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LITHUANIA IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

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Abstract. The goal of this paper is to analyze the tendencies of social exclusion and inequality in Lithuania and in the context of Europe. By using statistical methods such as Gini coefficient and Lorenz curve, firstly we analyze the inequality of average county disposable household income per month. In the second part of the study, we analyze an indicator of people at-risk-of poverty or social exclusion in 26 different countries of Europe. In this section, we want to test the fixed and random effects models on our data. Based on them, the average effect of the at-risk-of poverty or social exclusion indicator can be measured. Based on real expenditure per capita analysis, Lithuania can be classified to a group of post-Soviet countries, where tendencies of poverty or social exclusion risk are similar.

Keywords: sustainability, inequality, social exclusion, poverty, Gini coefficient, Lorenz curve, panel data models.

1. Introduction

The term "sustainable development" is not that frequent in Lithuania. Despite the fact that the United Nations made a huge progress and laid the foundation for the process of sustainable development back in 1992, these foundations are still not firm enough in Lithuania. Increased consumption and a doubtful level of social responsibility can be reflected in the numbers of environmental pollution or income inequality. It is also a question whether the local business representatives are active in a social sphere working towards better social and environmental conditions. There are many examples when local businesses base their production in cost efficient third world countries where suitable work conditions and facilities are neglected. In addition, these markets are known for child labor and high corruption. In 2003, Lithuania published a Sustainable Development Strategy and set up key priority areas which should be developed in order to secure economic growth, non-renewable resources and social well being.

2. Sustainability process background

The National Sustainable Development Strategy (NSDS) was confirmed by the Government of the Republic of Lithuania on 11 September 2003. It is based on the decisions of the United Nations meeting in Rio de Janeiro in 1992. The NSDS has three parts: environmental, social and economic development. The essential goal of the strategy is "to reach the mean value of European Union indicators of 2003 by 2020 based on the economic, social and environmental performance" [4]. It is emphasized that, in order to achieve this, the government must focus on the development of innovation in science and education, which would ensure good professionals and cost efficient figures in the future.

The definition of the term "sustainable development" was introduced by the World Commission on Environment and Development in the report called "Our Common Future" in 1987. The term is described as a process which "seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future" [9]. This definition generally describes a sustainable and qualitative development of the three areas mentioned.

After twenty years of the United Nations meeting in Rio, 2012 was the year of reuniting the ideas and reviewing guidelines and agendas. 172 countries' representatives met once again in Rio and analyzed the achievements in sustainable development. This meeting resulted in the document "The Future We Want" [8], which was dedicated to the renewal of the oaths of promise of transparent and stable economies. One of the most interesting results of the meeting is the agreement to investigate sustainability indicators and find alternatives

to GDP, which could focus not only on economic development but would also include social and environmental wealth of the country.

In addition, these twenty years between the events are a good starting point for the analysis of sustainability indicators. The Statistical Office of the European Union (Eurostat) has produced a report on social, environmental and economic development indicators [3]. It is important to note that the data of Baltic countries mostly draw conclusions for the last ten years since them joining the EU in 2004. According to Eurostat, European employment indicators had grown until 2008, when the EU-27 average has reached as much as 70.3% for the citizens aged 20–64 [3]. Despite the recession, compared to 1997, employment has increased by more than 5 per cent in Europe. It is important to note that this indicator was boosting more between employable age female than male citizens. However, every year this gap has been shrinking, thus, employment inequality gender-wise has been decreasing.

3. Tendencies in Lithuania

In this section, we will take a look into the tendencies of average monthly disposable household income in 10 different counties of Lithuania in 2007–2011. This indicator will be summarized by statistical inequality measures such as Gini coefficient and Lorenz curve. The indicators were obtained from Eurostat statistical database and Statistics Lithuania. To start with, we can easily notice that average monthly disposable income increased in almost all of the counties until 2008 (Figure 1):

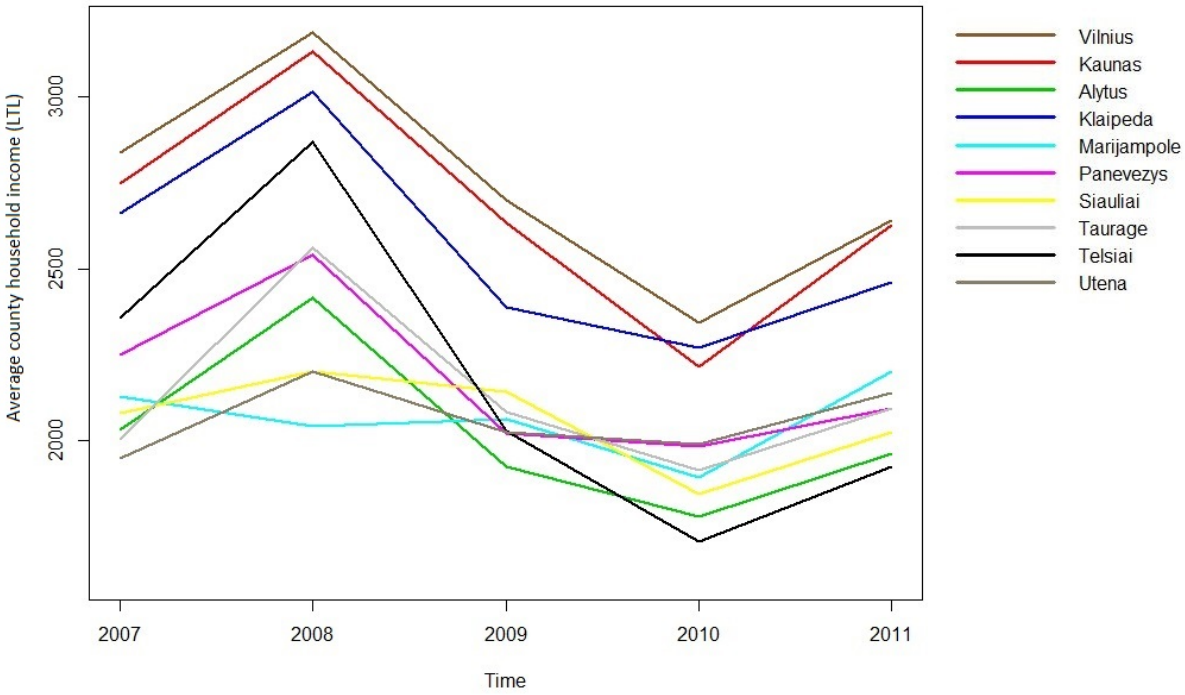

Figure 1: Average monthly disposable household income in the counties of Lithuania in 2007–2011

There is a slight decrease in the county of Marijampole, which is the leading county in used-car sales in Lithuania. The longest drop in income can be seen in Telsiai, where disposable income was by as much as LTL 1000 lower and reached only LTL 1704 per month in 2010, compared to 2008. These decline tendencies have started to change in 2010, when economic recession has slowed down and the economies of different countries started to stabilize. The highest income in Lithuania can be seen in the counties of Kaunas and Vilnius – it was approximately LTL 2600 in 2011, which testifies to the well being of metropolitan residents. We see that the highest household income is in Vilnius county, the second – Kaunas, the third in Klaipeda. Based on this, we see that people are more wealthy in the biggest cities of Lithuania and, on the contrary, the situation is worse in such counties as Telsiai, Taurage, etc. These common tendencies between most

of the counties can be explained by the fact of small geographical distances and inner migration of the residents. We can also notice that, despite the high correlation between income in different counties, income inequality can be observed in 2007–2011.

3.1. Inequality of average monthly disposable income in the counties of Lithuania

In order to evaluate social exclusion in the counties of Lithuania in 2007–2011, we will use Lorenz curve and Gini coefficient analysis. According to Dagum et al. [2], the Lorenz curve is used to measure financial or any other inequality between individuals. This curve is a function, which depends on cumulative sorted individual (for example household, countries or other) proportion and size. Assume we have a set of n individuals, where each individual i has a size x_i'. When $x_1' < x_2' < \cdots < x_n'$, then this curve is a polygon connecting points $(h/n, L_h/L_n)$, where $h = 0, 1, 2, \ldots, n$, $L_0 = 0$ and $L_h = \sum_{i=1}^{h} x_i'$.

Based on the estimated Lorenz curve for five years (Figure 2), we can see that the area between the absolute line of equality and Lorenz curves was not significantly big. This indicates that social exclusion and inequality in different counties of Lithuania was not an essential issue. The smallest area occurs in the year 2011, which can be explained by the previously analyzed tendencies in Figure 1. At the time, the economic recession was the strongest in the counties of Lithuania.

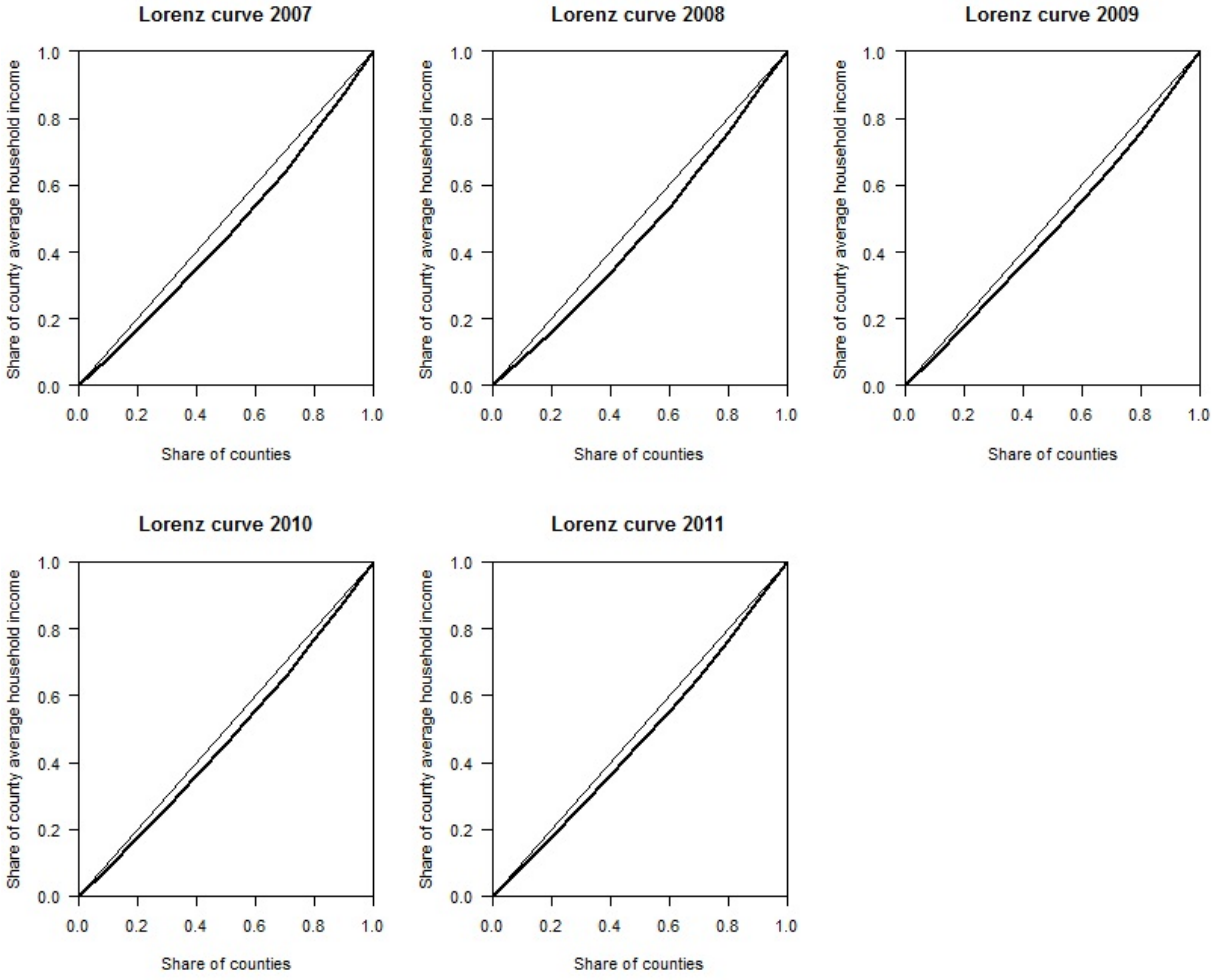

Figure 2: Lorenz curves representing household income distribution between the counties in Lithuania

We can also draw a conclusion that, during the times of prosperity, financial social exclusion between households in different counties is higher than exclusion during the recession, when people lose their jobs and income. To prove that,

we will calculate a Gini coefficient for each year. The Gini coefficient can be calculated as:

$$G = \frac{\Sigma_{i=1}^{n}\Sigma_{j=1}^{n}|x_i - x_j|}{2n^2\mu} \quad \text{or, alternatively,} \tag{1}$$

$$G = \frac{\Sigma_{i=1}^{n}(2i-n-1)x_i'}{n^2\mu}. \tag{2}$$

Here we have a set of n individuals (counties in our case), where each individual (county) i has a size x_i' (average income per year) and μ is a population mean. The coefficient indicates the ratio of the area between the absolute line of equality and the Lorenz curve and the area bellow the line. The change in Gini coefficients measured by the average monthly disposable household income can be observed in Figure 3:

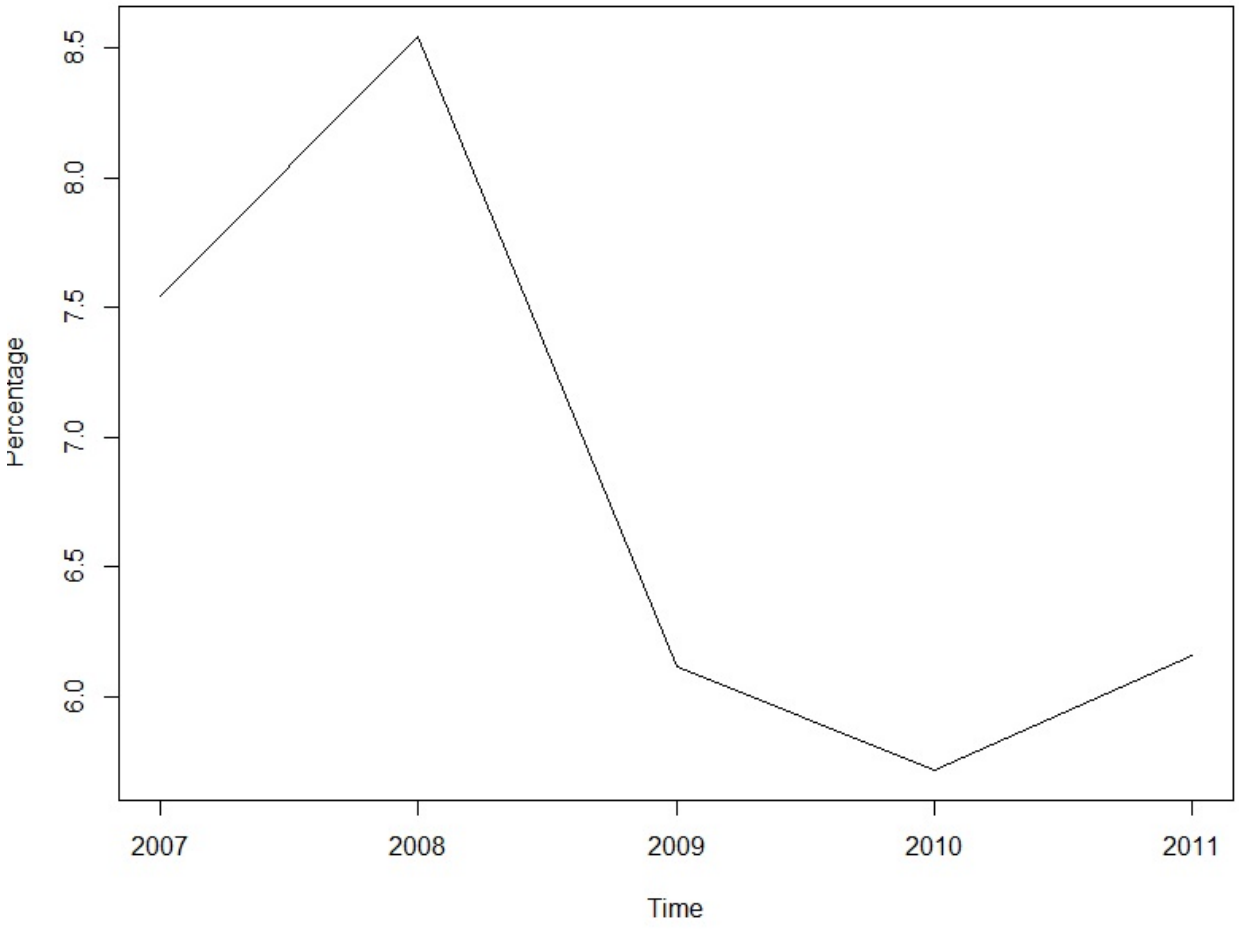

Figure 3: Gini coefficients of disposable household income

It is worth mentioning that in 2008 the coefficient indicated 8.5% and decreased to 5.7% in 2010. During the period of 2007–2011, the Gini coefficient was, on average, 6.8%. This leads us to a conclusion that, indeed, the issue of social exclusion was not of major concern during the observed period. It also confirms the idea that exclusion is higher during prosperity times, when residents most likely have more income and property. In comparison, the country level Gini coefficient of equivalised disposable income was around 38% in 2008 and has decreased to 34.6% in 2013 [7].

4. Tendencies in Europe

The European strategy "Europe 2020" consists of different goals in different areas, one of them is social exclusion and poverty. The main point is to improve the social situation for people in Europe. By 2020, the at-risk-of poverty or social exclusion indicator (P_{it}) should decrease by 20 million people. This implied indicator is based on three different groups of people. According to Eurostat [5], the first category is a percentage of people who are at risk of poverty and their

disposable income is lower than the poverty line. Each country has a different poverty line, based on a 60% disposable income median equivalent. The second category is the percentage of people living in straitened circumstances such as inability to pay the rent, buy meat, etc. The last – third – category is a percentage of adults (aged 18–59), who live in low labor productivity households and have worked less than 20% of possible working time in the last year.

The indicators analysed were obtained from the Eurostat statistical database and Statistics Lithuania. Our observed data are balanced panel data with $n = 26$ countries in the period of 2005–2012 ($T = 8$). There are $N = nT = 208$ observations in total, which can be seen in Figure 4 below:

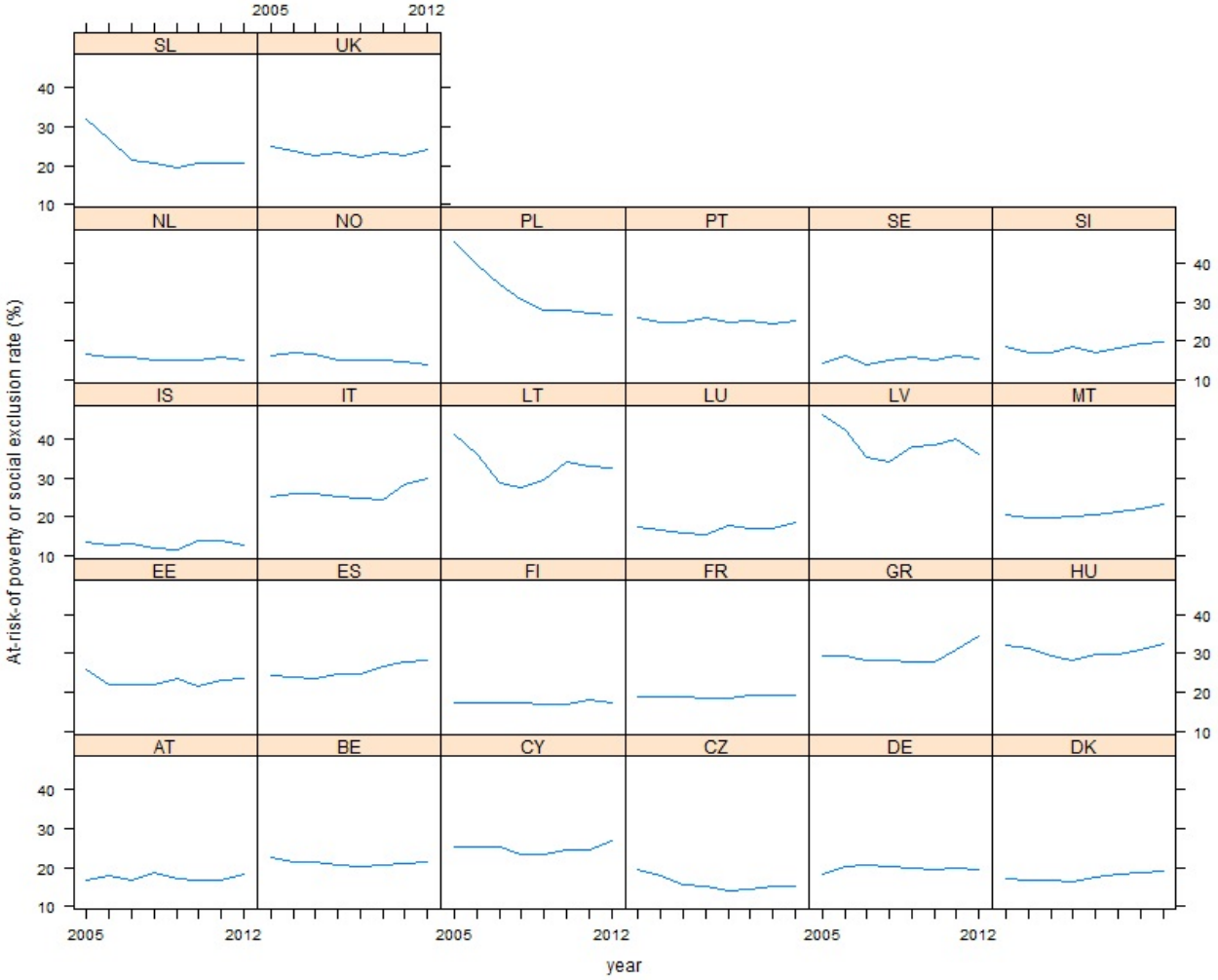

Figure 4: At-risk-of poverty or social exclusion rate in 26 countries of Europe, 2005–2012

We can see that at-risk-of poverty or social exclusion rate was constantly changing in Lithuania. Compared to other countries in Europe, it was still quite high: in 2012, it was approximately more than 30% of residents. It is obvious that Lithuania has one of the highest rate. Another country with a high risk at poverty or social exclusion rate is Latvia, where, on average, the rate was about 37% in 2005–2012. The Lithuania's neighboring country Poland has similar poverty risk tendencies as Lithuania. We can also notice that countries which previously were part of the Soviet block tend to have higher risk of poverty or social exclusion rates. It can be explained by economic stagnation, which happened during the occupation and annexation. It seems that it is hard to keep up together with Western European countries; however, the situation improving. Iceland is one of the countries with the lowest rate. In general, Scandinavian countries are at the top of the list, with less than 20% of risk due to a high level of development.

Further, we will analyze the observed rate in relation to the annual employment level in different countries and real expenditure per capita (PPP EU-27 adjusted) E_{it}, which is converted from expenditures of different countries to real expenditures. It reflects differences in the volume measures. First, we want to test whether our data are stationary, and to do that we conduct a Dickey–Fuller test, with a hypothesis:

H_0: At least one data set sequence contains a unit root,
H_A: None of the sequences contains a unit root.

The test statistic is $DF = -12.0518$ and $p - value = 0.01$, which is less than the significance level $\alpha = 0.05$, thus, we reject the null hypothesis.

4.1. Panel models

In this subsection, the goal is to analyze indicator's P_{it} dependency on employment level by using different panel data models. In addition, we want to understand how the employment level affects different risk groups in Europe. To do that, we will model three different panel data models: pooling model, fixed effects and random effects model. Pooling model:

$$P_{it} = \alpha + \beta E_{it} + \varepsilon_{it}, \tag{3}$$

where $i = 1, \ldots, 26$, $t = 1, \ldots, 8$. This model has several assumptions, which indicate that there is a constant error variance and different subject remainders do not mutually correlate:

$$\begin{aligned} \mathrm{E}(\varepsilon_{it}|E_{it}) &= 0, \\ \mathrm{Var}(\varepsilon_{it}) &= \sigma_i^2, \\ \mathrm{Corr}(\varepsilon_{it}, \varepsilon_{js}) &= 0, \quad \forall i \neq j, \ t \neq s. \end{aligned}$$

In other words, this model means that there is no panel effect in the dataset. Data do not depend either on a year or on a country. We treat these data as one cross-sectional dataset. We imply that this model might wrongly describe our underlying data due to different economic development levels of each country analyzed. Let's evaluate this model by the ordinary least squares method. The results are:

$$\widehat{P_{it}} = 62.816 - 0.614 E_{it}, \quad R^2 = 0.3982.$$

All coefficients are significant, and the negative coefficient of employment level indicates that when the employment rate increases, the poverty and social exclusion risk group decreases by 0.614. Based on the Breusch–Godfrey test [1], we use it to test the problem of autocorrelation in regression model errors. Compared to a usual Durbin–Watson test statistic, the BG test is less restricted and has more power. On the contrary, BG can test stochastic regressors and higher than first rank autoregressive errors. The hypotheses are:

$$\begin{aligned} H_0: &\quad \rho_i = 0, \quad \forall\, i, \\ H_A: &\quad \text{there is at least one i, } \rho_i \neq 0, \end{aligned}$$

where $\widehat{u_t} = \alpha_0 + \alpha_1 X_{t,1} + \alpha_2 X_{t,2} + \rho_1 \widehat{u}_{t-1} + \rho_2 \widehat{u}_{t-2} + \cdots + \rho_p \widehat{u}_{t-p} + \varepsilon_t$. The test statistic is $\chi^2_p = 127.855$ and $p - value < 2.2 \cdot 10^{-16} < \alpha = 0.05$ is lower than the significance level chosen, which allows us to reject the null hypothesis and admit that errors of the model are autocorrelated. In this case, estimated model coefficients are unbiased, however residuals are still not reliable. This issue usually occurs due to a wrong model specification – as we implied, the data might depend on the country and, most likely, time effects, which we further analyze. Let's model the fixed effects model. This model has the same assumptions as the previously analyzed pooling model:

$$P_{it} = \alpha_i + \beta_i E_{it} + \varepsilon_{it}, \tag{4}$$

where $i = 1, \ldots, 26$, $t = 1, \ldots, 8$. Here the coefficient α_i stands for "individual effect", which does not depend on time t. Since α_i can correlate with predicted variables, we cannot use OLS for model evaluation. In this case, OLS estimators would be biased and inconsistent. In order to evaluate the regression we will use dummy variables, which describe the country effect. We have D_2=1 if i_2 (2nd country), D_3=1 if i_3 (3rd country) and so on.

$$P_{it} = \alpha_1 + \alpha_2 D_2 + \cdots + \alpha_{26} D_{26} + \beta_i E_{it} + \varepsilon_{it}, \tag{5}$$

where $i = 1, \ldots, 26$, $t = 1, \ldots, 8$. We call this model least squares dummy variable model (*LSDV*). We estimate it with OLS, and the results show that all dummy variables and the employment rate variable are significant. Again, to test autocorrelation in model residuals, we use the Durbin–Watson test. The test statistic $DW = 1.131$ denotes that model residuals

might still contain an autocorrelation issue. Coefficient next to employment level indicate how much the variability of the social exclusion and poverty risk indicator changes when the employment rate increases by one unit for a specific country. Based on the results, we conclude that the fixed effects model is better than the pooling model. To be more certain, we want to test whether country effects are necessary. We will rewrite the model by including coefficients for different countries next to the employment rate:

$$P_{it} = \alpha_i + \beta_1 E_{1t} + \cdots + \beta_{26} E_{26t} + \varepsilon_{it}, \tag{6}$$

where $i = 1,\ldots,26$, $t = 1,\ldots,8$. Estimated coefficients of this alternative model are significant, and individual country effects are the same as in the previous LSDV model. The model's coefficient of determination is $R^2 = 0.144$. To answer the country-effect question, we can also formulate it as a hypothesis and use a F-test to reject or accept it. We consider the fixed model as unrestricted and the pooling model as restricted:

$$\begin{aligned} H_0: &\quad \beta_1 = \cdots = \beta_{26} = 0, \\ H_A: &\quad \exists \text{ at least one } \beta_i \neq 0. \end{aligned}$$

The value of the test statistic is $F = 44.264$ and its $p - value = 2.2 \cdot 10^{-16} < \alpha = 0.05$, which allows us to reject the null hypothesis and accept that our data are better described by using individual country effects.

We know that cross-sectional observations of our panel dataset represent 26 different countries. Assume that individual country effects as random. We construct the last, third, random effect model:

$$P_{it} = \beta_i E_{it} + \varepsilon_{it} + u_i, \tag{7}$$

where $i = 1,\ldots,26$, $t = 1,\ldots,8$, $u_i \sim N(0,\sigma_u^2)$. Here ε_{it} is an individual error and u_i – independent from time unobservable effect, which denotes all omitted elements in the regression. It is a random variable, which contains a value for each country i. The analyzed indicator might possibly be explained by other factors, such as disposable household income, labor productivity, education, etc. All previously stated assumptions are valid for this model; also, there are several additional ones. Compared to the fixed effect model, the main difference is that, in this model, u_i does not correlate with predicted variables $t = 1,\ldots,T$:

$$\begin{aligned} \mathrm{E}(u_i) &= 0, \\ \mathrm{Corr}(u_i,\varepsilon_{jt}) &= 0, \quad i = 1,\ldots,26,\ \ j = 1,\ldots,26,\ \ t = 1,\ldots,8 \text{ and ß} \neq j, \\ \mathrm{Corr}(u_i,u_j) &= 0, \quad i = 1,\ldots,26,\ \ j = 1,\ldots,26 \text{ and } i \neq j, \\ \mathrm{E}(u_i|E_{it}) &= 0, \\ \mathrm{Var}(u_i) &= \sigma_u^2. \end{aligned}$$

These assumptions guarantee that residuals $u_i + \varepsilon_{it}$ do not correlate with the predicted variable, and OLS β estimators would be unbiased and consistent. However, we know that, if residuals are autocorrelated and heteroscedastic, then OLS estimators will be ineffective. In this case, we can evaluate the regression by the general OLS method by calculating β in a different way. Now the coefficients are significant, $R^2 = 0.184$. However, the coefficient of determination does not provide us any sufficient information since we cannot compare different methods and models. The results of the random effects model might be tricky and hard to interpret because these coefficients denote the differences between countries and time changing tendencies within the countries. The estimated employment rate E_{it} coefficient is -0.459312, which could be described as average poverty and social exclusion risk group change, when the employment rate increases by one. Usually, it is hard to judge which one of the random or fixed effects models to use. To answer this, we will use a Hausman test with the hypothesis:

$$\begin{aligned} H_0: &\quad \mathrm{E}(c_i|E_{it}) = 0, \quad \text{where } \alpha_i = \text{const} = c_i, \\ H_A: &\quad \mathrm{E}(c_i|E_{it}) \neq 0. \end{aligned}$$

The test statistic is $\chi^2 = 1.709$ and $p - value = 0.1991$ is higher than the confidence level $\alpha = 0.05$; thus, we accept the null hypothesis that our data are better described by the random effects model. To add, we noticed that the estimated coefficients of both models are not significantly different: the fixed effects coefficient next to E_{it} is -0.415076, while the random one is -0.459312.

4.2. At-risk-of poverty and social exclusion indicator dependency on real government expenditure by capita

In this subsection, we analyze how the social exclusion and poverty risk indicator in Europe depends on real expenditure per capita in 2005–2012. Annual smoothed curves are shown in Figure 5.

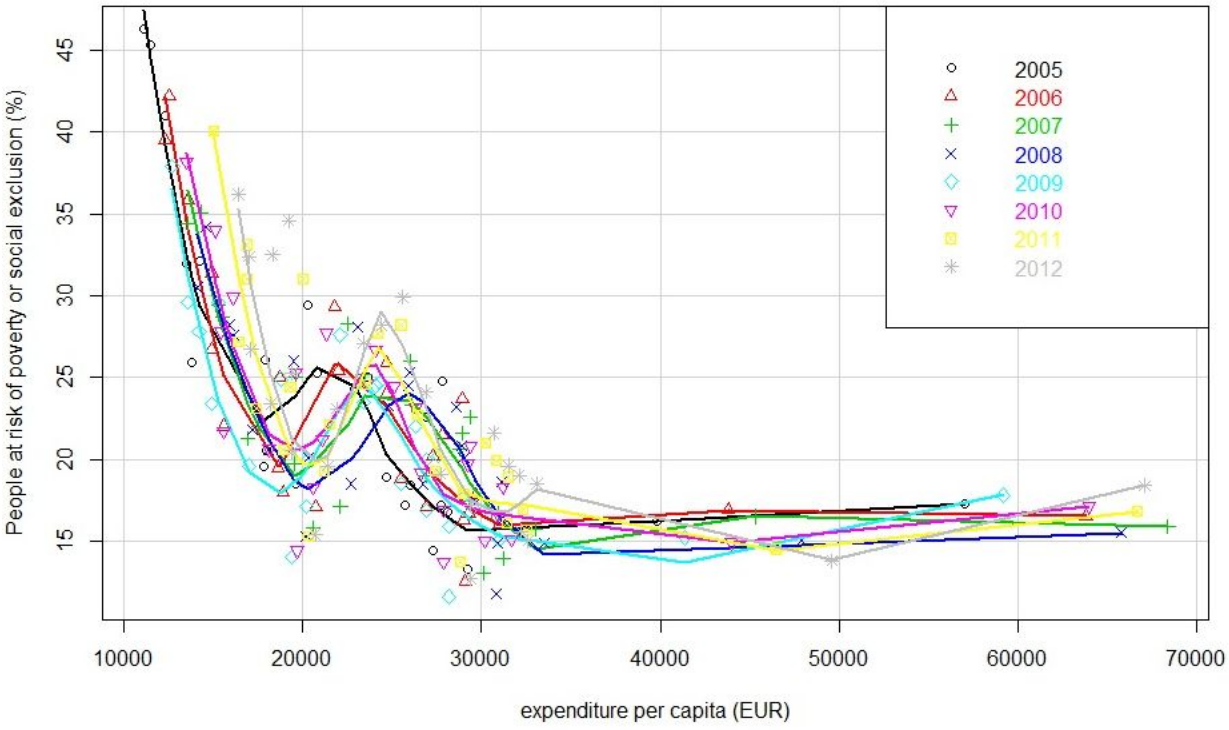

Figure 5: Real expenditure per capita and at-risk-of poverty or social exclusion scatterplot in 2005–2012

These eight year tendencies might be described by a sentence: the higher expenditure per capita is in the country, the smaller the social exclusion or poverty risk indicator. Indeed, this theory might be true – higher country's expenditure means more expenditure on health, education and other sectors. This results in more job opportunities on the market, higher education quality, better social and health security, which ensures the stability of social and financial status of the country's residents. Having more expenditure, the probability for a person to be at-risk-of poverty or social exclusion is lower – he/she can or is able to maintain his/her living place and make ends meet. However, to prove that, we will divide the countries into two blocks.

Based on the scatter plot, we notice that the countries, where expenditure per capita is, on average, EUR 20–30 thousand, have a more volatile poverty and social risk indicator. Let's regroup the countries. We create two blocks: the first one contains the Baltics, Poland, Czech Republic, Slovakia, Slovenia, Hungary, Portugal and Malta, which have a low expenditure per capita indicator. Another block contains Western and Southern European countries and Scandinavia – countries which conditionally have a high expenditure per capita indicator. The tendencies of these two blocks can be seen in the scatterplot graphs, see figures 6 and 7.

We can easily notice that the poverty or social exclusion risk indicator is increasing when the real expenditure per capita is decreasing in the first block countries. Looking at the second block, we can see that there are only a few points where the expenditure is higher than EUR 40 thousand per capita, and the most common value is EUR 20-30 thousand per capita. In conclusion, as expenditure decreases, there are more and more people getting into a risk group of poverty or social exclusion. It is essential to mention that the risk indicator also depends on various factors and government decisions – the educational level in the country is one of the factors, together with size of social benefits, workplaces, etc.

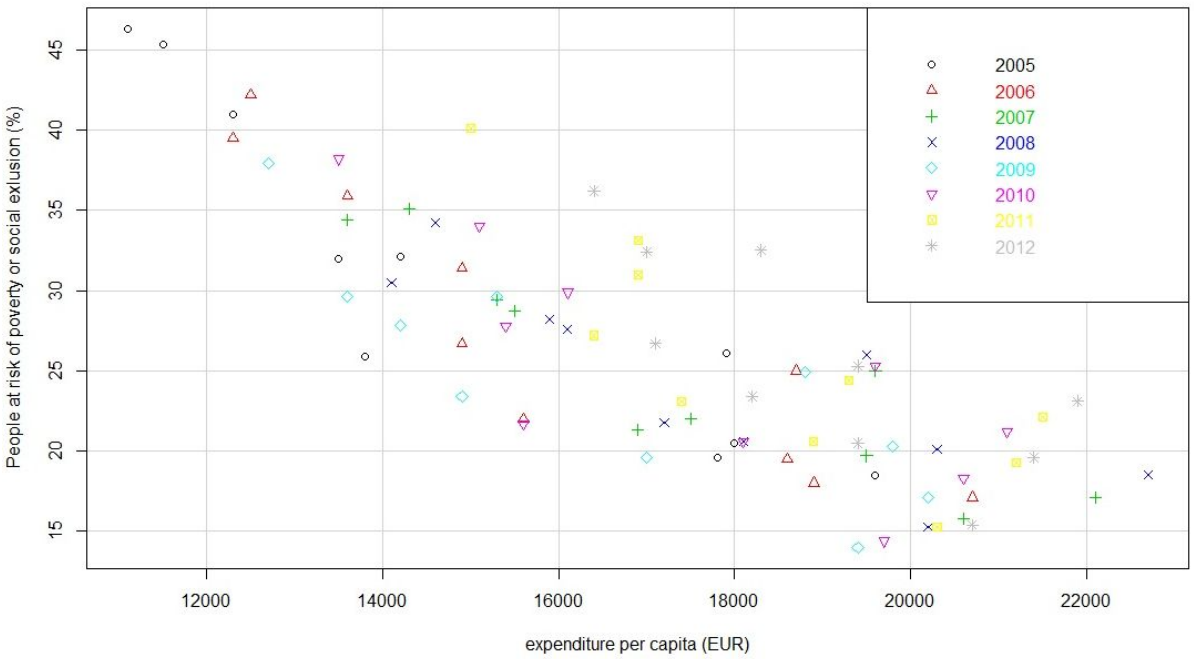

Figure 6: Scatterplot of the first block countries (Baltics, Poland, Czech Republic, Slovakia, Slovenia, Hungary, Portugal and Malta) real expenditure per capita and at-risk-of poverty or social exclusion group indicators in 2005–2012

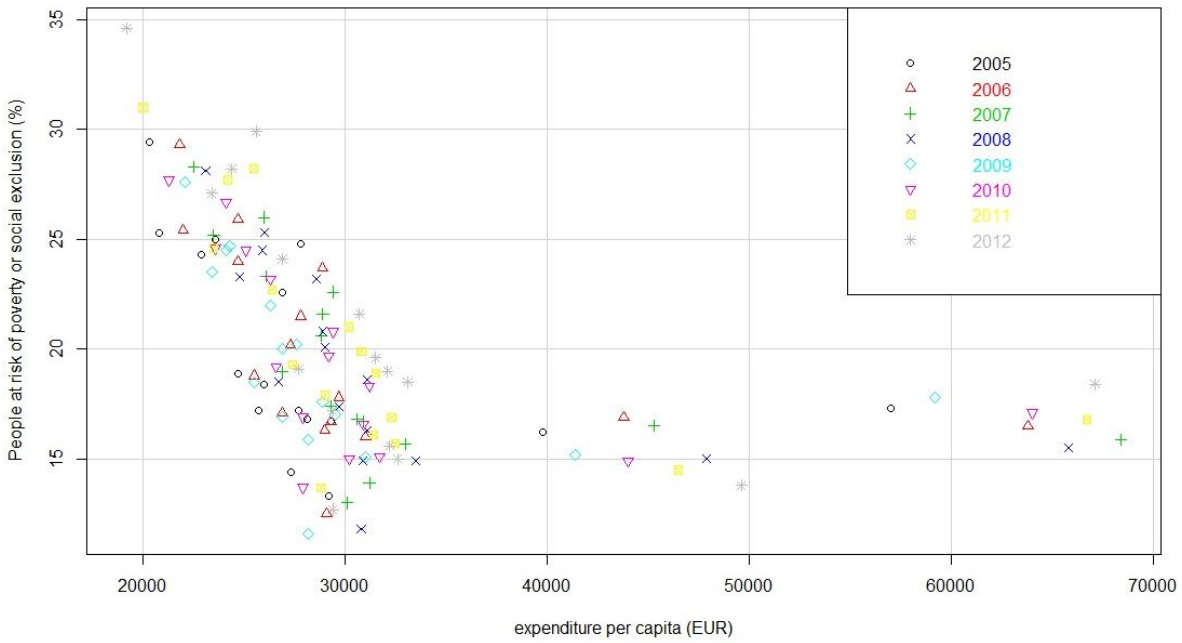

Figure 7: Scatterplot of the second block countries' (Western and Southern European countries and Scandinavia) real expenditure per capita and at-risk-of poverty or social exclusion group indicators in 2005–2012

5. Conclusions and recommendations

Sustainable development is a process, which secures social welfare of the society. It also ensures that the environment which we live in is convenient and fulfils our objectives. The economic development of the country is concurrent with integrated growth, involving both citizens and the environment. This analysis has successfully answered the problematic question – based on the results, we admit that Lithuania is slowly growing in the context of sustainable development.

In order to maintain this process, there is a need for transparency in economics, innovations and new investments in the market.

Based on the results from the first section, there was an approximately 8–11% financial inequality in the counties of Lithuania during the last 20 years. It is difficult to judge whether this is high or low inequality. In order to answer this question, further analysis of financial inequality in the countries with similar economic and social development would be informative. It would also allow us to test the factors and financial inequality tendencies in Europe. Based on the results in the second part, we have tried three different panel data models. We use them to outline the average change in the indicator analyzed when the variables of different countries change. We can also use them to forecast future tendencies. In the second section, social exclusion or poverty dependency on expenditure per capita in Europe was also analyzed. The results showed that there are two different tendencies and Lithuania belongs to the first block countries, where expenditure per capita is around LTL 6000-7000 per year. We can also conclude that the higher the expenditure per capita, the lower the poverty risk indicator. This allows us to ensure lower risk while forming the budget in the country. In order to gain a deeper knowledge of the risk of poverty or social exclusion indicator, it is also essential to take into account other variables such as labor productivity, education, laws, etc. Another possible improvement might be to test differences between the countries and their estimated coefficients.

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LIETUVOS PADĖTIS TVARAUS VYSTYMOSI KONTEKSTE

Beatričė Leiputė

Santrauka. Šio darbo tikslas yra ištirti, kokios yra socialinės atskirties ir nelygybės tvaraus vystymosi tendencijos Lietuvoje bei Europos kontekste. Naudojantis statistiniais nelygybės tyrimo metodais tokiais kaip Gini koeficientas ir Lorenz kreivė, pirmoje dalyje tiriame vidutinių disponuojamų namų ūkių pajamų nelygybę. Antroje darbo dalyje nagrinėjamas skurdo ir socialinės atskirties rizikos rodiklis 26-iose Europos valstybėse. Pasinaudojus panelinių duomenų modeliais, ieškomas geriausiai skurdo ir socialinės atskirties rizikos rodiklį aprašantis modelis. Remiantis modelių analize, nagrinėjama darbo lygio pokyčio priklausomybė nuo skurdo ir socialinės atskirties rizikos rodiklio vidutinio pokyčio. Pagal vienam gyventojui tenkančias valstybės išlaidas, Lietuva gali būti priskiriama prie Postsovietinio valstybių bloko, kuriose vyrauja panašios skurdo rizikos tendencijos, kurios ir nagrinėjamos tolimesniame darbe.

Reikšminiai žodžiai: Tvarus vystymasis, nelygybė, socialinė atskirtis, skurdas, Gini koeficientas, panelinių duomenų modeliai.