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Poverty rate determinants in the Central and Eastern Europe member states

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Abstract. *This paper aims to provide an analysis of the determinants of poverty rate in ten member states of the European Union from the Central and Eastern Europe, and of the way how its influenced poverty in the 2009-2016 period. In order to estimate the impact, I used panel technique and Estimated Generalized Least Squares method with no effects, weighted by Period SUR option to provide more consistent estimators. To verify if the model is correctly specified and to confirm the maximum verisimilitude of the estimators, I tested the Gauss-Markov. The conclusion of the paper is that the unemployment rate, rural population, as well as the early leavers rate of people aged between 18-24, have a positive impact on the rate of people at risk of poverty rate after social transfers. On the other hand, the government spending on social protection has a negative impact on the used dependent variable.*

Keywords: poverty, panel, unemployment rate, rural, early leavers rate.

JEL Classification: C23, G01, G31, O47.

1. Introduction

Poverty reflects a situation in which people obtain lower incomes so that they cannot afford to achieve a decent standard of living, acceptable by the society. In the European Union (EU), the poverty risk rate after social transfers, was 17.3% in 2016. This indicator has been growing slightly since 2013, due to the global economic crisis, which appeared at the end of 2006 in the United States, affecting Europe since 2008, and later spreading worldwide.

The countries analysed in this paper are the following: Bulgaria (BG), Czechia (CZ), Estonia (EE), Hungary (HU), Lithuania (LT), Latvia (LV), Poland (PL), Romania (RO), Slovenia (SI) and Slovakia (SK). The Central and Eastern European states (CEE) of the EU have the highest levels of the population at risk of poverty rate, seven of the member states analysed recording a higher poverty rate than the EU28 average. In addition, Romania (25.3%) and Bulgaria (22.9%) are the countries for which were reported the highest rates of poverty in EU28. On the other hand, Czechia is the country recording the lowest poverty rate in 2016 (9.7%).

The reason I chose this theme is that the economy was born as a consequence of the growing need to reduce poverty and create well-being. Gradually, the economy has transformed into a wealth accumulation tool, which is not necessarily in line with the initial objective, which also argues the need of integrating the social objectives into the sustainable development policies. Also, one of the European Union objectives is the social inclusion and reduction of poverty, this being also highlighted in the Europe 2020 Strategy. I chose these countries because this grouping is geographically appropriate and reacts differently to the economic policy changes towards the Western European Union member states, the analysed states being even more socially vulnerable.

The main objective of this paper is to determine the impact of the factors that influence the poverty rate in Central and Eastern European member states. This objective can be achieved by reaching its specific objectives, as follows: identifying the impact of the determinants of poverty, testing the Gauss-Markov hypotheses and performing the economic analysis of the obtained results. Within this paper, poverty was analysed in terms of unemployment rate, rural population, government spending on social protection and early leavers rate of people aged between 18-24 years.

Regarding unemployment rate, the people included in this indicator are more exposed to poverty risk, given their low incomes hinder their capacity to afford a satisfactory life. The rural population is very high in the Central and Eastern Europe countries, the jobs occupied in this environment being generally in agriculture, which change unemployment rate according to the seasonal factors and generates new social challenges. Government spending on social protection has the role to reduce poverty, which also applies to the analysed countries. These kind of transfers are received by people in the form of social aid to help them benefiting from a satisfactory standard of living. The last indicator used in the paper is the early leavers rate of people aged between 18-24 years. Education is very important when it comes to finding a stable job and getting an average wage. In this country

group, the early leavers rate of people aged between 18-24 years is also high, which may have a positive effect on poverty.

The role of this study is to elucidate the directions that need to be taken to reduce poverty by establishing programs and measures favorable to inclusion in EU member states.

2. Literature review

The concept of poverty was analysed by several authors, including Akoum (2008), Lenagala and Ram (2010), Smith (2010), O'Boyle and O'Boyle (2012). Their results showed that poverty is a multidimensional socio-economic phenomenon that can be influenced by sex, age, culture, social and economic factors. Zamfir (2001) argued that the most vulnerable groups to poverty are children, single-parent families and those having more than three children, people living in rural areas and earning their living from subsistence agriculture, the unemployed, retirees, young people which are not included in the labour market and do not follow any educational training program (NEETs), respectively abandoned children.

In economics, there are a lot of studies assessing different ways of measuring poverty. In this context, Smith (2010) analysed two concepts: absolute poverty and relative poverty. The first concept is based on the required individual budget which can satisfy the minimum needs of physical, intellectual and social nature. On the other hand, relative poverty, which is set at 60% of median equivalised disposable national income, calculates the rates of people exposed to poverty risk. Decancq et al. (2013) argued that authors studying the dimension of poverty in a country, first must determine the level of well-being, the poverty threshold and poverty sensitivity to its drivers.

Šileika and Bekerytė (2012) analysed the theoretical aspects of the relationship between unemployment and poverty and found a positive relationship between them, but also stated that poor countries do not always face high unemployment. Nasar (2014) concluded that poverty is the result of high unemployment and chronic underemployment of the workforce.

Fiszbein et al. (2014) have shown that spending on social protection in European Union prevents millions of people from facing poverty. However, even if developing countries have the highest potential of benefiting from these expenditures, only half of them reduce the poverty rate through social protection expenditures. Moreover, Kiendebeogo et al. (2017) showed that the number of people at risk of poverty increased in financial crisis periods, and the countries allocating high amounts for social protection during these periods reduced the share of people at risk of poverty in total population. Socol et al. (2010) proved that there is an inverse correlation between the share of social protection spending in GDP and the poverty rate after social transfers. On the other hand, Deaton (2017) stated that social aid does not eliminate poverty, given that this tool have a different purpose.

Celikai and Gumus (2016) found that, in the short term, there is a negative relationship between poverty and social protection expenditure, while in the long run, they identified a positive relationship between them. The researchers previously mentioned proved also a

negative relationship between public spending on education and poverty, on long-term and short-term.

According to Klugman et al. (2002) rural households are more likely to be poorer because of the quality of education, health services and the undeveloped access to infrastructure. In addition, it is important to assess the impact of income sources, assets (social capital) and labour market participation rates on poverty. Also, Dreze and Khera (2013) calculated the impact of public spending on the rural area, and demonstrated that those reduce the rural poverty rate.

Khan et al. (2015) have shown that, as a consequence of some factors (the employment rate, remittances, employment in agriculture) poverty rate have a significant negative impact on the rural areas. Polanyi (2013) identified several factors that lead to an increase of poverty, as follows: cereals deficit, low wages in agriculture, disappearance of free farmers, reluctance of farmers to pay higher wages, the lack of internal savings. On the other hand, Christiaensen and Todo (2014) showed that the migration of the labour force from agriculture, respectively from the rural environment, leads to a sustainable growth model and to a faster reduction of the number of people at risk of poverty.

Lavrijsen and Nicaise (2015) showed that young people from disadvantaged families face high risks of school dropout, and the design of the education system (age, breadth of vocational education) and the characteristics of the socio-economic context (poverty rate, unemployment) have a positive impact on school dropout. Kingston and Webster (2015) showed that children who leave school early are more marginalized, having to take up jobs in the services (hospitality, catering), often half-time and low salaries, being more at risk of poverty.

Merce et al. (2015) analysed the issue of school dropout in Romania and found that its deepening depends on poverty (especially in rural areas). The analysis of the authors shows that school dropout start from secondary education, being also extended to post-secondary and university level.

3. Methodology

This section describes the techniques used to estimate the impact of exogenous variables on the people at risk of poverty rate after social transfers. In this context, I used the quantitative method, which strengthen the construction of the analysis.

The model performed examine the determinants of poverty rate in the analysed period (2009-2016). In order to analyse this phenomenon, I started from establishing and subsequently, verifying the hypotheses taken into account, as follows:

- the rise of unemployment rate influences positively the rate of people at risk of poverty rate after social transfers;
- the increase in government spending on social protection impacts negatively the rate of people at risk of poverty rate after social transfers;
- the rate of people at risk of poverty rate after social transfers is positively influenced by the increase of rural population in the respective country;

- the increase in early leavers rate of people aged between 18-24 from the previous year, leads to an increase in the people at risk of poverty rate after social transfers in the current year.

Most studies analysing the drivers of poverty rate used the panel technique, given that the poverty rate indicators are published annually. The panel technique is considered effective due to the fact that it helps to increase the degrees of freedom and to make the estimation more robust. However, it may bring new challenges regarding the manifestation of autocorrelation and heteroscedasticity between cross-sections. This technique was supported by the method Estimated Generalized Least Squers (EGLS) method, weighted by Period SUR option. The Period SUR option was used to correct the possible obstacles that may block the validation of the model, such as heteroscedasticity and the general correlation between the cross sections.

I did not use the fixed effects model because the Period SUR option is not compatible with this method. Regarding the random effects model, the Hausman test processed to verify the compatibility with it did not report consistent results at standard errors level. In this case, I used a model without effects and I applied the Period SUR option, which has the ability to provide more consistent estimators compared to the perspectives offered by the two models mentioned above. More details were provided in the empirical analysis section. I also checked the stationarity of the variables using the Summary test, which aggregates the results of the following tests: Lewin, Lin and Chu, Breitung T-Stat, Im Pesaran and Shin W-Stat, Augmented Dickey-Fuller, Fisher Chi- Square, PP-Fisher, Chi-Square.

In the impact assessment process, I used data with annual frequency for 2009-2016 period in the case of CEE countries. The reason I chose this group is that these countries react differently to changes in economic policy compared to the Western European Union member states, and are more vulnerable in social area. This assessment use statistical data published by Eurostat and the World Bank (Annex 1). Following the inclusion of the mentioned statistical data in the model, it has been resulted a number of 80 observations. The data proved to be stationary at the initial level and at the first level of difference, a situation generally compatible with Autoregressive Distributed Lag model (ARDL). However, the use of the autoregressive term may make the Durbin-Watson test inconsistent and increase the risk of autocorrelation and multicollinearity. Therefore, the Period SUR option applied to the following equation, which solved the problem of cross-section autocorrelation.

$$povertyrate = \alpha + \beta_0 unem + \beta_1 socialgov + \beta_2 rural + \beta_3 leavers_{(-1)} + \varepsilon_t,$$

where $povertyrate$ reflects the share of people at risk of poverty after social transfers (60% of the national median equivalised disposable income), $unem$ represents the unemployment rate (as a percentage of active population), $social\ gov$ is the government spending on social protection as a % of GDP, $rural$ represents the share of rural population in total population, $leavers_{(-1)}$ reflects the share of people aged 18-24 dropping out school early in the total pupils/students in education, and ε_t represents the error term.

In order to test the model for heteroscedasticity, I used the Breusch-Pagan Godfrey test, but considering that Eviews does not display the result of this test in panel, I estimated its specific equation manually in Microsoft Office Excel by the following function: "CHISQ.DIST.RT(n*R^2, Ω)", where n is the number of observations (in this case, 80), R^2 is the coefficient of determination and Ω as the number of degrees of freedom (in this case, 4).

To verify if the model is correct specified and to confirm the maximum verisimilitude of the estimators, I examined the Gauss-Markov hypotheses, as follows:

- the linearity of the model – R-squared must have a high value;
- significance of parameters – the estimators are statistically significant if the associated probability is less than 5%;
- including a large number of observations in the model;
- absence of autocorrelation. To test this hypothesis, the Durbin-Watson (DW) test was applied, using the following formula:

$DW = \frac{\sum_{t=2}^{n}(u_t - u_{t-1})^2}{\sum_{t=1}^{n} u_t^2}$, for n = 80 and k = 4.

- absence of multicollinearity – was verified using Klein's criterion, which confirm its absence if the correlation coefficient between exogenous variables is less than the coefficient of determination;
- absence of heteroscedasticity – the model is homoscedastic if the probability is greater than 5%;
- normal distribution of residuals – I used the Histogram of residuals and Jarque-Bera test, this hypothesis being confirmed if the probability associated with the test is greater than 5%;
- the absence of dependence between cross-sections – it was examined by Breusch-Pagan and Pesaran test, which accept the null (there is no dependence between cross-sections) if the associated probability is greater than 5%;
- standard errors non-zero, but close to 0;
- errors are independent of exogenous variables;
- the conditional mean error is zero.

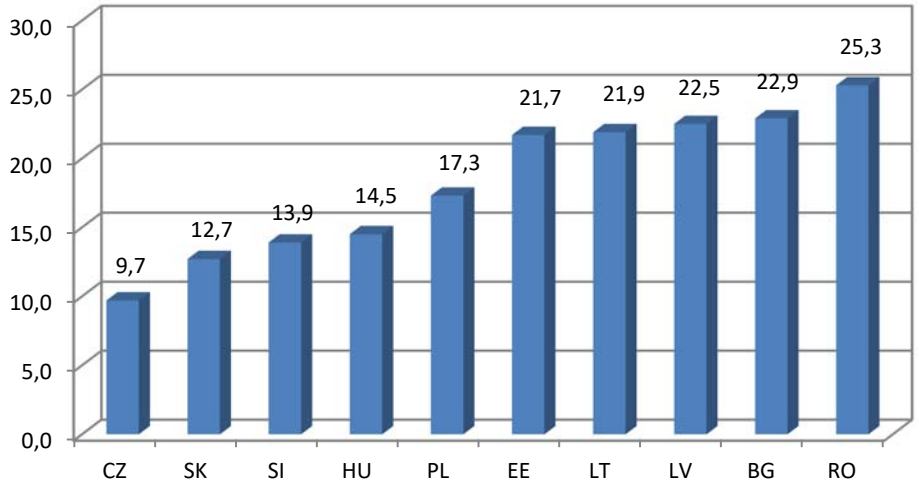
4. Results and interpretations

In this section I analysed the impact of the determinants of population exposed to the risk of poverty in the CEE countries, and I verified the verisimilitude of the obtained results.

Figure 1 shows the state of play in CEE countries in terms of *people at risk of poverty rate after social transfers*. As can be seen, the highest values were recorded in RO (25.3%), BG (22.9%), respectively LV (22.5%). On the other hand, the lowest values were registered in CZ (9.7%), SI (12.7%) and SK (13.9%). A key feature of these states is that they all belong to the former Soviet bloc. With the collapse of the Soviet Union in 1989, the transition (either by a shock therapy, as was the case of Poland, or by a gradual therapy, as was the case of Hungary, or a combination between them – the case of Romania) has led to a

decrease in the standard of living, increase of unemployment, and the reduction of social protection funding, which in turn led to an increase of the population at risk of poverty.

Figure 1. *People at risk of poverty rate after social transfers (60% of the national median equivalised disposable income) in 2016*



Source: Own calculations using Eurostat database.

Another event that led to the increase of the population exposed to the risk of poverty was the global economic crisis that began to make its presence felt in Europe from 2007-2008, affecting the whole European Union. One of the main causes of the economic crisis was the sharp rise in commodity prices (such as the increase in the price of oil and energy). With the increase of prices, the real incomes of the employees began to decrease, and the costs of companies increased, which led to a reduction in the aggregate demand. Another cause was the inequitable distribution of income from capitalist states, which was reflected in a high difference between the income obtained by the rich individuals and those obtained by the poor. The high-income population used their money not only on goods and services, but also to carry out financial speculation on financial markets, but the poor individuals had to borrow money from financial institutions to maintain their standard of living.

Figure 2 shows the comparison between the rate of people at risk of poverty rate after social transfers (60% of the national median equivalised disposable income) registered in 2009 and that recorded in 2016. In LV, the measures taken to reduce poverty were effective, which led to the decrease of the indicator with 4.6 pp, unlike the other states, where the rate of people at risk of poverty increased during the analysed period, the highest increases being recorded in RO (3.2 pp), SI (2.6 pp) and EE (2.0 pp). This shows that social challenges have intensified in these countries and new measures/efforts are needed to reduce the poverty rate.

Regarding the unemployment rate, with the spread of the economic crisis, the number of unemployed has started to increase in all the member states of the European Union. Since 2009, CEE countries have started to see successive increases in the unemployment rate,

with the highest values being recorded in LV (17.5%), LT (13.8%) and EE (13.5%). In 2016, unemployment rates decreased, with the highest drop being reported for LV (7.9 pp), EE (6.7%) and LT (5.9%). These decreases are due to the increased number of newly created jobs. However, in SI and BG, the unemployment rate increased in 2016 compared to 2009 with 2.1 pp, respectively 0.8 pp, which establishes the need to compensate for this evolution through measures to support the reduction of unemployment.

Government spending on social protection did not show significant differences in 2016 compared to 2009. The states that decided to increase their spending are Bulgaria and Slovakia, with 1 pp of GDP and 0.2 pp of GDP, this being also the cause of the increase in the number of unemployed. In the case of other CEE countries, they reduced their social protection expenses by less than 1 pp of GDP.

Figure 5 shows how early leavers rate of people aged between 18-24 from 2009 to 2016 has changed. LV, LT, EE, BG, SI and PL have taken appropriate measures to reduce school dropout. On the other hand, in SK, RO, CZ and HU, the indicator has increased and further measures are needed to improve the results in the educational system. Figure 6 shows that the rural population has increased in 8 of 10 analysed member states. In the other two countries, Slovakia and Poland, the share of rural population in total population increased by 1.15 pp and 0.82 pp. The largest decrease of the degree of ruralization was recorded in BG (2.37 pp), LV (2.31 pp) and SI (1.59 pp), in the other states, the reductions being below 1 pp, mainly due to the low mobility of the population.

Figure 2. *People at risk of poverty rate after*

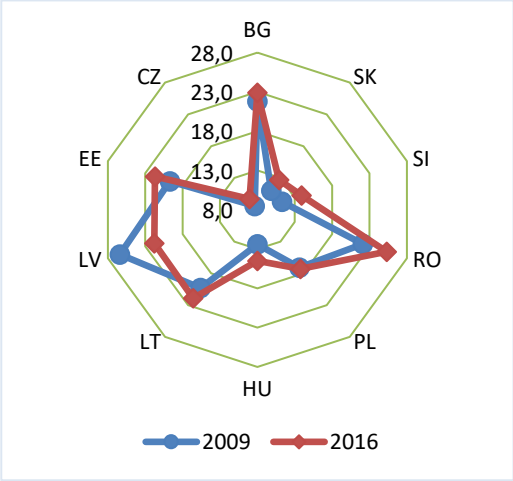


Figure 3. *Unemployment rate in CEE (%) social transfers in CEE (%)*

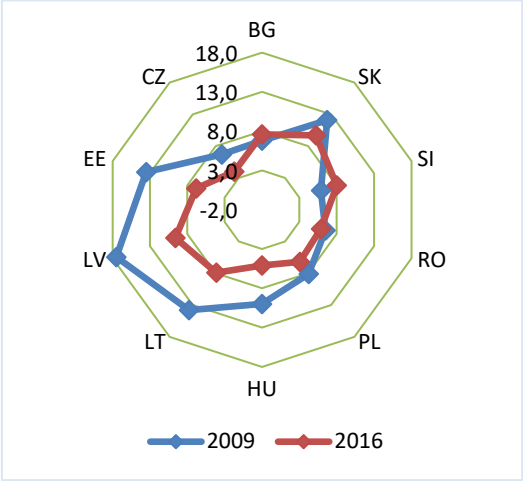


Figure 4. *Social protection government spending in CEE (% of GDP)*

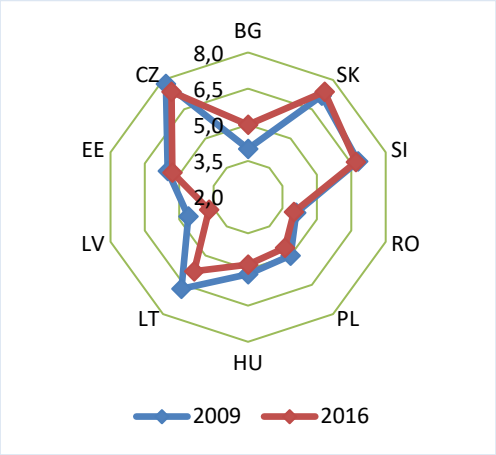


Figure 5. *Early leavers rate of people aged between 18-24 in CEE (%)*

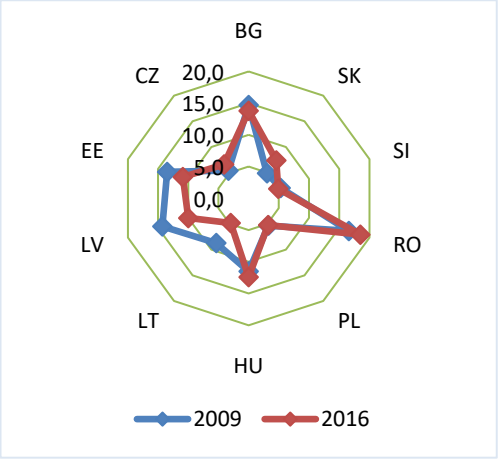
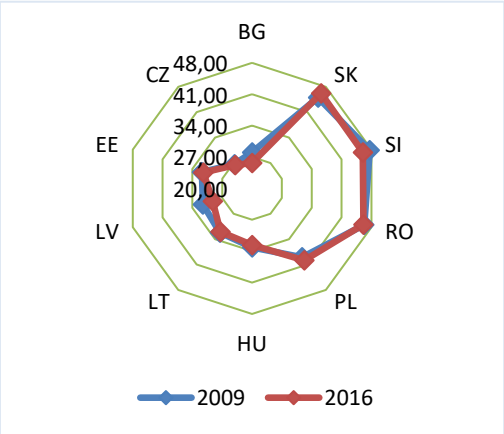


Figure 6. *Rural population (% of total) in CEE*



Source: Own calculations using Eurostat and World Bank database.

Next, I presented the correlations between the population exposed to poverty risk rate after social transfers and the exogenous variables used in the analysis.

Thus, the highest correlation was registered between the people at risk of poverty rate after social transfers and the early leavers rate of people aged between 18-24 (68.02%), indicating that the level and quality of the educational system have an important role in designing social developments within the analysed states. Also, the people at risk of poverty rate after social transfers has been found to be strongly correlated (in this case negative) with social protection government spending (-50.37%), suggesting that they are a relevant driver of poverty reduction. Between the people at risk of poverty rate after social transfers and the unemployment rate, respectively the rural population, the correlations are

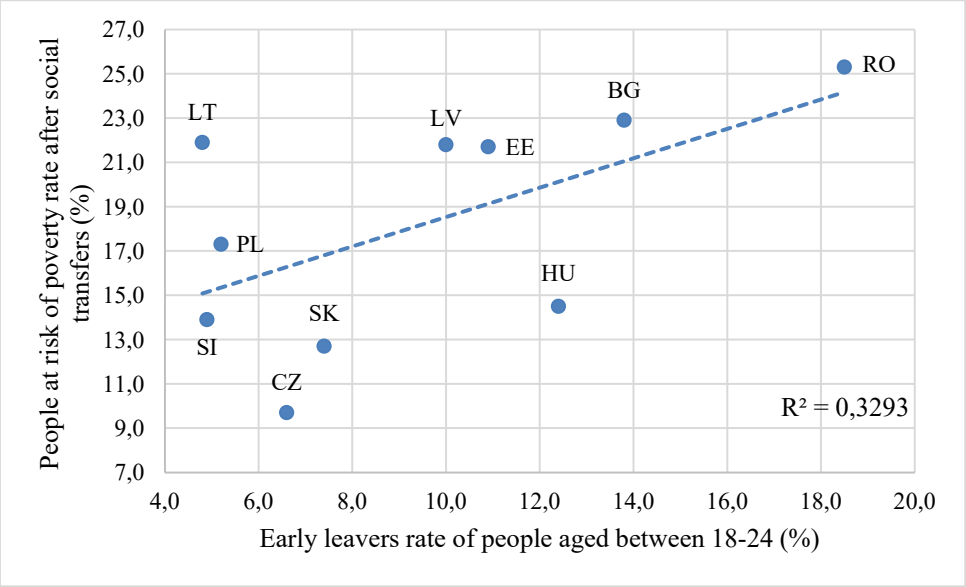
lower, their values being of 11.54% and 3.0%, indicating that the unemployment rate and the rural population did not have a similar evolution to that of the poverty rate. These correlations indicate a possible high influence of the mentioned indicators on the people at risk of poverty rate, according to the economic theory. The coefficient of determination from the four graphs designed record similar values to the Pearson correlation coefficients. However, the accuracy of their estimation may be affected by the low number of observations.

Within this section I presented the results of the estimation carried out in order to identify the impact of the determinants of the population exposed to the risk of poverty. The model was estimated using the EGLS method weighted by Period SUR option, the results being attached in the Figure 11. Also, all estimators are statistically significant, given that the probabilities associated with them are below the significance threshold of 5%. At the same time, errors are null, which indicates the possibility of very small deviations of the estimators. According to the Figure 11, the value of the coefficient of determination is 0.7346, which confirms the linearity of the regression, as well as the appropriate selection of the regressors, considering that their evolution explains 73.46% of the fluctuation of the endogenous. At the same time, the probability associated with the Fisher test which is less than 5% (in this case has a value of 0.00%) which confirmed the statistical validity of the model.

Figure 7. *Correlation between unemployment rate and people at risk of poverty rate after social transfers in CEE (2016)*

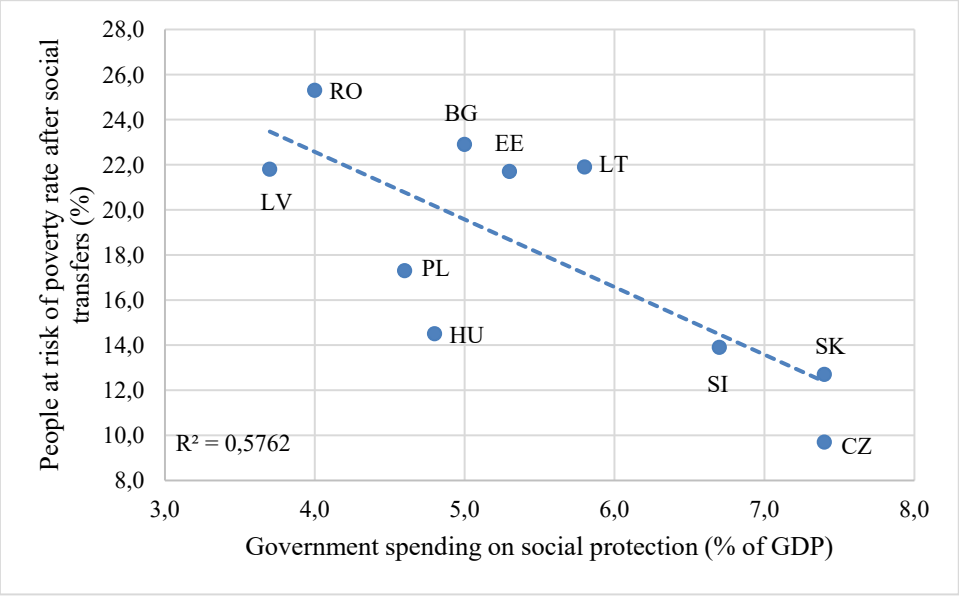
Source: Own calculations using Eurostat database.

Figure 8. *Correlation between early leavers rate of people aged between 18-24 and people at risk of poverty rate after social transfers in CEE (2016)*



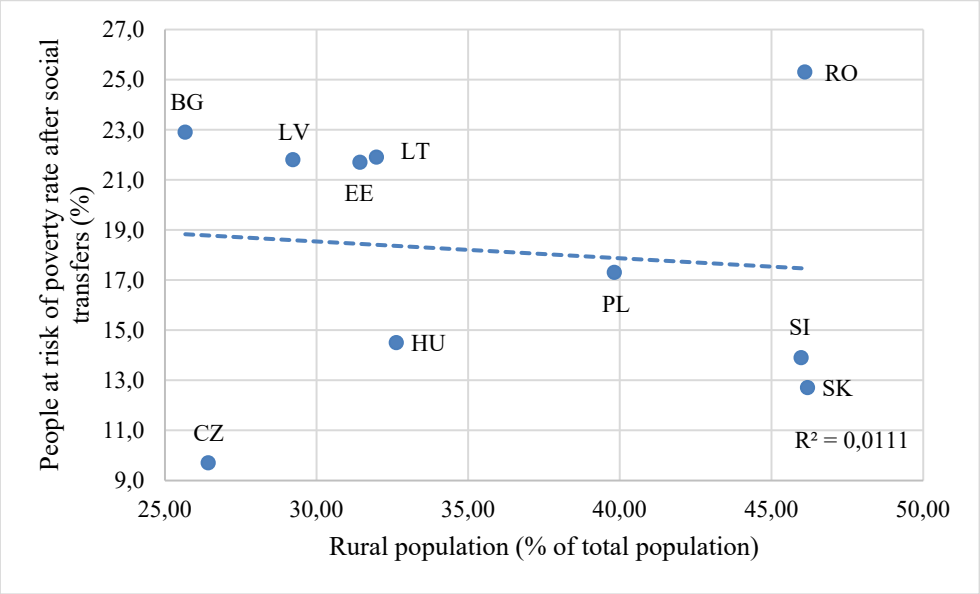
Source: Own calculations using Eurostat database.

Figure 9. *Correlation between government spending on social protection and people at risk of poverty rate after social transfers in CEE (2016)*



Source: Own calculations using Eurostat database.

Figure 10. *Correlation between rural population and people at risk of poverty rate after social transfers in CEE (2016)*



Source: Own calculations using Eurostat database.

In the initial form, I tested the stationarity of the variables. For this procedure, I used the tests mentioned in the methodology. The tests I had run indicated a stationary character for some variables (unemployment rate and social protection government spending), while other variables (people at risk of poverty rate after social transfers, rural population and the early leavers rate of people aged between 18-24) became stationary after processing the first difference. For a clear picture, I attached the result of the stationarity in Table 1.

Next, I presented the impact of the regressors on the dependent variable. According to the results of Figure 11, the increase of the unemployment rate by 1 pp leads to an increase in the people at risk of poverty rate after social transfers by 0.2149 pp in the CEE countries. When a person who is fit for work goes into temporary unemployment, will feel a drop in its disposable income which will increase the risk of entering into the category of vulnerable persons if the reintegration into the labour market will not achieved in an adequate time period.

Figure 11. *Model estimation using the EGLS Panel component with Period SUR option*

Dependent Variable: POVERTYRATE
Method: Panel EGLS (Period SUR)
Date: 11/30/19 Time: 10:27
Sample (adjusted): 2009 2016
Periods included: 8
Cross-sections included: 10
Total panel (balanced) observations: 80
Linear estimation after one-step weighting matrix
Period SUR (PCSE) standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEM	0.214941	0.037424	5.743457	0.0000
SOCIALGOV	-0.792148	0.073019	-10.84859	0.0000
RURAL	0.127519	0.040097	3.180246	0.0021
LEAVERS(-1)	0.535879	0.048671	11.01019	0.0000
C	16.33612	1.410677	11.58034	0.0000

Weighted Statistics

R-squared	0.734648	Mean dependent var	2.516954
Adjusted R-squared	0.720496	S.D. dependent var	5.859261
S.E. of regression	1.014457	Sum squared resid	77.18416
F-statistic	51.91082	Durbin-Watson stat	1.914611
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.548031	Mean dependent var	17.27625
Sum squared resid	775.2370	Durbin-Watson stat	0.245503

Source: Own calculations using Eviews 9.0, Eurostat and World Bank database.

On the other hand, according to the results, the increase by 1 pp of the social protection government spending leads to the decrease of the people at risk of poverty rate after social transfers by 0.7921 pp. The social assistance offered by the government, which aims to support people at risk of poverty, contributes to reducing the number of people at risk of poverty, because these incentives will increase the incomes of the individuals and will improve their standard of living.

Regarding the rural population, its increase by 1 pp leads to a growth of people at risk of poverty rate after social transfers with 0.1275 pp. The population living in the rural area is more exposed to the risk of poverty compared to those who are in the urban area. This can be argued by the fact that there are more rural residents working in agriculture and forestry, and the wages in these field are lower compared to those in the industry or services.

When the early leavers rate of people aged between 18-24 increases by 1 pp, people at risk of poverty rate after social transfers will increase by 0.5358 pp. Education is one of the most important pillars of development in a country, and the higher the level of education and qualification, the easier it is for the citizens to access better paid jobs, thus reducing the number of people exposed to poverty.

If all the dependent variables remain constant, people at risk of poverty rate after social transfers increases by 16.33612 pp, but this coefficient loses its statistical credibility given that the standard error is high.

Of the mentioned regressors, the government spending on social protection have the strongest impact on the dependent variable. Increases in spending on social protection lead to a reduction of people at risk of poverty, but it must also be borne in mind that social aid can create permanent social workers, never wanting to enter on the labour market. Therefore, the impact is likely to be moderated by this medium-term effect. The early leavers rate strongly influences the endogenous variable, which shows that education remains a significant factor for the social situation.

Table 1. *Summary test*

Variable	*Initial value*	*First difference*
	Tests that confirm the stationarity of total tests	
People at risk of poverty rate after social transfers	4 of 12	11 of 12
Unemployment rate	5 of 12	-
Social protection government spending	7 of 12	-
Rural population	6 of 12	5 of 12
Early leavers rate of people aged between 18-24 (-1)	4 of 12	11 of 12

Source: Own calculations using Eviews 9.0, Eurostat and World Bank database.

Another hypothesis to be fulfilled is the DW test. In this case, the result of the test (1.91) is found in the interval between the statistics of DU (1.74) and 4-DU (2.26), which confirms the hypothesis that the errors are not autocorrelated.

Also, I presented the test that verifies multicollinearity in Annex 2. According to Klein's criterion, the hypothesis of the absence of multicolinearity is confirmed when the correlation between two independent variables is lower than R-squared (in this case 73.46%). Annex 2 demonstrates the absence of multicollinearity given that the R-squared is higher than the correlations between the independent variables. Also, the correlations between the dependent variables and errors (according to Annex 3) are small, which attests that there are premises for accepting the hypothesis that there is no correlation between residuals and regressors.

The Breusch-Pagan-Godfrey test, processed according to the methodology, with a number of 4 degrees of freedom, provided a probability of 58.43%, which confirmed the null hypothesis (the model is homoscedastic), given that the probabilities of the variables have higher values than the significance threshold (5%), the result being also in accordance with Gauss-Markov's theory. The result of the Breusch-Pagan-Godfrey test can be found in Annex 4.

Moreover, I attached the results of the Jarque-Bera test in Annex 5. Given that the test probability is 28.52%, which is higher than 5%, I confirmed the hypothesis that residuals are normally distributed. In Annex 6, I observed the constant evolution of the errors towards 0, which confirmed the hypothesis that the mean of the residuals is zero. Following the tests performed, I have also confirmed that the model fulfills all the conditions required for accepting the maximum verisimilitude of the estimators (hypotheses of Gayss-Markov's theorem).

5. Conclusions

The analysis carried out showed that the unemployment rate, the rural population and the early leavers rate of people aged between 18-24 have a positive impact on the people at risk of poverty rate after social transfers. On the other hand, government spending on social protection has a negative impact on the endogenous. The coefficient of determination is statistically significant, and the model fulfilled all the assumptions of the Gauss-Markov theorem, required to validate the maximum verisimilitude of the estimators. Poverty is a major issue in Central and Eastern European countries, many of them facing high levels of poverty, which intensifies the challenges related to inclusion and therefore additional measures are needed to tackle this phenomenon. In this way, the analysed countries must take appropriate measures to reduce poverty, mainly by seeing its causes, and then applying the necessary solutions to reduce it.

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Annex 1. *Structure of the model*

Variable	Source
People at risk of poverty rate after social transfers (60% of the national median equivalised disposable income)	Eurostat
Unemployment rate (% of active population)	Eurostat
Social protection government spending (% of GDP)	Eurostat
Rural population (% of total population)	World Bank
Early leavers rate of people aged between 18-24 (% of total)	Eurostat

Source: Own calculations.

Annex 2. *Absence of multicollinearity – Klein's criterion*

Correlation	UNEM	SOCIALGOV	RURAL	LEAVERS1
UNEM	1.000000	0.035485	-0.039383	0.011449
SOCIALGOV	0.035485	1.000000	0.403756	-0.429479
RURAL	-0.039383	0.403756	1.000000	-0.107718
LEAVERS1	0.011449	-0.429479	-0.107718	1.000000

Source: Own calculations using Eviews 9.0

Annex 3. *Absence of correlation of residues with regressors*

Correlation	RESID01	UNEM	SOCIALGOV	RURAL	LEAVERS1
RESID01	1.000000	-0.140388	0.155535	0.223197	-0.055722
UNEM	-0.140388	1.000000	0.035485	-0.039383	0.011449
SOCIALGOV	0.155535	0.035485	1.000000	0.403756	-0.429479
RURAL	0.223197	-0.039383	0.403756	1.000000	-0.107718
LEAVERS1	-0.055722	0.011449	-0.429479	-0.107718	1.000000

Source: Own calculations using Eviews 9.0

Annex 4. *Heteroscedasticity – Breusch-Pagan-Godfrey*

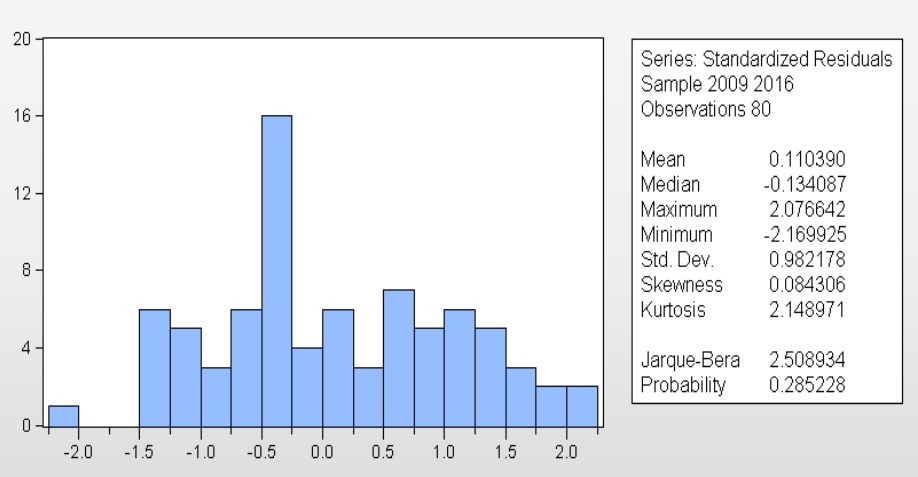
Dependent Variable: RESID01^2
Method: Panel Least Squares
Date: 11/30/19 Time: 14:55
Sample (adjusted): 2009 2016
Periods included: 8
Cross-sections included: 10
Total panel (balanced) observations: 80

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEM	0.049459	0.036708	1.347369	0.1819
SOCIALGOV	0.050289	0.067783	0.741918	0.4605
RURAL	0.002909	0.017464	0.166565	0.8682
LEAVERS(-1)	0.017302	0.031167	0.555147	0.5804
C	-0.503534	1.117347	-0.450651	0.6535

R-squared	0.035546	Mean dependent var	0.964802
Adjusted R-squared	-0.015891	S.D. dependent var	1.066741
S.E. of regression	1.075183	Akaike info criterion	3.043321
Sum squared resid	86.70141	Schwarz criterion	3.192197
Log likelihood	-116.7328	Hannan-Quinn criter.	3.103010
F-statistic	0.691057	Durbin-Watson stat	2.281626
Prob(F-statistic)	0.600433		

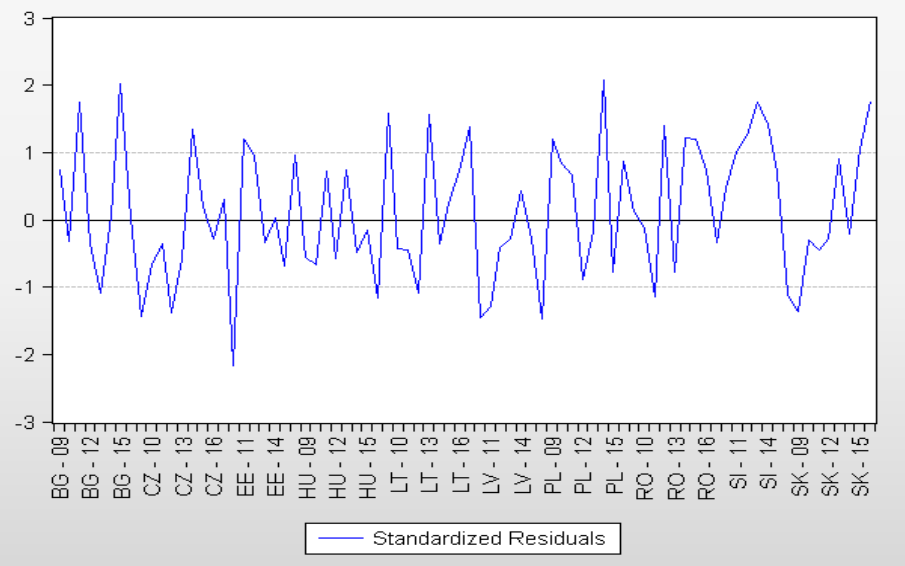
Source: Own calculations using Eviews 9.0

Annex 5. *Jarque-Bera Test*



Source: Own calculations using Eviews 9.0

Annex 6. *Residuals distribution*



Source: Own calculations using Eviews 9.0