Demand for the Food Diversity in Central and Eastern European Countries: an Evidence from Slovakia

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Summary

We estimate demand for food diversity in Central and Eastern Europe. Food diversity is a proxy for the quality of a diet and it is one of the measures of households' food and nutritional security status. Using data from the Slovak Household Budget Survey, we estimate the impact of household's income and other socio-economic and demographic characteristics on the demand for food diversity by standard OLS. To deal with the endogeneity problem as some important variables affecting demand for food diversity such as health status, preferences, etc. are not observed, we also apply 2SLS estimation method. Households' expenditures on purchase of assets serve as a suitable instrumental variable in the 2SLS estimation. We find that households' demand for food diversity has been increasing since 2004 reflecting mainly rising incomes in Slovakia in that period. Recent economic crisis had a negative impact on diversity of food consumption of the Slovak households'. We also find that the estimated income elasticities are understated by OLS approach and are greater when the income endogeneity issue is addressed. Demand for food diversity is significantly higher for urban households than for households living in rural areas. Demand for food diversity is also affected by individual characteristics of the household's head, such as education level, age or employment status as well as by the regional characteristics.

Keywords: Central and Eastern Europe, food and nutrition security, food diversity, food diversity indexes, Slovakia

JEL Classification codes: C12, C21, D12, I10, I15

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1. INTRODUCTION

Recent spikes in food prices have led to increased concerns about food security. High food prices increase the cost of food for consumers but increase the income of farmers (Swinnen and Squicciarini, 2012). Net effects depend on whether households are net sellers or buyers of food. Food security is especially relevant issue for developing countries (Sub-Sahara, Latin America or Asia), where most food insecure people live, but economic stagnation and rising food prices can significantly affect low income and marginalized groups in developed countries as well. It is therefore important to analyze how income and price shocks affect vulnerable households in developed and transition countries as well.

There are many definitions of food security. FAO (1998) provides the most comprehensive one. It defines food security as a situation "… when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." Hoddinott (1999) offers several frameworks how to measure household food security. He suggests using indicators such as: i) individual food intake; ii) household caloric acquisition; or iii) dietary diversity. In the present study we employ dietary diversity as a measure of the household food security. This measure is especially appropriate for transition and developed countries where severe problems with lack of food are rather rare and low income households suffer mainly from the low quality of diet and variety of diet. More varied diet is more expensive and unaffordable for low income households. Nutrition literature (see, e.g., Hatloy et al., 2000) shows that consumption of diverse diet has positive impact on health and the food diversity is a good indicator of food security for the particular household. Since a large number of vulnerable households reside in the CEE, it is timely to analyze the demand for food diversity in CEE countries. In this paper we particularly focus on Slovakia.

With improved access to household and individual micro data, in the last decades, there has been growing literature on demand for diet diversity. The count measure of food items actually consumed is commonly used as an indicator of the food diversity (see, e.g., Jackson, 1984 or Schonkwiler et al., 1987). Although easy to interpret, the measure does not take into account the distribution of the food consumption. On the other hand, the Berry-Index (Berry, 1971) considers the shares of food items actually purchased in total food household expenditures on food. Drescher et al. (2007) constructed the Healthy Food diversity index which nests the previous two indexes and takes into account three important aspects of food diversity: frequency, distribution, and the health value of the consumed food items. Unfortunately, this index was specifically designed for detailed German data which are rarely available for other countries.

Majority of studies on demand for food diversity focus on developed countries (see, for example, Lee, 1987; Drescher and Goddard, 2011; Theil and Weiss, 2003) while only a few studies investigate food diversity in Central and Eastern Europe (CEE). Given a strong correlation between diet diversity and food and nutritional security and considering significantly lower incomes in CEE than in more developed countries in Western Europe and the USA, the lack of studies on food diversity in CEE countries represents a significant gap in the existing literature. The paper by Cornia (1994) on demand for nutrients and food diversity is an exception. More recently, diet diversity has been analyzed in studies conducted by Moon et al. (2002) for Bulgaria and Herzfeld, Huffman and Rizov (2014) for Russia.

The majority of empirical studies analyze the impact of income on the diet diversity using standard linear regression model (see, e.g., Thiele and Weiss, 2003) or negative binominal regression (see, e.g., Moon et al., 2002). However, some studies have addressed the possible issue of endogeneity of income when modeling demand for food diversity (see, e.g., Skoufias et al., 2009), and estimate the model by two-stage least-squares (2SLS) regression with instrumental variables (IV). The problem of endogeneity arises primarily due to omitted variables such as tastes, physical activity, consumer perceptions, health conditions which are not observable and therefore not included in the household budget survey data. Omitted variables create bias but the sign of it is ambiguous (Doan, 2014).

We estimate the impact of income and other household's socio-economic characteristics on demand for food diversity. We employ Count Measure (CM) and Berry Index (BI) to measure the food diversity. We work with data obtained from the Household Budget Survey of the Slovak Republic; overall covering 8 years (2004-2011).Estimation is done with standard OLS and 2SLS method. Household's monthly net income is the key explanatory variable determining demand for food diversity. We also control for the effect of other socio-demographic variables, such as, region, type of municipality, family size, number of children, number of adults, and age, education and employment status of the household's head.

The main contribution of our paper is an analysis of the detailed micro household data and the computation of income elasticities for food diversity. This has not been done before for any of the new member states of the EU.Theremainderofthepaperisorganizedasfollows. In the second section we describe the theoretical framework that we employ in our study. In the third section the data is described. The estimation approach and results are presented and discussed in section four while the last section concludes.

2. THEORETICAL FRAMEWORK

Our theoretical framework is based on Jackson's (1984) hierarchic demand model for food diversity. Assuming separability of food with non-food commodities, we consider the utility maximization problem for q_j, where j$= 1, .., n$ as follows,

$$u(q_j) = u(q_1, q_2, q_3, \dots, q_n); \ \text{s.t.} \sum_{j=1}^{n} P_j q_j = E \text{ and } q_j \geq 0, \tag{1}$$

where P_j represents the price for commodity$j$ and E stands for the total food expenditure. Kuhn-Tucker conditions are satisfied by the maximization of *u(q)* such that,

$$\frac{\partial u}{\partial q_j} - \lambda \mathrm{P_j} = 0 \text{ if } j \in S \text{ and } q_j > 0\,, \tag{2}$$

$$\frac{\partial u}{\partial q_j} - \lambda \mathrm{P_j} < 0 \text{ if } j \in \bar{S} \text{ and } q_j = 0\,, \tag{3}$$

where the Lagrangian multiplier is denoted by λ, *S* represents the set of goods actually purchased, and $\bar{S}$ is the set of goods not purchased. Solving through (1), (2) and (3), we obtain the Marshallian demand functions $q_j = g_j(P, E)$. If the condition (3) is fulfilled, then $g_j(P, E)$ is equal to zero meaning that in the optimum there should be zero consumption of the good *j* given the price vector and total expenditure. If we define $M(E) = \{i | g_i(P, E) > 0\}$ to represent set of goods in a purchased set given the prices, then the number of distinct food items purchased is determined (by the cardinality of *M*)as a function of the price vector and total expenditure. Hence, Jackson (1984) showed that the set *M* has to be a monotonically increasing function of total expenditure. This theoretical framework leads to the count measure of food diversity during a specific time period which we employ in our analysis.

Second, we construct Berry Index (Berry, 1971) to measure the diet diversity as follows,

$$BI = 1 - \sum_{i=1}^{n} s_i^2, \tag{4}$$

where n represents the total number of food items consumed in a given time period and s_i is the frequency of the particular food consumption (measured as the expenditure share). Berry-Index is bounded between 0 and $1 - \frac{1}{n}$; 0 meaning that a household consumes only one food item and the latter meaning that each food item is consumed equally.[1] Since values of the Berry Index lie in the interval between 0 and 1, the assumption of the

[1]Note that if *n* tends to infinity, the expression $1 - 1/n$ approaches 1.

normality may not be fulfilled. To overcome this issue, the usual logistic transformation can be used (see, Greene, 1997), so that standard OLS regression can be estimated. The modified index is called Transformed Berry Index and is computed as,

$$TBI = \ln\left[\frac{BI}{(1-BI)}\right]. \quad (5)$$

3. DATA

We estimate the impact of income and household's socio-economic characteristics on demand for food diversity based on data from the Household Budget Survey of the Slovak Republic, for years 2004 and 2011. The survey provides detailed information on household incomes and expenditures on food and non-food goods and services. The Household Budget Survey database also contains 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 the annual samples contains approximately 4700 households; however, the samples do not form a genuine panel as surveyed households are randomly selected from the population in each round.

Count measure and Berry Index are employed to measure food diversity. Household's monthly net income is the key explanatory variable determining demand for food diversity. We also control for the effect of socio-demographic variables, such as, regions, type of municipality, family size, number of children, number of adults, age, education and employment status of the household's head.

Table 1 shows definitions and summary statistics of the main variables entering the econometric model. Both count and Transformed Berry Index indicate increase in demand for food diversity of Slovak households between 2004 and 2011. Likewise, there has been a significant increase in the average household's income throughout the time period. Whereas the average family size was 2.91 in 2004, we can observe a slight decrease in household size in 2011 (2.69). The average number of children per household also dropped from 0.53in 2004 to0.46in 2011. On average, there were more households residing in urban areas (62% in 2004 and 58% in 2011), than in rural areas. Average age of the household's head was 51.03 in 2004 and 52.26 in 2011. The household's head was a male more frequently than a female (68.2% in 2004 and 64.4% in 2011). On average, in 73% (2004) and 76% (2011) of all households, the highest educational level of the household's head was high school. Overall, around 60% of all the households' heads were employed in 2004 and 2011, respectively.

Table 1. Definition of the main variables and summary statistics.

Variables	Definition	2004		2011	
		Mean	SD	mean	SD
Count	Number of food items consumed	29.28	6.50	30.66	6.28
TBI	Transformed Berry-Index	2.46	0.36	2.54	0.32
Income	Net household's monthly income (€)	565.16	394.47	1053.95	603.00
Kids	Number of household members below age 16	0.53	0.86	0.46	0.81
Adults	Number of household members above age 18	2.22	0.97	2.11	0.92
Single	1 if single member household; 0 otherwise	0.17	0.37	0.22	0.41
Urban	1 if household residing in urban area; 0 otherwise	0.62	0.49	0.58	0.49
Age	Age of the head of a household	51.03	14.79	52.26	14.57
Gender	1 if male; 0 otherwise	0.68	0.47	0.64	0.48
Elementary	1 if grammar school; 0 otherwise	0.14	0.35	0.09	0.28
High school	1 if high school; 0 otherwise	0.73	0.44	0.76	0.43
University	1 if university; 0 otherwise	0.13	0.34	0.15	0.36
Instruments					
housing	monetary expenses on housing (€)	21.166	72.576	34.474	109.795
travelling	monetary expenses on travelling (€)	35.270	114.862	68.134	199.932

Note: For 2004 monetary values the exchange rate used is 1€ = 40,045 Slovak crowns. There are eight regions in Slovakia, Bratislava, Trnava, Trencin, Nitra, Zilina, BanskaBystrica, Presov, and Kosice which are approximately equally represented in the survey.
Source: HBS (2004, 2011); authors' calculations

4. METHODOLOGY

4.1. Regression analysis

To model the relationship between income and food diversity, we estimate the following regression model,

$$FD_i = \beta_0 + \beta_1 Y_i + \beta_2 H'_i + \beta_3 HH'_i + \beta_4 REG'_i + \varepsilon_i, \quad (6)$$

where FD_i represents two indexes of food diversity (count measure[2] of food diversity and Berry Index respectively); Y_i is the logarithm of household's net monthly income; H'_i represents a vector of household's characteristics, such as family size, number of children and number of adults; $HH'_i$is a vector of individual characteristics of household's head including gender, age, educational level, employment status;REG'_i are covariates capturing regional differences and the type of municipality; andε_i is the unobserved error term. The income elasticity of the food diversity is measured directly by β_1 when diversity is measured by the Berry Index. All estimations are carried out with correction for heteroschedasticity and robust standard errors are reported (White, 1980).[3]

4.2 Two-stage-least-squares regression with instrumental variables

Whereas the majority of empirical studies modeling the relationship between income and demand for food diversity apply standard OLS approach, the possible issue of endogeneity has been stressed (see, e.g. Doan, 2013). In the presence of endogeneity, the estimated impact of income will be biased and inconsistent under the standard OLS approach. Therefore, a more sophisticated two-stage-least-squares regression methodology with instrumental variables has to be applied to address the problem of endogeneity.[4] The use of instrumental variable estimation is often hindered by a lack of suitable instruments. In our case, we need an instrumental variable which is highly correlated with income, but is not correlated with the food diversity or any other unobserved omitted variables influencing food diversity. There have been instruments for income proposed in the economic literature. For example, Behrman and Deolalikar (1987) use education of household head and Skoufias et al. (2009) use non-food expenditure and count of household expenditure as instruments for income. We use expenditure on purchases of household equipment (furniture, appliances, etc.) and expenditure on transportation vehicles (cars, motorbikes, etc.) as instruments for household income. Here we assume that such instruments are likely to be correlated with the net monthly household income, and do not necessarily correlated with the diet diversity measures. The estimation strategy of the 2SLS consists of two stages. The first stage is estimated as follows:

$$Y_i = \pi_0 + \pi_1 IV_{1i} + +\pi_2 IV_{2i} + \pi_3 H'_i + \pi_4 HH'_i + \pi_5 REG'_i + \epsilon_i, \quad (7)$$

where Y_i is logarithm of income; IV_{1i} and IV_{2i} are instrumental variables; H'_i, HH'_i, and REG'_i are same covariates as in (6) and ϵ_i represents the error term. Second stage is estimated as

$$FD_i = \beta_0 + \beta_1 \hat{Y}_i + \beta_2 H'_i + \beta_3 HH'_i + \beta_4 REG'_i + \varepsilon_i, \quad (8)$$

where $\hat{Y}_i$ is the estimated income from the first stage and H'_i, HH'_i, and REG'_i are again the same set of exogenous variables as in equation (6). The error term is given by ε_i. Estimation of the 2SLS is carried out

[2]Note, that count data with lots of zero values may display over-dispersion (i.e. variables variance being greater than its conditional mean). In this case the normal distribution of a variable would be violated. If this was a case, Negative binominal distribution model would be more appropriate to model count variable with many zeros (see, Moon et al., 2002). Furthermore, it has been showed by Gourierouxet al. (1984) that in a presence of over-dispersion, models that assume equal mean and its variance, may lead to inconsistent estimations. However, this is not a case with our dataset, where both variables transformed Berry Index and count measure closely follow a normal distribution with a negligible frequency of zeros (see Appendix 1).

[3]To address the impact of outliers in income, we trim any observations that lie outside two standard deviations of the mean.

[4] Concerns of income endogeneity have also played o role in other empirical studies about the demand for nutrients and food diversity (see, e.g. Strauss and Thomas, 1995; or Skoufias et al., 2009).

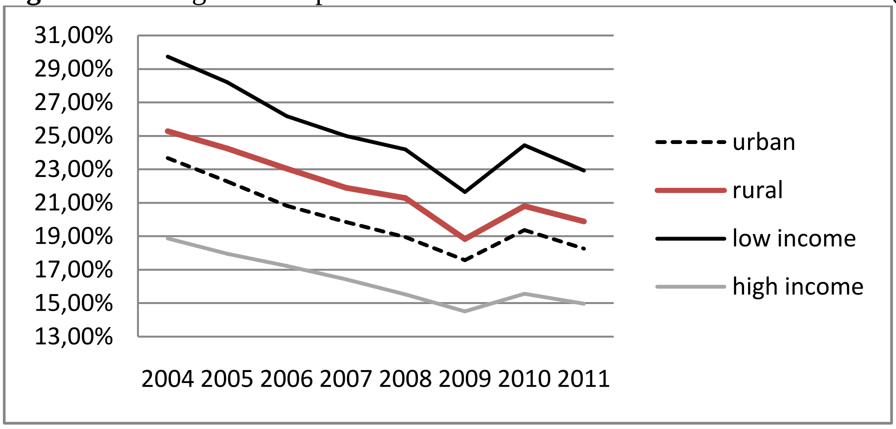
by `ivregress 2sls` command in Stata. We further address the heteroschedastic error term by `vce (robust)` option.

5. RESULTS

Figure 1 shows that the ratio of food expenditure and total income has been steadily declining since 2004. For the low-income subsample (households with income below the median) the ratio has dropped from 30% in 2004 to 22% in 2009. Because of economic crisis the ratio subsequently increased in 2010. The trend for the high-income subsample is very similar but the levels are different – the drop is from 19% in 2004 to 14% in 2009. The food expenditure to income ratio of 14% is comparable with EU-15 levels. There are also differences between rural (20% in 2011) and urban (18% in 2011) household food expenditure to income ratios but these differences are relatively small. The trend in development of food expenditures to income ratio indicates that the food security situation in Slovakia has improved between 2004 and 2011 but there are still differences between income groups and between rural and urban households.

Since 2004, food security situation in Slovakia has also improved from the perspective of consumption of more diverse diet. Figure 2 indicates clear trend towards more diverse food consumption as captured both by the Transformed Berry Index (TBI) and the count measure (CM). Although TBI and CM are highly correlated (see Appendix 2), we can observe different patterns of the food diversity evolution. Whereas the TBI indicates a clear difference between the urban and rural households over the time period, CM indicates that the diet diversity of rural households converged to the urban levels between 2006 and 2009. Nevertheless, an obvious improvement in the demand for the food diversity is noteworthy for both urban and rural households.

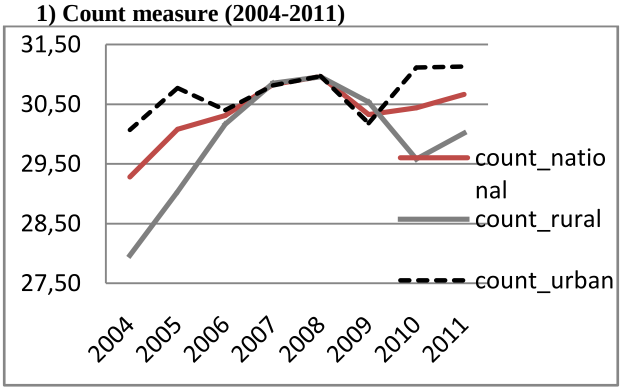
Figure 1. Average food expenditure to income ratios of Slovak households (2004- 2011).



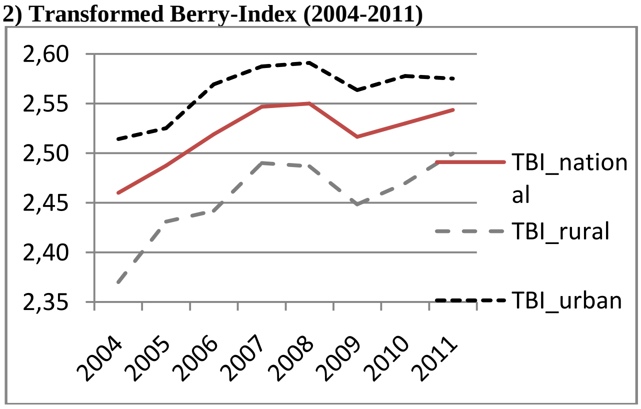
Source: Household Budget Survey of Slovakia, (2004-2011); authors' calculations

Figure 2. Food diversity measures (2004-2011).

1) Count measure (2004-2011)



2) Transformed Berry-Index (2004-2011)



Source: Household Budget Survey of Slovakia, (2004-2011); authors' calculations

Tests of endogeneity and week instruments are listed in Table 2 from which it follows that instruments are highly correlated with the household income in the first stage with R-squared values 0.562 (in 2004) and 0.582 (in 2011) respectively. Using instrumental variables for income, we do not reject the null hypothesis (income is exogenous) in three out of four cases with p-values of the Robust regression F-statistics bigger than 0.05. We either do not reject the hypothesis about the weakness of instruments with p-values of Score chi-squared test bigger than conventional level what confirms that we have found valid instruments for the household income.

Table 2. Tests of endogeneity and weak instruments.

Instruments: expenditures on household equipment and transportation vehicles		2004		2011	
		TBI	CM	TBI	CM
	R-squared	0.562	0.562	0.582	0.582
First stage regression	Robust F	13.507	13.507	10.005	10.005
	P-value	0.000	0.000	0.000	0.000
Test of endogeneity	Robust regression F	4.981	3.246	0.000	0.750
H_0: Variables are exogenous	P-value	0.026	0.072	0.991	0.387
Test of overidentifying restrictions	Score chi-squared	1.472	2.244	0.451	1.749
(Week instruments)	P-value	0.225	0.134	0.502	0.186

Source: HBS (2004, 2011); authors' calculations

Results of the OLS and 2SLS regression analyses are presented in the Table 3. The hypothesis that all coefficients are jointly equal to zero was rejected with the p-values of the F-test (Chi-square test) lower than 0.01 significance level in all regression models. We present results for years 2004 and 2011. Full regression results can be obtained from the authors upon a request.

Based on the regression results from the two rounds (2004 and 2011) we found a significant positive impact of income on demand for food diversity. We have addressed the possibility of non-linear relationship between income and food diversity by estimating regressions with the quadratic term and the inverse term of income respectively, but we did not find any significant contribution to the explanatory power of the particular models. It is worth to mention that estimated income elasticities of food diversity are higher in 2SLS approach. The OLS approach, as shown in this study, understates the role of income.

Food variety is significantly higher for urban households and varies from region to region. As expected, number of adults and kids impacts demand for food variety. Single-member households have lower demand for food diversity in comparison to other household types. Demand for diverse food is also significantly influenced by individual characteristics of the household's head such as education level, gender, and age.

Table 3. OLS and 2SLS regression results (2004).

	OLS				2SLS (second stage)			
	TBI		CM		TBI		CM	
Variable	Coef.	S.E.	Coef.	S. E.	Coef.	S.E.	Coef.	S.E.
Constant	1.058***	0.174	1.813***	0.114	-1.168	0.820	0.474	0.688
Income	0.113***	0.016	0.126***	0.011	0.331***	0.080	0.257***	0.067
Kids	0.001	0.008	0.021***	0.005	-0.004	0.008	0.017***	0.005
Adults	-0.020***	0.007	0.014***	0.004	-0.069***	0.019	-0.016	0.016
Single	-0.079***	0.022	-0.135***	0.017	0.004	0.036	-0.085***	0.030
TT	-0.020	0.022	0.024	0.017	0.004	0.024	0.039**	0.019
TN	0.034	0.023	0.066***	0.017	0.066**	0.026	0.086***	0.020
NR	0.002	0.022	0.020	0.017	0.046*	0.028	0.046**	0.022
ZA	0.056**	0.022	0.064***	0.017	0.084***	0.025	0.081***	0.019
BB	-0.024	0.023	0.028*	0.017	0.019	0.028	0.054**	0.022
PO	0.022	0.022	0.035**	0.017	0.058**	0.026	0.057***	0.020
KE	0.024	0.023	0.048***	0.017	0.055**	0.026	0.067***	0.020
Urban	0.139***	0.011	0.091***	0.007	0.135***	0.012	0.088***	0.008

Age	0.003***	0.001	0.002***	0.000	0.005***	0.001	0.003***	0.001
Primary	-0.056**	0.022	-0.012	0.016	0.032	0.040	0.040	0.032
High school	0.001	0.015	0.023**	0.011	0.047**	0.023	0.051***	0.019
Gender	0.074***	0.014	0.041***	0.010	0.093***	0.016	0.053***	0.011
Prob> F	0.000	-	0.000	-	0.000	-	0.000	-
R-squared	0.078	-	0.203	-	0.027	-	0.167	-

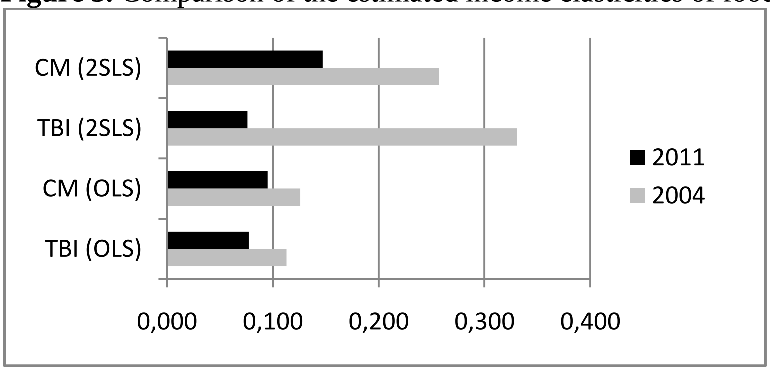
Note: robust standard errors (SE) are presented. *P(<0.1); **P(<0.05); ***P(<0.01). Variables *BA* and *University* were omitted from regressions because of the colinearity problem.
Source: HBS (2004); authors' calculations.

Table 4. OLS and 2SLS regression results (2011).

	OLS				2SLS (second stage)			
	TBI		CM		TBI		CM	
TBI	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Constant	1.791***	0.109	2.436***	0.083	1.803**	0.730	2.070***	0.457
Income	0.077***	0.014	0.095***	0.010	0.076	0.103	0.147**	0.064
Kids	0.018***	0.007	0.031***	0.005	0.018**	0.008	0.029***	0.005
Adults	-0.013**	0.007	0.023***	0.004	-0.013	0.021	0.013	0.013
Single	-0.066***	0.018	-0.118***	0.013	-0.066	0.043	-0.097***	0.027
TT	-0.007	0.019	0.040***	0.014	-0.007	0.021	0.044***	0.015
TN	0.024	0.019	0.077***	0.014	0.024	0.023	0.083***	0.016
NR	-0.059***	0.021	-0.006	0.015	-0.059**	0.027	0.003	0.019
ZA	0.014	0.020	0.050***	0.014	0.014	0.022	0.054***	0.015
BB	-0.019	0.020	0.009	0.014	-0.019	0.026	0.017	0.018
PO	-0.031	0.020	0.025*	0.014	-0.031	0.022	0.030*	0.016
KE	0.012	0.019	0.048***	0.015	0.011	0.024	0.055***	0.017
Urban	0.075***	0.010	0.056***	0.006	0.075***	0.011	0.053***	0.007
Age	0.003***	0.000	0.003***	0.000	0.003***	0.001	0.003***	0.001
Primary	-	-	-	-	-0.003	0.044	0.018	0.028
High school	0.028	0.017	0.040***	0.012	0.025	0.022	0.046***	0.014
University	0.003	0.021	0.002	0.015	0.000	-	-	-
Gender	0.039***	0.011	0.031***	0.008	0.039**	0.016	0.037	0.010
Prob> F	0.000	-	0.000	-	0.000	-	0.000	
R-squared	0.047	-	0.207	-	0.047	-	0.202	

Note: robust standard errors (SE) are presented. *P(<0.1); **P(<0.05); ***P(<0.01). Variables *BA*, *Primary* and *University* were omitted from regressions because of the colinearity problem.
Source: HBS (2011); authors' calculations.

Figure 3. Comparison of the estimated income elasticities of food diversity (2004, 2011).



Source: HBS (2004, 2011); authors' calculations

We present comparison of the estimated income elasticities of food diversity by different estimation methods in Figure 3. It is noteworthy to mention that the magnitude of such elasticities significantly dropped between 2004 and 2011 what clearly indicates an improvement of the household food security in Slovakia.

5. CONCLUSIONS

We have found a clear trend of food diversity increase throughout the period 2004- 2011 which is consistent with other studies on transition countries. Furthermore, the estimated income elasticities of the food diversity seem to converge to the levels of the Western European countries, taking the example of Germany.

We have estimated income elasticities for food diversity by standard OLS and 2SLS because of the possible income endogeneity issue. If we compare the estimated elasticities by both methods we find that 2SLS income effects are larger in magnitudes than income effect produced by OLS indicating downward bias of the OLS estimation.

Regression results also indicate quite low explanatory power of the models what can be attributed to the unobserved household preferences for food diversity. As argued by Thiele and Weiss (2003), a more advanced panel data approach is necessary to employ in order to assess demand for food diversity. True panel data is therefore needed to advance further the analysis on the issue of unobserved heterogeneity.

As it has been argued in the nutritional literature, consuming diverse diet ensures balanced intake of macro and micro nutrients, supports overall human health and prevents from several serious illnesses. Therefore an income aid for the low income households and an educational enlightenment on the nutritional value of food items could improve food and nutritional security of vulnerable households in CEE.

ACKNOWLEGMENT

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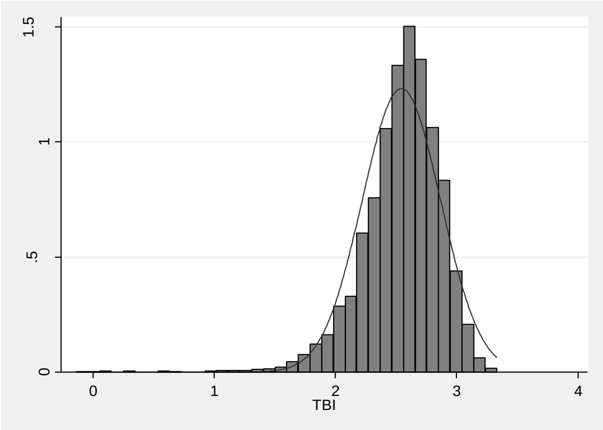
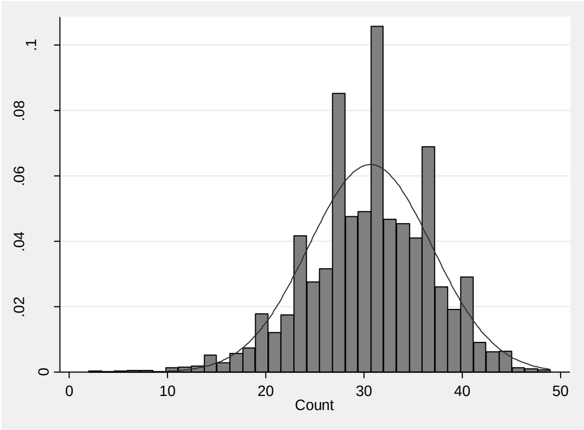
Appendix 1. Distribution of the food diversity indexes (2011).

1) Histogram: Transformed Berry- Index



2) Histogram: Count Measure



Appendix 2. Correlation between Transformed Berry-Index and Count Measure.