

# ANALYSIS OF MONETARY POVERTY MEASURES IN SLOVAKIA, THE CZECH REPUBLIC AND SPAIN

Iveta Stankovičová – Estefanía Mourelle

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## Abstract

More than 120 million people are at risk of poverty or social exclusion in the EU. EU leaders have pledged to bring at least 20 million people out of poverty and social exclusion by 2020. The fight against poverty and social exclusion is at the heart of the Europe 2020 strategy for smart, sustainable and inclusive growth. Each individual member state will have to adopt one or several national targets.

The EU statistics on income and living conditions (EU-SILC) is the reference source for comparative statistics on income distribution and social exclusion in the EU. We used Slovak, Czech and Spain EU-SILC data for empirical analysis of monetary poverty measures. We computed monetary poverty measures, namely 3 FGT indexes and Watts index. The aim of this paper is to analyse trends for these indicators in Slovakia, the Czech Republic and Spain in the period 2008-2014 and compare results by NUTS 2 regions too. We also assess how individual countries meet the stated objectives of the Europe 2020 Strategy in the social area.

**Key words:** Monetary Poverty, FGT Indexes, Watts Index, EU-SILC Database, Strategy Europe 2020.

**JEL Code:** O15, C46, I32.

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## Introduction

A strategy for smart, sustainable and inclusive growth, Europe 2020 was proclaimed by European Commission at the beginning of 2010. Primarily, it was a reaction on the impact of last world-wide economic crisis which revealed crucial structural deficiencies in EU economics. The strategy is formulated into five major goals concerning the assurance of general growth of EU (European Commission, 2010).

Particularly, in social area the goal was defined in the following way: Reduction of the number of Europeans living below national poverty lines by 25%, lifting 20 million people out of poverty and social exclusion is one of the five headlines Europe 2020 (compared to 2008).

Each individual Member State will have to adopt one or several (sub)national targets. The national targets for the three analysed countries in the social field were set as follows<sup>1</sup>:

- Target for Czech Republic (CZ): Reduce by 100 000 the number of persons living in poverty or social exclusion (- 100 000 persons).
- Target for Slovakia (SK): Reduce to a rate of 17.2 % the number of persons living in poverty or social exclusion (compared to 20.6% in 2008; estimation is -170 000 persons).
- Target for Spain (ES): 1 400 000-1 500 000 reduction of population at risk of poverty or social exclusion (in number of persons).

The aim of the article is to assess how individual countries meet the stated objectives of the Europe 2020 Strategy in the social area. We will focus mainly on the trends of indicators of monetary poverty and social exclusion in these 3 selected countries<sup>2</sup>, but also on the values and the trends of the monitored indicators by NUTS 2 regions.

## **1 Monetary poverty measures: literature review**

### **1.1 Theoretical background**

From social researchers' point of view, poverty is a complex phenomenon influenced by a large number of factors which can be studied from many different perspectives. The study and interpretation of poverty is not a simple task as there are as many ways of measuring poverty as there are ways of defining it (Kakwani & Silber, 2008, p. 2).

Poverty analysis is concerned with the lower part of the distribution of well-being. The measurement of poverty generally involves three steps: 1. selecting an appropriate indicator to represent individuals' well-being; 2. choosing a poverty line which identifies the lower part of the distribution to the object of the study and hence to categorize people into poor and non-poor; 3. selecting a function to aggregate individuals.

The application of a poverty measure requires the specification of a poverty line which separates population into poor and non-poor. In the literature, there are three distinct ways to specify a poverty line: the absolute, relative, and subjective methods. While absolute poverty lines have been used in most government poverty statistics, relative poverty lines have recently gained momentum in both international poverty comparisons and intra-national cross-time analyses of poverty.

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<sup>1</sup> Europe 2020 Targets (Updated on 07/03/2017). Retrieved from website: [http://ec.europa.eu/europe2020/pdf/annexii\\_en.pdf](http://ec.europa.eu/europe2020/pdf/annexii_en.pdf)

<sup>2</sup> The selection of three countries for the analysis is determined by the nationality of the authors.

The absolute method sets the poverty line as a minimum amount of resources at a point in time and updates the line only for price changes over time. The relative method specifies the poverty line as a point in the distribution of income or expenditure, and hence, the line can be updated automatically over time for changes in living standards. In practice, researchers often specify the relative poverty line as a percentage of mean income or expenditure but as a percentage of median income or expenditure. The subjective method derives the poverty line based on public opinion on minimum income or expenditure levels that the people have to “get along” or “make ends meet”. Compared with the first two approaches, the subjective method is relatively less popular and has been rarely used.

Topicality of the analysed issue can be documented by a wide range of recent papers dedicated to the analysis of poverty or material deprivation. Among the papers concerning situation in the Czech Republic and Slovakia ranks results of Želinský (2010), Bartošová & Bína (2012), Bartošová & Želinský (2013), Stankovičová et al. (2013, 2014) or Řezánková & Želinský (2014). In Spain the problem of poverty<sup>3</sup> has been dealt with, for example, by Jin (2017)<sup>4</sup>, Moneo & Adiego (2005), Méndez (2001), or Del Río & Gradín (2001), among others.

The computation of monetary poverty indicators are based on data from EU Statistics on Income and Living Conditions (EU-SILC). EU-SILC survey is harmonized survey for all EU countries by Commission. Via these regulations, good quality and a high level of comparability between countries is ensured.

## 1.2 Construction of common poverty measures

Nowadays there is a large literature on monetary poverty measures. In this paper we will focus only on the most common poverty measures, namely the class of measures proposed by Foster et al. (1984) and Watts (1968) index.

Let  $y = (y_1, y_2, \dots, y_n)$  be a vector of household incomes in increasing order and  $n$  is the total number of households. Suppose that  $z > 0$  is the predetermined poverty line,  $q$  is the number of poor households ( $y_1 \leq y_2 \leq \dots \leq y_q \leq z$ ). The Foster–Greer–Thorbecke (FGT) general poverty measure  $P_\alpha$  for a non-negative parameter  $\alpha$  is defined (Foster et al. 1984, 2010) as:

$$P_\alpha(y, z) = \frac{1}{n} \sum_{i=1}^q \left( \frac{z - y_i}{z} \right)^\alpha \quad (1)$$

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<sup>3</sup> Poverty (English) = pobreza (Spanish).

<sup>4</sup> OECD (2017). By Yosuke Jin: Reducing poverty durably is a key challenge in Spain. Retrieved from: <https://oecdoscope.wordpress.com/2017/03/14/reducing-poverty-durably-is-a-key-challenge-in-spain/>

Equation (1) allows a range of aggregation procedures that depends on  $\alpha$ . When  $\alpha=0$ , equation (1) produces a simple poverty headcount; for  $\alpha=1$ , equation (1) is the average proportionate poverty gap; and for  $\alpha=2$ , equation (1) produces a weighted-average proportionate poverty gap, where the weights are the poverty gaps themselves, giving relatively more importance to relatively poorer individuals. The three indexes are referred to as  $P_0$ ,  $P_1$ , and  $P_2$ , respectively.

The headcount index ( $P_0$ ) measures the proportion of the population that is poor. It is popular because it is easy to understand and measure. But it does not indicate how poor the poor are. It indicates the proportion of the population for whom income  $y$  (or the level of another welfare indicator) is not greater than the poverty line  $z$ . A great advantage of this measure is its simplicity of calculation and understanding. But suppose that a poor person suddenly becomes much poorer. The value of  $P_0$  will not change, i.e. it is totally insensitive to differences in the depth of poverty.

The poverty gap index ( $P_1$ ) measures the extent to which individuals fall below the poverty line (the poverty gaps) as a proportion of the poverty line  $z$ . The sum of these poverty gaps gives the minimum cost of eliminating poverty if transfers were perfectly targeted. The measure does not reflect changes in inequality among the poor. The value of  $P_1$  depends on the distances of the poor below the poverty line, so it gives a good indication of the depth of poverty. We then obtain the mean proportionate poverty gap across the whole population. The measure is not sensitive to the distribution among the poor, i.e. the value of  $P_1$  will be unaffected by a transfer from a poor person to someone who is very poor.

The squared poverty gap (“poverty severity”) index ( $P_2$ ) averages the squares of the poverty gaps relative to the poverty line.  $P_2$  is the mean of squared proportionate poverty gaps. The measure’s advantage is that it takes inequality among the poor into account (i.e. a transfer from a poor to an even poorer person would reduce the index). The main disadvantage of the measure is that it is not easy to interpret, but the measure can be thought of as a useful tool for comparing the situation of the poorest across countries or over time or for comparing policies aimed at reaching the poorest.

The first distribution-sensitive poverty measure was proposed in 1968 by Watts (see Zheng, 1997), and in its discrete version takes the form:

$$W = \frac{1}{n} \sum_{i=1}^q [\ln(z) - \ln(y_i)] \quad (2)$$

where the  $n$  individuals in the population are indexed in ascending order of income (or expenditure), and the sum is taken over the  $q$  individuals whose income (or expenditure)  $y_i$  falls below the poverty line  $z$ .

Poverty measures, as inequality indexes, should satisfy the basic axioms or principles for evaluating (definitions of axiom see in Hagenaaers, 1986; European Commission, 2003; Morduch, 2005). The poverty rate satisfies the focus, impartiality, and replication invariance axioms but it violates the weak monotonicity and weak transfer axioms. Hence, many economists find the poverty rate unacceptable as poverty index since it captures the incidence of poverty but is insensitive to the depth of poverty. The average poverty gap ratio of the poor satisfies the focus, weak monotonicity, and impartiality axioms but not the weak transfer axiom — which means that captures the depth of poverty but is insensitive to the distribution aspect of poverty. The Watts index satisfies all axioms (Zehng, 1997). Many authors recommended using set of poverty indexes, namely 3 FGT indexes and Watts index.

### 1.3 AROPE - headline indicator under the Europe 2020 strategy

Poverty is a complex issue, and a variety of approaches are used for measuring and analysing it. Measures based on income are input based methods (indirect approach), measures based on outcomes (direct approach) concentrate on the actual standard of living of people and not on the means available to achieve a certain level of well-being. Measures of material deprivation fall into category of measures based on outcomes. The measurement of material deprivation has been regularly on the EU agenda since 2004. But only since 2009 two indicators have been formally agreed and added to the EU set of indicators for social inclusion: *Severe material deprivation rate* and *Depth of material deprivation*. Yet another possibility to identify endangered individuals is *Low work intensity indicator*.

For quantitative evaluation of Europe 2020 goals was defined an aggregated indicator *AROPE (at-risk-of-poverty-or-social-exclusion rate)* in the following way: The sum of persons who are either at risk of poverty (AROP), or severely materially deprived (SMD), or living in households with very low work intensity (LWI) as a share of the total population, expressed in numbers or shares of the population.

*At-risk-of-poverty rate (AROP)* - Share of population aged 0+ with an equalised disposable income below 60% of the national equalised median income (after social transfers). The poverty risk rate must always be analysed in conjunction with the at-risk-of-poverty threshold.

The equalised median income is defined as the household's total disposable income divided by its "equivalent size", to take account of the size and composition of the household, and is attributed to each household member (including children). Equalisation is based on the OECD modified scale.

*Severe material deprivation rate (SMD)* – The share of the population lacking at least 4 items among the 9 following items. The household could not afford: 1. to face unexpected expenses; 2. one-week annual holiday away from home; 3. to pay for arrears (mortgage or rent, utility bills or hire purchase instalments); 4. a meal with meat, chicken or fish every second day; 5. to keep home adequately warm, or could not afford (even if wanted to); 6. a washing machine; 7. a colour TV; 8. a telephone; 9. a personal car.

*Low work intensity (LWI)* - People aged 0-59, living in households, where working-age adults (18-59) work less than 20% of their total work potential during the past year. This indicator refers to people living in households with work intensity less than 0.2.

## 2 Comparison of poverty or social exclusion measures in 3 selected countries: CZ, SK and ES

### 2.1 Trends of poverty lines

The poverty-risk-rate (the headcount index  $P_0$  or AROP) must always be analysed in conjunction with the at-risk-of-poverty threshold (poverty line  $z$ ). In accordance with the Eurostat methodology (Eurostat 2009) as poverty lines ( $z$ ) was used poverty line for single person in EUR, which is defined as 60 % of the national median equalised disposable income.

**Tab. 1: Values of poverty lines ( $z$ ) in CZ, SK and ES (in EUR and PPS)**

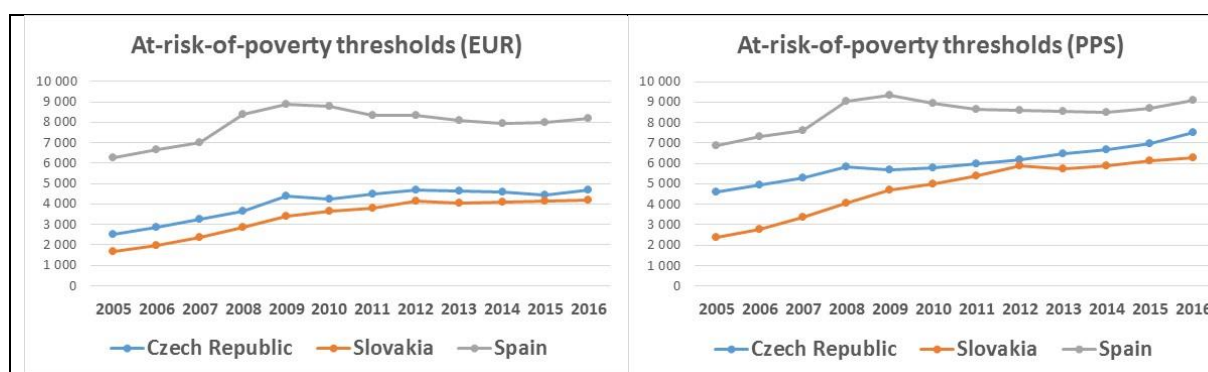
Country	2005	2008	2011	2014	2015	2016	Diff. 2014-2008	Diff. 2016-2005
<b>EUR</b>								
<b>CZ</b>	2 540	3 641	4 471	4 573	4 454	4 703	932	2 163
<b>SK</b>	1 698	2 875	3 784	4 086	4 158	4 171	1 211	2 473
<b>ES</b>	6 272	8 379	8 358	7 961	8 011	8 209	-418	1 937
<b>PPS</b>								
<b>CZ</b>	4 585	5 835	5 993	6 654	6 991	7 508	819	2 923
<b>SK</b>	2 394	4 058	5 385	5 883	6 132	6 304	1 825	3 910
<b>ES</b>	6 896	9 026	8 655	8 517	8 678	9 105	-509	2 209

PPS = Purchasing Power Standard

Source: Eurostat database, own calculation in Excel

The progress of at-risk-of-poverty threshold in Slovakia, the Czech Republic and Spain (in EUR and PPS) for period 2005 – 2016 is depicted on Fig. 1 and Tab. 1. The lowest values of the poverty line show Slovakia, in the Czech Republic are higher and the highest values are in Spain.

**Fig. 1: Poverty lines (z) in EUR and PPS**



Source: Eurostat database, own construction in Excel

## 2.2 Trends of poverty or social exclusion measures

The at-risk-of-poverty-or-social-exclusion rate (AROPE) in the 28 EU Member States (EU28) continued to decrease slightly in 2015 to 23.8%, down from 24.4% in 2014. Nevertheless, the EU28 AROPE rate was still slightly higher in 2014 than in 2008. This corresponded to 4.68 million more people in 2014 compared to 2008. The at-risk-of-poverty rate (AROP,  $P_0$ ) increased slightly in the EU28 to 17.2% in 2014 up from 16.5% in 2008 (Tab. 2).

Compared with the EU average, resp. EU28, the current situation in the Czech Republic as well as in the Slovakia in the area at-risk-of-poverty and social exclusion is better. The number of people at risk of poverty and social exclusion has been declining steadily in both countries, since 2008. The national goals of the Europe 2020 strategy are being implemented gradually.

Unfortunately, the situation is even worse in Spain (Tab. 2 and Fig. 2). Both indicators analysed in the Spain are above the EU average, resp. EU28, throughout in the period of 2008-2015. The number of people at risk of poverty and social exclusion has increase in 2014 by more than 2 million people, since 2008. We arrived at a conclusion that Spain is unable to meet the defined national goal of the social strategy in order to reduce the number of people at risk of poverty and social exclusion by 1.4 to 1.5 millions of people until 2020.

**Tab. 2: Values of AROPE indicators in CZ, SK and ES (2008-2016)**

	2008	2011	2014	2015	2016	Target 2020	diff. 2014-2008	diff. 2016-2008
<b>AROPE (Thousand persons)</b>								
<b>CZ</b>	1566	1598	1532	1444	1375	-100	-34	-191
<b>SK</b>	1111	1112	960	963	950	-170	-151	-161
<b>ES</b>	10786	12363	13402	13175	12827	-1400	2616	2041
<b>EU</b>	115908	120667	121900	119080		-20000	4680	
<b>AROPE (Percentage of total population)</b>								
<b>CZ</b>	15.3	15.3	14.8	14.0	13.3		-0.5	-2.0
<b>SK</b>	20.6	20.6	18.4	18.4	18.1	17.2	-2.2	-2.5
<b>ES</b>	23.8	26.7	29.2	28.6	27.9		05.4	04.1
<b>EU</b>	23.7	24.3	24.4	23.8				
<b>At-risk-of-poverty rate – AROP (Percentage of total population)</b>								
<b>CZ</b>	9.0	09.8	09.7	09.7	09.7		0.7	0.7
<b>SK</b>	10.9	13.0	12.6	12.3	12.7		01.7	01.8
<b>ES</b>	19.8	20.6	22.2	22.1	22.3		02.4	02.5
<b>EU</b>	16.5	16.8	17.2	17.3			0.7	

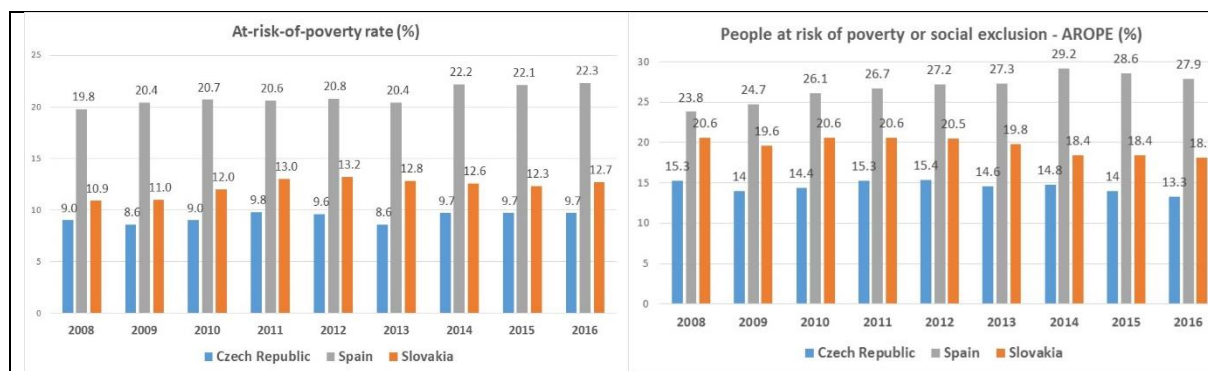
Source: Eurostat database, own calculation in Excel

Source for AROPE in thousand persons:

[http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=t2020\\_50&language=en](http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=t2020_50&language=en)

Note: The abbreviation EU means EU28 or EU27 (for year 2008).

**Fig. 2: Values of indicators: at-risk-of-poverty rate (AROP) and AROPE (%), in the period 2008-2016**

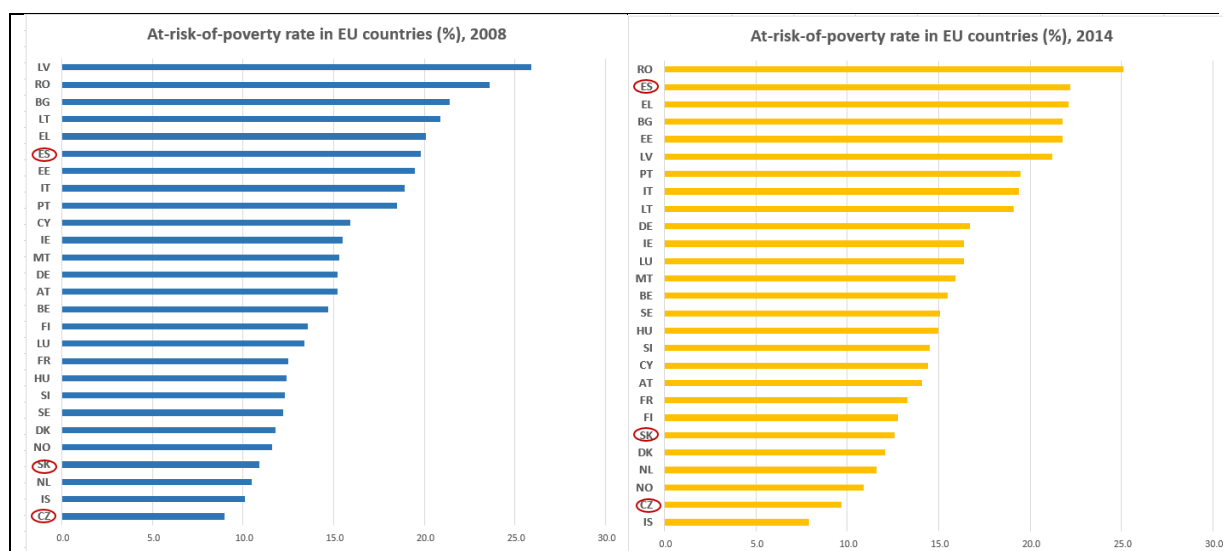


Source: Eurostat database, own construction in Excel

On the ground of ranking of EU countries formed by AROP ( $P_0$ ) indicator was Spain sixth from the end. This position was aggravated in 2014 (see Fig. 3) when Spain (22.2%), together with Romania (25%), take last position on the ranking. Moreover, we record small deterioration position on the ranking for Slovakia and the Czech Republic. As long as 2008 was on first position Czech Republic (9%) and Slovak Republic (10.9%) lead fourth position. In 2014 have been changes and shift Czech Republic on second position (9.7%) and Slovak Republic (12.6%) on sixth position. Evaluate the situation we should declare this position are better than average of EU.

**Fig. 3: At-risk-of-poverty rate ( $P_0$  or AROP) by EU countries in 2008 and 2014**





Source: Eurostat database, own construction in Excel

### 2.3 Trends of monetary poverty measures by NUTS2 regions in SK, CZ and ES

The empirical analysis uses data from the EU-SILC the years 2008, 2011 and 2014. The data contain detailed income and demographic information for individuals, families, and households and are used to generate official Slovak, Czech and Spain poverty rate estimates. In accordance with the Eurostat methodology (Eurostat 2009) as poverty lines z was used poverty line for single person in EUR (Tab. 1), which is defined as 60 % of the national median equivalised disposable income.

The picture (Fig. 4) depicts the main result of our analysis. We can see and compare values of all poverty indexes on the bar ( $P_0$ ) and line charts ( $P_1$ ,  $P_2$ ,  $W$ ) – 2 FGT indexes and Watts index by NUTS 2<sup>5</sup> regions in the Czech Republic (Tab. 2), Slovakia (Tab. 3) and Spain (Tab. 4). The differences in poverty levels among 3 countries are significant and differ by regions. While the share of poor ( $P_0$ ) is around 9-9.7% in the Czech Republic, the share of poor Slovaks is higher; it increased from 10.9% to 12.6% in the years 2008 to 2014. The highest share of poor is in Spain, it increased from 19.8% to 22.2%.

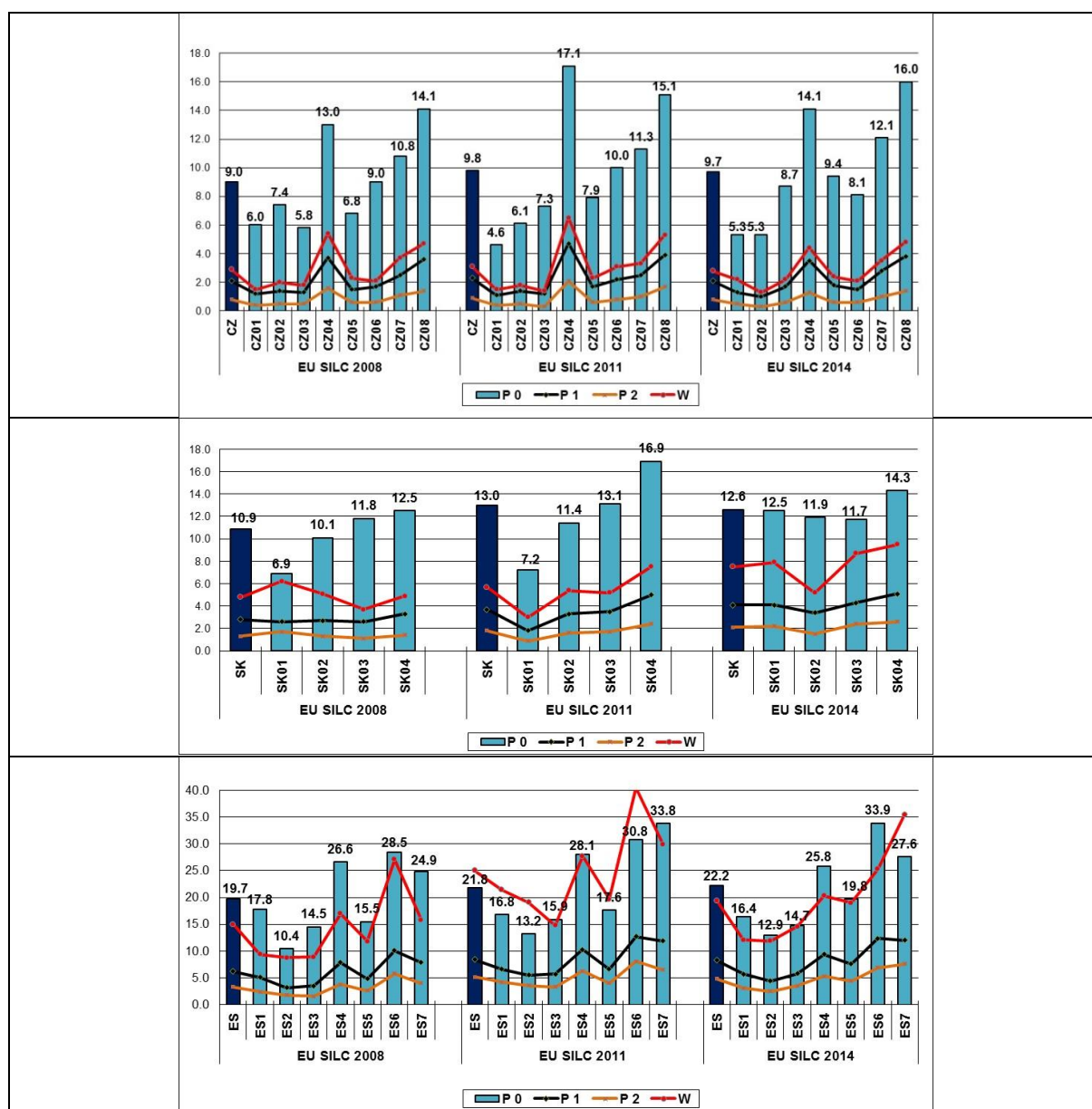
The differences between regions deepen in all 3 countries from year to year. The low values of the calculated indicators are usually in the regions of the capital cities and high in regions with a low share of industrial production, i.e. in the low-developed regions.

In Slovakia, the risk of poverty rate (headcount index  $P_0$ ) and the depth of poverty (poverty gap index  $P_1$ ) are highest in Eastern Slovakia (SK04: Košice and Prešov Regions;  $P_0$ :

<sup>5</sup> See Appendix 1 for NUTS classification of regions in CZ, SK and ES.

12.5-14.3% and P<sub>1</sub>: 3.3-5.1%). In the Czech Republic, there are 2 regions where there is a significantly higher risk of poverty rate than the national average, namely they are the Northwest region (CZ04: Karlovy Vary and Ústí nad Labem Regions; 13.0-14.1%) and also Moravian-Silesian Region (CZ08: 14.1-16.0%). In the Spain, there are 2 regions where there is a significantly higher risk of poverty rate than the national average, namely they are the Sur Region (ES6: Andalusia, Murcia, Ceuta, Melilla; 28.5-33.9%) and Canarias Region also (ES7: Canary Island; 24.9-27.6%).

**Fig. 4: Monetary poverty measures by NUTS2 regions in CZ, SK and ES – 3 FGT indexes and Watts index (in years 2008, 2011 and 2014)**



Source: EU-SILC data, own construction in Excel

**Tab. 2: Monetary poverty measures in the Czech Rep. by regions (CZ: 2008, 2011, 2014)**

Year	2008				2011				2014			
	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	W	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	W	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	W
Region												

<b>CZ01</b>	0.060	0.012	0.004	0.015	0.046	0.011	0.004	0.015	0.053	0.013	0.005	0.022
<b>CZ02</b>	0.074	0.014	0.005	0.020	0.061	0.014	0.005	0.018	0.053	0.010	0.003	0.013
<b>CZ03</b>	0.058	0.013	0.005	0.018	0.073	0.012	0.003	0.014	0.087	0.017	0.006	0.022
<b>CZ04</b>	0.130	0.037	0.016	0.054	0.171	0.047	0.021	0.065	0.141	0.035	0.013	0.044
<b>CZ05</b>	0.068	0.015	0.006	0.023	0.079	0.017	0.006	0.023	0.094	0.018	0.006	0.024
<b>CZ06</b>	0.090	0.017	0.006	0.021	0.100	0.022	0.008	0.031	0.081	0.015	0.006	0.021
<b>CZ07</b>	0.108	0.025	0.011	0.037	0.113	0.025	0.010	0.033	0.121	0.028	0.010	0.035
<b>CZ08</b>	0.141	0.036	0.014	0.047	0.151	0.039	0.017	0.053	0.160	0.038	0.014	0.048
<b>CZ</b>	<b>0.090</b>	<b>0.021</b>	<b>0.008</b>	<b>0.029</b>	<b>0.098</b>	<b>0.023</b>	<b>0.009</b>	<b>0.031</b>	<b>0.097</b>	<b>0.021</b>	<b>0.008</b>	<b>0.028</b>

**CZ – Czech Republic:** CZ01 – Prague, CZ02 - Central Bohemia, CZ03 – Southwest, CZ04 – Northwest, CZ05 - Northeast, CZ06 – Southeast, CZ07 – Central Moravia, CZ08 – Moravian-Silesian Region)

Source: Computation based on CZ EU-SILC data, own calculation in SAS

**Tab. 3: Monetary poverty measures in Slovakia by regions (SK: 2008, 2011, 2014)**

Year	2008				2011				2014			
	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	W	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	W	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	W
<b>SK01</b>	0.069	0.026	0.017	0.062	0.072	0.018	0.009	0.030	0.125	0.041	0.022	0.079
<b>SK02</b>	0.101	0.027	0.013	0.051	0.114	0.033	0.016	0.054	0.119	0.034	0.015	0.052
<b>SK03</b>	0.118	0.026	0.011	0.037	0.131	0.035	0.017	0.052	0.117	0.043	0.024	0.087
<b>SK04</b>	0.125	0.033	0.014	0.049	0.169	0.050	0.024	0.075	0.143	0.051	0.026	0.095
<b>SK</b>	<b>0.109</b>	<b>0.028</b>	<b>0.013</b>	<b>0.048</b>	<b>0.130</b>	<b>0.037</b>	<b>0.018</b>	<b>0.057</b>	<b>0.126</b>	<b>0.041</b>	<b>0.021</b>	<b>0.075</b>

**SK - Slovakia:** SK01 - Bratislava Region, SK02 - Western Slovakia, SK03 - Central Slovakia, SK04 - Eastern Slovakia

Source: Computation based on SK EU-SILC data, own calculation in SAS

**Tab. 4: Monetary poverty measures in Spain by regions (ES: 2008, 2011, 2014)**

Year	2008				2011				2014			
	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	W	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	W	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	W
<b>ES1</b>	0.178	0.051	0.024	0.094	0.168	0.066	0.042	0.214	0.164	0.057	0.031	0.121
<b>ES2</b>	0.104	0.032	0.018	0.088	0.132	0.055	0.036	0.191	0.129	0.044	0.025	0.119
<b>ES3</b>	0.145	0.035	0.016	0.089	0.159	0.057	0.033	0.148	0.147	0.058	0.035	0.146
<b>ES4</b>	0.266	0.079	0.038	0.170	0.281	0.103	0.063	0.277	0.258	0.094	0.053	0.203
<b>ES5</b>	0.155	0.048	0.026	0.118	0.176	0.066	0.040	0.197	0.198	0.076	0.044	0.190
<b>ES6</b>	0.285	0.101	0.058	0.271	0.308	0.127	0.081	0.405	0.339	0.124	0.069	0.253
<b>ES7</b>	0.249	0.079	0.040	0.158	0.338	0.119	0.065	0.299	0.276	0.120	0.076	0.355
<b>ES</b>	<b>0.197</b>	<b>0.062</b>	<b>0.033</b>	<b>0.150</b>	<b>0.218</b>	<b>0.084</b>	<b>0.052</b>	<b>0.250</b>	<b>0.222</b>	<b>0.083</b>	<b>0.048</b>	<b>0.194</b>

**ES - Spain:** ES1 - Noroeste (ES), ES2 - Noreste (ES), ES3 - Comunidad de Madrid, ES4 - Centro (ES), ES5 - Este (ES), ES6 - Sur (ES), ES7 - Canarias (ES)

Source: Computation based on ES EU-SILC data, own calculation in SAS

Note: Green cells mean minimal values of indicators and red cells mean maximal values of indicators.

**Tab. 5: Number of household with equivalised income ( $y_i \leq 0$ ) in EU-SILC data**

Country	2008	2011	2014
<b>Sample size (number of household)</b>			
<b>CZ</b>	11294	8866	8053
<b>SK</b>	5450	5200	5200
<b>ES</b>	13014	13109	11965
<b>Number of household with equivalised income (<math>y_i \leq 0</math>) in sample</b>			
<b>CZ</b>	1	1	1
<b>SK</b>	5	0	12
<b>ES</b>	91	208	100

Source: Computation based on EU-SILC data, own calculation in SAS

We noticed an interesting development for Watts index (W) in Slovakia and Spain. While in 2008 there was the lowest poverty rate (P<sub>0</sub>) in Bratislava Region (SK01: 6.9%), so

Watts index reached the highest values (0.062). In 2011 and 2014 Watts index follows the development of headcount index  $P_0$  in SK01 region (SK01:  $P_0 = 7.2\%$  and  $12.5\%$ ) and reached the lowest values among Slovak regions (SK01:  $W = 0.030$  and  $0.079$ ). This trend of Watts's indexes means changes in income distribution by Slovak regions.

In Spain, in 2008 there was the lowest poverty rate ( $P_0$ ) in Sur Region (ES6:  $28.5\%$ ), so Watts index reached the highest values (0.271). In 2011 Watts index follows the development of headcount index  $P_0$  in the ES6 region (ES6:  $P_0 = 30.8\%$ ) and reached the highest value among Spain regions (ES6:  $W = 0.405$ ). However, in 2014 the Watts index fell to 0.253 in the ES6 region and the highest value reached in the region ES7 (0.355). This trend of Watts's indexes means changes in income distribution by Spain regions too.

It should be noted, that mathematical problems also exist in the Watts index calculations (see equation (2)). From the natural logarithm function ( $\ln(y_i)$ ), the problem arises when the number  $y_i$  is negative or equal to 0. The natural logarithm can be defined for any positive real number, i.e. the interval  $(0, \infty)$ . Table 5 shows that in EU-SILC data for Slovakia and the Czech Republic is a negligible occurrence of negative and zero values of equalized incomes ( $y_i$ ), while in Spanish data the occurrence of these values is higher, especially in 2011. In the calculations we replaced the negative values of equalized incomes ( $y_i$ ) by number 1, because  $\ln(1) = 0$ . This fact also affected the calculated values of Watts index mainly in the Spain and the values for the Spain are the highest in 2011, because of the highest incidence of these problematic values. The Watts index values can therefore be considered disputable or questionable if the data have equalised incomes  $(y_i) \leq 0$ .

## Conclusion

Our results show that the crisis and the ensuing high unemployment have resulted in poverty and income disparities in all 3 analysed countries. Making growth more inclusive will require further reducing unemployment, better policies to reduce poverty and improving the quality of jobs via better skills, training and job matching.

The situation in the field of poverty and social exclusion is the worst in Spain, where the values of the indicators are higher than the average in the EU countries and the country does not meet the national target set by the Europe 2020 strategy. Since 2008, the number of people at risk of poverty and social exclusion is increasing. There is a better situation in Slovakia and the Czech Republic. All indicators are below the EU average, resp. EU28. Both countries meet the Europe 2020 national targets. In terms of reducing the number of people at risk of poverty

and social exclusion, the Czech Republic has already achieved the planned reduction and Slovakia is a well-established target for 2020.

Differences persist in regions in all three countries. The risk of poverty and social exclusion is the lowest in regions of the capital cities, except for Spain. In Spain, the smallest indicators of monetary poverty are in the Noreste region (ES2: Basque Community, Navarre, La Rioja and Aragon) and Madrid (ES3) is on the second position. The highest figures are in less-developed regions.

Calculation of the Watts index in case of occurrence of equalized incomes  $(y_i) \leq 0$  in EU-SILC data should be considered problematic. There are problems with the mathematical properties of the natural logarithm function.

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## Contact

Iveta Stankovičová  
Comenius University in Bratislava (Slovak Republic)  
Faculty of Management, Odbojárov 10, 820 05 Bratislava  
[iveta.stankovicova@fm.uniba.sk](mailto:iveta.stankovicova@fm.uniba.sk)

Estefanía Mourelle  
Universidade da Coruña (Spain)  
Faculty of Economic and Business, Campus de Elviña s/n, 15071 A Coruña  
[estefania.mourelle@udc.es](mailto:estefania.mourelle@udc.es)

## Appendix 1: The NUTS classification

The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU for the purpose of:









1. the collection, development and harmonisation of European regional statistics;
2. socio-economic analyses of the regions;
3. framing of EU regional policies.

The NUTS classification:

- NUTS 1: major socio-economic regions
- NUTS 2: basic regions for the application of regional policies
- NUTS 3: small regions for specific diagnoses

The current NUTS 2013 classification is valid from 1 January 2015 and lists 98 regions at NUTS 1, 276 regions at NUTS 2 and 1342 regions at NUTS 3 level.

### NUTS regions in Spain (ES)

	Code	NUTS 1	NUTS 2	NUTS 3	
	ES0	Spain			
	ES1		Noroeste (ES)	Galicia Asturias Cantabria	
	ES2		Noreste (ES)	Basque Community Navarre La Rioja Aragon	
	ES3		Comunidad de Madrid	Madrid	
	ES4		Centro (ES)	Castile-Leon Castile-La Mancha Extremadura	
	ES5		Este (ES)	Catalonia Valencian Community Balearic Islands	
	ES6		Sur (ES)	Andalusia Region of Murcia Ceuta Melilla	
	ES7		Canarias (ES)	Canary Islands	

### NUTS regions in Slovakia (SK)

Code	NUTS 1	NUTS 2	NUTS 3
<b>SK0</b>	<b>Slovakia</b>		
SK01		Bratislava Region	SK010 Bratislava Region
SK02		Western Slovakia (Západné Slovensko)	SK021 Trnava Region SK022 Trenčín Region SK023 Nitra Region
SK03		Central Slovakia (Stredné Slovensko)	SK031 Žilina Region SK032 Banská Bystrica Region
SK04		Eastern Slovakia (Východné Slovensko)	SK041 Prešov Region SK042 Košice Region

### NUTS regions in Czech Republic (CZ)

Code	NUTS 1	NUTS 2	NUTS 3	Code
<b>CZ0</b>	<b>Czech Republic</b>			
CZ01		Prague (Praha)	Prague	CZ010
CZ02		Central Bohemia (Střední Čechy)	Central Bohemian Region	CZ020
CZ03		Southwest (Jihozápad)	South Bohemian Region Plzeň Region	CZ031 CZ032
CZ04		Northwest (Severozápad)	Karlovy Vary Region Ústí nad Labem Region	CZ041 CZ042
Z05		Northeast (Severovýchod)	Liberec Region Hradec Králové Region Pardubice Region	CZ051 CZ052 CZ053
Z06		Southeast (Jihovýchod)	Vysočina Region South Moravian Region	CZ063 CZ064
Z07		Central Moravia (Střední Morava)	Olomouc Region Zlín Region	CZ071 CZ072
CZ08		Moravian-Silesian Region (Moravskoslezsko)	Moravian-Silesian Region	CZ080