds in two stages; first, we analyse access to food by the means of a demand system (QUAIDS) and second, we set up a framework for diet diversity analysis.[14] Taken together the two stages generate results capable of qualifying the food security situation of Slovak households in terms of both access to food and quality of diet.

2.1 Quadratic Almost Ideal Demand System

Several demand systems have been popular 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 et al., 1975), and the Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980). LES is unable to describe demand behaviour consistent with the Engel's law where 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 et al. (1996; 1997) show that the correct approximation of Engel curves requires a higher order logarithmic

[14] Nutrition science experts argue that as global food supply system is facing serious challenges from economic crises (and climate change), there are increasing constraints to the nutritional well-being of the populations, especially the poor. To cope, vulnerable populations prioritise consumption of calorie-rich but nutrient-poor food. Consequently, dietary quality and eventually quantity decline, increasing micronutrient malnutrition (or hidden hunger) and exacerbating pre-existing vulnerabilities that lead to poorer health, lower incomes, and reduced physical and intellectual capabilities (e.g., Bloem et al., 2010). In this context diet diversity is shown to be an important indicator of quality the diet (Drescher et al., 2007; Brinkman et al., 2010; Thorne-Lyman et al., 2010; Iannotti et al., 2012).

term of expenditure and propose QUAIDS which nests AIDS and also satisfies the restrictions of demand theory.[15] QUAIDS thus allows as income increases a good to change from normal to inferior one. Household preferences follow the indirect utility function:

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

where the term [ln*m* - ln*a*(p)]/*b*(p) is the indirect utility function of the PIGLOG[16] demand system, *m* is household income, and a(p), *b*(p)and *λ*(p)are 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)arehomogenous of degree zero in p. The price index ln*a*(p)has the usual translog form

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

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

$$b(\mathrm{p}) = \prod_i \; p_i^{\beta_i},$$

and λ(*p*) is defined as

$$\lambda(\mathrm{p}) = \sum_i \; \lambda_i \ln p_i, \text{ where } \sum_i \; \lambda_\mathrm{i} = 0.$$

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

$$\omega_i = \alpha_i + \sum_j \; \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(\mathrm{p})}\right] + \frac{\lambda_i}{b(\mathrm{p})}\left\{\ln\left[\frac{m}{a(\mathrm{p})}\right]\right\}^2. \qquad (2)$$

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*), $\sum_j \; \gamma_{ij} = 0 \;\; \forall j$. And 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.

[15] 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 aggregate commodity group Engel curves, and in demand analysis generally.

[16] 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).

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 (2). However, we follow the scaling approach introduced 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 $e(\mathrm{p}, \mathrm{z}, u)$, underlying the budget shares is written as the expenditure function of a reference household $e^R(\mathrm{p}, u)$, scaled by the function $m_0(\mathrm{p}, \mathrm{z}, u) = \bar{m}_0(\mathrm{z})\varphi(\mathrm{p}, \mathrm{z}, u)$ 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, ($\bar{m}_0(\mathrm{z})$) measures the increase in a household's expenditures as a function of z, not controlling for any differences in consumption patterns. The second term ($\varphi(\mathrm{p}, \mathrm{z}, u)$)controls for differences in relative prices and the actual goods consumed. For example, 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 where in the first stage, the allocation of total expenditure between food and other commodity groups (housing, transport, entertainment, etc.) is decided.[17] In the second stage, the food expenditure is allocated among different food groups. 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 (2) augmented with demographic effects becomes:

$$\omega_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + (\beta_i + \eta'_i \mathrm{z}) \ln\left[\frac{m}{\bar{m}_0(\mathrm{z})a(\mathrm{p})}\right] + \frac{\lambda_i}{b(\mathrm{p})c(\mathrm{p},\mathrm{z})}\left\{\ln\left[\frac{m}{\bar{m}_0(\mathrm{z})a(\mathrm{p})}\right]\right\}^2, \qquad (3)$$

where $c(\mathrm{p}, \mathrm{z}) = \prod_j p_j^{\eta'_j z}$, η'_jrepresents the jth column of parameter matrix η. The adding-up condition requires that $\sum_j \eta_{sj} = 0 \ \forall s$.

[17] The assumption about separability of the food expenditure decision from other expenditure choices is motivated by Maslow's (1943) hierarchy of needs theory. Jackson (1984) studies in detail the implications of hierarchy of needs (wants) and purchases for demand analysis. Stewart and Harris (2005) is an example ofempirical application of the theory to the analysis of diet diversity.

Following Banks et al. (1997) the expenditure and price elasticities are obtained by partially differentiating equation (3) with respect to ln$m$ and lnp_j respectively:

$$\mu_i \equiv \frac{\partial \omega_i}{\partial \ln m} = \beta_i + \eta'_i \mathrm{z} + \frac{2\lambda_i}{b(\mathrm{p})c(\mathrm{p,z})} \ln\left[\frac{m}{\bar{m}_0(\mathrm{z})a(\mathrm{p})}\right] \text{ and} \tag{4}$$

$$\mu_{ij} \equiv \frac{\partial \omega_i}{\partial \ln p_j} = \gamma_{ij} - \mu_i\left(\alpha_j + \sum_k \gamma_{jk} \ln p_k\right) - \frac{\lambda_i(\beta_j + \eta'_j \mathrm{z})}{b(\mathrm{p})c(\mathrm{p,z})}\left\{\ln\left[\frac{m}{\bar{m}_0(\mathrm{z})a(\mathrm{p})}\right]\right\}^2. \tag{5}$$

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 the compensated price elasticities: $e_{ij}^c = e_{ij}^u + e_i\omega_j$.

.2 Diet Diversity under uncertainty

It is established in the literature that as incomes increase consumers tend to increase not only the quantity but also the number of goods consumed (Theil and Finke, 1983; Jackson, 1984). Following Jackson (1984), we specify a (expected) utility function $u(q)$ defined for any vector of quantities q in some food commodity set N

$$u(q) = u(q_{1,}q_{2,} \dots, q_n). \tag{6}$$

The utility function is maximised subject to budget constraint, $\sum p_i\, q_{i,} = m$ and non-negativity constraints $q_i \geq 0$ where p_i is the price for the i^{th}food commodity and m is income. The following Kuhn-Tucker conditions should be satisfied

$$\frac{\partial u}{\partial q_i} - \lambda p_i = 0 \; if \; i \in S\,, \;\; q_i > 0 \text{ and} \tag{7}$$

$$\frac{\partial u}{\partial q_i} - \lambda p_i < 0 \; if \; i \in \bar{S}\,, \;\; q_i = 0, \tag{8}$$

where λ is the Lagrangian multiplier, S is the set of commodities purchased, and $\bar{S}$is the set of commodities not purchased; thus, in cardinality notation $|N| = |S| + |\bar{S}|$. The above conditions lead to the following (Marshalian) food demand function

$$q_i = q_i(p', m), \tag{9}$$

where p' is a vector of food prices.

An important result of Jackson's (1984) analysis is that the number of food commodities in set S is also a function of food prices and income (food expenditures). Let $s_h = |S|$denotes the number of different food commodities consumed by household h which is a measure of diet diversity (D) at household level (e.g., Jackson, 1984; Stewart and Harris, 2005). Then $D_h = s_h$ is a function of food prices and food expenditures, i.e.

$$D_h = s_h = f_h(p', m_h), \tag{10}$$

where m_h is total household disposable income and $f_h$is household specific diet diversity function which accounts for the household characteristics and circumstances affecting diet choices.

The count of food items consumed is one measure of diet diversity but there are alternative ways of measuring diversity. A measure, which has become popular in the diet diversity economics literature (e.g., Thiele and Weiss, 2003; Drescher and Goddard, 2011; Hertzfeld et al., 2014) is the Berry index (Berry, 1971), $BI = 1 - \sum \omega_i^2$, where ω_i is the budget share of the i^{th}(disaggregate) food commodity specified in a manner similar to eq. (3).[18] It thus follows that this measure of diet diversity is also a function of food prices, income (expenditure), and household characteristics

$$D_h = BI_h = f_h(p', m_h). \tag{11}$$

Given the focus of the paper on food security, the analysis of diet diversity needs to be linked to decision making under uncertainty. Looking into implications of uncertainty for the dietary choices and quality of diet of risk-averse households is consistent with the demand analysis in the previous section. There the estimated expenditure and price elasticities measure the sensitivity of households to market shocks and thus provide insight into the access of households to food in uncertain market environment. Therefore, it is only logical to also ask what the impact of uncertainty on household diet diversity choices would be.

Our starting point in answering the question is the neoclassical economics framework for decision making under uncertainty where concavity of the expected utility function is equivalent to consumer's (household's) risk aversion. The more concave the expected utility function the more risk averse the consumer - a property captured by the well-known Arrow-Pratt measure of absolute risk aversion:

$$r(q) = -\frac{u''(q)}{u'(q)}, \tag{12}$$

where $u'(q)$ and $u''(q)$ are the first and second derivative respectively of the utility function. The interpretation of $r(q)$ is that a consumeris more risk averse the larger the value of $r(q)$is and that she/he is less willing to accept a (small) gamble on the amount of her/his consumption. For example, if consumer has monetary income M (consumption is an increasing function of income, i.e., q=q(M)) and there is some probability π that she/he will lose an amount of income

[18] The Berry index formulation implies that diversity is higher when more foods are eaten in equal (quantity or expenditure) proportions such that a higher value of the index indicates a more balanced diet. The Berry index is also known as the Simpson index (Stewart and Harris, 2005) and is closely related to the well-known Hirschman-Herfindahl index (Theil and Finke, 1983).

L in the future, a risk averse consumer will want to purchase insurance in order to avoid the (potential) loss, thus forgoing some consumption at present.[19] It is established in the literature that absolute risk aversion decreases with income (wealth), i.e., as consumers become wealthier they are willing to accept more (monetary) gambles (Pratt, 1964).

Furthermore, the Pratt's theorem formulates the conditions under which one consumer can be said to be more risk averse than another for all levels of wealth. Thus, if consumer A is more risk averse than consumer B then A would be willing to pay more to avoid a given risk than B would. Each consumer's risk premium is defined by the condition that the expected utility of a risky income with no insurance should be equal to the utility of the expected income minus the risk (insurance) premium. For small variation in income Pratt (1964) has shown that the risk premium (rp) is a function of the consumer's degree of absolute risk aversion, $r(q)$ and the variance of income. Then it can be said that consumer A is (globally) more risk averse than consumer B if $rp_A > rp_B$ for all levels of wealth and variation in income.

Therefore, taking uncertainty into account the household's diet diversity choice can be modelled as

$$D_h = f_h(p', m_h, rp_h). \tag{13}$$

We empirically implement the household diet diversity demand function by specifying an estimating equation where household diet diversity (D) is explained by household risk premium (rp), income, prices, and household demographic characteristics (household size and composition, education level of household head, etc.); as controls we also add year, season, and region dummy variable sets. The household risk premium is not directly observable in our data and therefore we rely on our (compensated price) elasticity estimates at household level which we obtain from the QUAIDS analysis; we aggregate the estimated own price elasticities into a single measure by the means of factor analysis (see Appendix 1 for details). Considering that household level elasticities capture the sensitivity of individual households to price and income shocks they appear to be a good proxy for household risk premium capturing both the household risk aversion and the variance of expected income faced by each household.[20]

[19] Under uncertainty a risk-averse consumer will reduce spending on food and thus *ceteris paribus* reduce consumption. Following Jackson (1984) the reduction would occur at both the intensive and extensive margins, thus resulting in reduction in diet diversity.

[20] In a recent paper Liu et al. (2014) study diet diversity in China and emphasise the importance of access cost for consuming more diverse diet. Considering their theoretical framework the risk premium in our analysis can be seen as confining effects of uncertainty with transaction cost effects even though our theoretical foundation is consumer optimal behaviour under uncertainty.

3. Data

We apply our methodology to the 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, marital status. Each of our annual samples contains approximately between 4500 and 6000 households, however, the samples do not form a (real) panelas surveyed households are randomly selected from the population each round.

The information on food consumption is collected on a one-month recall basis in four waves, one for each of the four seasons in the year. We aggregate food commodities consumed into five food groups: cereals, meat and fish, dairy products and eggs, fruits and vegetables, and other food products. The other food products group comprises of food commodities such as fats, oils, condiments, and sugar. Appendix 2 provides details on the aggregation of food commodities into groups. 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 simpler.

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). 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 (seasonality), 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 wherequality adjusted prices are constant within narrowly defined segments and it avoids problems of estimated negative household prices.[21]

For our diet diversity analysis we compute two diet diversity measures as discussed in the methodology section using disaggregate food commodity consumption data. It is useful to consider more than one measure of variety, such as the count measure (CM)and the transformed Berry index (TBI).[22] An increase in CM would indicate that a household introduces new food commodities to its diet. However, TBI would provide information whether the new commodities and, possibly, other commodities are purchased in sufficiently larger amounts to affect the distribution of consumption shares. Van Trijp and Steenkamp (1990) provide an empirical comparison of methods for modelling diet diversity, and find only a weak correlation between measures similar to CMand TBI thus confirming our strategy to use the two measures.

[21] 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.

[22]Since the values of the Berry index (BI) lie in the interval between 0 and 1, the assumption of normality may not be fulfilled. To overcome this problem, a logistic transformation can be used (e.g., Greene, 1997) so that standard OLS regression can be estimated. The Transformed Berry Index (TBI) is $TBI = \ln\left[\frac{BI}{(1-BI)}\right]$.

The evolution over time and correlation analyses of our two diet diversity measures, CM and TBI are presented in Appendix 3.

In empirical studies, it is important to consider the time horizon over which diet diversity is measured. For ease of understanding, diet recommendations are often expressed in terms of a person's daily diet. However, references to daily intakes do not reflect the true goals of dietary recommendations which "apply to diets consumed over a reasonable period of time" (e.g., Shaw et al., 1996, p. 1). Moon et al. (2002) find that consumer preferences for diet diversity exhibit different patterns depending on the length of time allowed for consumption. Estimated correlation coefficients indicate that daily diet diversity deviates from that measured weekly and monthly as later two time dimensions appear to exhibit a similar pattern. Stewart and Harris (2005) adopt even one year time period in their analysis of fruit and vegetable diet diversity analysis. Therefore, our diet diversity measurescomputed on the monthly recall basis seem appropriate.

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 real incomes and prices in Slovakia (in Appendix 4 we present the evolution of the aggregate commodity group prices). Incomes almost doubled while the prices of cereals and diary increased more than twofold with prices of meat and fish, fruits and vegetables, and other food products increased more modestly which is reflected in the modest increase in total food expenditure. 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 and the improvement in the diet diversity measures over time seems to indicate a shift of Slovak consumers towards a healthier diet which is an indicator of improved food security.

- Table 1 here -

In terms of food security there is further evidence of improvement indicating the potentially important driving force – the rise of incomes. Figure 1 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 (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 is similar but the

levels are quite different – the drop is from 17% to 15%, which is comparable with EU-15 levels. There are differences between rural (21% in 2010) and urban (20% in 2010) household food expenditure shares as 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. There is also a relative homogeneity in terms of composition of the diet when comparing rural and urban subsample, and interestingly as well as across income-based subsample (see Figure 2).

- Figure 1 here -

- Figure 2 here -

4. Estimation and results

Our methodology underlines a two stage approach to the analysis of food security situation of Slovak households. To comprehensively analyse and understand the factors affecting both the access to food and the quality (diversity) of the diet we first estimate the price and income elasticities at household level which characterise the sensitivity of households to market shocks and thus the degree of households' constraints to access food. Second, we estimate diet diversity demand functions where key variables are household income and a measure of household's risk premium both describing the degree of households' constraints to consume diverse and healthy diet.

4.1 Food demand

We start our demand analysis by first estimating the Engel curves for the five food groups for the whole sample and by rural and urban subsamples using a non-parametric kernel regression as in Banks et al. (1997); graphic presentation of the Engel curves can be found in Appendix 5. 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 income and the expenditure share of meat and fish suggesting that commodities from this food group are perceived as luxury. However, the patterns of the Engel curves for dairy products and for fruits and vegetables appear non-linear with inverted-U shape. The Engel curve for the other food products group is also highly non-linear. This preliminary analysis suggests that our choice of QUAIDS for estimating food demand behaviour in Slovakia is justified.

We estimate QUAIDS with Stata software using the code developed by Poi (2008; 2012). Parameter estimates are obtained for the full sample and for subsamples of rural and urban households and of low-income and high-income households by round. In the estimated

samples large majority of own and cross-price parameters and linear expenditure parameters 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 suggest that meat and fish, and for the rural households in early rounds also fruits and vegetables, are luxury. 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. The QUAIDS estimated parameters are reported in Appendix 6.[23]

Table 2 reports compensated and uncompensated price elasticities and expenditure elasticities calculated from the QUAIDS parameters. These elasticieties are averages over the seven rounds (2004-2010) used. The expenditure elasticities of all food groups are positive as the largest in magnitude are the elasticities of fruits and vegetables (1.44) and meat and fish (1.22). 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. 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 here -

The fact that the signs of several (thirteen 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 3 we present the evolution of the compensated own-price elasticities for the five food groups over time. The general impression from Figure 3 is that since 2004 the own-price elasticities have declined for all food commodity groups. This observation suggests that Slovak

[23] 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 Chi-square tests rejected the restricted models in all samples. Similar tests confirm the validity of the demographic controls used. The test results are reported in Appendix 7.

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 adopted the Euro currency and experienced effects from the global economic crisis.

- Figure 3 here -

Our results from the analysis by subsamples of households further demonstrate the substantial heterogeneity of demand responses. The compensated and uncompensated price elasticities and expenditure elasticities computed from the QUAIDS parameters for rural and urban and low-income and high-income households are reported in Appendix 8. Generally, we can observe higher sensitivity and volatility of responses in the rural and low-income household subsamples throughout the period, since the Slovak EU accession. There is a substantial hike in the price sensitivity of meat and fish 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 in the post-Euro period while urban household experienced similar effects on their demand for dairy products, fruits and vegetables and other food products.

- Figure 4 here -

To sum up, 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 4. This suggests reduction in the relative income constraints on food consumption and diet composition choices. Following this logic one could argue that the quality of the diet has been improving over time with the convergence in the income elasticity magnitudes. We analyse the quality of the diet measured by diet diversity next.

4.2 Diet diversity

We estimate empirical specifications of the diet diversity function, Equation (13) for each of the two diversity measures - food count (CM) and transformed Berry index (TBI) - by the means of both OLS and quantile regressions (Koenker and Bassett, 1978; Koenker and Hallok, 2000).[24] The advantage of the quantile regression (QR) is that unlike the standard OLS which estimates the average relationship between the outcome variable and a set of explanatory variables based on the conditional mean function, QR describes the relationship at different

[24] Only a few studies have applied quantile regressions for diet diversity analysis; for example Variyam et al. (2002) estimate demand for macronutriens in the USA and Drescher and Goddar (2011) analyse food diversity in Canada.

points of the outcome variabledistribution. As it is likely that the effects of independent variables are different at different points of the diet diversity distribution the QR analysis is appropriate.[25] Furthermore, QR is more robust to non-normalerrors and outliers than OLS.

The estimation results from OLS and QR (for three quantiles – 0.1, 0.5, and 0.9) for both CM and TBI specifications are reported in Table 3 and show relationships consistent with theory. We find a significant positive effect of income on diet diversity as the OLS and QR median estimates are similar. Income has a stronger effect on diet diversity at lower quantiles. Following our theoretically motivated specification food prices are also included (as controls) and they indeed have significant effect on diet diversity in several cases however the directions of the effects is difficult to interpret as discussed by Thiele and Weiss (2003); therefore we do not discuss the price coefficients further.

- Table 3 here -

The variable of key interest according to our theoretical framework is the measure of the impact of uncertainty – the household's risk premium, *rp*. We find that the effects of *rp*are always significant negative as predicted by theory. The effects do not differ substantially between OLS and QR median estimates, while across quantiles the effects monotonically decline along the diet diversity distribution for the CM specification and increase for the TBI specification. The later finding is interesting and suggests that at the lower end of the diet diversity distribution households are more likely to adjust consumption at the extensive margin (reduce number of commodities consumed) rather than at the intensive margin (rebalance quantities consumed); the opposite behaviour is exhibit by households at the higher end of the diet diversity distribution.

Among demographic characteristics likely to influence household diet diversity, we considered the education level of the household head. The estimated effect is generally significant positive for the TBI specification as the OLS and QR median estimates are similar and the effect is stronger at higher quantiles of the diet diversity distribution. In the CM specification education does not show significant effect. Blisard et al. (2003) argue that better-educated consumers may be more aware of the importance of healthy eating and therefore spend

[25]Quantile regression can be specified as $Q_\theta(D|X) = X'\beta_\theta$, where D denotes the food diversity measure as a function of a set of independent variables, X within the θth quantile of the outcome variable D. The special feature of the quantile regression approach is that the set of coefficients of the independent variables,β_θ can differ across quantiles. The estimatorβ_θ of the quantile regression is obtained by minimizing the objective function $Q(\beta_\theta) = \sum_{i:y_i \geq x_i'\beta}^{N} \theta|y_i - x_i'\beta_\theta| + \sum_{i:y_i < x_i'\beta}^{N} (1-\theta)|y_i - x_i'\beta_\theta|$via Simplex method. We estimate our quantile regressions using Stata's qreg and sqreg commands and report bootsraped standard errors.

money on more diverse (balanced) diet. Moon et al. (2002) found empirical evidence to support the argument. However, other studies have not found a strong relationship between education and diet diversity (e.g., Thiele and Weiss, 2003).

Another demographic variable – the size of the household – we find to have opposite effects on diet diversity depending on the measure. In the TBI specification the effect is significant negative, while it is significant positive in the CM specification. Thiele and Weiss (2003) argue that reconciling the effects of household size on diet diversity, measured by count and share-based measures, is complicated as the two measures reveal different aspects of a consumption pattern. Kinsey (1990) notes that larger households, with three or more children, are considered a prime market for the basic food ingredients, traditionally provided by (cheap) grocery stores. For (sufficiently) small households, Lee and Brown (1989) find that an increase in household size will expand the variety of a household's purchases. However, Lee and Brown (1989) also find that the effect of introducing an additional member to a household will be smaller as the total size of the household increases, and would even become negative in larger households. A possible explanation is that introducing an additional person to a large family would increase the difficulty of coordination in preparing foods acceptable to all family members, and thus lead to more simplified, uniform diet that fits to a variety of heterogeneous tastes in a large family. The estimation results for two additional variables characterising household demographics – dummies for single households and households with children are consistent with our previous results, on household size, as generally single households consume less diverse diet while the presence of children leads to increase in diet diversity measured by TBI; the later effect is the strongest at lower quantiles of the distribution.

In all estimated specifications we have included controls for time (year dummy variable set) and location (regional dummy variable set) which show significant effects. The main results are that diet diversity throughout the period of analysis is higher compared to the reference 2004 year and that relative to the capital city Bratislava diet diversity (measured by TBI) is lower in other regions, except Trencin and Zilina. The control for seasonality (a set of four dummies) also shows significant effects as diet diversity generally appears lower during the winter compared to other three seasons, thus suggesting that consumers may be constraint in accessing some food commodities during the winter months. In terms of differences between rural and urban locations, there is a pronounced divide in diet diversity as urban households appear to

consume a more diverse diet. This result is robust to diversity measure used and estimation technique.[26]

- Figures 5a and 5b here -

Figures 5a and 5b illustrate how the effects of income, risk premium, education, household size and location (rural vs. urban) on diet diversity vary over quantiles, and how the magnitude of the effects at various quantiles differ considerably from the OLS estimate. An exception is the effect of education which is relatively uniform along the diet diversity distribution. It is noteworthy that the intercept is quite large and increasing along the distribution showing that households in the higher quantiles*ceteris paribus* have stronger preferences for diverse diet.

5. 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 and diet diversity analyses for the new EU member states. We apply a two-stage analytical framework where, in the first stage, we estimate QUAIDS and diet diversity quantile regressions, in the second stage, respectively. The Slovak longitudinal BHS data employed covering seven year period allow us to reveal changes in demand behaviour over time as well as cast light on 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 16% for high-income households – a level comparable with demand patterns in the richer EU-15. The ratio is still quite high though, at about 26% for the low-income households.

Our first stage results show that Slovak households are price and income responsive as food expenditure patterns vary across types of household. All five food groups analysed have positive expenditure elasticities as their magnitudes suggest that cereals, dairy products and other food products are necessities while fruit and vegetables and meat and fish are luxuries for some groups of households. In line with demand theory, all own price elasticities are negative while a significant number 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. Furthermore, the results from subsamples by household type reveal that the demand sensitivity of low-income and rural households is higher compared with high-income, urban households.

[26] In Appendix 9 we report Wald test results for the coefficient differences across quantiles, for both CM and TBI specifications. One can observe that large majority of key variables have differential effects across quantiles.

In the second stage of our analysis we find that the diet diversity, measured by both food item count and Berry index, has been increasing since 2004 indicating again improving food security situation of Slovak households. Besides tastes which seem to be very important, income has a strong impact on diet diversity while the risk premium, proxied by an aggregate factor of the compensated price elasticities has a strong negative effect on diet diversity. The household demographic characteristics generally have trivial effects on diet diversity as expected. It is noteworthy that there is a pronounced seasonal pattern with lowest diversity of the household diet during winter months – finding suggesting that there are possible binding supply side constraints during that period. We also find dietary differences between rural and urban locations as well as between the capital city and the rest of the country, with notable exceptions. These later findings are consistent with the supply side constraint hypothesis.

Our findings are generally consistent with studies from other developed countries, where food security does not present a significant challenge. For example, Michalekand Keyzer (1992), Abdulai (2002), and Chern et al. (2003) find that for majority of the population food demand is price and income inelastic and food is perceived as necessity rather than luxury while diet diversity is positively affected by income and certain demographic characteristics (Thiele and Weiss, 2003; Drescher and Goddard, 2011).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. Income-generation oriented policies would also be consistent with our second stage results where income has strong positive effect on diet diversity while the risk premium which is decreasing in income has a negative effect. Hence, in order to improve the household access to food and achieve diverse (and healthy) diet income-generation oriented policies would be appropriate which should also be complemented with policies for rural development and improvement of the food supply chains.

A final point on generalizability of our findings and policy recommendations, considering the fact that Slovakia has been one of the most economically successful NMS during the period of analysis, the food security situation in other east European NMS could be relatively less optimistic. In support of the later conjecture is also the fact that in recent years Slovakia has had one of the lowest levels of inequality in the EU as measured by the Gini coefficient indicating relatively more favourable general welfare conditions while several other NMS such as the Baltic states, Bulgaria, and Romania rank quite high in terms of inequality.

References

Abdulai, A., 2002. Household demand for food in Switzerland: A Quadratic Almost Ideal Demand System. *Swiss Journal of Economics and Statistics* 138(1): 1-18.

Banks, J., Blundel, R.,Lewbel, A.,1996. Tax reform and welfare measurement: Do we need demand system estimation?*Economic Journal*106: 1227-1185.

Banks, J., Blundel, R.,Lewbel, A., 1997.Quadratic Engel curves and consumer demand.*Review of Economics and Statistics*79: 527-539.

Barten, A. P., 1964. Consumer demand functions under conditions of almost additive preferences.*Econometrica* 32(1-2): 1-38.

Berry, C. H., 1971.Corporate growth and diversification.*Journal of Law & Economics* 14: 371-383.

Blaylock, J. and Smallwood, D., 1982. Analysis of income and food expenditure distributions: A flexible approach. *Review of Economics and Statistics* 64: 104-109.

Blisard, N., Variyam, J., Cromartie, J., 2003. *Food Expenditures by U.S. Households: Looking Ahead to 2020*.Agricultural Economics Report No. 821.Washington, DC: U.S. Department of Agriculture, ERS.

Bloem, M.W., Semba, R.D., Kraemer, K., 2010. Castel Gandolfo Workshop: An introduction to the impact of climate change, the economic crisis, and the increase in the food prices on malnutrition. *Journal of Nutrition*, 140: 132S–135S.

Brinkman, H.J., de Pee, S., Sanogo, I., Subran, L., Bloem, M.W.,2010.High food prices and the global financial crisis have reduced access to nutritious food and worsened nutritional status and health. *Journal of Nutrition*, 140: 153S–161S.

Chern, W., Ishibashi, K., Taniguchi, K.,Tokoyama, Y.,2003.Analysis of the food consumption of Japanese households,*FAO Economic and Social Development Paper* 152, Food and Agriculture Organization of the United Nations, Rome.

Christensen, L., Jorgenson, D., Lau, L., 1975. Transcendentallogarithmic utility functions.*American Economic Review* 65(3): 367-383.

Cox, T.,Wohlgenant, M., 1986. Prices and quality effects in cross-sectional demand analysis.*American Journal of Agricultural Economics*, 68(4): 908-919.

Deaton, A., 1989. Quality, quantity, and spatial variation of price.*American Economic Review* 78: 418-430.

Deaton, A., Muellbauer, J., 1980. Analmost ideal demand system.*American Economic Review* 70(3): 312-336.

Drescher, L., Goddard, E., 2011. Heterogeneous demand for food diversity: A quantile regression analysis. GEWISOLA Paper, September,Halle, Germany.

Drescher, L.S., Thiele, S., Mensink, G.B.M., 2007. A new index to measure health food diversity better reflects healthy diet than traditional measures.*Journal of Nutrition* 137: 647-651.

European Commission, 2010.*The CAP towards 2020: Meeting the Food, Natural Resources and Territorial Challenges of the Future.* Brussels.18 November 2010, Brussels.

European Environment Agency (EEA), 2005. *Household Consumption and the Environment*. EEA Report No 11/2005, Copenhagen.

Eurostat, 2012.Food Supply Chain-Price Indices. http://appsso. eurostat.ec.europa.eu/nui/, November 20, 2012.

Eurostat, 2013.Gini coefficient of equivalised disposable income.http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ilc_di12&lang=en, December, 2013.

Greene, W.H., 1997. *Econometric Analysis*, 3rd Edition. Prentice Hall, Englewood Cliffs,NJ.

Herzfeld, T., Huffman,S., Rizov, M., 2014.The dynamics of food, alcohol and cigarette consumption in Russia during transition.*Economics and Human Biology*13: 128-143.

Hoddinott, J. Yohannes, Y., 2002. Dietary diversity as a food security indicator. FCND Discussion Paper No136, IFPRI.

Hupkova, D., Bielik, P.,Turcekova, N., 2009. Structural changes in the beef meat demand in Slovakia and demand elasticity estimation. *Agricultural Economics – Czech* 55(8): 361-367.

Iannotti, L., Robles, M., Pachon, H., Chiarella, C., 2012. Food prices and poverty negatively affect micronutrient intakes in Guatemala. *Journal of Nutrition*, 142: 1568–1576.

Jackson, L.F. (1984). Hierarchic demand and the Engel curve for variety, *Review of Economics and Statistics*, 66: 8–15.

Janda, K., Mikolasek, J., Netuka, M., 2009.The estimation of complete Almost Ideal Demand System from Czech Household Budget Survey data.*IES Working Paper*31/2009, IES FSV, Charles University.

Kinsey, J., 1990. A Geographic Look at Key Economic Figures. Diverse Demographics Drive the Food Industry. *Choices*5(2):22–23.

Koenker, R., Bassett, G., 1978.Regression quantiles.*Econometrica*, 46: 33–50.

Koenker, R.,Hallok, K. F., 2000.Quantile regression.*The Journal of Economic Perspectives* 15(4): 143-156.

Lee, J., Brown M., 1989.Consumer demand for food diversity.*Southern Journal of Agricultural Economics*21:47–53.

Liu, J., Shively, G., Binkley, J., 2014. Access to variety contributes to dietary diversity in China. *Food Policy* 49(1): 323-331.

Maslow, A.H., 1943. A theory of human motivation.*Psychological Review*50(4): 370–396.

Michalek, J.,Keyzer, M., 1992. Estimation of a two-stage LES-AIDS consumer demand system for eight EC countries. *European Review of Agricultural Economics* 19(2): 137-163.

Molina, J., 1994. Food demand in Spain: An application of the almost ideal demand system.*Journal of Agricultural Economics* 45(2): 252-258.

Moon, W., Florkowski, W.J., Beuchat, L.R., Resurreccion, A.V.,Paraskova, P., Jordanov, J.,Chinnan, M.S., 2002. Demand for food variety in an emerging market economy.*Applied Economics*34(5): 573-581.

Moro, D.,Sckokai, P.,2000.Heterogeneous preferences in household food consumption in Italy.*European Review of Agricultural Economics*27(3): 305-323.

Park, J., Holcomb, R., Raper, K.,Capps, O., 1996. A demand systems analysis of food commodities by U.S. households segmented by income.*American Journal of Agricultural Economics* 78(2): 290-300.

Poi, B., 2008. Demand system estimation: Update.*Stata Journal*8(4): 554-556.

Poi, B., 2012.Easy demand-system estimation with QUAIDS.*Stata Journal* 12(3): 433-446

Pollak, R., Wales, T., 1981.Demographic variables in demand analysis.*Econometrica*49(6): 1533-1551.

Pratt, J., 1964.Risk aversion in the small and the large.*Econometrica* 32: 112–36.

Reisch, L., Eberle, U., Lorek, S., 2013. Sustainable food consumption: an overview of contemporary issues and policies. *Sustainability: Science, Practice, & Policy* 9(2): 7-25.

Ray, R., 1983.Measuring the costs of children: An alternative approach.*Journal of Public Economics* 22: 89-102.

Shaw, A., Fulton, L., Davis, C.,Hogbin,M., 1996.*Using the Food Guide Pyramid: A Resource for NutritionEducators*. Washington DC: U.S. Department of Agriculture, Center for Nutrition Policy and Promotion.

Stewart, H., Harris, J.M., 2005. Obstacles to overcome in promoting dietary variety: The case of vegetables. *Review of Agricultural Economics* 27: 21-36.

Stone, R., 1954. Linear Expenditure Systems and demand analysis: An application to the pattern of British demand.*Economic Journal* 64: 511-527.

Szigetii, J.,Podruzsik, S., 2011. How does it work for Hungarian food consumers? A medium-term analysis.*Studies in Agricultural Economics* 113: 33-46.

Theil, H., Finke, R., 1983.The consumer's demand for diversity.*European Economic Review* 23: 395-400.

Thiele, S., Weiss, C.,2003. Consumer demand for food diversity: Evidence for Germany. *Food Policy* 28: 99-115.

Thorne-Lyman, A.L., Valpiani, N., Sun, K., Semba, R.D., Klotz, C.L., Kraemer, K., Akhter, N., de Pee, S., Moench-Pfanner, R., et al.,2010.Household dietary diversity and food expenditures are closely linked in rural Bangladesh, increasing the risk of malnutrition due to the financial crisis. *Journal of Nutrition*140:182–188.

USAID (U.S. Agency for International Development), 1992.*Policy determination 19, Definition of food security*. April. Washington, D.C.

VanTrijp, H.C.M.,Steenkamp, J.E.M., 1990. Aninvestigation into the validity of measures for variation in consumption used in economics and marketing.*European Review of Agricultural Economics*17(1):19–41.

Variyam, J., Blaylock, J., Smallwood, D., 2002. Characterizing the distribution of macronutrient intake among U.S. adults: A quantile regression approach.*American Journal of Agricultural Economics*84(2): 454-466.

Zentkova, I.,Hoskova, E., 2009. The estimation of the Marshallian demand functions for the selected foodstuff groups according to the household income quartiles. *Agricultural Economics-Czech* 55(6): 406-412.

Table 1 Summary statistics of variables used in QUAIDS and diet diversity analyses

		2004		2010	
Variable	Definition	Mean	SD	Mean	SD
foodexp	Total monthly household food expenditure(€)	91.66	47.57	116.95	58.95
income	Net monthly household real income (€)	449.93	317.51	715.74	420.32
foodratio	Ratio of food expenditure and net income	0.24	0.13	0.19	0.12
$p_{cereals}$	Price of cereals (€)	0.81	0.15	2.22	0.22
p_{meat}	Price of meat and fish (€)	2.46	0.28	3.85	0.29
p_{dairy}	Price of dairy products (€)	1.30	0.28	2.78	0.35
p_{fruits}	Price of fruit and vegetables (€)	0.72	0.18	1.06	0.20
p_{other}	Price of other food (€)	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
hh_size	Total household size	2.92	1.42	2.85	1.42
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
child	Dummy: 1 if a household has children	0.34	0.47	0.30	0.46
single	Dummy: 1 for a single member household	0.17	0.37	0.20	0.40
edu	Education of the household head: categorical scale from primary (0) to higher (3) education	1.99	0.52	2.03	0.49
gender	Gender of the household head; 1 if male	0.68	0.47	0.68	0.47
urban	Dummy: 1 if urban household and 0 otherwise	0.62	0.49	0.55	0.50
CM	Count measure of the food diversity	29.49	6.21	31.02	6.09
TBI	Transformed Berry-index	2.47	0.34	2.55	0.31
rp	Risk premium (computed by factor analysis from the compensated own and cross price elasticities	-1.47	0.48	0.41	0.17

Note: All monetary values were transformed to Euros from Slovak crowns with the corresponding exchange rate and were deflated with CPI (base 2000=100). There are eight regions in Slovakia, Bratislava, Trnava, Trencin, Nitra, Zilina, BanskaBystrica, Presov, and Kosice which are approximately equally represented in the survey.

Table 2 Average food demand elasticities, 2004-2010

	C	MF	DP	FV	OF	
	Compensated price elasticities					Expenditure
C	**-0.61**	0.27	0.13	0.13	0.10	**0.92**
MF	0.21	**-0.69**	0.22	0.08	0.19	**1.22**
DP	0.08	0.40	**-0.86**	0.23	0.15	**0.68**
FV	0.30	0.04	0.35	**-0.96**	0.27	**1.44**
OF	0.05	0.39	0.12	0.22	**-0.78**	**0.73**
	Uncompensated price elasticities					
C	**-0.81**	-0.01	-0.04	0.00	-0.06	
MF	-0.04	**-1.06**	-0.01	-0.09	-0.04	
DP	-0.06	0.20	**-0.98**	0.13	0.03	
FV	0.01	-0.39	0.08	**-1.15**	0.01	
OF	-0.09	0.17	-0.02	0.12	**-0.91**	

Note: C denotes cereals; MF- meat and fish; DP- dairy products; FV- fruits and vegetables; OF- other food. In bold are reported the expenditure, uncompensated and compensated own price elasticities.

Table 3 Determinants of food diversity: pooled sample, 2004-2010

	ln(CM)				TBI			
Variable	OLS	Q(0.1)	Q(0.5)	Q(0.9)	OLS	Q(0.1)	Q(0.5)	Q(0.9)
ln(income)	0.03***	0.05***	0.04***	0.03***	0.06***	0.09***	0.06***	0.04***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
$ln(p_{cereals})$	-0.12***	-0.18***	-0.10***	-0.05***	-0.01	-0.02	0.00	0.03**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
$ln(p_{meat})$	0.02***	0.03***	0.01	0.00	-0.06***	-0.05***	-0.06***	-0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$ln(p_{dairy})$	-0.04***	-0.02*	-0.05***	-0.04***	0.06***	0.07***	0.05***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
$ln(p_{fruits})$	0.10***	0.14***	0.09***	0.05***	0.04***	0.06**	0.03**	0.03**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)
$ln(p_{other})$	0.08***	0.12***	0.07***	0.04***	0.02***	0.03**	0.01*	0.01
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
rp	-0.12***	-0.12***	-0.11***	-0.10***	-0.13***	-0.11***	-0.15***	-0.16***
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
2005	0.04***	0.04***	0.05***	0.03***	0.04***	0.04***	0.03***	0.04***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
2006	0.33***	0.34***	0.32***	0.28***	0.29***	0.28***	0.32***	0.36***
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)
2007	0.34***	0.35***	0.33***	0.28***	0.29***	0.28***	0.32***	0.35***
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)
2008	0.35***	0.37***	0.33***	0.28***	0.28***	0.27***	0.30***	0.33***
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)
2009	0.33***	0.32***	0.33***	0.30***	0.29***	0.27***	0.32***	0.35***
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.04)	(0.02)	(0.02)
2010	0.28***	0.29***	0.28***	0.25***	0.25***	0.23***	0.28***	0.32***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)
qy2	0.01***	0.02***	0.01***	0.01**	0.03***	0.03***	0.03***	0.02***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
qy3	0.03***	0.04***	0.02***	0.02***	0.02***	0.02*	0.01**	0.01*
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
qy4	0.01**	0.01	0.01**	0.01	0.01**	0.02**	0.02***	0.01*
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
TT	0.01	0.05***	-0.01	-0.02***	-0.02***	0.01	-0.02***	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)

Note: Note: Robust (bootstrapped) standard errors are presented in parentheses, * p<0.05, ** p<0.01, *** p<0.001. Reference category for the season dummy set is the winter (qy_1).

Table 3 Determinants of food diversity: pooled sample, 2004-2010, continued

	ln(CM)				TBI			
Variable	OLS	Q(0.1)	Q(0.5)	Q(0.9)	OLS	Q(0.1)	Q(0.5)	Q(0.9)
TN	0.03***	0.09***	0.01**	-0.02***	0.00	0.04***	0.00	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
NR	0.01**	0.06***	0.00	-0.03***	-0.05***	-0.01	-0.05***	-0.07***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
BB	0.00	0.04***	-0.01**	-0.03***	-0.02***	0.02	-0.02**	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
PO	0.00	0.05***	-0.01**	-0.04***	-0.03***	0.02	-0.03***	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
ZA	0.02***	0.07***	0.01**	-0.01***	0.01	0.05***	0.01	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
KE	0.02***	0.06***	0.01**	-0.02***	-0.03***	0.01	-0.03***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
urban	0.03***	0.05***	0.04***	0.02***	0.09***	0.12***	0.08***	0.06***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
edu	0.00	0.01	0.00	0.01**	0.02***	0.02*	0.02***	0.02***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
hh_size	0.01***	0.01**	0.01***	0.00**	-0.02***	-0.02***	-0.02***	-0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
single	-0.04***	-0.07***	-0.02***	-0.01***	-0.02***	-0.05***	-0.01	0.00
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
child	0.01**	0.01	0.01	0.00	0.03***	0.04***	0.02***	0.02***
	(0.00)	(0.01)	(0.000	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
cons	2.87***	2.40***	2.92***	3.25***	1.90***	1.28***	1.94***	2.38***
	(0.02)	(0.04)	(0.02)	(0.02)	(0.03)	(0.06)	(0.03)	(0.03)
N	33243	33243	33243	33243	33243	33243	33243	33243
(Pseudo)R^2	0.08	0.06	0.04	0.03	0.07	0.04	0.04	0.04

Note: Note: Robust (bootstrapped) standard errors are presented in parentheses, * p<0.05, ** p<0.01, *** p<0.001. Reference category for the season dummy set is the winter (qy_1).

Figure 1 Share of household food expenditure in net income, 2004-2010

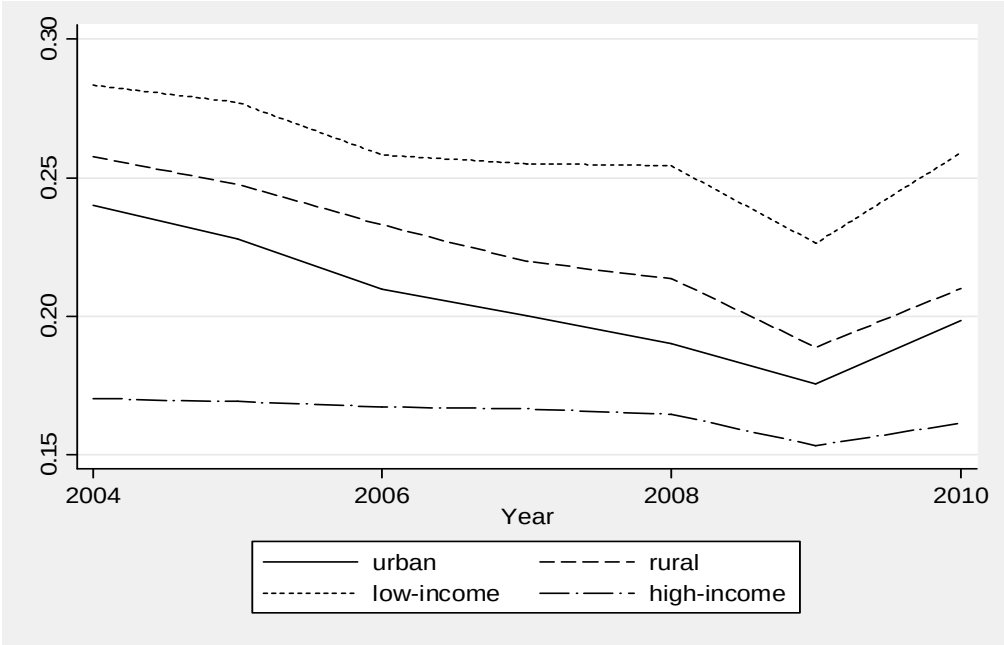


Figure 2 Composition of the diet by household type, 2004-2010

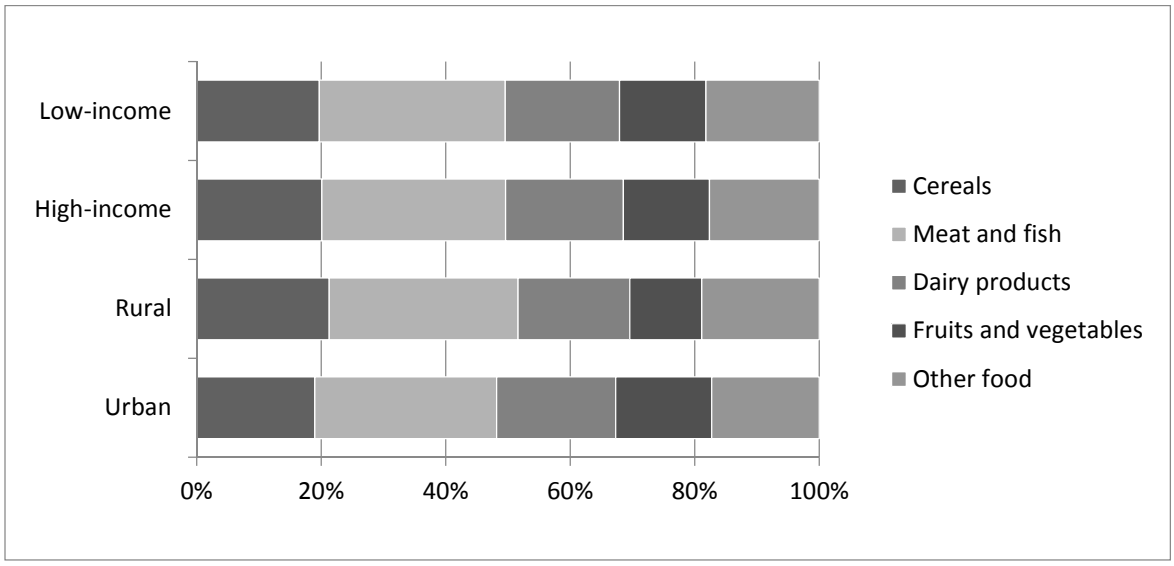


Figure 3 Compensated own-price elasticities, 2004-2010

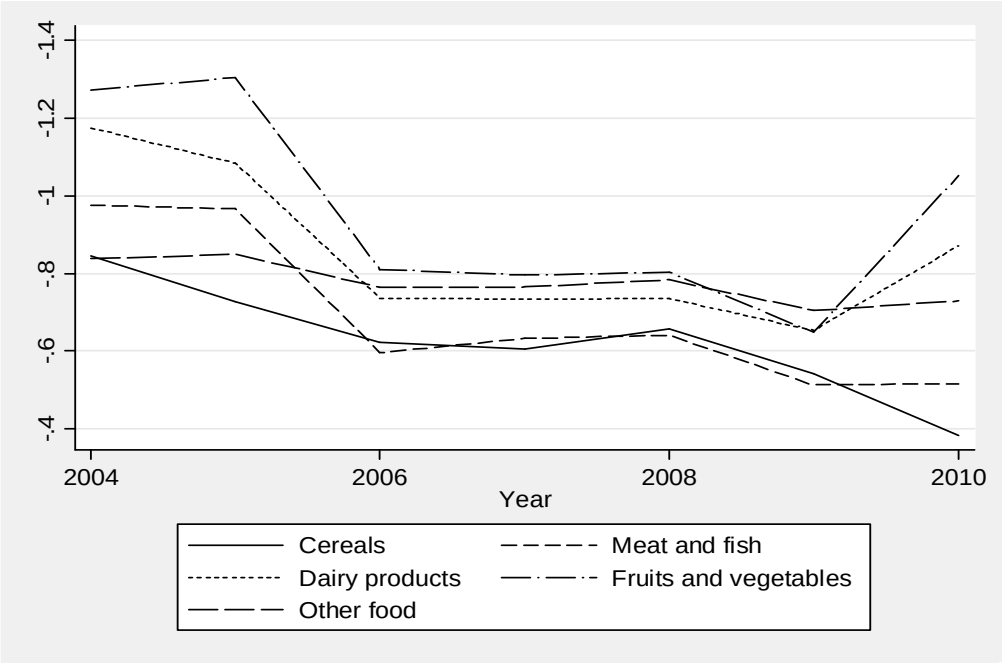


Figure 4 Expenditure elasticities of aggregated food groups

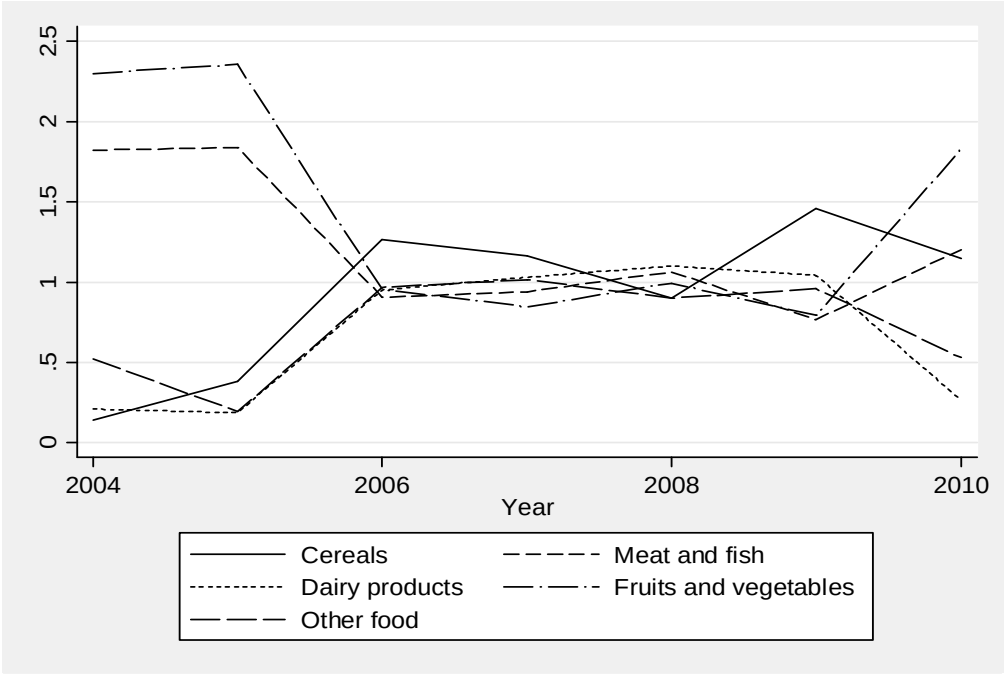


Figure 5a Effects of selected variables across quantiles, CM specification

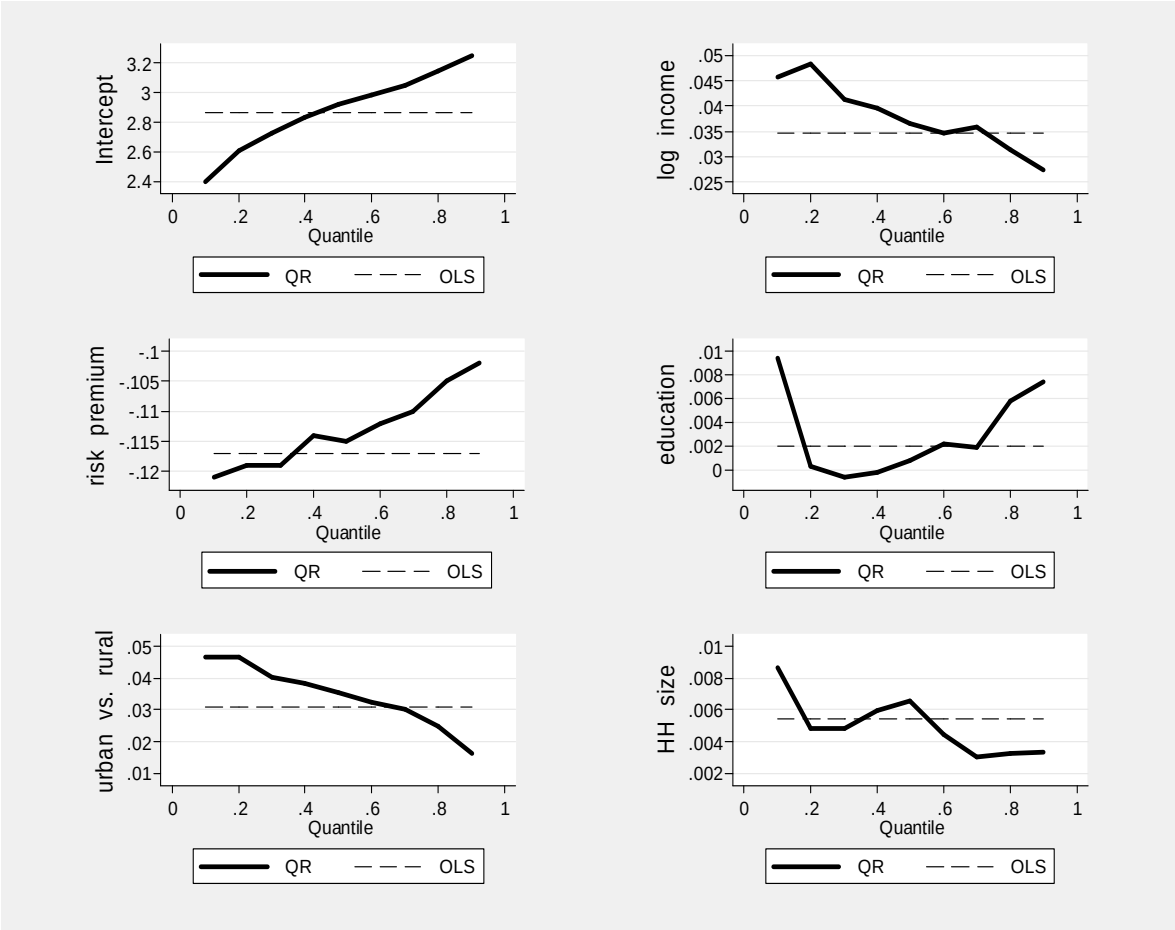
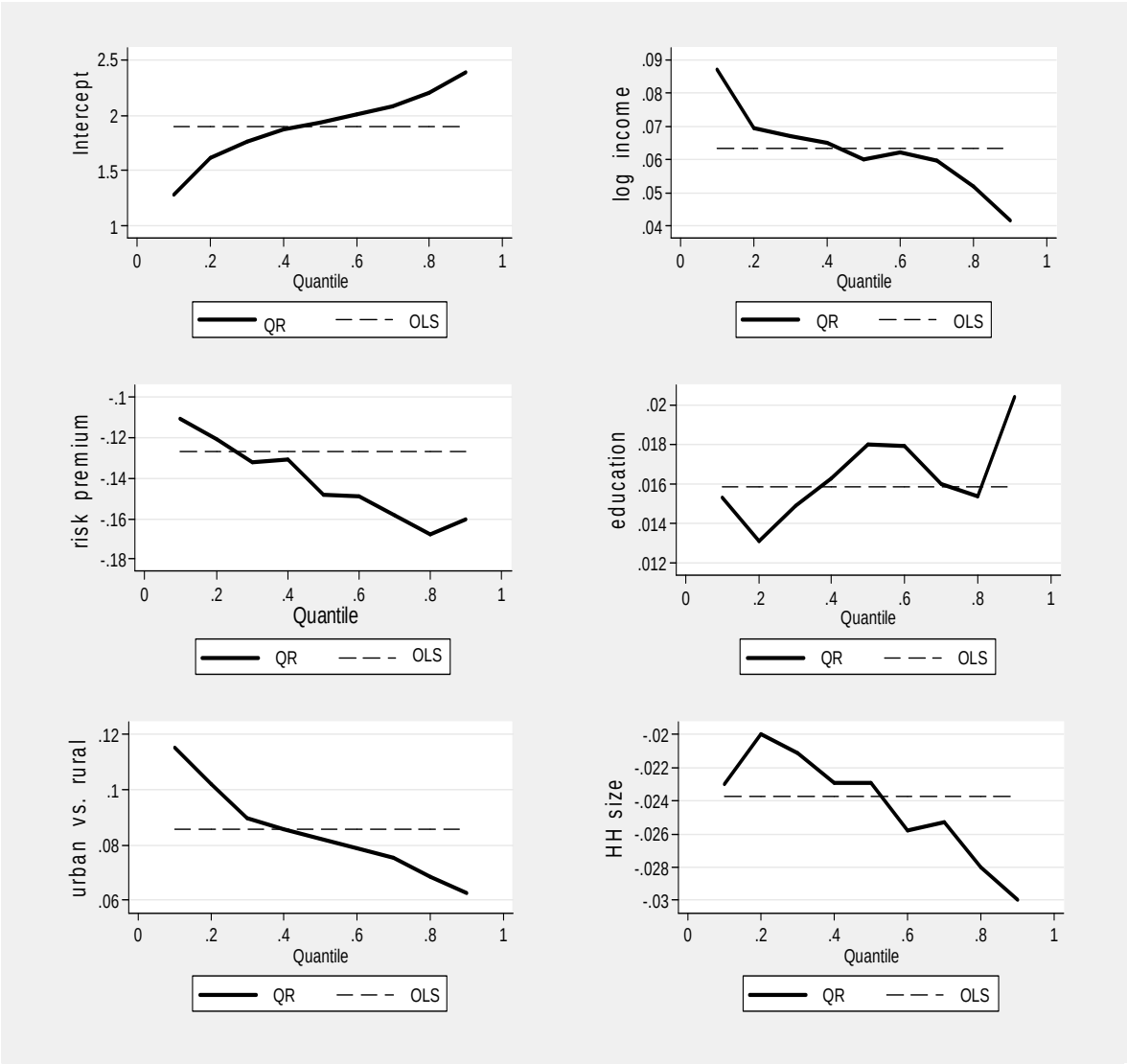


Figure 5b Effects of selected variables across quantiles, TBI specification



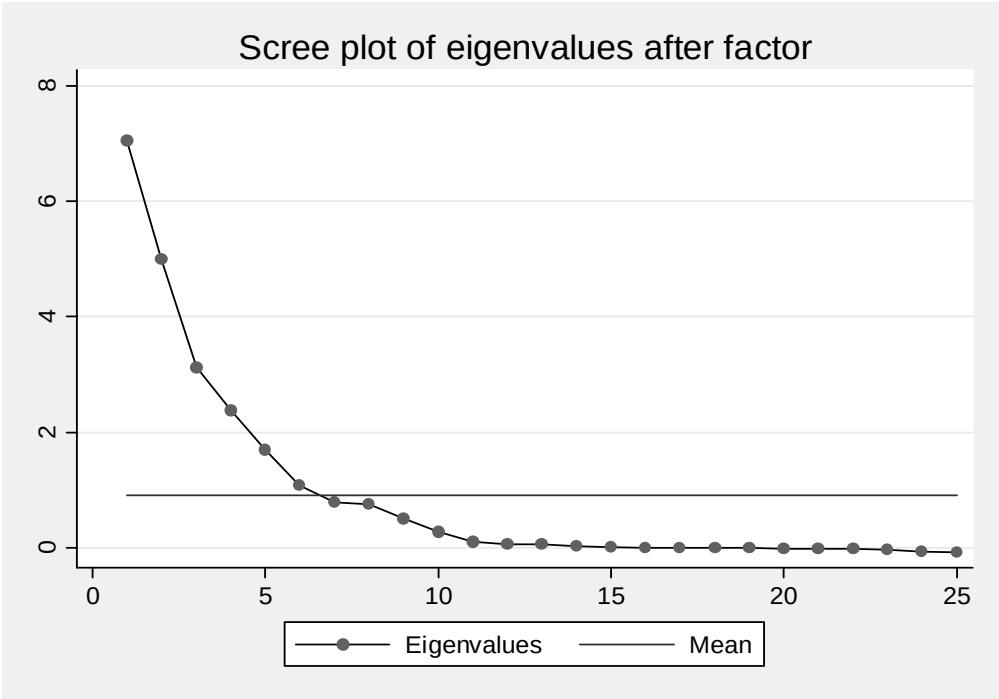
Appendix 1 Generating risk premium by the means of factor analysis

Since the risk premium, *rp* is not directly measured in our data we use information on the compensated price elasticities which we obtained from the QUAIDS analysis. Given that we use both own and cross price compensated elasticities (25 in total) which are mutually correlated by definition the use of factor analysis (FA) is appropriate. FA is a multivariate statistical method which is often used to create indexes from a large set of correlated variables. We carry out factor analysis on the compensated price elasticities by the principal-factor method and list the estimates in Table A1. When deciding on how many factors to retain, it is suggested in the literature to look at several criteria. According to the Kaiser criterion, factors with eigenvalues equal or larger than one should be retained. Another criterion that can be considered is the variation/proportion explained by each factor. In our case, we could eventually keep first six factors (see Figure A1), where Factor1 has the highest eigenvalue (7.05) and explains around 31% of the variability in the data, while Factor6 has eigenvalue just above 1 and explains only 5% of the data variability. When the goal of the procedure is to reduce the number of variables to a single index it is common to retain only the top one or two factors. In our analysis we need an index capturing the impact of uncertainty on household diet diversity and we keep only the first factor, Factor1 which we call “risk premium”. We also experimented as a robustness check using the top two factors and the results remain the same.

Table A1 Factor analysis- principal component method

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	7.05	2.05	0.31	0.31
Factor2	5.00	1.88	0.22	0.53
Factor3	3.12	0.74	0.14	0.67
Factor4	2.38	0.67	0.10	0.77
Factor5	1.71	0.63	0.08	0.85
Factor6	1.08	0.29	0.05	0.89
Factor7	0.79	0.03	0.03	0.93
Factor8	0.76	0.24	0.03	0.96
Factor9	0.51	0.24	0.02	0.99
Factor10	0.27	0.16	0.01	1.00
Factor11	0.11	0.04	0.00	1.00
Factor12	0.07	0.01	0.00	1.01
Factor13	0.06	0.03	0.00	1.01
Factor14	0.03	0.02	0.00	1.01
Factor15	0.01	0.01	0.00	1.01
Factor16	0.00	0.00	0.00	1.01
Factor17	0.00	0.00	0.00	1.01
Factor18	0.00	0.00	0.00	1.01
Factor19	0.00	0.01	0.00	1.01
Factor20	-0.01	0.01	0.00	1.01
Factor21	-0.02	0.00	0.00	1.01
Factor22	-0.02	0.01	0.00	1.01
Factor23	-0.03	0.02	0.00	1.01
Factor24	-0.05	0.02	0.00	1.00
Factor25	-0.08	.	0.00	1.00

Figure A1 Scree plot of eigenvalues



Appendix 2 Aggregation of food commodities

Table A1 Aggregation of food commodities into food groups

Food group	Unit	Food commodity
I. CEREALS	kg	Rice
		Bread
		Pasta products
		Pastry-cook products
		Sandwiches
		Other products
II. MEAT and FISH	kg	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 or 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
III. DAIRY PRODUCTS and EGGS	kg	
		Whole milk
		Low fat milk
		Preserved milk
		Yoghurt
		Cheese and curd
		Other milk products
		Eggs
IV. FRUITS and VEVETABLES	kg	
		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

Table A1 Aggregation of food commodities into food groups, continued

Food group	Unit	Food commodity
		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
V. OTHER FOOD PRODUCTS	kg	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

Appendix 3 Trends and correlations of food diversity measures, CM and TBI

Figure A1 Evolution of CM over time, 2004-2010

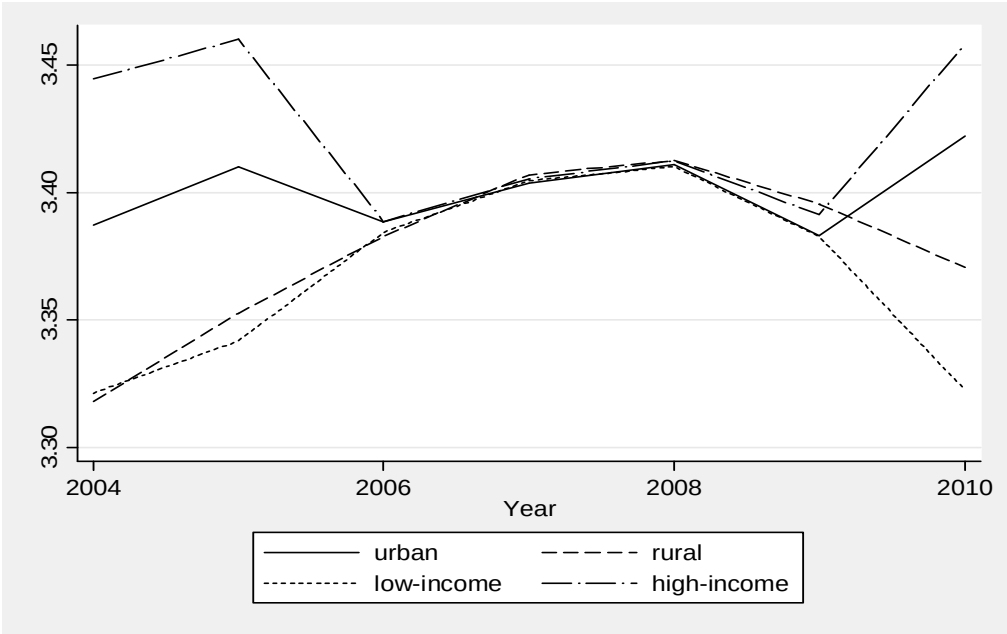


Figure A2 Evolution of TBI over time, 2004-2010

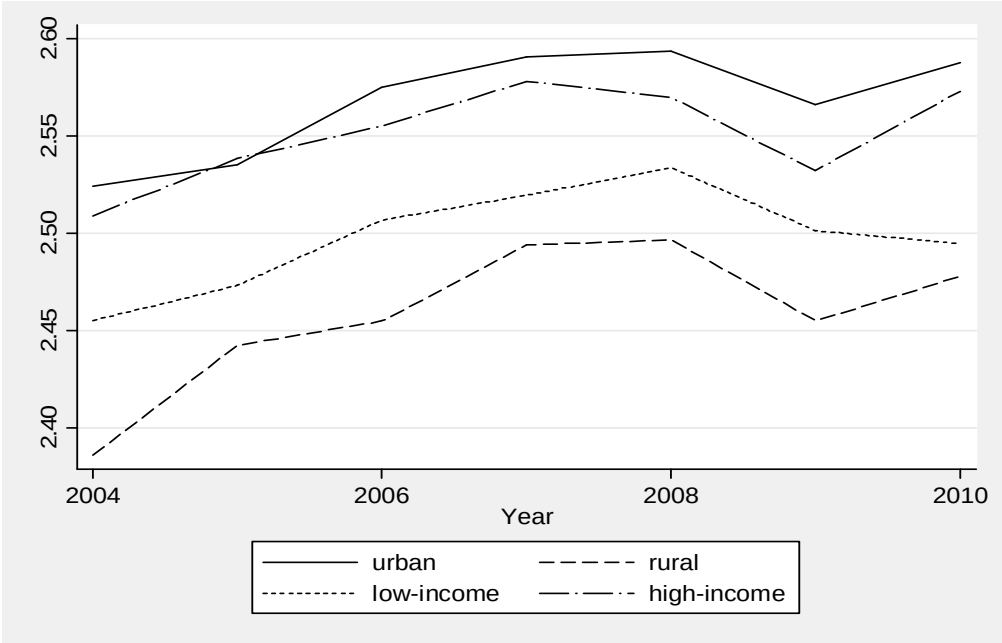
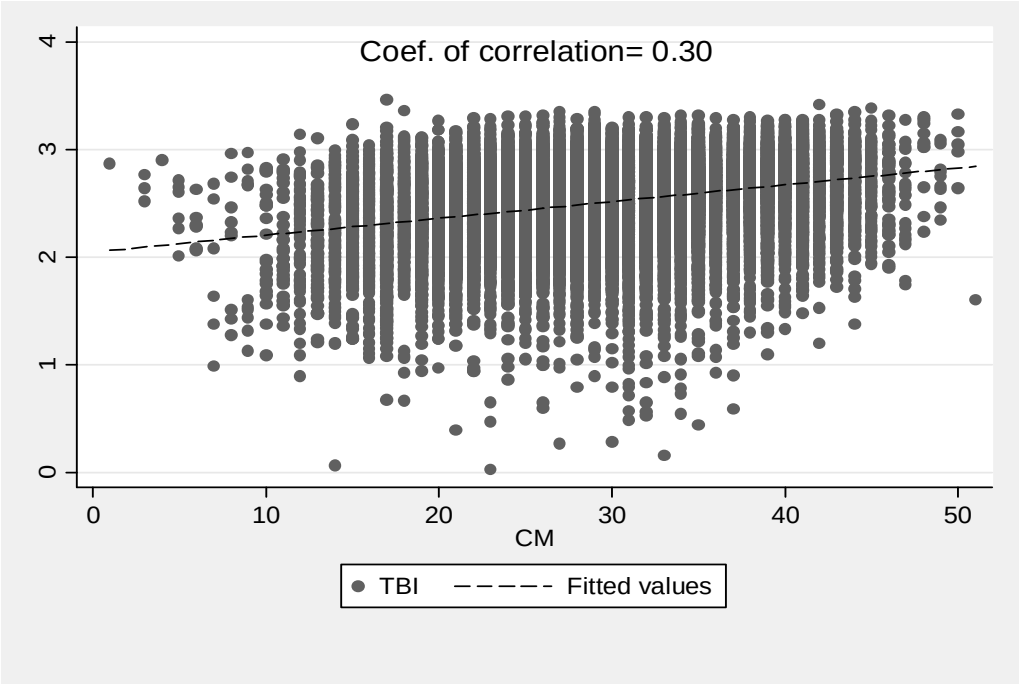
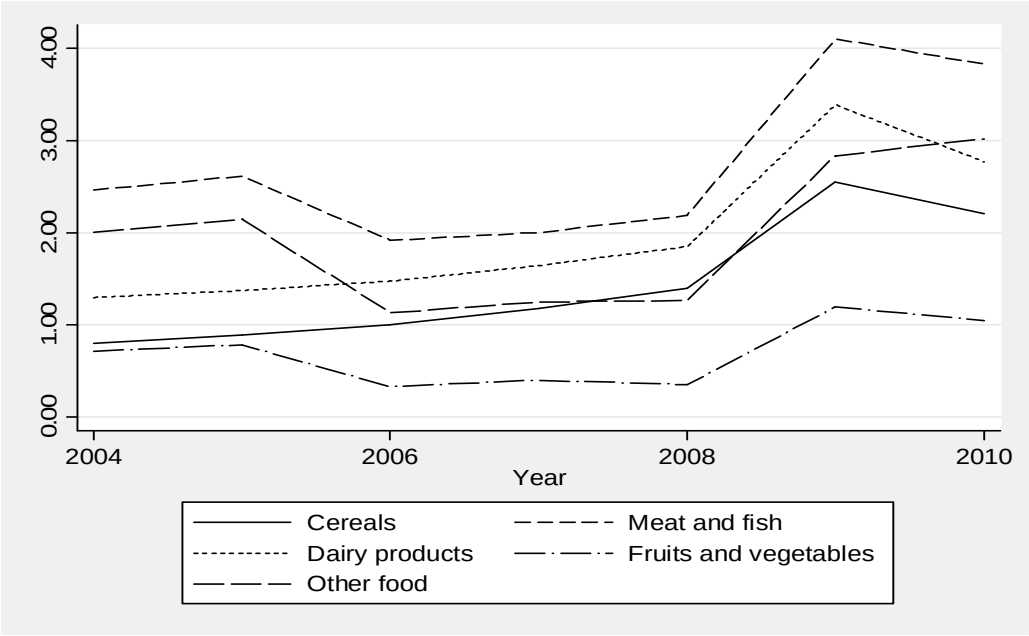


Figure A3 Correlation between CM and TBI



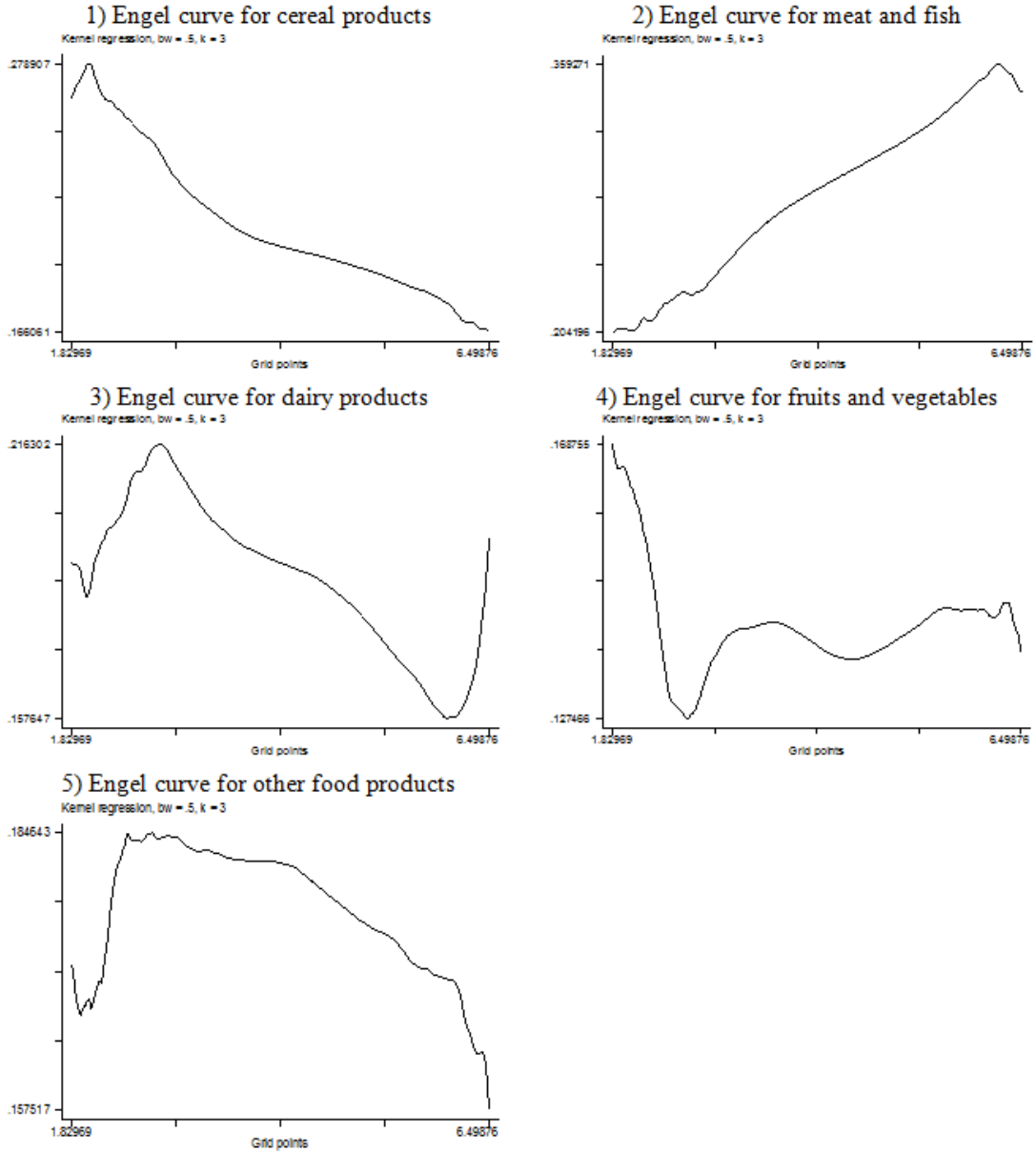
Appendix 4 Food prices

Figure A1 Evolution of food prices over time, 2004-2010



Appendix 5 Engel curves

Figure A1 Engel curves for aggregated food groups



Appendix 6 QUAIDS estimates

Table A1 QUAIDS estimated parameters

Parameter	2004	2005	2006	2007	2008	2009	2010
Alpha							
α_1	-0.292***	-0.241**	0.108***	0.096***	-0.032	0.214***	0.114
	(0.102)	(0.120)	(0.035)	(0.022)	(0.072)	(0.074)	(0.101)
α_2	0.986***	1.184***	0.408***	0.406***	0.514***	0.370***	0.614***
	(0.141)	(0.180)	(0.033)	(0.029)	(0.092)	(0.053)	(0.159)
α_3	-0.147*	-0.328***	0.121***	0.134***	0.174***	0.104***	-0.208*
	(0.086)	(0.120)	(0.014)	(0.019)	(0.065)	(0.028)	(0.117)
α_4	0.421***	0.585***	0.181***	0.188***	0.236***	0.155***	0.471***
	(0.083)	(0.112)	(0.014)	(0.022)	(0.060)	(0.029)	(0.109)
α_5	0.032	-0.201*	0.182***	0.176***	0.108*	0.157***	0.008
	(0.086)	(0.109)	(0.014)	(0.016)	(0.064)	(0.026)	(0.091)
Beta							
β_1	-0.119***	-0.106***	0.002	-0.006	-0.031*	0.039	0.001
	(0.039)	(0.033)	(0.013)	(0.008)	(0.017)	(0.024)	(0.029)
β_2	0.157***	0.198***	-0.002	0.000	0.027	-0.030*	0.047
	(0.055)	(0.049)	(0.012)	(0.010)	(0.023)	(0.017)	(0.046)
β_3	-0.092***	-0.122***	-0.014**	-0.001	0.011	-0.003	-0.094***
	(0.032)	(0.033)	(0.006)	(0.007)	(0.017)	(0.009)	(0.033)
β_4	0.105***	0.135***	0.011**	0.000	0.009	-0.008	0.094***
	(0.029)	(0.027)	(0.005)	(0.008)	(0.016)	(0.010)	(0.030)
β_5	-0.050	-0.105***	0.003	0.007	-0.016	0.001	-0.048*
	(0.032)	(0.029)	(0.005)	(0.006)	(0.017)	(0.009)	(0.026)
Gamma							
γ_{11}	0.101***	0.078***	0.032***	0.036***	0.033***	0.057***	0.081***
	(0.031)	(0.025)	(0.002)	(0.002)	(0.004)	(0.007)	(0.010)
γ_{12}	-0.094**	-0.092**	-0.016***	-0.014***	-0.018***	-0.024***	-0.032***
	(0.039)	(0.039)	(0.002)	(0.002)	(0.004)	(0.005)	(0.010)
γ_{13}	0.041**	0.050**	-0.006***	-0.008***	-0.005**	-0.012***	-0.021*
	(0.019)	(0.020)	(0.002)	(0.001)	(0.002)	(0.003)	(0.011)
γ_{14}	-0.043**	-0.043**	-0.007***	-0.009***	-0.007***	-0.017***	-0.007
	(0.019)	(0.022)	(0.001)	(0.001)	(0.002)	(0.003)	(0.009)
γ_{15}	-0.005	0.007	-0.003**	-0.004***	-0.002	-0.003	-0.022***
	(0.014)	(0.018)	(0.001)	(0.001)	(0.002)	(0.002)	(0.006)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table A1 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
γ_{22}	0.134**	0.177**	0.027***	0.018***	0.024***	0.052***	0.077***
	(0.062)	(0.078)	(0.003)	(0.003)	(0.005)	(0.005)	(0.021)
γ_{32}	-0.051*	-0.088**	-0.007***	-0.005***	-0.006**	-0.012***	-0.029
	(0.030)	(0.042)	(0.002)	(0.002)	(0.002)	(0.003)	(0.020)
γ_{42}	0.045**	0.081***	-0.001	0.003**	0.002	-0.006**	0.009
	(0.022)	(0.030)	(0.001)	(0.001)	(0.002)	(0.003)	(0.015)
γ_{52}	-0.034	-0.079**	-0.003**	-0.002	-0.002	-0.009***	-0.024**
	(0.023)	(0.037)	(0.001)	(0.001)	(0.003)	(0.002)	(0.012)
γ_{33}	-0.004	0.039	0.015***	0.015***	0.014***	0.029***	0.048**
	(0.020)	(0.030)	(0.002	(0.002)	(0.002)	(0.003)	(0.022)
γ_{43}	-0.015	-0.045**	0.002	0.000	-0.001	-0.002	-0.014
	(0.014)	(0.022)	(0.001)	(0.001)	(0.001)	(0.002)	(0.016)
γ_{53}	0.029***	0.043**	-0.003***	-0.002	-0.002	-0.003*	0.016
	(0.011)	(0.018)	(0.001)	(0.001)	(0.002)	(0.002)	(0.010)
γ_{44}	0.018	0.039	0.007***	0.008***	0.008***	0.030***	0.014
	(0.018)	(0.026)	(0.001)	(0.002)	(0.001)	(0.003)	(0.017)
γ_{54}	-0.004	-0.031	-0.001	-0.002**	-0.001	-0.005***	-0.002
	(0.012)	(0.019)	(0.001)	(0.001)	(0.001)	(0.002)	(0.010)
γ_{55}	0.014	0.060**	0.010***	0.010***	0.008***	0.021***	0.033***
	(0.012)	(0.024)	(0.001)	(0.001)	(0.002)	(0.002)	(0.010)
Lambda							
λ_1	-0.006	-0.004*	0.004***	0.003***	0.001	0.007***	0.003
	(0.004)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
λ_2	0.009*	0.010**	-0.003***	-0.003***	-0.001	-0.006***	0.000
	(0.005)	(0.004)	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)
λ_3	-0.007**	-0.006**	0.000	0.001**	0.002	0.002*	-0.005**
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
λ_4	0.008***	0.008***	-0.001*	-0.002***	-0.001	-0.002**	0.005**
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
λ_5	-0.005*	-0.008***	0.000	0.001	-0.001	0.000	-0.004**
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Eta							
$\eta_{foodratio1}$	-0.007**	0.001	-0.001	0.002	-0.001	-0.003	0.000
	(0.003)	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)	(0.001)
$\eta_{foodratio2}$	-0.003	-0.005**	-0.016***	-0.017***	-0.010***	-0.005	-0.002
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.006)	(0.001)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table A1 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
$\eta_{foodratio3}$	0.009***	0.004***	0.013***	0.009***	0.006***	0.005*	0.000
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)
$\eta_{foodratio4}$	0.000	0.000	-0.001	0.003	0.004**	0.003	0.000
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)
$\eta_{foodratio5}$	0.001	0.000	0.005**	0.003	0.001	0.000	0.001
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
$\eta_{n\_children1}$	-0.005***	-0.003***	-0.003***	-0.002***	-0.001***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_children2}$	0.006***	0.005***	0.005***	0.005***	0.002***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
$\eta_{n\_children3}$	-0.002***	-0.002***	-0.003***	-0.003***	-0.002***	-0.003***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_children4}$	0.001***	0.001***	0.002***	0.001***	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_children5}$	-0.001***	-0.001***	-0.001***	-0.001**	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults1}$	-0.005***	-0.002***	-0.001***	0.000**	0.000	-0.002***	-0.002***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults2}$	0.003***	0.000	-0.002***	-0.002***	-0.001***	0.001	0.001**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults3}$	0.000	0.000	0.001***	0.001***	0.001***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults4}$	0.002***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{n\_adults5}$	0.000	0.000	0.000	0.000	0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{age_HH1}	0.000	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{age_HH2}	0.000	0.000*	0.000	0.000	0.000***	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{age_HH3}	0.000	0.000***	0.000**	0.000*	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table A1 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
η_{age_HH4}	0.000	0.000	0.000	0.000	0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_{age_HH5}	0.000***	0.000***	0.000***	0.000***	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{gender1}$	-0.001	0.003***	-0.003***	-0.001***	0.001	-0.001**	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
$\eta_{gender2}$	0.005***	-0.001	0.006***	0.005***	0.002***	0.006***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\eta_{gender3}$	-0.002***	0.001**	-0.002***	-0.002***	-0.001**	-0.002***	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
$\eta_{gender4}$	-0.001***	-0.002***	-0.001	-0.001***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\eta_{gender5}$	-0.001***	-0.001*	0.000	-0.001**	0.000	-0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
η_{edu1}	0.000	0.002***	0.001	0.001***	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000	(0.000)	(0.000
η_{edu2}	0.004***	0.002**	0.004***	0.003***	0.001***	0.000**	0.001***
	(0.001)	(0.001)	(0.001)	(0.001	(0.000)	(0.000)	(0.000)
η_{edu3}	-0.002***	-0.002***	-0.002***	-0.002***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
η_{edu4}	-0.002***	-0.002***	-0.002***	-0.002***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
η_{edu5}	0.000	0.000	-0.001*	0.000	0.000	0.000***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
η_{urban1}	0.007***	0.004***	0.008***	0.010***	0.008***	0.002***	0.005***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)
η_{urban2}	-0.003***	-0.002**	-0.004**	-0.007***	-0.006**	0.001	-0.002**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)
η_{urban3}	-0.002***	-0.001**	0.001	0.003***	0.003**	-0.001	0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
η_{urban4}	-0.005***	-0.004***	-0.008***	-0.010***	-0.007***	-0.005***	-0.006***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.000	(0.001)
η_{urban5}	0.003***	0.003***	0.003***	0.003***	0.002***	0.002***	0.003***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001	(0.000)	(0.000)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table A1 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
η_{Q21}	0.000	-0.001	0.000	0.000	0.000	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
η_{Q22}	0.001	0.002*	0.001	0.002***	0.000	0.003***	0.002**
	0.001	0.001	0.001	0.001	0.001	0.001	0.001
η_{Q23}	0.001***	0.001	0.002***	0.002***	0.001***	0.001**	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
η_{Q24}	-0.001	-0.002***	-0.002***	-0.002***	-0.001***	-0.001***	-0.003***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q25}	-0.002***	0.001*	-0.001	-0.002***	0.000	-0.003***	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q31}	0.000	0.000	0.001	0.000	0.000	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001
η_{Q32}	0.001	0.003***	0.001	0.000	-0.001	0.002	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001	(0.001	(0.001)
η_{Q33}	0.002***	0.002***	0.003***	0.002***	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
η_{Q34}	-0.001	-0.003***	-0.002***	0.000	0.001**	0.000	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q35}	-0.002***	-0.002***	-0.003***	-0.002***	-0.002***	-0.004***	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q41}	-0.002**	0.001	0.000	-0.001*	0.000	0.002**	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
η_{Q42}	0.001	0.001	-0.001	0.001	-0.002***	-0.003**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
η_{Q43}	0.002***	0.002***	0.004***	0.002***	0.002***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
η_{Q44}	0.002***	-0.003***	-0.001*	0.000	0.001***	0.000	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
η_{Q45}	-0.003***	-0.001**	-0.002***	-0.002***	-0.001***	-0.002***	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
$\rho_{foodratio}$	-0.004	-0.108	-0.434***	-0.926***	-5.278	0.045	0.026
	(0.144)	(0.548)	(0.067)	(0.229)	(4.216)	(0.454)	(0.276)

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Table A1 QUAIDS estimated parameters, continued

Parameter	2004	2005	2006	2007	2008	2009	2010
$\rho_{n\_children}$	-0.058***	-0.276	-0.084***	-0.144***	0.216	-0.130***	-0.185***
	(0.015)	(0.176)	(0.026)	(0.035)	(0.262	(0.032)	(0.055)
ρ_{n_adults}	-0.073***	-0.138	-0.044**	-0.045	0.275	-0.076**	-0.008
	(0.013)	(0.095)	(0.017)	(0.033)	(0.306)	(0.040)	(0.056)
ρ_{age_HH}	0.000	0.017	0.009***	0.014**	0.079	0.008	0.009
	(0.001)	(0.015)	(0.003)	(0.006)	(0.060)	(0.005)	(0.006)
ρ_{gender}	-0.060***	0.646	-0.295***	-0.111**	1.339	-0.292***	-0.036
	(0.032)	(0.632)	(0.073)	(0.050	(1.143)	(0.069)	(0.083)
ρ_{edu}	-0.042***	0.300	-0.063	-0.069	-0.146	0.032	0.007
	(0.014)	(0.308)	(0.061)	(0.049)	(0.135)	(0.020)	(0.014)
ρ_{urban}	0.073**	0.063	0.652**	2.688**	18.372	0.036	0.568**
	(0.037)	(0.160)	(0.256)	(1.311)	(,)	(0.077)	(0.239)
ρ_{Q2}	-0.024	-0.257	-0.053	-0.162	-0.320	-0.220**	-0.113
	(0.051)	(0.225)	(0.082)	(0.100)	(0.634)	(0.093)	(0.108)
ρ_{Q3}	-0.001	-0.106	0.008	-0.096	0.486	-0.134	-0.018
	(0.051)	(0.202)	(0.091)	(0.089)	(0.752)	(0.106)	(0.122)
ρ_{Q4}	-0.127	-0.034	-0.053	-0.189**	0.054	0.094	-0.179
	(0.042)	(0.210)	(0.071)	(0.095)	(0.662)	(0.128)	(0.109)
N	4520	4644	4651	4671	4681	4678	6078

Note: Standard errors are presented in parentheses; * p<0.05, ** p<0.01, *** p<0.001

Appendix 7 QUAIDS specification tests

To formally test the significance of the quadratic expenditure term and the set of demographic variables, we perform Wald tests on the estimated parameters. Results of the tests are presented in Table A1, where we list the values of the χ^2 statisticsand 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 all surveyed years (except 2008) 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 set of seasonal dummies - 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 zerofor 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 have significant impact on food expenditures in all the surveyed years with exception for the food expenditure ratio in 2009 and 2010.

Table A1 Wald tests on the quadratic expenditure term and demographic parameters

	2004	2005	2006	2007	2008	2009	2010
Testing H_0	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2
H_0: $\lambda_i = 0$	16.52	31.39	21.52	25.30	4.34	24.62	19.94
	(0.00)	(0.00)	(0.00)	(0.00)	(0.36)	(0.00)	(0.00)
H_0: $\eta_{foodratio\_i}$	43.80	21.70	90.15	171.28	27.65	7.68	4.30
and $\rho_{foodratio} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.17)	(0.51)
H_0: $\eta_{n\_children\_i}$	122.07	141.12	166.40	247.29	203.84	227.23	202.25
and $\rho_{n\_children} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0: $\eta_{n\_adults\_i}$	102.83	33.62	65.03	64.12	54.38	23.84	89.16
and $\rho_{n\_adults} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0: $\eta_{age\_HH\_i}$	13.80	53.91	57.32	59.06	30.62	57.92	66.80
and $\rho_{age\_HH} = 0$	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0: η_{gender_i}	42.67	51.02	44.79	59.48	44.08	77.60	37.95
and $\rho_{gender} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0: η_{edu_i}	86.10	122.17	67.75	94.53	134.21	110.58	198.31
and $\rho_{edu} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0: η_{urban_i}	229.75	83.30	198.61	213.77	29.94	185.86	251.82
and $\rho_{urban} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0: η_{Q2_i}	20.80	47.50	41.34	77.58	28.25	80.09	76.71
and $\rho_{Q2} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0: η_{Q3_i}	35.74	78.91	53.70	36.25	56.87	105.39	84.37
and $\rho_{Q3} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0: η_{Q4_i}	61.94	59.65	69.59	42.73	64.49	60.68	130.92
and $\rho_{Q4} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: $i = 1, \ldots, 5$. P-values of the Wald tests are presented in parentheses.

Appendix 8 Food demand elasticities by subsamples

Table A1 Food demand elasticities, urban subsample, 2004-2010

	C	MF	DP	FV	OF	
	Compensated price elasticities					Expenditure
C	**-0.57**	0.15	0.23	0.06	0.13	**1.52**
MF	0.16	**-0.70**	0.24	0.09	0.21	**0.94**
DP	0.12	0.45	**-0.91**	0.27	0.07	**0.73**
FV	0.14	0.05	0.39	**-0.94**	0.36	**1.29**
OF	0.07	0.48	0.01	0.32	**-0.88**	**0.60**
	Uncompensated price elasticities					
C	**-0.85**	-0.30	-0.06	-0.17	-0.13	
MF	-0.02	**-0.98**	0.06	-0.06	0.05	
DP	-0.01	0.23	**-1.05**	0.16	-0.05	
FV	-0.10	-0.33	0.14	**-1.14**	0.13	
OF	-0.04	0.31	-0.10	0.22	**-0.99**	

Table A2 Food demand elasticities, rural subsample, 2004-2010

	C	MF	DP	FV	OF	
	Compensated price elasticities					Expenditure
C	**-0.80**	0.36	0.22	0.17	0.05	**0.77**
MF	0.19	**-0.65**	0.16	0.09	0.21	**1.07**
DP	0.44	0.12	**-0.92**	0.10	0.27	**1.29**
FV	0.43	0.08	0.25	**-1.06**	0.29	**1.39**
OF	-0.06	0.45	0.22	0.20	**-0.81**	**0.71**
	Uncompensated price elasticities					
C	**-0.96**	0.12	0.08	0.07	-0.09	
MF	-0.03	**-0.98**	-0.03	-0.03	0.00	
DP	0.16	-0.27	**-1.16**	-0.05	0.02	
FV	0.13	-0.34	0.00	**-1.21**	0.02	
OF	-0.21	0.24	0.09	0.11	**-0.94**	

Table A3 Food demand elasticities, low-income subsample, 2004-2010

	C	MF	DP	FV	OF	
	Compensated price elasticities					Expenditure
C	**-0.59**	0.23	0.12	0.14	0.11	**0.94**
MF	0.18	**-0.69**	0.27	0.08	0.17	**1.10**
DP	0.07	0.46	**-0.96**	0.25	0.18	**0.78**
FV	0.28	0.10	0.37	**-0.99**	0.23	**1.37**
OF	0.07	0.33	0.16	0.20	**-0.76**	**0.86**
	Uncompensated price elasticities					
C	**-0.78**	-0.05	-0.06	0.01	-0.06	
MF	-0.04	**-1.02**	0.06	-0.07	-0.03	
DP	-0.09	0.22	**-1.11**	0.15	0.04	
FV	0.01	-0.30	0.11	**-1.18**	-0.01	
OF	-0.10	0.07	0.00	0.08	**-0.91**	

Table A4 Food demand elasticities, high-income subsample, 2004-2010

	C	MF	DP	FV	OF	
	Compensated price elasticities					Expenditure
C	**-0.71**	0.21	0.30	0.10	0.10	**1.18**
MF	0.18	**-0.64**	0.17	0.12	0.17	**1.11**
DP	0.17	0.41	**-0.97**	0.20	0.19	**0.42**
FV	0.33	0.08	0.28	**-0.94**	0.24	**1.52**
OF	0.06	0.32	0.16	0.20	**-0.74**	**0.84**
	Uncompensated price elasticities					
C	**-0.94**	-0.14	0.08	-0.07	-0.11	
MF	-0.03	**-0.97**	-0.04	-0.03	-0.04	
DP	0.09	0.29	**-1.05**	0.14	0.11	
FV	0.04	-0.38	0.00	**-1.14**	-0.04	
OF	-0.11	0.07	0.01	0.08	**-0.90**	

Appendix 9 Testing equality of effects across quantiles

Table A1 F-tests for equality of slope parameters across quantiles

	ln(CM)		TBI	
Variable	Q(0.1)=Q(0.9)	Q(0.25)=Q(0.75)	Q(0.1)=Q(0.9)	Q(0.25)=Q(0.75)
ln(income)	6.01	7.05	17.35	5.60
	(0.01)	(0.01)	(0.00)	(0.02)
rp	6.20	3.64	11.33	11.17
	(0.01)	(0.06)	(0.00)	(0.00)
$ln(p_{cereals})$	47.60	29.67	3.76	2.61
	(0.00)	(0.00)	(0.05)	(0.11)
$ln(p_{meat})$	6.19	1.23	0.55	2.81
	(0.01)	(0.27)	(0.46)	(0.09)
$ln(p_{dairy})$	3.11	2.24	3.38	6.59
	(0.08)	(0.13)	(0.07)	(0.01)
$ln(p_{fruits})$	28.05	13.23	1.37	0.00
	(0.00)	(0.00)	(0.24)	(0.99)
$ln(p_{other})$	49.23	34.30	2.41	1.61
	(0.00)	(0.00)	(0.12)	(0.20)
2005	0.78	0.07	0.01	1.58
	(0.38)	(0.78)	(0.92)	(0.21)
2006	6.37	4.68	3.56	11.02
	(0.01)	(0.03)	(0.06)	(0.00)
2007	17.85	7.24	2.92	11.98
	(0.00)	(0.01)	(0.09)	(0.00)
2008	18.06	14.46	1.82	7.43
	(0.00)	(0.00)	(0.18)	(0.01)
2009	1.13	2.10	4.41	10.52
	(0.29)	(0.15)	(0.04)	(0.00)
2010	5.41	8.03	6.40	14.08
	(0.02)	(0.00)	(0.01)	(0.00)
qy2	2.94	1.59	0.60	0.03
	(0.09)	(0.21)	(0.44)	(0.87)
qy3	3.93	2.95	0.51	0.01
	(0.05)	(0.09)	(0.47)	(0.91)
qy4	0.02	0.13	1.37	0.44
	(0.89)	(0.72)	(0.24)	(0.51)
TT	28.88	19.78	11.29	22.46
	(0.00)	(0.00)	(0.00)	(0.00)

Note: P-values of the F-statistics are presented in parentheses.

Table A1 F-tests for equality of slope parameters across quantiles, continued

	ln(CM)		TBI	
Variable	Q(0.1)=Q(0.9)	Q(0.25)=Q(0.75)	Q(0.1)=Q(0.9)	Q(0.25)=Q(0.75)
TN	59.66	61.73	19.49	2.56
	(0.00)	(0.00)	(0.00)	(0.11)
NR	66.68	19.19	14.90	0.94
	(0.00)	(0.00)	(0.00)	(0.33)
BB	56.38	16.45	19.94	6.08
	(0.00)	(0.00)	(0.00)	(0.01)
PO	81.87	84.02	14.62	1.22
	(0.00)	(0.00)	(0.00)	(0.27)
ZA	54.04	34.81	30.32	6.32
	(0.00)	(0.00)	(0.00)	(0.01)
KE	34.98	21.25	8.29	1.65
	(0.00)	(0.00)	(0.00)	(0.20)
urban	44.73	18.67	44.35	38.76
	(0.00)	(0.00)	(0.00)	(0.00)
edu	0.08	1.26	0.47	0.06
	(0.77)	(0.26)	(0.49)	(0.80)
hh_size	2.62	1.40	1.96	3.32
	(0.11)	(0.24)	(0.16)	(0.07)
single	65.48	39.44	9.69	27.09
	(0.00)	(0.00)	(0.00)	(0.00)
child	4.27	5.27	1.96	0.32
	(0.04)	(0.02)	(0.16)	(0.57)

Note: P-values of the F-statistics are presented in parentheses.

FOODSECURE
FOR POLICIES THAT MATTER

The FOODSECURE project in a nutshell

Title	FOODSECURE – Exploring the future of global food and nutrition security
Funding scheme	7th framework program, theme Socioeconomic sciences and the humanities
Type of project	Large-scale collaborative research project
Project Coordinator	Hans van Meijl (LEI Wageningen UR)
Scientific Coordinator	Joachim von Braun (ZEF, Center for Development Research, University of Bonn)
Duration	2012 - 2017 (60 months)

Short description

In the future, excessively high food prices may frequently reoccur, with severe impact on the poor and vulnerable. Given the long lead time of the social and technological solutions for a more stable food system, a long-term policy framework on global food and nutrition security is urgently needed.

The general objective of the FOODSECURE project is to design effective and sustainable strategies for assessing and addressing the challenges of food and nutrition security.

FOODSECURE provides a set of analytical instruments to experiment, analyse, and coordinate the effects of short and long term policies related to achieving food security.

FOODSECURE impact lies in the knowledge base to support EU policy makers and other stakeholders in the design of consistent, coherent, long-term policy strategies for improving food and nutrition security.

EU Contribution	€ 8 million
Research team	19 partners from 13 countries

FOODSECURE project office
LEI Wageningen UR (University & Research centre)
Alexanderveld 5
The Hague, Netherlands

T +31 (0) 70 3358370
F +31 (0) 70 3358196
E foodsecure@wur.nl
I www.foodscecure.eu

This project is funded by the European Union under the 7th Research Framework Programme (theme SSH) Grant agreement no. 290693