

At-Risk-of-Poverty Rate or Social Exclusion in Visegrad Countries 2005–2017: Impact of Changes in Households' Structure

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Abstract

The paper focuses on the poverty and social exclusion measurement. The aim of the paper is to analyse the factors influencing the differences in at-risk-of-poverty or social exclusion (AROPE) rates and their development across the Visegrad countries. As these factors, we consider the different structure of households by their social status (employed, unemployed, retired, other inactive) and the different highest attained level of education (primary, secondary, tertiary). We use data from the EU-SILC and decompose the AROPE rates as the price indices of unit value. We prove the significant impact of the structure of households by their social status in years 2005–2017 on the AROPE rate comparison for all Visegrad countries and the effect of educational composition on the AROPE rate development for all Visegrad countries except Hungary.⁴

Keywords

At-risk-of-poverty, social exclusion, price index of unit value, AROPE, international comparison

JEL code

I32, C43

INTRODUCTION

Measurement and analysis of poverty is the subject of many recent papers. Angel, Heuberger and Lamei (2018) compared differences in households' incomes based on surveys and registers. They also analysed how the methodological and empirical differences influence the number of people at risk of poverty.

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They used Austrian data from the European harmonised survey Statistics on Income and Living Conditions (EU-SILC). Angel et al. (2018) compared the data from surveys and registers using two models based on the income situation of households and the social and economic characteristics of households. The first model applied the Ordinary Least Squares (OLS) method; the second one used the multinomial regression. They utilised data from years 2008–2011 of about 6 000 households. The authors concluded a substantial increase in the at-risk-of-poverty rate between 2008 and 2011 and the difference in results when using data from the different data sources (registers and surveys).

Ayllón and Gábos (2017) analysed the relationship between indicators of poverty and social inclusion constructed in the framework of the Europe 2020 Strategy (Eurostat, 2019). This strategy sets up five main goals related to the social and economic area of the EU countries and supports the smart, sustainable and inclusive growth. The authors used three indicators: At-Risk-of-Poverty Rate (AROP), Severe Material Deprivation Rate (SMD) and Low Work Intensity Rate (LWIR). The authors compared data on eight EU countries from the years 2004–2010. For the Central European countries (Hungary and Poland), they prove the relationship between AROP, SMD and LWIR. For other countries, they did not verify a connection between these indicators.

Giarda and Moroni (2018) explored the regional differences in the at-risk-of-poverty rate. They compared the data for Italy with the data from the period 2009–2012 for France, Spain and the UK. Similarly to Ayllón and Gabos (2017), they took into account the targets of the Europe 2020 Strategy. The authors analysed the transition processes from and to the at-risk-of-poverty state. Using the econometric models, they found the main factors which influence the at-risk-of-poverty. As the factors, they considered regional differences for the explanation of the persistent-at-risk-of-poverty. According to the authors' conclusion, the economic recession affected more the Mediterranean countries compared to the Central European and Nordic countries. Using the Heckman model (Heckman, 1979), the authors proved the persistent-at-risk-of-poverty in all analysed countries; this type of poverty is stronger in Italy, France and Spain comparing to the UK. In Italy, there is a stronger impact of regional differences in the persistent-at-risk-of-poverty, comparing to other countries.

There are several ways to understand changes in poverty using index decomposition. Inchauste et al. (2014) summarised slightly different approaches, the Datt-Ravallion Method (Datt and Ravallion, 1992) and the Shapley Decomposition proposed by Shorrocks (2013). Some authors use one of these types of decomposition for analysing country data (e.g. Huppi and Ravallion, 1991, for Indonesia; Fujii, 2017, for Philippines). We discuss these approaches in detail in the methodology section.

Our paper aims to analyse the factors of the differences in the at-risk-of-poverty rates between four Visegrad countries using the decomposition of the unit value index into the levels effect and substitution effect. We focus on the impact of changes in households' structure by the demographic characteristics of households and head of households, in particular by the status and education attained of the head of household.

We organise the paper as follows. Firstly, we describe data sources (Eurostat EU-SILC) database and methodology (index decomposition). Secondly, we present results of our analysis, divided into the effect of changes in the social structure of households and changes in their education structure, comparing the development in Visegrad countries. Finally, we discuss the results.

1 DATA AND METHODOLOGY

For the analysis of differences in at-risk-of-poverty or social exclusion (AROPE) rate between the Czech Republic, Poland, Slovakia and Hungary we use the data from the European survey Statistics on Income and Living Conditions (EU-SILC). From the Eurostat database, we extract data from four EU-SILC tables:

- *Distribution of population over 18 years by most frequent activity status, age group and sex,*
- *People at risk of poverty or social exclusion by most frequent activity status (population aged 18 and over),*

- *Distribution of population aged 18 and over by educational attainment level and age group, and*
 - *People at risk of poverty or social exclusion by educational attainment level (population aged 18 and over).*
- Data from these tables for all four countries are presented in Tables 1 to 4.

Table 1 Distribution of population over 18 years and at-risk-of-poverty and social exclusion rate by most frequent activity status and education attainment level, 2005–2017, Czech Republic

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Population by most frequent activity status (%)													
Employed	55.9	55.1	54.7	55.5	55.7	54.4	53.8	53.7	54.3	54.2	54.7	55.4	56.5
Unemployed	6.3	6.2	5.9	4.9	4.0	5.2	5.4	5.2	5.4	5.6	5.3	4.8	3.9
Retired	27.5	28.0	28.3	28.4	24.3	24.4	25.5	26.2	26.2	26.4	26.6	27.0	27.1
Other inactive	9.9	10.4	10.8	10.9	15.6	15.5	14.9	14.5	13.6	13.4	13.0	12.6	12.3
Population by educational attainment level (ISCED11, %)													
Levels 0–2	15.5	14.6	14.1	13.9	14.5	13.8	12.9	12.6	12.2	11.4	11.2	11.0	10.7
Levels 3–4	73.3	74.2	74.0	74.0	72.5	72.2	72.1	71.8	72.2	71.1	71.0	70.9	70.2
Levels 5–8	11.2	11.2	11.9	12.2	13.0	14.1	15.0	15.6	15.7	17.5	17.9	18.1	19.1
AROPE by most frequent activity status (%)													
Employed	9.1	8.1	6.5	7.0	6.4	6.7	7.3	7.6	7.4	6.6	6.3	5.9	5.2
Unemployed	69.1	64.9	61.0	62.9	60.5	53.5	56.8	59.6	59.3	59.0	57.0	62.3	57.5
Retired	22.2	20.7	17.8	19.2	14.3	12.3	12.5	12.8	12.3	11.7	11.8	10.8	13.2
Other inactive	24.3	22.4	18.8	18.6	23.5	24.4	26.3	27.1	26.2	26.8	25.1	25.1	23.8
AROPE by educational attainment level (ISCED11, %)													
Levels 0–2	33.8	33.0	30.2	29.7	29.0	28.7	29.8	29.7	32.4	32.0	31.6	32.8	29.5
Levels 3–4	16.9	15.5	13.0	13.1	11.6	12.1	13.4	14.0	13.3	13.3	12.3	11.4	11.2
Levels 5–8	5.5	4.9	4.0	5.7	5.0	4.6	4.7	4.7	4.1	4.2	4.1	3.8	4.1
AROPE total	18.1	16.8	14.4	14.5	13.3	13.3	14.2	14.6	14.2	13.7	13.0	12.3	11.8

Note: ISCED 0–2 consists of less than primary, primary and lower secondary education; ISCED 3–4 consists of upper secondary and post-secondary non-tertiary education; ISCED 5–8 consists of tertiary education.

Source: Eurostat Database, tables ilc_peps04, ilc_peps02, ilc_lvhl02, ilc_lvps04

Table 2 Distribution of population over 18 years and at-risk-of-poverty and social exclusion rate by most frequent activity status and education attainment level, 2005–2017, Hungary

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Population by most frequent activity status (%)													
Employed	52.2	48.0	50.0	48.2	48.3	46.6	46.0	46.4	46.5	47.3	51.3	52.7	54.6
Unemployed	4.1	5.7	4.4	4.9	4.4	6.0	6.6	6.9	7.2	7.5	5.3	4.5	3.4
Retired	33.1	33.6	34.0	33.8	25.2	26.8	26.2	25.9	28.3	27.8	27.3	27.0	26.7
Other inactive	10.4	12.3	11.2	12.7	21.5	19.9	20.7	20.4	17.5	17.0	15.6	15.5	14.8
Population by educational attainment level (ISCED11, %)													
Levels 0–2	35.2	28.2	26.4	26.3	26.2	25.5	24.3	23.5	23.2	22.1	20.3	20.9	22.0
Levels 3–4	50.9	56.0	57.8	57.3	56.8	57.3	58.4	58.0	57.6	58.1	57.7	57.8	57.3

Table 2

(continuation)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Population by educational attainment level (ISCED11, %)													
Levels 5–8	13.9	15.8	15.8	16.4	17.0	17.2	17.4	18.5	19.2	19.8	22.1	21.2	20.6
AROPE by most frequent activity status (%)													
Employed	23.0	18.8	18.0	16.8	19.2	18.7	19.5	20.9	23.6	20.3	18.7	18.4	19.0
Unemployed	64.5	71.5	70.1	70.3	72.7	70.8	71.3	78.3	77.8	77.4	77.5	70.4	73.1
Retired	35.6	33.9	32.7	29.8	20.4	20.5	21.3	23.8	24.8	22.5	20.3	18.0	19.0
Other inactive	38.3	41.3	40.3	40.3	44.8	44.5	47.4	48.1	50.0	45.1	42.9	41.7	38.2
AROPE by educational attainment level (ISCED11, %)													
Levels 0–2	42.1	46.7	43.1	41.2	41.5	43.1	46.3	51.7	52.8	51.2	47.7	44.2	41.9
Levels 3–4	28.3	26.6	26.6	25.4	26.9	26.4	28.0	29.3	31.0	28.4	25.0	22.8	21.4
Levels 5–8	9.2	10.7	8.9	9.4	9.4	10.1	11.3	13.1	14.0	9.7	10.5	9.9	12.0
AROPE total	30.5	29.7	27.9	26.9	27.5	27.6	29.3	31.3	32.6	29.6	26.2	24.4	23.8

Note: ISCED 0–2 consists of less than primary, primary and lower secondary education; ISCED 3–4 consists of upper secondary and post-secondary non-tertiary education; ISCED 5–8 consists of tertiary education.

Source: Eurostat Database, tables ilc_peps04, ilc_peps02, ilc_lvh02, ilc_lvps04

Table 3 Distribution of population over 18 years and at-risk-of-poverty and social exclusion rate by most frequent activity status and education attainment level, 2005–2017, Poland

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Population by most frequent activity status (%)													
Employed	44.7	47.1	49.4	52.0	52.4	51.5	51.9	52.1	51.5	52.1	52.1	52.7	53.8
Unemployed	11.5	10.5	8.3	4.4	3.4	5.2	5.9	6.6	7.0	7.1	6.5	6.0	5.1
Retired	29.4	19.7	19.8	20.2	21.7	22.1	22.4	22.3	22.9	22.6	23.6	23.8	24.0
Other inactive	13.9	22.0	21.7	23.0	22.0	20.6	19.3	18.6	18.0	17.6	17.5	17.1	16.8
Population by educational attainment level (ISCED11, %)													
Levels 0–2	23.8	22.8	21.5	20.5	20.8	19.9	19.2	18.9	18.1	17.3	17.2	16.2	15.9
Levels 3–4	62.8	63.2	63.7	63.5	62.6	62.3	62.3	61.4	61.1	60.9	60.2	60.9	60.5
Levels 5–8	13.5	13.9	14.8	16.0	16.6	17.8	18.5	19.7	20.8	21.8	22.6	22.9	23.5
AROPE by most frequent activity status (%)													
Employed	32.0	27.1	23.2	20.6	17.9	17.8	17.3	17.0	16.4	15.0	14.4	13.4	12.0
Unemployed	74.1	70.0	63.6	59.3	58.4	60.1	60.3	58.7	56.3	58.0	58.3	57.2	51.5
Retired	48.5	35.0	30.3	29.6	27.9	26.7	26.2	24.5	21.0	18.8	17.4	17.0	18.1
Other inactive	52.3	53.2	48.5	45.8	44.0	41.8	41.5	41.5	40.1	40.2	40.8	40.4	37.6
AROPE by educational attainment level (ISCED11, %)													
Levels 0–2	58.5	53.2	47.1	45.5	43.7	44.1	42.2	42.0	38.3	38.5	37.5	36.8	34.7
Levels 3–4	45.5	40.1	34.5	30.3	27.2	27.3	27.2	27.0	26.1	25.1	24.0	23.1	21.3
Levels 5–8	16.8	11.9	10.3	9.1	8.2	8.2	8.5	8.4	8.8	7.8	8.0	7.2	6.4
AROPE total	44.7	39.1	33.6	30.1	27.4	27.2	26.6	26.1	24.7	23.5	22.7	21.6	19.9

Note: ISCED 0–2 consists of less than primary, primary and lower secondary education; ISCED 3–4 consists of upper secondary and post-secondary non-tertiary education; ISCED 5–8 consists of tertiary education.

Source: Eurostat Database, tables ilc_peps04, ilc_peps02, ilc_lvh02, ilc_lvps04

Table 4 Distribution of population over 18 years and at-risk-of-poverty and social exclusion rate by most frequent activity status and education attainment level, 2005–2017, Slovakia

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Population by most frequent activity status (%)													
Employed	54.3	54.8	54.9	56.5	56.1	52.7	52.1	51.9	51.3	55.0	55.5	57.3	59.1
Unemployed	7.9	7.0	5.1	4.2	4.3	8.2	8.4	7.9	8.2	9.0	8.4	7.4	5.9
Retired	26.9	27.5	28.4	27.9	24.2	23.2	23.2	23.5	23.3	23.3	23.8	24.4	24.4
Other inactive	10.4	10.3	11.1	10.9	15.0	15.4	15.6	16.2	16.5	12.3	11.8	10.5	10.3
Population by educational attainment level (ISCED11, %)													
Levels 0–2	15.1	14.8	14.3	13.5	12.5	14.7	14.1	14.1	13.2	13.0	11.6	11.8	11.6
Levels 3–4	70.3	69.9	69.6	71.4	70.6	67.4	66.9	66.3	67.6	66.7	68.4	68.4	68.3
Levels 5–8	14.6	15.3	16.0	15.1	16.9	17.9	19.0	19.6	19.1	20.3	20.0	19.8	20.0
AROPE by most frequent activity status (%)													
Employed	24.6	18.3	12.1	12.4	11.3	11.1	11.3	11.0	10.5	9.7	9.9	10.1	9.0
Unemployed	61.6	59.4	60.1	56.4	63.4	57.7	58.2	55.7	54.9	58.0	59.1	59.7	58.3
Retired	34.5	30.5	27.1	26.5	21.0	18.6	16.2	17.6	15.2	14.3	13.6	13.1	12.8
Other inactive	33.8	28.2	24.7	25.5	29.4	29.6	30.9	30.2	28.7	26.7	26.6	30.0	28.4
AROPE by educational attainment level (ISCED11, %)													
Levels 0–2	41.3	36.9	38.1	34.7	35.3	34.9	34.6	35.1	32.5	33.0	33.3	35.2	33.5
Levels 3–4	31.8	26.2	19.3	19.3	18.3	19.1	19.3	18.8	18.0	17.1	16.8	16.0	14.1
Levels 5–8	17.6	12.6	9.0	8.1	7.7	8.7	9.2	9.8	10.1	7.6	8.0	7.8	6.9
AROPE total	31.3	25.6	20.3	19.7	18.6	19.6	19.6	19.3	18.4	17.3	17.0	16.7	14.8

Note: ISCED 0–2 consists of less than primary, primary and lower secondary education; ISCED 3–4 consists of upper secondary and post-secondary non-tertiary education; ISCED 5–8 consists of tertiary education.

Source: Eurostat Database, tables ilc_peps04, ilc_peps02, ilc_lvhl02, ilc_lvps04

Our methodological approach is inspired by the summarizing book of Inchauste et al. (2014). There are two main approaches how to decompose the total poverty rate. The Datt-Ravallion Method (Datt and Ravallion, 1992) decomposes the total poverty rate into the size effect, the redistribution effect and a residual term, which is interpreted as an interaction effect. The advantage of this approach consists in the path independency. On the other hand, the residual term could be harder to explain. The Shorrocks (2013), using the Shapley value approach, decomposes the overall poverty into just two components (within-group poverty and the contribution of population shifts). This is more understandable; but, as Inchauste et al. (2014, p. 25) note, this decomposition is path-dependent. While Datt and Ravallion (1992) have to choose the path (changes in poverty are weighted by the base-year population and changes in population shares are weighted by the end-year poverty level), Shorrocks' approach is path-independent (he uses an arithmetic average of weights).

The terminology is not stable: while Datt and Ravallion (1992) use the terms “size effect” and “redistribution effect”, Shorrocks uses “within-group poverty” and “contribution of population shifts” and Fujii (2017), applying the Datt-Ravallion method, proposes the terms “growth component” and “redistribution component”. In our paper, we use the terminology “levels effect” and “substitution effect”, according to Lippe (2007). Our paper is based on the decomposition of the price index of unit value (Hindls et al., 2007). This method combines the approaches of Datt-Ravallion and Shorrocks: the total poverty rate is decomposed into two components (similarly to Shorrocks), is path-dependent

(as well as the Shorrocks method), but uses the weights from the base year and end year (similarly to Datt-Ravaillon) and not the average.

All the index decompositions were applied by the cited authors to the comparison in time (changes of poverty rates between two time periods). As the index theory allows to use the index approach for spatial comparisons, we adjusted the decomposition of unit value index for the comparison between countries.

The main objective is to compare the AROPE rates and their development in the Czech Republic with other Visegrad countries. Since the AROPE rates are very stable in time (and the most stable among all four countries), we choose the Czech Republic as the benchmark and compare the AROPE rates development in other countries to this benchmark.

The results could be influenced by the slight difference in definitions of the head of households across the compared countries. In the Czech Republic⁴ and in Hungary,⁵ the head of the household (family) is always the husband of a married couple, in lone-parent families mostly the parent. In non-family households the economic activity and then the income is considered. In Slovakia,⁶ as the head of household is considered the person which mostly covers the basic expenditure of the household. Finally, in Poland,⁷ the socio-economic groups of households are distinguished by the prevailing source of income; the term “head of household” is not used in the methodology at all.

1.1 Social-status effect

Firstly, for single spatial comparison of AROPE in Hungary, Poland and Slovakia to AROPE in the Czech Republic, we use the price index of unit value (1), according to Hindls et al. (2007):

$$\bar{I}_p = \frac{\bar{p}_c}{\bar{p}_{CZ}} = \frac{\frac{\sum_{i=1}^n Q_{c,i}}{\sum_{i=1}^n q_{c,i}}}{\frac{\sum_{i=1}^n Q_{CZ,i}}{\sum_{i=1}^n q_{CZ,i}}} = \frac{\frac{\sum_{i=1}^n p_{c,i} q_{c,i}}{\sum_{i=1}^n q_{c,i}}}{\frac{\sum_{i=1}^n p_{CZ,i} q_{CZ,i}}{\sum_{i=1}^n q_{CZ,i}}} = \frac{\frac{\sum_{i=1}^n Q_{c,i}}{\sum_{i=1}^n \frac{Q_{c,i}}{p_{c,i}}}}{\frac{\sum_{i=1}^n Q_{CZ,i}}{\sum_{i=1}^n \frac{Q_{CZ,i}}{p_{CZ,i}}}}, \quad (1)$$

where:

\bar{p}_c ... the total AROPE rate in country c (Hungaria, Poland, Slovakia),

\bar{p}_{CZ} ... the total AROPE rate in the Czech Republic,

$p_{c,i}$... the specific AROPE rate in social status i in country c ,

$q_{c,i}$... the number of people in social status i in country c ,

$Q_{c,i} = p_{c,i} q_{c,i}$... the number of people in at-risk-of-poverty or social exclusion in social status i in country c ,

$p_{CZ,i}$... the specific AROPE rate for social status i in the Czech Republic,

$q_{CZ,i}$... the number of people with social status i in the Czech Republic,

$Q_{CZ,i} = p_{CZ,i} q_{CZ,i}$... the number of people in at-risk-of-poverty or social exclusion in social status i in the Czech Republic.

As the social status, we consider following statuses of the head of household:

- Employed,
- Unemployed,
- Retired,
- Other inactive.

⁴ <<https://www.czso.cz/csu/czso/household-income-and-living-conditions-2016>>.

⁵ <https://www.ksh.hu/apps/meta.objektum?p_lang=EN&p_menu_id=220&p_ot_id=200&p_obj_id=4076&p_session_id=46665581>.

⁶ <<https://www7.statistics.sk/PortalTraffic/fileServlet?Dokument=5fa25b56-41dc-4f3c-8ca8-061a3426e8a6>>.

⁷ <https://stat.gov.pl/download/gfx/portalinformacyjny/en/defaultaktualnosci/3305/1/10/1/incomes_and_living_conditions_eu-silc_2017.pdf>.

For computing levels effect and substitution effect of the social status of the head of household, within bilateral spatial comparison, we decompose the price index of unit value (1) to the *levels effect and substitution effect*:⁸

$$I_{LE}^{(L)} = \frac{\frac{\sum_{i=1}^n P_{c,i} q_{CZ,i}}{\sum_{i=1}^n q_{CZ,i}}}{\frac{\sum_{i=1}^n P_{CZ,i} q_{CZ,i}}{\sum_{i=1}^n q_{CZ,i}}} = \frac{\sum_{i=1}^n P_{c,i} q_{CZ,i}}{\sum_{i=1}^n P_{CZ,i} q_{CZ,i}}, \tag{2}$$

and

$$I_{SE}^{(P)} = \frac{\frac{\sum_{i=1}^n P_{c,i} q_{c,i}}{\sum_{i=1}^n q_{c,i}}}{\frac{\sum_{i=1}^n P_{c,i} q_{CZ,i}}{\sum_{i=1}^n q_{CZ,i}}}, \tag{3}$$

where:

$I_{LE}^{(L)}$... the levels-effect index, describing the effect of the difference in specific AROPE rates in individual social statuses between the country *c* and the Czech Republic,

$I_{SE}^{(P)}$... the substitution effect index, describing the effect of the difference in the structure of households between the country *c* and the Czech Republic.

Letters *L*, *P* in the brackets refer to the type of index. In this type of decomposition, the levels-effect index is based on the Laspeyres index (we use the structure of households in the Czech Republic as weights), while the substitution-effect index is based on the Paasche index (we use the structure of households in country *c* for weighting). We can call this way as “levels effect first”: we assume that we firstly analyse the impact of the difference in specific AROPE rates and secondly the impact of change in the population structure.

We can also make the decomposition in another way (“substitution effect first”):

$$I_{LE}^{(P)} = \frac{\frac{\sum_{i=1}^n P_{c,i} q_{c,i}}{\sum_{i=1}^n q_{c,i}}}{\frac{\sum_{i=1}^n P_{CZ,i} q_{c,i}}{\sum_{i=1}^n q_{c,i}}} = \frac{\sum_{i=1}^n P_{c,i} q_{c,i}}{\sum_{i=1}^n P_{CZ,i} q_{c,i}}, \tag{4}$$

and

$$I_{SE}^{(L)} = \frac{\frac{\sum_{i=1}^n P_{CZ,i} q_{c,i}}{\sum_{i=1}^n q_{c,i}}}{\frac{\sum_{i=1}^n P_{CZ,i} q_{CZ,i}}{\sum_{i=1}^n q_{CZ,i}}}, \tag{5}$$

hence:

⁸ The decomposition is based on the approach presented by Hindls et al. (2007).

$$\bar{I}_p = I_{LE}^{(L)} \cdot I_{SE}^{(P)} = I_{LE}^{(P)} \cdot I_{SE}^{(L)} \quad (6)$$

We compute the price index of unit value (1) and its decomposition to the levels effect and substitution effect for years 2005, 2008, 2011, 2014 and 2017. We selected these years as we analyse the impact of structural differences shortly after the EU accession (2005), shortly before the Great Recession (2008), during the recession (2011), during the recovery period (2014) and in time of the substantial economic expansion (2017).

1.2 Education-level effect

Furthermore, we analyse the impact of educational changes. For this comparison, we adjust the price index of the unit value to the following form:

$$\bar{I}_{p,c} = \frac{\bar{p}_{c,2017}}{\bar{p}_{c,2005}} = \frac{\frac{\sum_{i=1}^n Q_{c,2017,i}}{\sum_{i=1}^n q_{c,2017,i}}}{\frac{\sum_{i=1}^n Q_{c,2005,i}}{\sum_{i=1}^n q_{c,2005,i}}} = \frac{\frac{\sum_{i=1}^n p_{c,2017,i} q_{c,2017,i}}{\sum_{i=1}^n q_{c,2017,i}}}{\frac{\sum_{i=1}^n p_{c,2005,i} q_{c,2005,i}}{\sum_{i=1}^n q_{c,2005,i}}} = \frac{\sum_{i=1}^n \frac{Q_{c,2017,i}}{p_{c,2017,i}}}{\sum_{i=1}^n \frac{Q_{c,2005,i}}{p_{c,2005,i}}}, \quad (7)$$

where:

- $\bar{p}_{c,t}$... the total AROPE rate in country c (Czech Republic, Hungaria, Poland, Slovakia) in time t (2005, 2017),
- $p_{c,t,i}$... the specific AROPE rate for educational level i in country c and time t ,
- $q_{c,t,i}$... the number of people with educational level i in country c and time t ,
- $Q_{c,t,i} = p_{c,t,i} q_{c,t,i}$... the number of people in at-risk-of-poverty or social exclusion with educational level i in country c and time t .

We consider the following educational levels (highest attained level of education):

- Primary education,
- Secondary education,
- Tertiary education.

Similarly to the previous decomposition, we analyse the factors of changes in the price index of unit value using the following decomposition into the *levels effect and substitution effect*:

$$I_{LE,c}^{(L)} = \frac{\frac{\sum_{i=1}^n p_{c,2017,i} q_{c,2005,i}}{\sum_{i=1}^n q_{c,2005,i}}}{\frac{\sum_{i=1}^n p_{c,2005,i} q_{c,2005,i}}{\sum_{i=1}^n q_{c,2005,i}}} = \frac{\sum_{i=1}^n p_{c,2017,i} q_{c,2005,i}}{\sum_{i=1}^n p_{c,2005,i} q_{c,2005,i}}, \quad (8)$$

and

$$I_{SE,c}^{(P)} = \frac{\frac{\sum_{i=1}^n p_{c,2017,i} q_{c,2017,i}}{\sum_{i=1}^n q_{c,2017,i}}}{\frac{\sum_{i=1}^n p_{c,2017,i} q_{c,2005,i}}{\sum_{i=1}^n q_{c,2005,i}}}, \quad (9)$$

where:

$I_{LE,c}^{(L)}$... the levels-effect index, describing the effect of the difference in specific AROPE rates in individual educational levels between the 2005 and 2017 in country c ,

$I_{SE,c}^{(P)}$... the substitution-effect index, describing the effect of the difference in educational structure of households between 2005 and 2017 in country c .

For completion, we mention the second decomposition way:

$$I_{LE,c}^{(P)} = \frac{\frac{\sum_{i=1}^n p_{c,2017,i} q_{c,2017,i}}{\sum_{i=1}^n q_{c,2017,i}}}{\frac{\sum_{i=1}^n p_{c,2005,i} q_{c,2005,i}}{\sum_{i=1}^n q_{c,2005,i}}} = \frac{\sum_{i=1}^n p_{c,2017,i} q_{c,2017,i}}{\sum_{i=1}^n p_{c,2005,i} q_{c,2017,i}}, \tag{10}$$

and

$$I_{SE,c}^{(L)} = \frac{\frac{\sum_{i=1}^n p_{c,2005,i} q_{c,2017,i}}{\sum_{i=1}^n q_{c,2017,i}}}{\frac{\sum_{i=1}^n p_{c,2005,i} q_{c,2005,i}}{\sum_{i=1}^n q_{c,2005,i}}}. \tag{11}$$

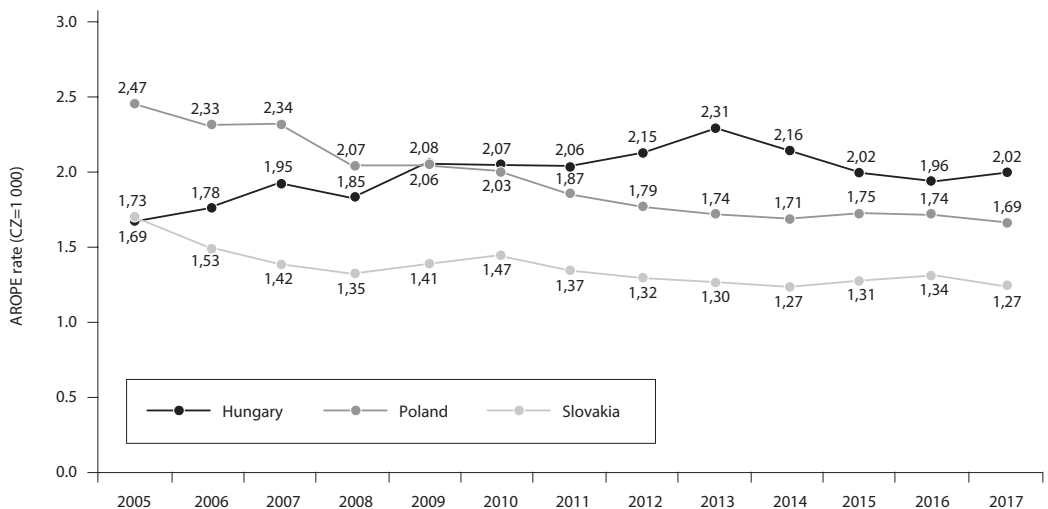
Formula (6) is also valid for this decomposition for each country c .

2 RESULTS

In Figure 1, we can compare the total AROPE rates for Hungary, Poland and Slovakia in the period 2005–2017 to the AROPE rate in the Czech Republic.

In all three countries, the share of the people at-risk-of-poverty or social inclusion is higher than the rate in the Czech Republic: index of AROPE for the countries comparing AROPE rate in CZ

Figure 1 Comparison of AROPE rates in Hungary, Poland and Slovakia to the AROPE rate in the Czech Republic



Source: EU-SILC, own computation

is higher than 1. Seeing the development in time, one can see that the difference in the share of the threatened people comparing to the Czech Republic has increased in Hungary (from 1.69 to 2.02) and continuously decreases in Poland (from 2.47 to 1.69). In Slovakia, after a slight decrease till 2011, the difference remains stable at around 1.25–1.35.

2.1 Social-status effect

Firstly, we compute the decomposition for Hungary. In Table 5, we state the values of the price indices of unit value (which refer to the numbers quoted in Figure 1), and then we compute the levels effect and the substitution effect for each year, using Formulas (2) and (3) and assuming “levels effect first”.

Table 5 Levels effect and substitution effect, AROPE rate, Hungary to the Czech Republic, social status, 2005–2017, levels effect first

Year	Total	Levels effect	Substitution effect
2005	1.694	1.699	0.997
2008	1.850	1.774	1.043
2011	2.061	1.903	1.083
2014	2.163	2.015	1.074
2017	2.018	2.005	1.007

Source: Own computation

In the whole period, there is a great difference between specific AROPE rates in Hungary and the Czech Republic within individual social groups of households (levels effect). In the period 2008–2014, we can also observe the difference in households’ composition, which contributes to the difference in total AROPE rates by 4.3–8.3%.

Table 6 Levels effect and substitution effect, AROPE rate, Hungary to the Czech Republic, social status, 2005–2017, substitution effect first

Year	Total	Levels effect	Substitution effect
2005	1.694	1.742	0.973
2008	1.850	1.746	1.060
2011	2.061	1.837	1.122
2014	2.163	1.910	1.132
2017	2.018	1.992	1.013

Source: Own computation

In Table 6, we make a decomposition by Formulas (4) and (5), assuming “substitution effect first”. We base this computation on the assumption that firstly we change the structure of households, and secondly, we change the AROPE rates within specific groups of households broken down by their social status. In this way of decomposition, the substitution effect (effect of the difference in households’ structure) seems to be higher, at a level of 6.0–13.2% in the period 2008–2014.

The development in Poland differs compared to Hungary. The difference in the total AROPE rate between Poland and the Czech Republic continuously decrease (see Table 7). With a small exception of the “crisis” the year 2011, the effect of the different composition of households remains stable

Table 7 Levels effect and substitution effect, AROPE rate, Poland to the Czech Republic, social status, 2005–2017, levels effect first

Year	Total	Levels effect	Substitution effect
2005	2.471	2.288	1.080
2008	2.065	1.920	1.076
2011	1.873	1.803	1.039
2014	1.715	1.602	1.070
2017	1.690	1.568	1.078

Source: Own computation

in the whole period 2005–2017 – this effect contributes to the difference in total AROPE rates by 7–8%. A continuous decrease in differences in AROPE rates is primarily caused by the differences in specific AROPE rates within individual social groups.

The development in Poland differs compared to Hungary. The difference in the total AROPE rate between Poland and the Czech Republic continuously decrease (see Table 7). With a small exception of the “crisis” the year 2011, the effect of the different composition of households remains stable in the whole period 2005–2017 – this effect contributes to the difference in total AROPE rates by 7–8%. A continuous decrease in differences in AROPE rates is primarily caused by the differences in specific AROPE rates within individual social groups.

Table 8 Levels effect and substitution effect, AROPE rate, Poland to the Czech Republic, social status, 2005–2017, substitution effect first

Year	Total	Levels effect	Substitution effect
2005	2.471	2.024	1.221
2008	2.065	2.049	1.008
2011	1.873	1.759	1.065
2014	1.715	1.552	1.105
2017	1.690	1.531	1.104

Source: Own computation

Unfortunately, the results critically depend on the methodology. Using another way of decomposition, i.e. Formulas (4) and (5) assuming “substitution effect first”, we obtain different results. The substitution effect is higher on average and much volatile in time. We can explain it by the primary data; in 2005, there was very high AROPE rate for people in households with “Employed” status.

For Slovakia (Table 9), we can observe the effect of the different structure of households in the years 2011–2014 (at a level of around 7–8%). On the other hand, there is a significant decrease in the impact of differences in specific AROPE rates to the total AROPE rates difference between Slovakia and the Czech Republic in years 2005–2014. While the levels effect (effect of differences in specific AROPE rates) reached 69.7% in 2005, this effect decreased to 16.9% in 2014.

We can compute the effects in the second way, “substitution level first” (Table 10). The results slightly differ in values (in 2011 and 2014 the substitution effects is stronger at a level of 10.3–10.5%), but the interpretation of results is very similar.

Table 9 Levels effect and substitution effect, AROPE rate, Slovakia to the Czech Republic, social status, 2005–2017, levels effect first

Year	Total	Levels effect	Substitution effect
2005	1.728	1.697	1.018
2008	1.353	1.381	0.980
2011	1.373	1.273	1.078
2014	1.266	1.169	1.083
2017	1.267	1.226	1.034

Source: Own computation

Table 10 Levels effect and substitution effect, AROPE rate, Slovakia to the Czech Republic, social status, 2005–2017, substitution effect first

Year	Total	Levels effect	Substitution effect
2005	1.728	1.641	1.053
2008	1.353	1.398	0.968
2011	1.373	1.243	1.105
2014	1.266	1.148	1.103
2017	1.267	1.220	1.039

Source: Own computation

2.2 Education-level effect

In this part, we compare the difference in AROPE rates in time, within all four countries, using Formulas (8) and (9).

Table 11 Levels effect and substitution effect in Visegrad countries, change in total AROPE rate, impact of education level, 2005–2017, levels effect first

Country	Total	Levels effect	Substitution effect
Czech Republic	0.647	0.726	0.891
Hungary	0.785	0.895	0.877
Poland	0.445	0.503	0.885
Slovakia	0.478	0.513	0.932

Source: Own computation

Total AROPE rate decreased in Poland by 55% (from 44.7 % to 19.9%) in years 2005–2017, by 53% in Slovakia (from 31.3% to 14.8%), by one third (from 18.1% to 11.8%) in the Czech Republic and by 22% in Hungary (from 30.5% to 23.8%). Table 11 shows the effects of changes in AROPE rates within specific groups (levels effect) and the effect of the change in educational structure. We can conclude, the change in education structure has a positive impact in all four countries. The contribution of the education structure change to decreasing AROPE rate varies from 6.8% in Slovakia to 12.3% in Hungary.

For completion, we can compute the effects by Formulas (10) and (11), assuming “substitution effect first”. The difference in result is small, but not negligible. We can see the contribution of the educational

Table 12 Levels effect and substitution effect in Visegrad countries, change in total AROPE rate, impact of education level, 2005–2017, substitution effect first

Country	Total	Levels effect	Substitution effect
Czech Republic	0.647	0.714	0.906
Hungary	0.785	0.875	0.897
Poland	0.445	0.488	0.911
Slovakia	0.478	0.496	0.964

Source: Own computation

change in the Czech Republic, Poland and Slovakia again; the contribution is slightly smaller compared to the previous analysis; varies from 3.6% in Slovakia to 10.3% in Hungary.

CONCLUSION

In this article, we present the analysis of the effects of change in the structure of households in the at-risk-of-poverty and social exclusion rate. The main interpretation obstacle follows the methodology: decomposition of the price index of the unit value can be done by two independent ways, with slightly different results. However, there is an evident impact of the structure of households in the total AROPE rate in Visegrad countries and on their mutual comparison.

At-risk-of-poverty and social exclusion rates are influenced by the structure of households both by their social status and by the educational level as well. Comparing the development of AROPE rates between the Czech Republic and other Visegrad countries, we can see the impact of differences in the social structure of households to the differences in total AROPE rates in all Visegrad countries in the part of the period 2005–2017.

Furthermore, there is a positive impact of the change in the educational structure of households on the development of the total AROPE rate in all Visegrad countries except Hungary.

For further research, we recommend including the aspect of the equivalence scale into the analysis. While Jirková and Musil (2017) analysed the impact of the equivalence scale to the total and specific AROPE rates, it should be useful to extend their approach also on our structural analysis. Moreover, some methodological issues related to AROPE rates construction should be taken into account. Prokop (2019, p. 33) points out some issues consisting AROPE: using national data and national median of income; using income before executions, high non-response rate within the SILC survey.

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