FOOD AND NUTRITION SECURITY IN THE EU: THE CASE OF SLOVAKIA

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

[a] Slovak University of Agriculture, Nitra, Slovakia
[b] Middlesex University Business School, London, UK

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Introduction and motivation

- **End of communism**
    - Per capita consumption of food in CEECs comparable to the West.
    - High food consumption achieved at much lower incomes.
    - Ag. production and food consumption heavily subsidized.
        - State subsidies to agro-food economy estimated to equal 10 % of GDP in 1990 (World Bank), bulk going to livestock sector

Introduction and motivation

- **Economic reforms and transition**
  - Sharp initial decline of food consumption
  - Changes of diets: away from livestock products and towards staple foods.
  - Better access to higher quality imported food products,
  - Widened assortment of foodstuffs
  - FDI into food processing and retail sectors
  - Competition forced domestic food companies to improve quality standards.

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Introduction and motivation

- **EU accession**
  - CAP subsidies significantly increased incomes of farmers,
  - Quality, sanitary, and phytosanitary standards of food products increased due to the application of EU laws as well as due to inflow of foreign direct investment into food processing and retail sectors (Dries and Swinnen, 2004, Dries, Reardon, and Swinnen, 2004, Chevassus-Lozza et al., 2005).
  - EU membership and reforms:
    - factors behind strong economic performance in 2000s that significantly increased incomes of majority of population.

Introduction and motivation

"Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life."

(World Food Summit, 1996/2009)

Introduction and motivation

Four pillars of food security

- **Availability**
- **Access**
- **Utilization**
- **Stability**

Introduction and motivation

Availability: extent to which food is within reach of households and largely determined by supply and demand.

- Production to large extent determined by CAP,
- Production determined by climate change and extreme weather events in Southern states
- Climate change transmitted via trade, EU the largest food importer
- Significant heterogeneity between countries

Introduction and motivation

Figure 2: Food availability in the EU15 and NMS
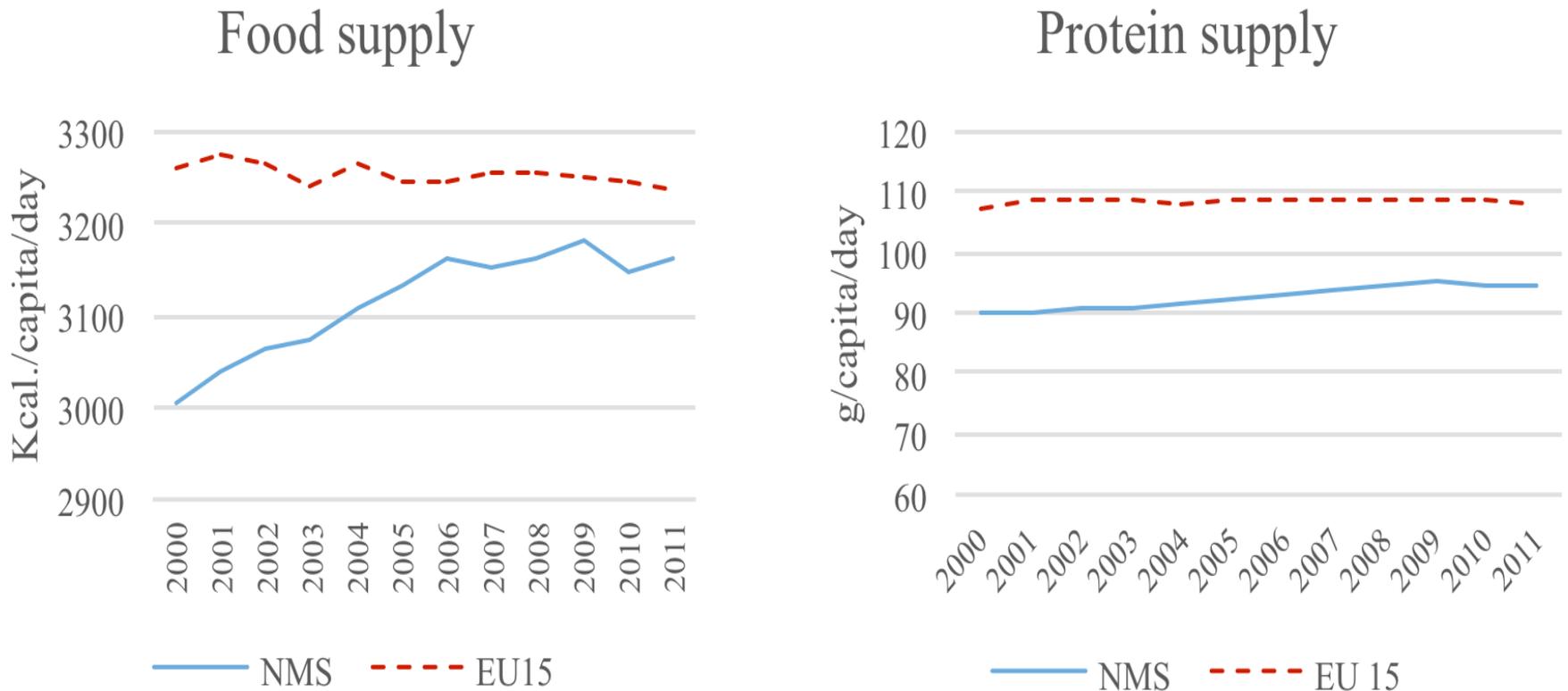
Source : FAO (2014)

Introduction and motivation

- **Availability** not a sufficient condition for *access* to food.

- **Access** determined by
  - cost of food
  - household income.

  The cost of food in the EU is low and the average household spends only 15 per cent of the total budget on food.

Introduction and motivation

Utilization dependent on food quality, sanitation, healthcare

- Overweight and obesity serious public health challenges in EU

- Cause 9-12 % and 16-20% of deaths in EU15 and NMS respectively (WHO, 2014).

- **Overweight/obesity mostly affect lower income people.**

Introduction and motivation

Figure 3: Overweight and obesity in the EU
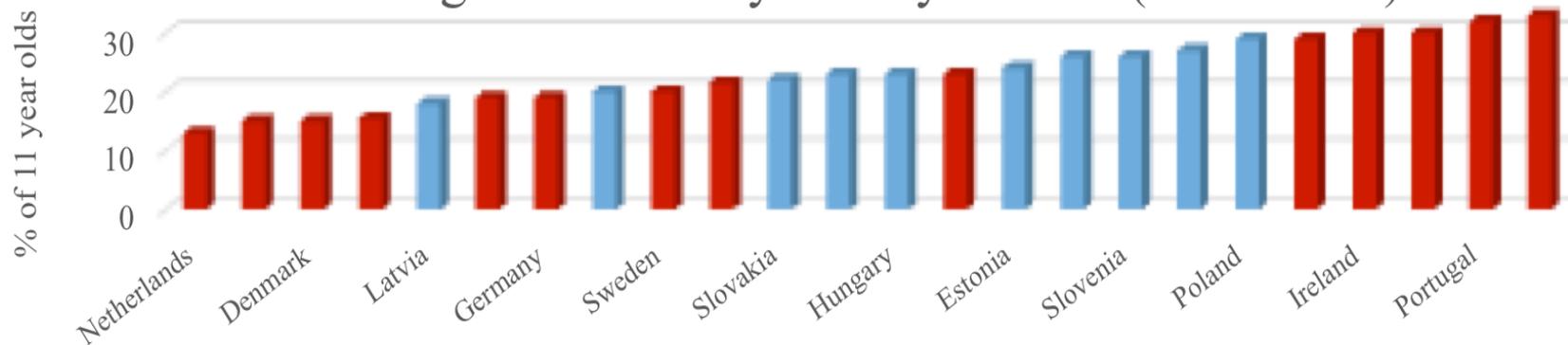
Source : WHO (2014); Currie et al.(2012)

Introduction and motivation

Micronutrient deficiencies are not uncommon.

- Viñas et al. (2011) report high prevalence of inadequate intakes of vitamin C, D, Calcium, Selenium and Iodine in the EU.

- **Socioeconomic conditions and income important predictors of diet quality** (Darmon and Drewnowski, 2008),

- NMS have higher prevalence of anemia among children.

Introduction and motivation

Figure 5: Anemia in the EU
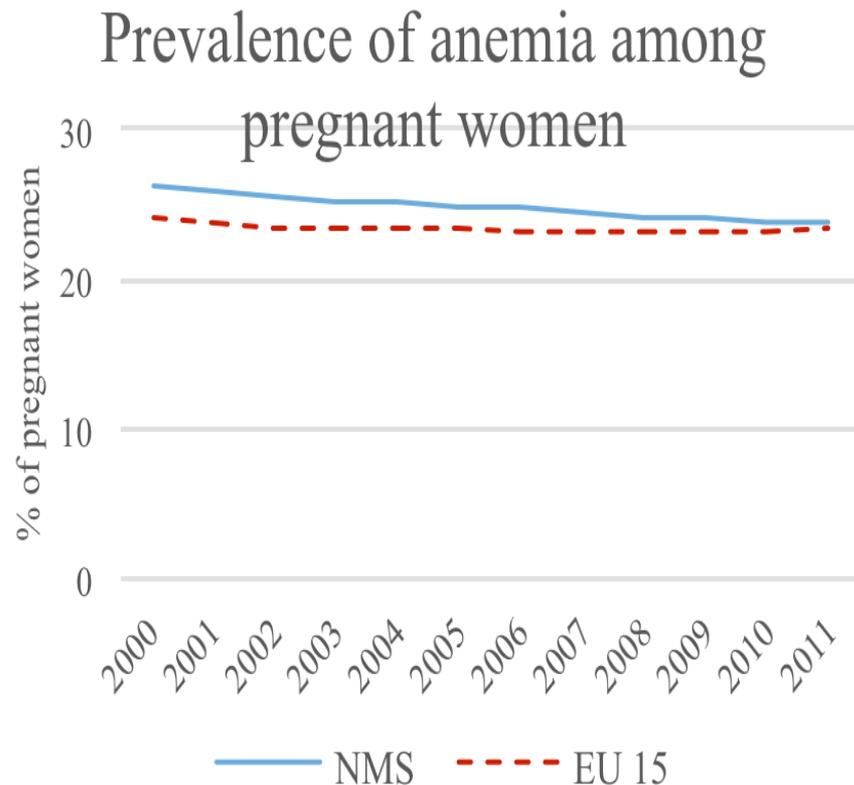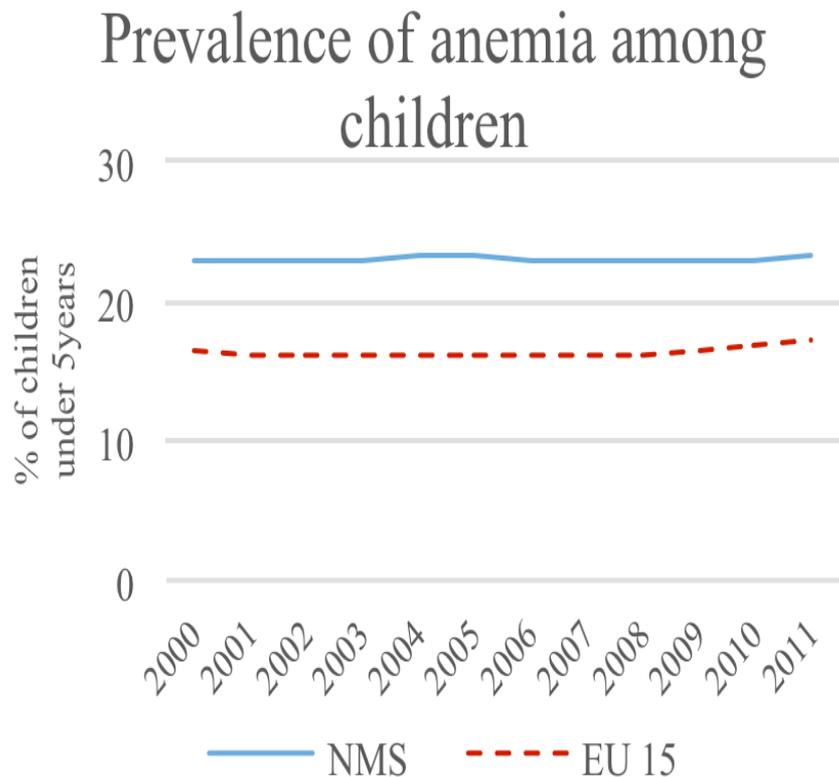
Source : FAO (2014)

Introduction and motivation

- **Diets in NMS particularly monotonous**, majority of energy from consumption of starch and cereals (Swinnen and Van Herck, 2011).

- Share of starchy foods in total dietary energy consumption on average remains larger in the NMS.

Introduction and motivation

Figure 6 : Share of starchy food (cereals, roots and tubers)
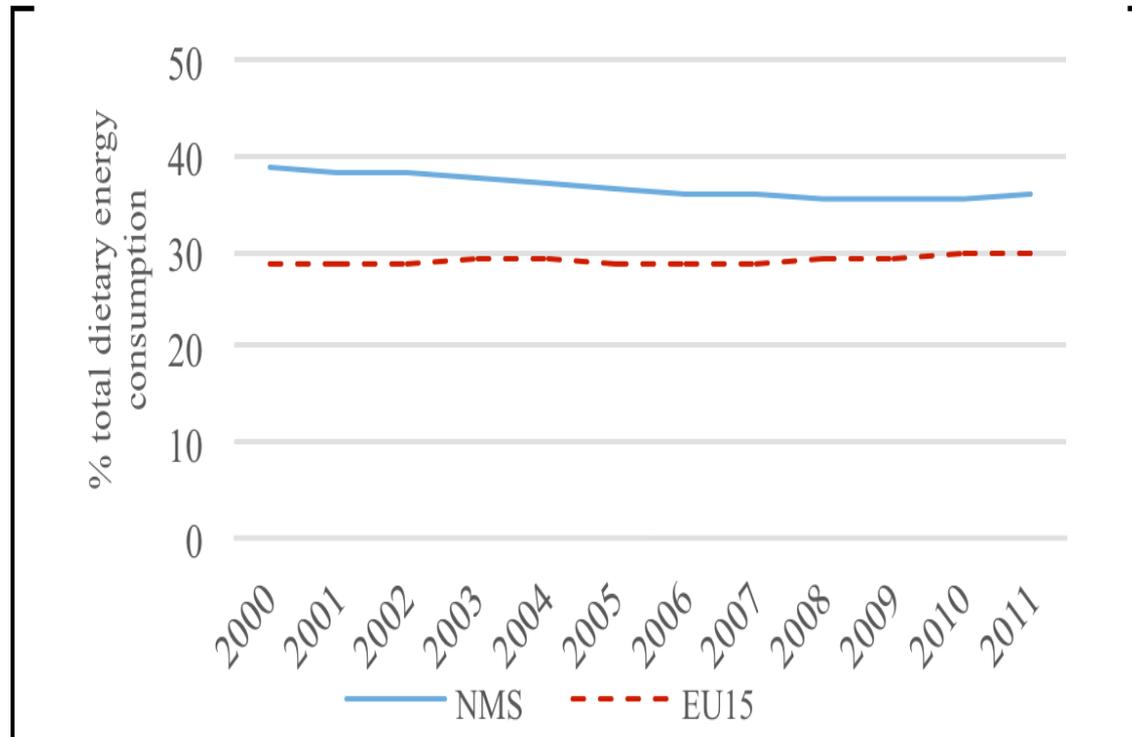
Source : FAO (2014)

Introduction and motivation

Stability of the food and nutrition status.

- The impact of food price volatility mitigated due to low average share of food expenses in the household budget.

- Considerable **heterogeneity** among Member States.

- Share of food consumption in total household expenditure remains considerably higher in the NMS (see Figure 7).

Introduction and motivation

Figure 7 : Share of food and non-alcoholic beverages consumption
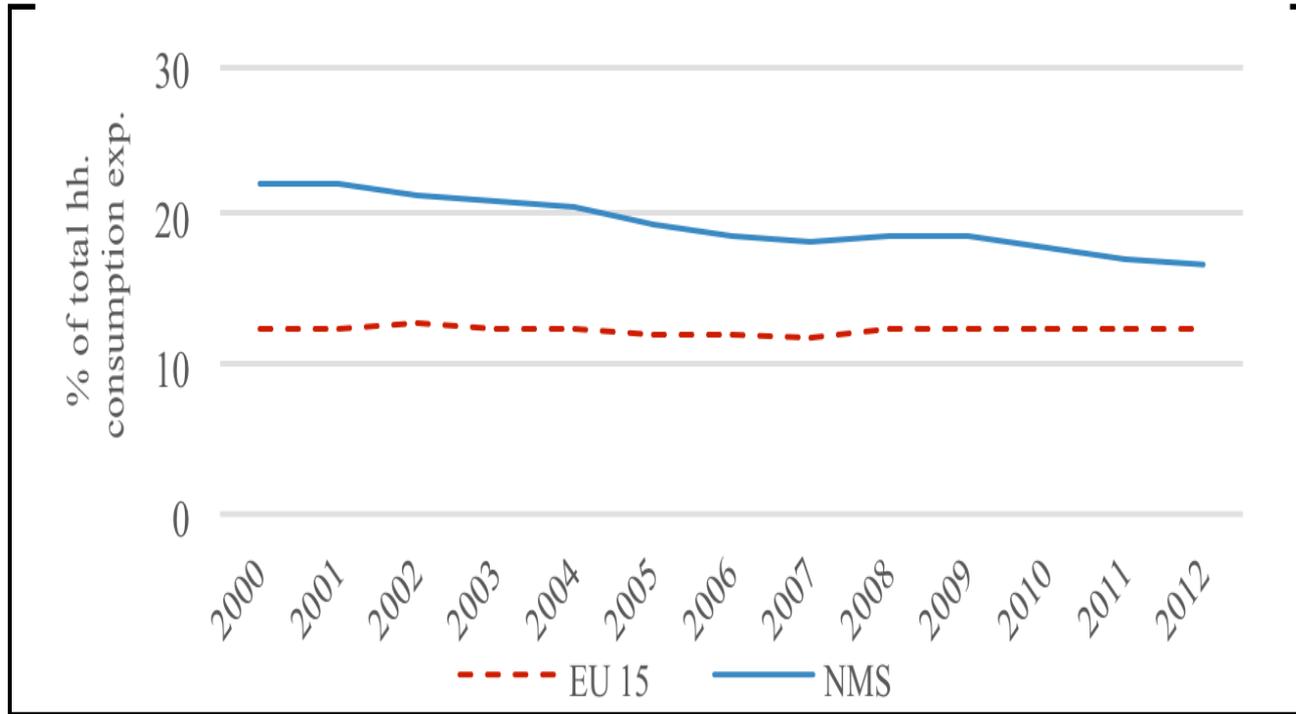
Source : Eurostat (2014)

Introduction and motivation

- Decreasing budget share of food in Slovakia

Food expenditure to income ratio

Legend: urban, rural, low-income, high-income
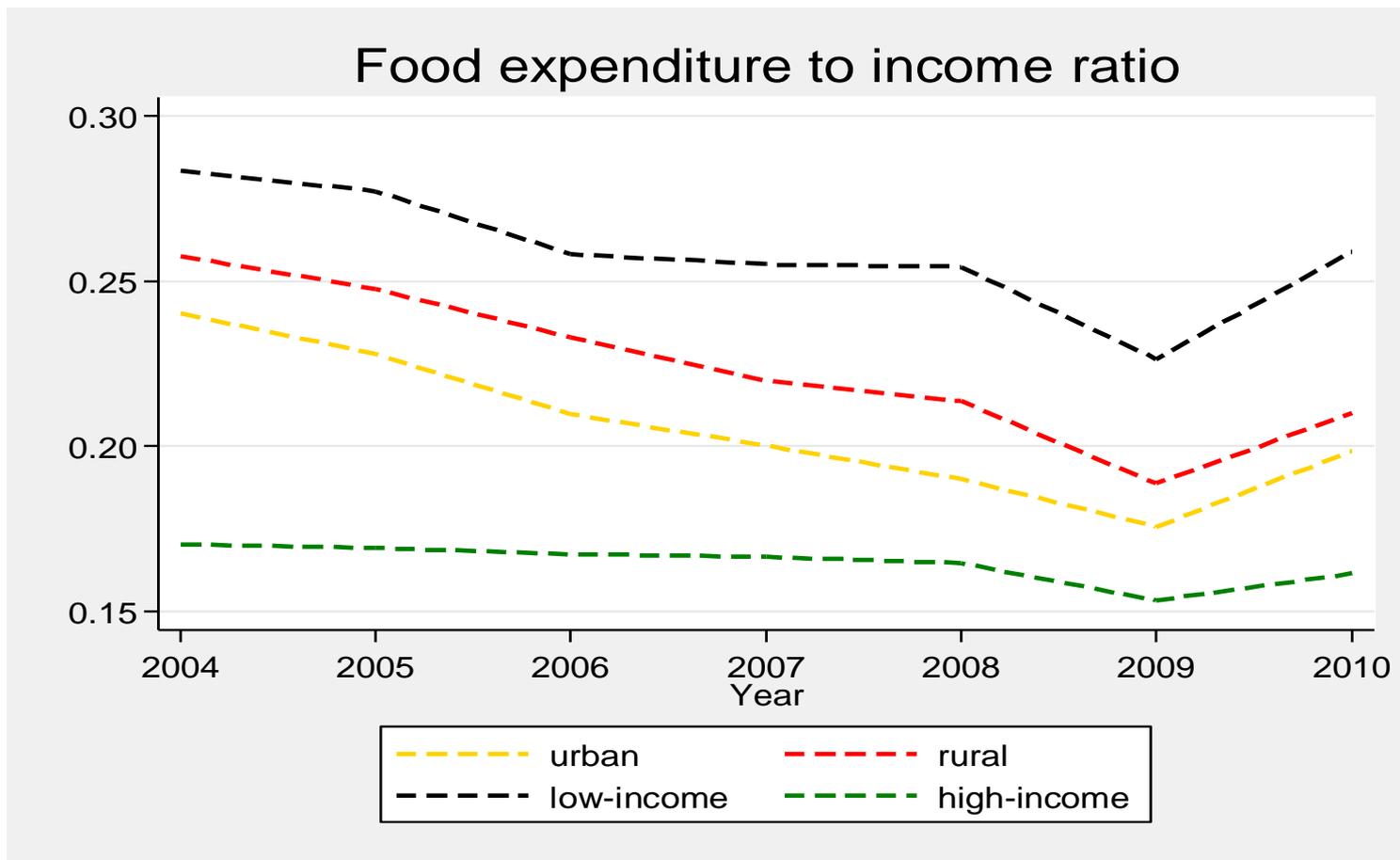
Introduction and motivation

- NMS will experience the strongest impact from climate change on domestic consumer prices (Oxfam, 2013).

- Domestic Food Price Volatility (standard deviation of the deviations from the trend over previous 5 years) higher in NMS (FAO, 2013).

Introduction and motivation

Figure 8 : Domestic Food Price Volatility
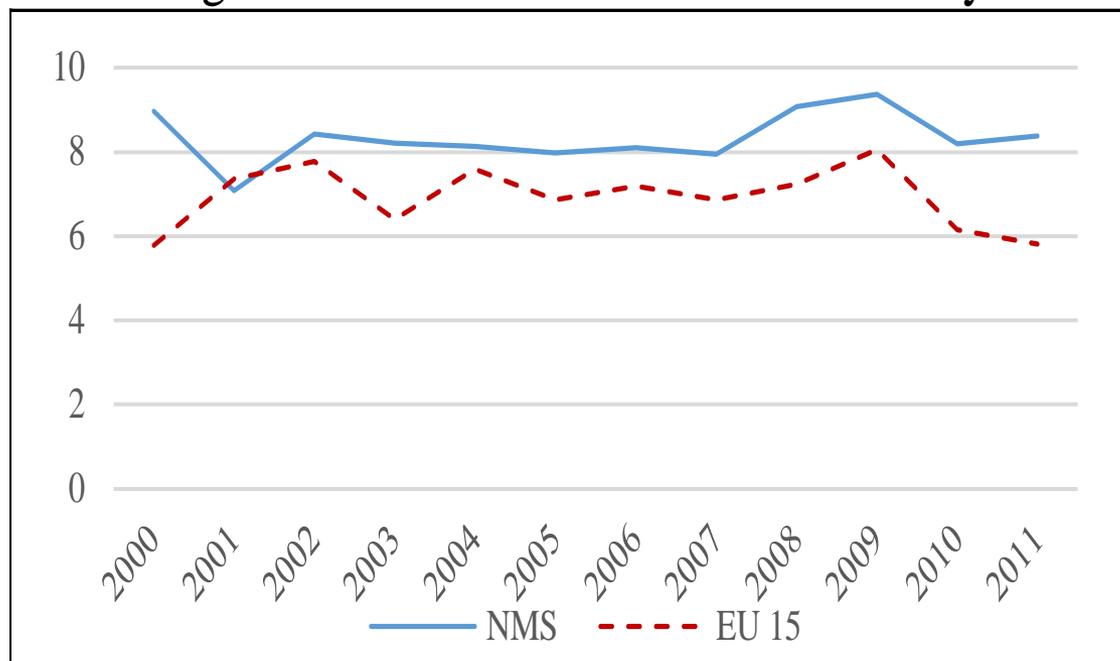
Source : FAO (2014)

Introduction and motivation

- We concentrate on
  - **Access to food (effective demand for food)**
  - **Quality of diets (dietary diversity)**

Previous studies

- There are several (older) studies on food demand in developed European countries (Molina, 1994 for Spain; Banks et al., 1996; 1997 for the UK; Moro and Sckokai, 2000 for Italy; Abdulai, 2002 for Switzerland).

- A few food demand analyses on the NMS, however they are usually partial, focusing on specific food groups, e.g., Hupkova et al., 2009 and Zetkova and Hoskova, 2009 for Slovakia; Szigeti and Podruzsik, 2011 for Hungary. Janda et al., (2009) estimate a complete demand system, including food for the Czech Rep.

- Some studies on diet diversity and quality of diet (e.g. Moon et al., 2002 for Bulgaria; or Rizov et al., 2014 for Russia).

Methodology

- Analysis of FNS in Slovakia is provided in two steps:

1. Analysing access to food by estimating food demand elasticities by QUAIDS model.

2. Analysing quality of diet by estimating diet diversity functions by standard OLS and Quantile regressions to capture heterogeneous effects

Methodology - QUAIDS

- Estimating food demand elasticities by QUAIDS,

  Several demand systems used for modelling the allocation of total expenditures among commodities given certain budget.

  - Linear Expenditure System (LES) (Stone, 1954),

  - Rotterdam model (Barten 1964)

  - Indirect Translog System (ITS) (Christensen et al., 1975),

  - **Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980).**

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Methodology - QUAIDS

- 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.**

Methodology - QUAIDS

- Banks et al. (1996; 1997) show that the correct approximation of Engel curves requires a higher order logarithmic term of expenditure and propose QUAIDS which nests AIDS and also satisfies the restrictions of demand theory.

- **QUAIDS thus allows as income increases a good to change from normal to inferior one**.

Methodology - QUAIDS

- As in Banks et al. (1997) household preferences follow the indirect utility function:

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

- term [ln*m* - ln*a*(p)]/*b*(p) is the indirect utility function, *m* is income, and a(p), *b*(p) and λ(p) are functions of the vector of prices p.

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Methodology - QUAIDS

- The price index ln$a$(p) has the translog form:

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

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

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

- λ(p) is defined as:

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

Methodology - QUAIDS

- Adding-up property of demand system requires that:

$$\sum_{i=1}^{n} \alpha_i = 1 \qquad \sum_{i=1}^{n} \beta_i = 0 \qquad \sum_{i=1}^{n} \lambda_i = 1 \qquad \sum_{i=1}^{n} \gamma_{ij} = 0$$

- Symmetry restriction of the Slutsky matrix is given by:

$$\gamma_{ij} = \gamma_{ji} \quad \forall i \neq j$$

- By applying Roy's identity to the indirect utility function, the budget shares in the QUAIDS are derived as:

$$w_i = \alpha_i + \sum_{i=1}^{k} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\frac{m}{a(p)}\right\}^2$$

Methodology - QUAIDS

QUAIDS with demographics

- Majority of previous studies extend the system with demographic variables following Pollak and Wales (1981) where the demographic effects shift the intercept α_i

- **We follow the scaling approach introduced by Ray (1983)** which has been implemented by Poi (2012) into QUAIDS where for each household the expenditure function of a representative consumer is scaled by function

$$m_0(p, z, u) = \overline{m}_0(z)\varphi(p, z, u)$$

  - z represents a vector of s characteristics and u is direct utility
  - first term measures the increase in a household's expenditures as a function of z, not controlling for any differences in consumption patterns.
  - second term (φ(p,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.

Methodology - QUAIDS

- The budget share equation augmented with demographic effects becomes

$$w_i = \alpha_i + \sum_{j=1}^{k} \gamma_{ij} \ln p_j + (\beta_i + \eta_i' z) \ln\left\{\frac{m}{\overline{m}_0(z)a(p)}\right\} + \frac{\lambda_i}{b(p)c(p,z)}\left[\ln\left\{\frac{m}{\overline{m}_0(z)a(p)}\right\}\right]^2$$

Methodology - QUAIDS

- Similar to Banks et al. (1997) and Poi (2012) the expenditure and price elasticities are obtained by partially differentiating the share equations with respect to ln*m* and lnp_j

$$\mu_i = 1 + \frac{1}{w_i}\left[\beta_i + \eta_i' z + \frac{2\lambda_i}{b(p)c(p,z)}\right]\ln\left\{\frac{m}{\overline{m}_0(z)a(p)}\right\}$$

$$\mu_{ij} = -\delta_{ij} + \frac{1}{w_i}\left(\gamma_{ij} - \left[\beta_i + \eta_i'z + \frac{2\lambda_i}{b(p)c(p,z)}\ln\left\{\frac{m}{\overline{m}_0(z)a(p)}\right\}\right]\times\left(\alpha_j + \sum_l \gamma_{il}\ln p_l\right) - \frac{(\beta_i + \eta_i'z)\lambda_i}{b(p)c(p,z)}\left[\ln\left\{\frac{m}{\overline{m}_0(z)a(p)}\right\}\right]^2\right)$$

- And then income and price elasticities are calculated as follows:

$$e_i = \mu_i / w_i + 1 \qquad e_{ij}^u = \mu_{ij}/w_i - \delta_{ij} \qquad e_{ij}^c = e_{ij}^u + e_i w_j$$

- Slutsky equation used to calculate compensated elasticities

Methodology – estimating diet diversity

- Diet diversity analysis is based on the Jackson's (1984) theoretical model of demand for variety

    - As incomes increase consumers tend to increase **quantity of goods consumed**

    - As incomes rise consumers increase **number of goods consumed**

- Final diet diversity demand function has the following form:

$$D_h = f_h\left(p', m_h, rp_h, Z_h\right)$$

- where D is food diversity indicator (BI or CM); p is vector of food prices, m is household income, and rp represents risk premium, and Z is a set of household characteristics (HH size, educations and working status of the HH head, etc.

- Food diversity measures: $\quad BI = 1 - \sum_{i=1}^{n} s_i^2$

- Demand functions are estimated by standard OLS and Quantile regressions

Methodology – estimating diet diversity

- Estimated **expenditure and price elasticities measure sensitivity of households to market shocks** and thus provide insight into the access of households to food in uncertain market environment.

- The more concave the expected utility function the more risk averse the consumer - a property captured by Arrow-Pratt measure of absolute risk aversion: $r(q)=-u''(q)|u'(q)$,

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, rq and the variance of income.

Methodology – estimating diet diversity

- **Diet diversity linked to decision making under uncertainty**

- **Risk premium proxied with price elasticity estimates from the QUAIDS.**

  - they are a good proxy for risk premium capturing both household risk aversion and variance of expected income

- We aggregate estimated price elasticities into a single measure by factor analysis.

- Estimated **elasticities** in the first stage **measure sensitivity to market shocks and access of households to food in uncertain market environment**

Data

- **HBS for Slovakia**

  - Seven annual rounds, from 2004 to 2010

  - Annual sample between 4700 and 6000 households

  - We aggregate food commodities into 5 groups: cereals, meat and fish, dairy products and eggs, fruits and vegetables, and other food products

  - 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 computed using the geometric mean with expenditure shares as weights (e.g., as in Abdulai, 2002).

Data

- **HBS for Slovakia**

  - We follow the Cox and Wohlgenant's (1986) approach and quality adjust aggregate commodity prices by regression. Prices in cross-sectional data reflect quality effects which should be corrected for prior to estimation (Deaton, 1989)

    - Price is household specific. Variation in prices due to differences in the composition of items consumed and due to quality differences, seasonal and regional conditions.

    - 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.

Data

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

Variable	Definition	2004		2010	
		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; dummy: 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, Banska Bystrica, Presov, and Kosice which are approximately equally represented in the survey.

Descriptive characteristics

- **Between 2004 and 2010 in Slovakia**
  - **Access to food and quality of diets improved**
    - **Incomes almost doubled**
    - Prices of cereals and diary more than doubled
    - Prices of meat and fish, fruits and vegetables, and other food products increased slightly.
    - **Slight increase in total food expenditure**.
  - **Food expenditure and quantities remained stable.**
  - **Noticeable increase in the fruits and vegetables expenditure share and diet diversity => important for the FNS; however households still do not consume the recommend levels**

Results: QUAIDS

- Parameters of QUAIDS model and food demand elasticities are estimated separately for each year.

- 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

- The demographic and regional control variables are generally significant and have the expected effects

- Wald tests confirm significance of the squared expenditure term as well as an importance of demographic variables regarding the food demand expenditure patterns

Results: QUAIDS

- **Income effects are important in consumer demand decisions**
  - Demand for fruits and vegetables (1.44), meat and fish (1.22) is income (expenditure) elastic
  - The uncompensated own-price elasticities of meat and fish and fruits and vegetables are close to unity or greater than unity revealing price elastic demand
  - The demographic and regional control variables are generally significant and have the expected effects
  - Signs of 13 of 20 compensated price elasticities differ from signs of uncompensated elasticities = income effects important.
- **Income is a major constraint in food consumption**

Results: QUAIDS Food demand elasticities, rural

	Cereals	Meats	Dairy	Fruits & veg.	Other	
Compensated price elasticities						**Budget el.**
Cereals	**-0.80**	0.36	0.22	0.17	0.05	**0.77**
Meats	0.19	**-0.65**	0.16	0.09	0.21	**1.07**
Dairy	0.44	0.12	**-0.92**	0.10	0.27	**1.29**
Fruits & vegs.	0.43	0.08	0.25	**-1.06**	0.29	**1.39**
Other	-0.06	0.45	0.22	0.20	**-0.81**	**0.71**
Uncompensated price elasticities						
Cereals	**-0.96**	0.12	0.08	0.07	-0.09	
Meats	-0.03	**-0.98**	-0.03	-0.03	0.00	
Dairy	0.16	-0.27	**-1.16**	-0.05	0.02	
Fruits & vegs.	0.13	-0.34	0.00	**-1.21**	0.02	
Other	-0.21	0.24	0.09	0.11	**-0.94**	

Results: QUAIDS

- **FNS has improved between 2004 and 2010**
  (Reduction in the relative income constraints on food consumption and diet composition choices)
  - **Own-price elasticities declined** for all food groups.
  - Convergence of expenditure elasticities at lower level.
  - Slovak households have become less prone to food price shocks.
  - Hike in price sensitivity around 2009-2010 due to global food crisis and economic crisis.

Results: QUAIDS

- **Substantial heterogeneity of demand responses**
  - Between rural and urban
  - Between low and high income households
  - Higher sensitivity to price and income shocks in the rural and low-income subsamples.

Results: QUAIDS

- **Evolution of the food demand elasticities over time**

Evolution of the compensated own-price elasticities

Evolution of the expenditure elasticities

Legend: Cereals, Meat and fish, Dairy products, Fruits and vegetables, Other food
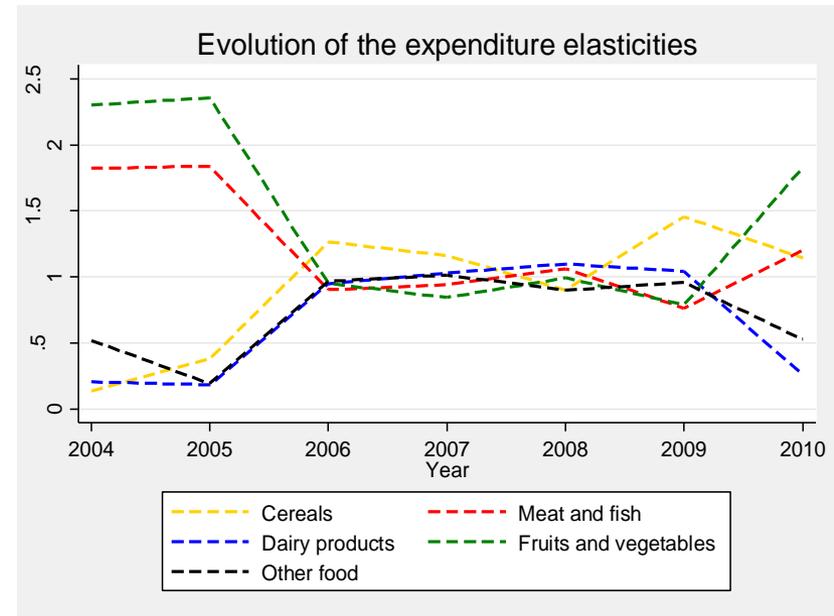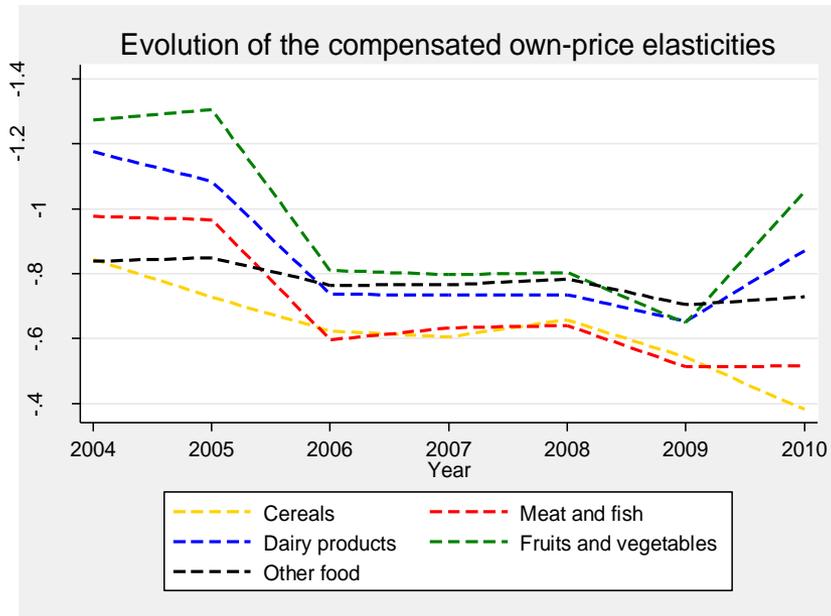
- Declining own-price elasticities; slight increase after crisis

- Convergence in expenditure elasticities towards 1; some divergence after crisis

Results: Diet Diversity

- **Significant positive effect of income on diet diversity, stronger effect of income at lower quantiles**
  - 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 exhibited by households at the higher end of the diet diversity distribution.
- **Uncertainty affects negatively food consumption and diet diversity**

Results: Diet Diversity

- **The effect of education is generally significant positive** and stronger at higher quantiles of the diet diversity distribution.
- Better-educated consumers may be more aware of the importance of healthy eating and therefore spend money on more diverse (balanced) diet.
- **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.
- Size of the household has some complex impacts on demand for diet diversity

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Conclusion

- Consumption patterns have changed along with improved FNS situation between 2004 and 2010

- Significant heterogeneity among groups of population

- Income is a major constraint to improve FNS

- Because 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** (reducing unemployment, income aid for food for vulnerable HH's, etc.)

- Improved quality of diets since 2004

- Education important for household quality of diets

THANK YOU FOR YOUR ATTENTION!

Jan Pokrivcak
Faculty of Economics and Management
Department of Economic Policy
jpokrivcak@yahoo.com | jan.pokrivcak@uniag.sk

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