A Comparative Analysis of Regional Inequality: the Case of Romania and Poland

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Abstract: There is a major interest from international and national bodies, but also from researchers for measuring inequality, materialized in numerous reports, studies and researches in the field. Multiple indicators are used to generate data and analyse the dynamics and patterns of inequality in order to find solutions to reduce economic disparities. This paper intends to carry out a comparative analysis regarding regional inequality. In order to carry out this analysis we have chosen two countries, Romania and Poland. We have analysed regional inequality based on regional Gross Domestic Product (GDP), for the period 2007-2016, and also based on the structural funds for 2007-2013. For measuring inequalities, we have used Theil index. Our results emphasize that there are significant inequalities between the regions of the two analysed countries and also that there is greater inequality in Romania than in Poland. The results of the study should be of interest to the policy makers as measuring and reducing inequality is a necessary process for meeting the objective of reducing European regional disparities and ensuring sustainable economic growth.

Keywords: income inequality; Theil index; GDP; structural funds

JEL Classification: D63; E64

1. Introduction

Inequality in income distribution is an important topic of studies on regional economic development. Economic development is not always consistent with reducing inequality; it does not always lead to reducing inequality in terms of income distribution. Throughout this paper we will use Theil Index to measure regional disparities between and within Romania and Poland on the basis of regional GDP and based on the absorption of structural funds for the period 2007-2013, the data used are for the period between 2007 and 2016, because the year 2016 is the year in which the last payments were made. The analysis at the level of the macro-regions of Poland will be carried out taking into account the territorial division according to

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the classification from the year 2013 and the classification from the year 2016, analysing how the territorial organization from a geographical point of view influences the size of the inequality.

The advantage of using Theil Index is that one can calculate the value of inequality in a particular region or between regions, simultaneously, so that the scope of analysis is expanded. The value of Theil Index shows the contribution of each region to inequality as a whole, so that development policies are targeted to reduce inequality punctually. The data considered in calculating the inequality between the two countries, between their regions and within the regions are the regional GDP values and the population to calculate the Theil Index for each country and between countries; and the values of the funds absorbed under the Cohesion Policy, the Agricultural Policy and the Social Policy and population to calculate Theil Index for 2007-2016. The calculation of Theil Index is performed with the purpose of analysing the gap between the two states and within them based on national incomes, but also how the value of the allocation of structural funds has increased or decreased the gap (inequality) at the level of Romania and Poland.

The replacement of GDP with other indicators was also carried out by Sbardella, Pugliese and Pietronero (2017), analysing the complex relationship between wage inequality and the development and industrialization of the United States for the time period 1990-2014, by using data on the level of wages and employment. Buturac (2013) made a comparison of the Theil Index values calculated based on the following variables: GDP / inhabitant, available population rate, salary, consumer price index and gross government debt for the countries of the European Economic Area for the period 2000-2011.

This paper is divided into two major parts, in the first part we consider the analysis of regional inequality at the level of Romania and Poland on the basis of regional GDP, and in the second part we analyse regional inequalities at the level of Romania and Poland on the basis of structural funds. Our analysis ends with conclusions.

2. Studies and Analysis for Measuring Inequality

Tudberidze et al. (2018) analyse the economic structure of Georgia's inequality using the Gini Coefficient, Theil Index, Hoover Index and Atkinson Index. Buturac (2013) compares the economic convergence between Croatia's economy and the economies of south-eastern Europe by calculating the Entropy Index, the Lafay Index, the Grubel-Loyd Index and the Trade Intensity Index and using, in

convergence analysis, Theil Index. Tambunan et al. (2018) uses the Theil Index and Weighted Variation Coefficient to measure regional income inequality by decomposing regional income based on labour productivity and its contribution to income inequality. Butkus et al. (2018) analyse the inequality at the level of the European NUTS 3 regions using the three-level construction of the Theil Index - between states, within the states at the level of the NUTS 2 regions and within the NUTS 2 regions at the level of the NUTS 3 regions.

Akita and Katoka (2002) combined the Coefficient of Variation and Theil Index to obtain a new measure of regional income inequality in post-war Japan. Shorrocks and Wan (2005) and Marquez and Lasarte (2019) have investigated space decomposition by using Theil Index. Anselin and Arribas-Bel (2013) have developed a statistical application based on regional data to measure inequality, while Rey and Smith (2013) have used the Gini coefficient to measure spatial development.

Carlino and Mills (1996), in their research, reached the conclusion that inequality in the US is also caused by regional differences related to the working population and the unemployed, which determine the differences of income per inhabitant between regions, even if the average productivity per inhabitants is similar. Other studies (Duro and Esteban, 1998) have determined productivity based on the Theil Index relative to the total population or improved the calculation method by weighting total incomes (Goerlich-Gisbert, 2001).

3. Analysis of Regional Inequality for Romania and Poland based on Regional GDP

For the present research, Theil Index will be calculated based on the formula of Conceição and Ferreira (2000). The data used are taken from Eurostat, specifying that for the period 2007-2013 there are no GDP data for the following regions of Poland: Lódzkie, Swietokrzyskie, Lubelskie, Podkarpackie, Podlaskie, Warszawski Stoleczny and Mazowiecki regionalny. The data for these regions were collected from the official statistics of Poland.

The calculation of Theil Index for Romania was made between and within the macro-regions, for Poland between and within the macro-regions and between Romania and Poland, for each year, based on regional GDP for the period 2007-2016. For Poland, the calculation of Theil Index was made after both the 2013 and 2016 regional

breakdowns in order to analyse whether the regional reorganization changes the inequality, adding to the main purpose, to still have an eligible region for the period 2020-2024.

The Theil Index decomposition from the macro-regional level to the regional level is made by calculating the inequality existing at the level of each macro-region based on population and regional GDP. According to our calculations, Theil Index values for each macro-region of each country are described in table 1.

Table 1. Theil Index Values at National Level (T), by Macro-Regions - Intra Inequality (T') and Inter-Macro-Regional Inequality (T") - for Romania and Poland for 2007-2016, Calculated on the Basis of Regional GDP

MACRO-REGIONS	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ROMANIA										
M. one	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M. two	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.01
M. three	0.13	0.15	0.12	0.14	0.14	0.15	0.14	0.12	0.15	0.15
M. four	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02
T'	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04
T"	0.05	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06
T'+ T"(Theil RO)	**0.09**	**0.11**	**0.09**	**0.10**	**0.11**	**0.10**	**0.10**	**0.10**	**0.11**	**0.10**
POLAND (2013)										
M. Poludniowy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M. Pólnocno-Zach.	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
M. Poludniowo-Zach.	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
M. Pólnocny	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
M. Centralny	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.03	0.03	0.03
M. Wschodni	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T'	0.07	0.06	0.07	0.07	0.07	0.07	0.07	0.02	0.02	0.02
T"	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.01	0.01	0.01
T'+ T"(Theil PL)	0.11	0.10	0.11	0.11	0.11	0.11	0.12	0.04	0.04	0.04
POLAND (2016)										
M. Poludniowy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

M. Pólnocno-Zach.	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
M. Poludniowo-Zach.	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
M. Pólnocny	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
M. Centralny	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
M. Wschodni	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M. W. Mazowieckie	0.05	0.06	0.06	0.06	0.06	0.07	0.07	0.10	0.09	0.09
T’	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.03	0.03	0.03
T”	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02
T’+ T”(Theil PL)	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.05	0.05	0.05

Data source: author’s own calculation

Note: T’- Theil between macro-regions, T” - Theil within macro-regions, T’ + T” = T national. The resulting values were rounded to 2 decimal places, so that the value T’+ T” does not, in some cases, correspond to the addition of the numbers in the table, but the value resulting from the calculations presented in the Appendices; this note is valid for all similar tables

The national T, T’ and T” values can be analysed according to figure 1. Analysing the data, it is found that major fluctuations of inequality are recorded, throughout the period analysed, in Poland more than in Romania, although GDP and GDP / inhabitant are higher in Poland than in the case of Romania. T’ - The Theil intra-macro-regional index - measures the inequality between the macro-regions of each country, with unequal income distributions, the values highlighting the unequal distribution of income among the population, the minimum values showing relative homogeneity in the distribution of income.

T” - Theil cross-regional index - shows the measure of the dispersion in the distribution of income between macro-regions, being a combined measure of inequality at national level by quantifying the contribution of each macro-region to inequality. Macro-regions that have high contribution values are major contributors to inequality. It is obtained by adding the value of each macro-region to the inequality, which is obtained by multiplying the value of macro-regional Theil Index (based on population rates and regional income) with the income rate of each macro-region. T - Theil index at national level - is summing of the values T’ and T”, and can be analysed by the decomposition of intra and inter-macro-regional inequality. T’ for Romania increases in 2008 and 2011 due to the increase of the income rate by

2% in M. three compared to 2007, respectively 2010, which generates an increase of inequality.

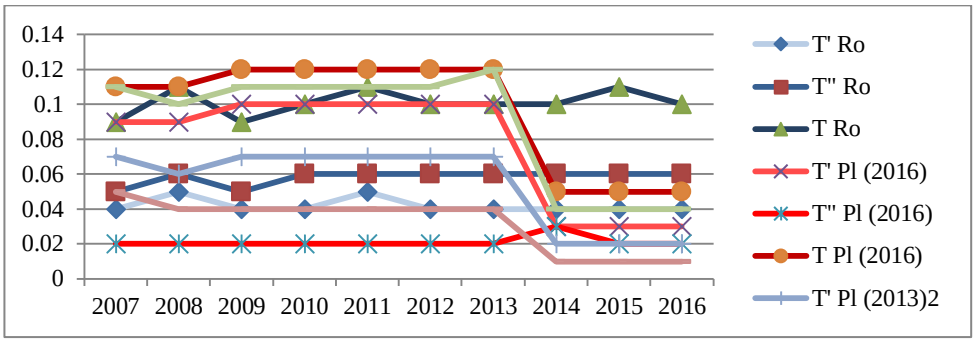

Figure 1. The Theil Index Values for Romania and Poland on the Basis of Regional GDP - 2007-2016 and iT's Decomposition

In 2007, the inequality is largely due to the second Macro-region, which has 22% of the total national income distributed to 30% of the population, the situation changing in 2008, when the income decreased to 21%, but increased in Macro-region three, from 37% to 39%.

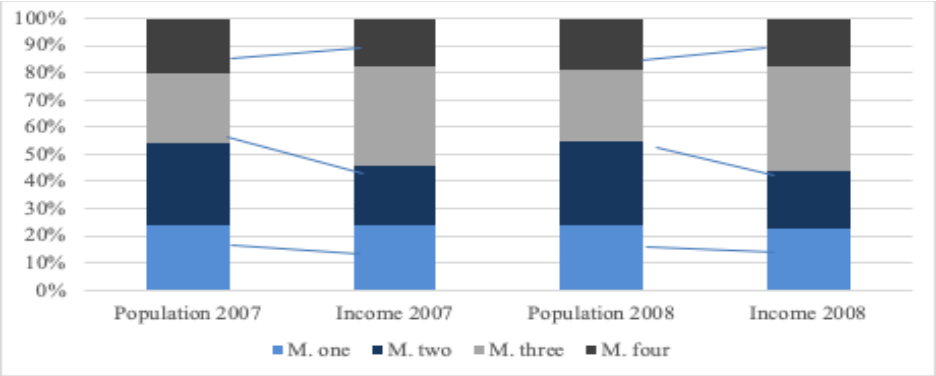

Figure 2. Inequality in Romania on Account of Regional GDP - 2007 and 2008: Population Rate and Income Rate by Macro-Regions

Changes in both the share of the population and the share of income do not change the value of inequality at the national level, but it is necessary to analyse the inequality at the level of the regions which form the macro-regions. T" for Romania changes in 2008 due to a 1% increase of the M. three contribution compared to 2007, in 2009 having the same value as in 2007. The contribution of each macro-region in obtaining T" for Romania is as follows: M. three is the only macro-region that

contributes to inequality in full in 2010, 2011, 2014, 2016 and 2017, during the rest of the period the other macro-regions contribute together with about 1%.

The Theil Index values at the level of each macro-region taking into account the population and income of the component regions, for Romania, are presented in table 2. Inequality at the level of the Romanian macro-regions is 0 for the Macro-region one for the period 2007-2016, has the value of 0.01 or 0.02 for the Macro-regions two and four and with values between 0.12 and 0.15 for the Macro-region three, this influencing the inequality at national level.

Table 2. Theil Index at the Level of the Romanian Macro-Regions for the Period 2007-2016

MACRO-REGIONS	M. one		M. two		M. three		M. four	
	T	R V	T	R V	T	R V	T	R V
2007	0.00	0.24	0.01	0.22	0.13	0.37	0.02	0.18
2008	0.00	0.23	0.01	0.21	0.15	0.30	0.02	0.18
2009	0.00	0.23	0.01	0.21	0.12	0.38	0.02	0.18
2010	0.00	0.23	0.01	0.21	0.14	0.38	0.02	0.18
2011	0.00	0.22	0.02	0.21	0.14	0.40	0.02	0.17
2012	0.00	0.23	0.01	0.21	0.15	0.39	0.01	0.17
2013	0.00	0.22	0.02	0.22	0.14	0.39	0.01	0.17
2014	0.00	0.22	0.02	0.21	0.12	0.40	0.02	0.16
2015	0.00	0.23	0.01	0.21	0.15	0.40	0.02	0.17
2016	0.00	0.23	0.01	0.21	0.14	0.39	0.02	0.17

Data source: author's own calculation

Note: T- Theil macro-regional index, RV- Macro-regional income rate

This fluctuation is due to the changes in the income of the two regions, the South-Muntenia region and the Bucharest-Ilfov region, the Bucharest-Ilfov region having a population between 40% and 46% over the period, but an income between 55% and 70% of the total macro-regional income. Inequality at the level of this macro-region also influences inequality at the national level. Theil index for Romania has a low value during the analysed period, increasing by 2% in 2008 compared to 2007, decreasing in 2009 to the value of 2007 and registering an increase of one percentage point in 2010 and 2011, for the rest of the years having the value since 2010, except for 2015, when its value is at the level of 2008 and 2011 (0.11), the highest value of the period. T' (2013) for Poland remains constant between 2007 - 2013 (0.07), with the exception of 2008 (0.06), registering a substantial decrease since 2014, of 5%, a value that is maintained for the rest of the analysed period. At the level of Poland, there is a decrease of inequality, from 0.07 in 2013 to 0.02 in 2014, which will be analysed in figure 3.

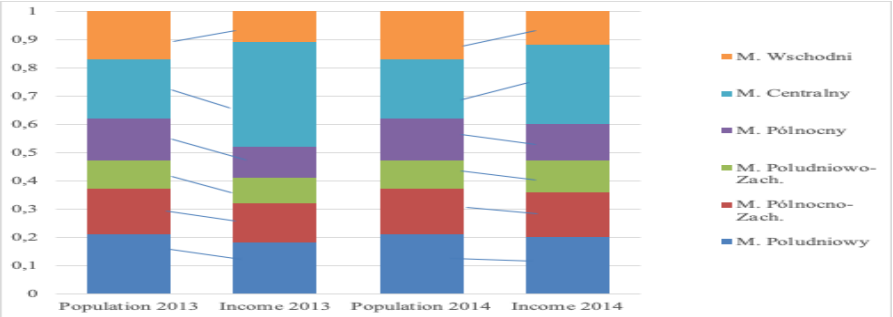

Figure 3. Inequality in Poland (NUTS 2013) on Account of Regional GDP - 2013 and 2014: Population Rate and Income Rate by Macro-Regions

In the two periods taken into account the population rates are the same, the income rates changing as follows: Poludniowy, Pólnocno-Zachodni, Poludniowo-Zachodni and Polnocny macro-regions - 2% increase in 2014, Wschodni Macro-region - 1% increase in 2014 2013, Central Macro-region - 9% decrease in revenue during the analysed period. T" for Poland is 0.05 in 2007, has the same value during the period 2008-2013 of 0.04 and decreases from 2014 to 0.01. The contribution of each macro-region in obtaining T" for Poland is as follows: M. Centralny contributes 2% in 2007-2009 and 2011, 3% in 2010, 2012 and 2013 and 1% in 2014 - 2016; Poludniowy macro-region contributes with 1% during the whole period analysed, the rest of the macro-regions having zero contribution.

The Theil Index values at the level of each macro-region, taking into account the population and income of the component regions, for Poland, are presented in table 3. Inequality at the level of the macro-regions of Poland is 0 or close to 0 for all the macro-regions, except M. Centralny, the values being 0.08 for the period 2007-2013, decreasing to 0.03 from 2014. This fluctuation is due to the changes in the income level of the two regions, Lodzkie Region and Mazowiecki Region, starting with 2014, as follows: 7% increase in income rate in Lodzkie Region and 7% decrease in revenue rate in Mazowiecki Region from 2014 compared to 2013.

Theil index for Poland has a relatively low value during the period analysed, of 0.11 in 2007-2012, except for 2008 (0.10), decreasing by 8% in 2014-2016. This major decrease is due to the change of the income rate at the level of each macro-region in 2014 compared to 2013, as follows: M. Centralny - decrease of the income rate from 37% to 28%, increase for the other regions from 1% to 2%, in the conditions under which the population rates remained constant.

Table 3. Theil Index (2013) in the Macro-Regions of Poland for the Period 2007-2016

MACRO-REGIONS	M. one		M. two		M. three		M. four	
	T	R V	T	R V	T	R V	T	R V
2007	0.00	0.24	0.01	0.22	0.13	0.37	0.02	0.18
2008	0.00	0.23	0.01	0.21	0.15	0.30	0.02	0.18
2009	0.00	0.23	0.01	0.21	0.12	0.38	0.02	0.18
2010	0.00	0.23	0.01	0.21	0.14	0.38	0.02	0.18
2011	0.00	0.22	0.02	0.21	0.14	0.40	0.02	0.17
2012	0.00	0.23	0.01	0.21	0.15	0.39	0.01	0.17
2013	0.00	0.22	0.02	0.22	0.14	0.39	0.01	0.17
2014	0.00	0.22	0.02	0.21	0.12	0.40	0.02	0.16
2015	0.00	0.23	0.01	0.21	0.15	0.40	0.02	0.17
2016	0.00	0.23	0.01	0.21	0.14	0.39	0.02	0.17

Data source: author's own calculation

Note: T- Theil macro-regional index, RV- Macro-regional income rate

To analyse whether the change of the geographical structure of Poland in the NUTS 3 and NUTS 2 regions generates a change of inequality, we calculated the values of Theil Index with the data for the period 2007-2016 considering 7 new macro-regions, the seventh macro-region being the Województwo Macro-region. Mazowieckie comprising the Warszawski stoleczny (capital region) and Mazowiecki regionalny regions, detached from the Central Macro-region, being replaced by the Swietokrzyskie region that belonged to the Wschodni Macro-region.

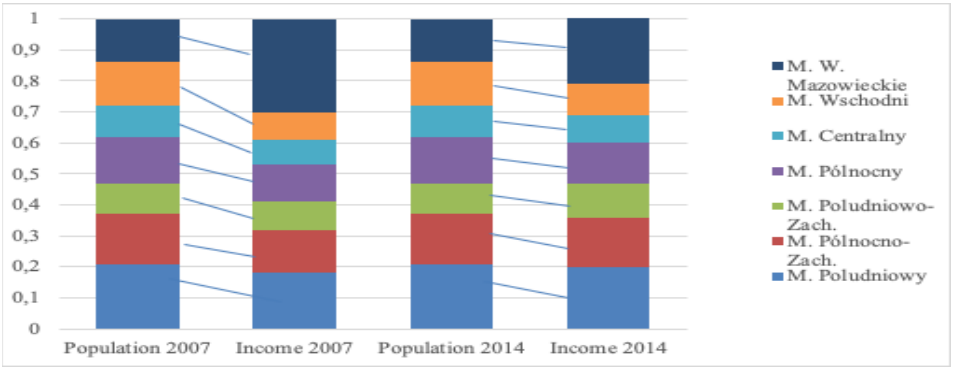

Figure 4. Inequality in Poland (NUTS 2016) by Regional GDP - 2007 and 2014: Population Rate and Macro-Region Income Rate

The data obtained are analysed in the following section. T' (2016) for Poland remains constant between 2007 - 2008 (0.09), increasing by 1% in 2009-2013, registering a substantial decrease since 2014, of 7%, a value that is maintained in 2016. Poland shows a decrease in inequality, from 0.09 in 2007 to 0.03 in 2014,

which will be analysed in figure 4. In the two periods taken into account the rates of the population are the same, the income rates changing as follows: Poludniowy, Pólnocno-Zachodni Macro-regions, Poludniowo-Zachodni - 2% increase in 2014, Mazowieckie Voivodship Macro-region - 8% decrease in 2007. T" for Poland has the same value during the analysed period of 0.02, except for 2014, when it is 0.03.

The contribution of each macro-region in obtaining T" for Poland is as follows: M. Województwo Mazowieckie is the only macro-region that contributes to inequality in the whole period 2007-2017, with the exception of 2014, when the other macro-regions contribute about 1%. The values of Theil Index at the level of each macro-region, taking into account the population and income of the component regions, for Poland, are presented in table 4. Inequality in the macro-regions of Poland is 0 or close to 0 for all macro-regions, with the exception of M. Mazowieckie, the values being 0.30 for the period 2007-2009, increasing by 1% for the period 2010-2013, decreasing to 0.22 from 2014. This fluctuation is due to changes in the incomes of the two regions, Warszawski Region and Mazowiecki Region, starting in 2014, as follows: 1% increase in population rate and 40% income rate in Warszawski Region and 1% decrease of the population rate and with 40% of the income rate in the Mazowiecki Region from 2014 compared to 2013.

Table 4. Theil Index in the Macro-Regions of Poland (2016) for the Period 2007-2016

MACRO-REGIONS	M. Poludniowy		M. Pólnocno-Zach.		M. Poludniowo-Zach.		M. Pólnocny		M. Centrally		M. Wschodni		M. W. Mazowieckie	
	T	R	V	T	R	V	T	R	V	T	R	V	T	R	V	T	R	V	T	R	V
2007	0.00	0.18	0.00	0.14	0.01	0.09	0.01	0.12	0.00	0.08	0.00	0.09	0.05	0.30
2008	0.00	0.18	0.00	0.14	0.01	0.09	0.01	0.12	0.00	0.08	0.00	0.09	0.06	0.30
2009	0.00	0.18	0.01	0.14	0.01	0.09	0.01	0.12	0.00	0.08	0.00	0.09	0.06	0.30
2010	0.00	0.18	0.01	0.14	0.01	0.09	0.01	0.11	0.00	0.08	0.00	0.09	0.06	0.31
2011	0.00	0.18	0.01	0.14	0.01	0.09	0.01	0.11	0.00	0.08	0.00	0.09	0.06	0.31
2012	0.00	0.18	0.01	0.14	0.01	0.09	0.01	0.11	0.00	0.08	0.00	0.09	0.07	0.31
2013	0.00	0.18	0.01	0.16	0.01	0.09	0.01	0.11	0.01	0.08	0.00	0.09	0.07	0.31
2014	0.00	0.20	0.01	0.16	0.01	0.11	0.01	0.13	0.01	0.09	0.00	0.10	0.10	0.22
2015	0.00	0.20	0.01	0.16	0.01	0.11	0.01	0.13	0.01	0.08	0.00	0.10	0.09	0.22
2016	0.00	0.20	0.01	0.16	0.01	0.10	0.01	0.13	0.01	0.08	0.00	0.10	0.09	0.22

Data source: author's own calculation

Note: T- Theil Macro-Regional Index, RV- Macro-regional Income Rate

Theil index for Poland (2016) has a relatively low value during the analysed period, of 0.11 in 2007 and 2008, increasing by 1% in the period 2009-2012 and by 2% in 2013, for the period 2014-2016 the value being 0.05, by 8% less than in 2013 and by 6% less than in 2007. This major decrease is due to the change of the income rate at the level of each macro-region in 2014 compared to 2013, as follows: M. Mazowiecki - decrease of the income rate from 31 % to 22%, growth for the other regions from 1% to 2%, given that the population rates remained constant.

Following the analysis of the data presented, it can be concluded that, in the case of Romania, the increase of GDP and GDP/ inhabitant due to the absorption of the structural funds during 2007-2013 did not significantly change the inequality at the level of macro-regions, regions and nationally.

In the case of Poland, the change of the inequality index over the period considered is large, which will be analysed in the next part of the paper, using the values of the structural funds absorbed at the level of the macro-regions and the regions. It can be concluded, comparing the data for the two modalities of regional division that the inequality between the regions and at national level is lower in the case of the regional division in 2013, but the index obtained from the contribution of each region to inequality is higher by 2013 by 2%, decreasing since 2014 by 2%. Centralny macro-region shows a decrease in inequality without the Mazowieckie region from 0.08 to 0.03 in 2014. The Wschodni macro-region is not influenced by taking over the Swietokrzyskie region.

The value of the inequality between Romania and Poland - Theil index - based on GDP is presented in table 5. The Theil Index values of 0.01 for the period 2007-2009, 2013-2017 and 0.02 for the period 2010-2012 show that the inequality between Romania and Poland is not large, but it exists, given the distribution of income to the population. This increases during 2010-2012 with the economic crisis, during which time only Romania was affected, Poland being the only EU country that did not enter the recession. Inequality is at a low value and due to the fact that at a lower GDP of Romania the population is also lower, but the values showing the distribution of income are much higher for Poland than for Romania. The population of Romania has been decreasing since 2012 (-6%), while in the same period the population of Poland increases by 0.003%, decreasing subsequently from 2014 by 11%.

Table 5. Theil Index for Romania and Poland based on GDP - 2007-2016

	ROMANIA		POLAND		THEIL INDEX
	Population rate	Income Rate	Population rate	Income Rate	
2007	0.36	0.29	0.64	0.71	0.01
2008	0.36	0.29	0.64	0.71	0.01
2009	0.36	0.28	0.64	0.72	0.01
2010	0.36	0.26	0.64	0.74	0.02
2011	0.36	0.26	0.64	0.74	0.02
2012	0.35	0.25	0.65	0.75	0.02
2013	0.34	0.27	0.66	0.73	0.01
2014	0.34	0.27	0.66	0.73	0.01
2015	0.34	0.27	0.66	0.73	0.01
2016	0.34	0.29	0.66	0.71	0.01

Data Source: Author's own Calculation

The value of GDP for Romania decreases during the period 2009-2013 (15%, 14.5%, 10%, 9%, respectively 1.9% - the reference being 2008), while for Poland, for the same period, there are increases (14.3%, 12.02%, 23.03%, respectively 24.82% - the reference being the year 2009).

In conclusion, there is inequality both at the level of Romania and Poland, as well as between the two states considering the value of GDP. Considering that the real impact of the structural funds on the GDP of the two states was 4% and the values of the national Theil Index for the period 2007-2016, it can be said that the EU funds have led to an increase of inequality of 1-2% in the case of Romania and a decrease of 7% in the case of Poland.

The analysis of how the structural funds were absorbed in the period 2007-2013 at the level of the two countries and the increase or decrease of inequality based on them will be analysed in the next part of the paper.

4. Analysis of Regional Inequality for Romania and Poland Based on Structural Funds for the Period 2007-2013

The period 2007-2013 was the beginning period for Romania to access the structural funds as a member country of the EU, without taking into account the pre-accession funds that it accessed in the period 2000-2006. For both periods, all the macro-regions and regions of Romania were eligible. The absorption of the pre-accession funds ended in 2015, for all regions of Romania, between 2007-2015 there is an overlap of the two types of funds.

For Poland, the last payments made by the EU for the period 2000-2006 were made in 2015. In 2000-2006 as well as in 2007-2013 all the macro-regions and regions of Poland were eligible. An amendment to facilitate the eligibility of the Mazowiecki region and the Warszawski stołeczny region was made in 2015, the development of the latter making it ineligible for 2014-2020. The Warszawski stołeczny region was a NUTS 3 region, part of the Mazowiecki - NUTS 2 region, both of which are within the Central Macro-region. Since 2016, a new macro-region, Mazowiecki, has been formed, which includes the Mazowiecki region and the Warszawski stołeczny region.

In calculating the inequality on the basis of the structural funds, we considered the regional organization of Poland from 2013. The variables considered to analyse inequality at the level of Poland and Romania are the population and the value of the structural funds absorbed during 2007-2013 through the funds of Cohesion Policy, Agricultural Policy and Social Policy, all having an impact on regional development, without being added the funds for the period 2000-2006. The amount of absorption for each fund by region is found in the document of the European Commission *Historic EU payments- regionalised and modelled*. The funds for which data were collected are CF, ERDF, ERDF and ESF.

Table 6. Theil Index Values at National Level (T), by Macro-Regions - Intra (T') and Inter-Regional (T") Inequality - for Romania and Poland for 2007-2016, Calculated on the Basis of the Absorbed Structural Funds at Regional Level

MACRO-REGIONS	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ROMANIA										
M. one	0.03	0.01	0.00	0.00	0.00	0.01	0.02	0.03	0.03	0.03
M. two	0.04	0.00	0.00	0.01	0.00	0.00	0.01	0.02	0.04	0.04
M. three	0.02	0.00	0.02	0.06	0.02	0.00	0.00	0.01	0.01	0.02
M. four	0.07	0.02	0.00	0.01	0.00	0.00	0.03	0.05	0.04	0.04
T'	0.01	0.04	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.00
T"	0.04	0.01	0.01	0.02	0.01	0.00	0.01	0.03	0.03	0.03
T'+ T"(Theil RO)	**0.05**	**0.04**	**0.02**	**0.03**	**0.02**	**0.02**	**0.02**	**0.04**	**0.03**	**0.04**
POLAND (2013)										
M. Poludniowy	0.01	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02
M. Pólnocno-Zach.	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.03
M. Poludniowo-Zach.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
M. Pólnocny	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.45
M. Centralny	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.16
M. Wschodni	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
T'	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.02	0.32
T"	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.09
T'+ T"(Theil PL)	0.02	0.03	0.02	0.03	0.02	0.01	0.02	0.02	0.03	0.42

Data source: author's own calculations

Note: T'- Theil between macro-regions, T" - Theil within macro-regions, T' + T" = T national

The amount of absorption for each region consists of the amounts resulting from the annual breakdown of the data set that follows the cycle of payments of the European Commission to the Member States and not the date on which the actual expenditure took place. This feature may adversely affect any subsequent analytical work for conducting policy assessments. In order to develop a more realistic estimate of the annual profile of real expenditures, the Commission has developed a model of "real" annual expenditures on the ground. Annual expenditure modelling represents the average of 100,000 simulations of EU annual payments to estimate actual expenditure (European Commission, European Structural and Investment Funds).

The calculation method for Theil Index is the one used by Conceição and Ferreira (2000). The Theil Index decomposition from the macro-regional level to the regional level is made by calculating the inequality existing at the level of each macro-region based on the population and the funds absorbed at the regional level. According to our calculations Theil Index values for each macro region of each country are

presented in table 6. The national T, T' and T" values can be analysed according to figure 5.

In figure 5 we have not introduced the values of 2016 because they are the last payments made, of small values compared to the rest of the period, which produces high values of inequality. Analysing the graph shows a value of inequality on account of the funds absorbed higher in the case of Romania compared to Poland, the reverse situation than that based on the regional GDP, due to the inequitable distribution of the amounts absorbed in the regions of Romania and of the funds of much higher value at the level of Poland compared to Romania.

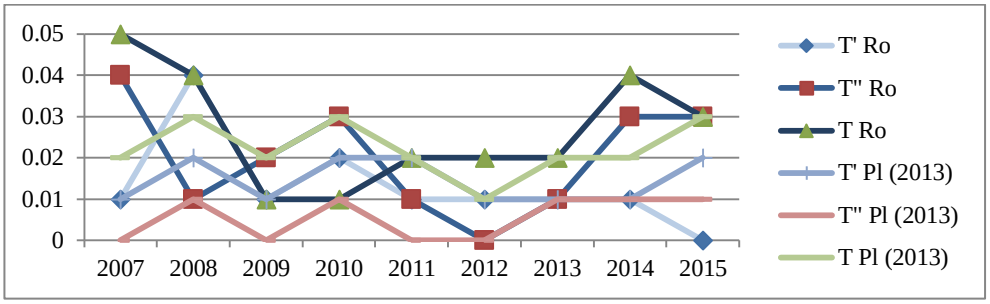

Figure 5. The Theil Index Values for Romania and Poland on Account of Absorbed Structural Funds - 2007-2015 and it's Decomposition

The total income of Poland from structural funds for the period 2007-2013 was 89 380 25 843 euros, and of Romania of 23 369 430 570, in the case of Poland the distribution by regions is much more equitable.

T' for Romania has the highest value in 2008, of 0.04, of 0.02 in 2010, of 0 in 2015 and 2016, the rest of the period having the value of 0.01. This increase in inequality is due to the decrease of the amounts absorbed in 2008 in the M. one, by 10% and of the increase in the rest of the macro-regions by 6%, 2% and 1%, respectively.

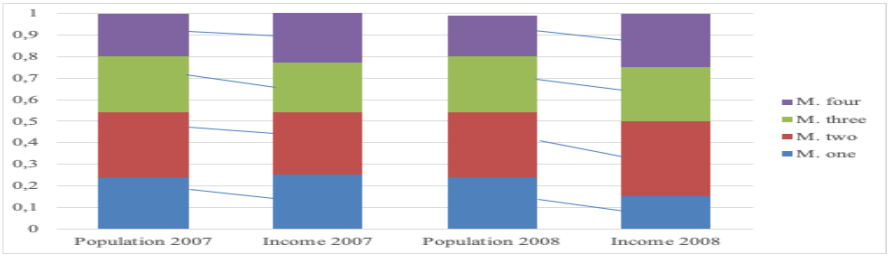

Figure 6. Inequality in Romania on Account of Absorbed Funds - 2007 and 2008: Population Rate and Income Rate by Macro-Regions

In 2007, the inequality is largely due to the four Macro-region, which have 24% of the income distributed to 20% of the population, the situation changing in 2008, when the income increased in Macro-region two, from 30% to 35% and decreased in Macro-region one from 24% to 15%. T" for Romania records fluctuations from 0.04 in 2007 to 0.03 in 2016, the value 0 being only in 2012. The contribution of each macro-region in obtaining T "for Romania is as follows: all macro-regions contribute with values of 0 and 0.01 every year, except for M. four which contributes 0.02 in 2007.

The Theil Index values at the level of each macro-region taking into account the population and income of the component regions, for Romania, are presented in table 7.

Table 7. Theil Index at the Level of the Romanian Macro-Regions for the Period 2007-2016, Based on the Absorbed Structural Funds

MACRO-REGIONS	M. one		M. two		M. three		M. four	
	T	R V	T	R V	T	R V	T	R V
2007	0.03	0.25	0.04	0.29	0.02	0.23	0.07	0.24
2008	0.01	0.15	0.00	0.35	0.00	0.25	0.02	0.25
2009	0.00	0.21	0.00	0.35	0.02	0.21	0.00	0.23
2010	0.00	0.20	0.01	0.37	0.06	0.21	0.01	0.23
2011	0.00	0.21	0.00	0.35	0.02	0.21	0.00	0.22
2012	0.01	0.23	0.00	0.33	0.00	0.22	0.00	0.23
2013	0.02	0.23	0.01	0.31	0.00	0.22	0.03	0.23
2014	0.03	0.24	0.02	0.29	0.01	0.23	0.05	0.24
2015	0.03	0.25	0.04	0.28	0.01	0.24	0.04	0.22
2016	0.00	0.26	0.03	0.28	0.04	0.24	0.02	0.22

Data Source: Author's Own Calculation

Note: T- Theil Macro-Regional Index, RV- Macro-Regional Income Rate

Inequality in the macro-regions of Romania is between 0 and 0.07, values much higher than those calculated on the basis of regional GDP. The years with the lowest values are 2011 and 2012, values between 0 and 2. This fluctuation is due to the changes in the income level of all the regions that form the macro-regions. Inequality at the level of this macro-region also influences inequality at the national level. Theil index for Romania has higher values than on the basis of regional GDP, with values between 0.02 and 0.05. It is found that the structural funds were absorbed without taking into account the population at regional level, but, as part of the GDP, they did not produce inequality at the level of Romania. T' (2013) based on the absorbed structural funds for Poland varies between 0.01 and 0.02, having values much lower than on the basis of regional GDP (by 5-6%). This situation indicates that there is a

macro-regional balance between the population rate and the income rate for the period 2007-2016. T" for Poland is 0.01 for this period, with the exception of 2007, 2009, 2011 and 2012, when the value is 0. The values calculated on the basis of regional GDP are increased by 4% until 2013, in 2014 and 2015 being the same value, of 0.01.

The values of Theil Index at the level of each macro-region taking into account the population and the funds absorbed at the level of the component regions, for Poland, are presented in table 8.

Inequality at the level of the macro-regions of Poland is between 0 and 0.02 for all the macro-regions, which denotes a proportional distribution of the absorption of the structural funds in accordance with the population distribution for the entire analysed period.

Theil index for Poland has a relatively low value during the analysed period, between 0.01 and 0.03, with approximately 10% lower than the Theil index calculated on the basis of regional GDP.

Table 8. Theil Index (2013) at the Level of the Macro-Regions of Poland for the Period 2007-2016 - Based on the Absorbed Structural Funds

MACRO REGIONS	M. Poludniowy		M. Pólnocno-Zach.		M. Poludniowo-Zach.		M. Pólnocny		M. Centralny		M. Wschodni	
	T	R V	T	R V	T	R V	T	R V	T	R V	T	R V
2007	0.01	0.16	0.01	0.14	0.00	0.09	0.01	0.15	0.00	0.22	0.00	0.24
2008	0.02	0.16	0.00	0.15	0.00	0.10	0.01	0.16	0.00	0.21	0.00	0.23
2009	0.01	0.16	0.00	0.15	0.00	0.10	0.01	0.16	0.00	0.21	0.00	0.23
2010	0.01	0.16	0.01	0.14	0.00	0.09	0.01	0.16	0.00	0.20	0.00	0.25
2011	0.01	0.16	0.01	0.15	0.00	0.09	0.01	0.16	0.00	0.20	0.00	0.24
2012	0.00	0.17	0.01	0.14	0.00	0.10	0.01	0.16	0.00	0.22	0.00	0.22
2013	0.00	0.18	0.01	0.13	0.00	0.09	0.02	0.16	0.00	0.23	0.00	0.21
2014	0.00	0.17	0.02	0.13	0.01	0.09	0.02	0.16	0.00	0.23	0.01	0.21
2015	0.00	0.17	0.01	0.13	0.01	0.09	0.01	0.16	0.01	0.26	0.00	0.20
2016	0.02	0.08	0.03	0.05	0.00	0.04	0.45	0.11	0.16	0.26	0.00	0.47

Data source: author's own calculation

Note: T- Theil Macro-Regional Index, RV- Macro-Regional Income Rate

The value of the existing inequality between Romania and Poland - Theil Index - based on the absorbed structural funds is presented in table 9. The Theil Index values presented in the table above show that the absorption rate of the structural funds for the period 2007-2013 is higher for Poland compared to Romania, both in absolute value, and compared to the population from 2007 to 2014, in 2015 the rate of income

from the funds structural is almost double for Poland compared to Poland, but same with population rate.

Table 9. Theil Index for Romania and Poland Based on Absorbed Structural Funds - 2007-2016

	ROMANIA		POLAND		THEIL INDEX
	Population rate	Income rate	Population rate	Income rate	
2007	0.36	0.24	0.64	0.76	0.03
2008	0.36	0.20	0.64	0.80	0.06
2009	0.36	0.17	0.64	0.83	0.09
2010	0.36	0.17	0.64	0.83	0.09
2011	0.36	0.17	0.64	0.83	0.09
2012	0.35	0.22	0.65	0.78	0.04
2013	0.34	0.26	0.66	0.74	0.02
2014	0.34	0.25	0.66	0.75	0.02
2015	0.34	0.34	0.66	0.66	0.00
2016	0.34	0.96	0.66	0.04	0.88

Data source: author's own elaboration

The figures for 2016 show that the rest of the payment for Poland is much reduced compared to Romania. Theil Index values calculated on the basis of regional GDP are lower than those calculated on the basis of absorbed structural funds, as shown in the following graph:

If there are discrepancies between Romania and Poland from the point of view of regional GDP, from the point of view of the value of the absorbed structural funds the gap increases due to the value of the allocated and absorbed funds and less because of the absorption rate of the allocated amounts over the period.

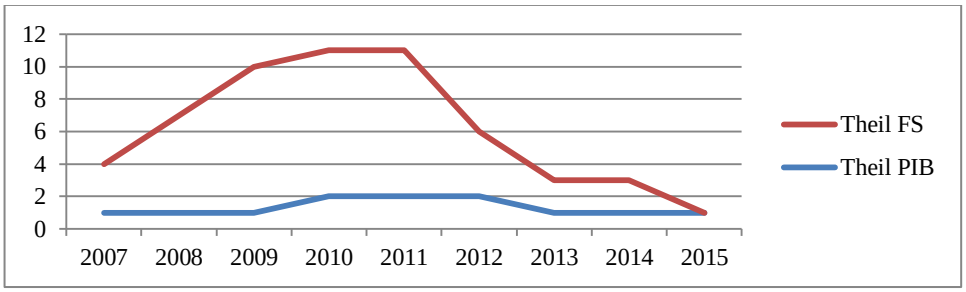

Figure 7. Theil Index - Inequality between Romania and Poland - 2007-2015- Based on Regional GDP and Absorbed Structural Funds

The amount absorbed by Poland is 282.5% higher than that of Romania, given that the population is approximately double. The absorption rates per year are shown in

figure 8. Poland has a higher absorption rate in 2008 (4.78% compared to 4.42%), in 2009 (7.84% compared to 6.28%), in 2010 (10.55% compared to 8.09 %) and in 2011 (13% compared to 10.13%). In the rest of the period, the absorption rate is lower, but the amounts, in absolute value, are higher.

In conclusion, using Theil Index, we can say that there is greater inequality in Romania than in Poland, as well as between the two states taking into account the value of the absorbed structural funds.

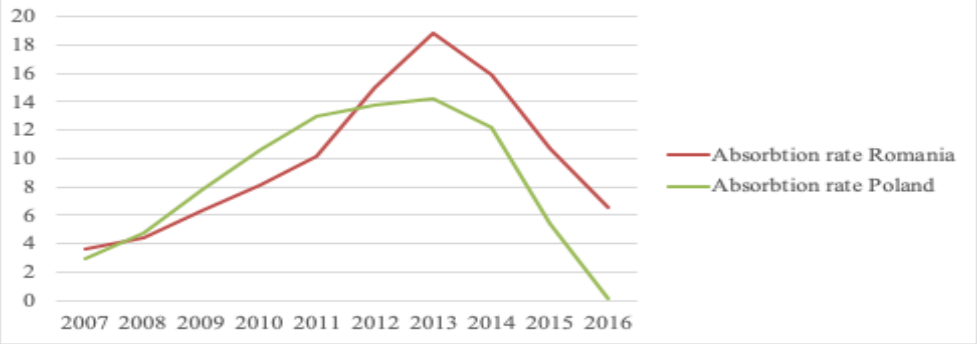

Figure 8. Annual Absorption Rate of Structural Funds - Romania and Poland - 2007-2016

The rate of total absorption and the rate of annual absorption are not very different at the level of the two states, which leads to inequality being the value of the funds allocated for the two states, Poland benefiting from much higher amounts than Romania, even if at 2007 level Romania did not have the degree of economic development of Poland.

5. Conclusions

The analyses and studies on European policies to reduce the economic gaps and poverty demonstrate the problems that the EU is still facing in terms of the pace of development of the newcomer countries and the contrast between the richest and the left behind regions and for which the pace growth is still very slow. Measuring and reducing inequality and poverty in the wider European context is a necessary and complex process that, in addition to economic growth, achieves the objective of reducing European regional disparities and ensures sustainable economic growth.

The international and national bodies have increased their interest for measuring and comparing inequality. Starting from this preoccupations, our paper intended to

realize a comparative analysis regarding regional inequality. In order to carry out this analysis we focused our attention on two countries, Romania and Poland. We have analysed regional inequality from two directions one based on regional GDP, for the period 2007-2016, and another direction based on the structural funds, for 2007-2013. For measuring the inequalities both in the chosen countries between regions and also between countries, we used Theil index.

Our findings point out the existence of significant inequalities between the regions of the two analysed countries and also that there is greater inequality in Romania than in Poland. Inequality at the level of the macro-regions of Poland, based on GDP, is 0 or close to 0 for all the macro-regions, except one. Theil index for Poland has a relatively low values during the analysed period. When we take into consideration the structural funds, we observe that the inequality in the macro-regions of Romania is between 0 and 0.07, values much higher than those calculated on the basis of regional GDP. This fluctuation is due to the changes in the income level of all the regions that form the macro-regions. Theil index for Romania has higher values than on the basis of regional GDP, between 0.02 and 0.05. Comparatively, inequality at the level of the macro-regions of Poland is between 0 and 0.02 for all the macro-regions, which denotes a proportional distribution of the absorption of the structural funds in accordance with the population distribution for the entire analysed period. Theil index for Poland has a relatively low value, between 0.01 and 0.03, with approximately 10% lower than the Theil index calculated on the basis of regional GDP.

Our results could be of interest to the policy makers because measuring and reducing inequality is a necessary process for meeting the objective of reducing European regional disparities and ensuring sustainable economic growth.

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