



Inequalities in Development in the European Union at the time of COVID-19 Pandemic

Nerovnosti v rozvoji v Európskej únii v čase pandémie COVID-19

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Abstract:

Balanced development is perceived as one of crucial objectives of the European Union integration. It is included in the treaties and promoted by the policies of the EU. Development inequalities among the EU economies result from a number of reasons. The COVID-19 pandemic did strengthen the problem of development inequalities in the EU. The main aim of the research is to diagnose and evaluate the impact of the COVID-19 pandemic on development disparities in the EU27. Multivariate comparative analysis was conducted with the application of Hellwig index of TMD (Taxonomic Measure of Development) and the standard deviations method of grouping of linearly ordered objects. The following eleven diagnostic variables were taken into consideration: X1 – GDP growth, X2 – GDP per capita PPP, X3 – share of service sector in value added, X4 – general government sector balance (deficit/surplus), X5 – general government sector debt, X6 – employment rate, X7 – unemployment rate, X8 – natural growth rate, X9 – infant mortality rate, X10 – population aged 30-34 with tertiary education, X11 – gross expenditure on research and development as % GDP. The research was conducted for the years: 2019 and 2021. The conducted research and analysis indicated the existence of considerable inequalities among the EU economies.

Keywords: *Development, Inequalities, European Union, COVID-19 pandemic.*

Abstrakt:

Vyvážený rozvoj sa považuje za jeden z kľúčových cieľov integrácie Európskej únie. Je zahrnutý v zmluvách a podporovaný politikami EÚ. Rozdiely v rozvoji ekonomík EÚ vyplývajú z viacerých dôvodov. Pandémia COVID-19 skutočne posilnila problém nerovnosti v rozvoji v EÚ. Hlavným cieľom výskumu je diagnostikovať a vyhodnotiť vplyv pandémie COVID-19 na rozdiely v rozvoji v



EÚ-27. Bola vykonaná viacrozmerná porovnávacia analýza s použitím indexu TMD navrhnutý profesorom Hellwigom (Taxonomická miera rozvoja) a metódy štandardných odchýlok zoskupenia lineárne usporiadaných objektov. Do úvahy sa bralo nasledujúcich jedenásť diagnostických premenných: X1 - rast HDP, X2 - HDP na obyvateľa v parite kúpnej sily, X3 - podiel sektora služieb na pridanej hodnote, X4 - saldo (deficit/prebytok) sektora verejnej správy, X5 - dlh sektora verejnej správy, X6 - miera zamestnanosti, X7 - miera nezamestnanosti, X8 - miera prirodzeného prírastku, X9 - miera dočenskej úmrtnosti, X10 - počet obyvateľov vo veku 30-34 rokov s vysokoškolským vzdelaním, X11 - hrubé výdavky na výskum a vývoj v % HDP. Výskum sa uskutočnil pre roky: 2019 a 2021. Vykonaný výskum a analýza poukázali na existenciu značných nerovností medzi ekonomikami EÚ.

Kľúčové slová: Rozvoj, rozdiely, Európska únia, pandémie COVID-19.

Introduction

The European Union promotes balanced development [22; 19; 23; 20; 21]. It is one of its crucial objectives [10; 12]. The 21st century, however, increased inequalities in the EU due to the enlargement of the bloc in 2004, 2007 and 2013 [5; 6; 7]. The global financial crisis brought further problems [2; 9; 17]. The COVID-19 pandemic created huge and multidimensional challenges and threats for the EU [1; 18]. The pandemic reinforced the problem development disparities in the EU. The main objective of the research is to diagnose and evaluate development disparities in the EU at the time of the COVID-19 pandemic. The following research questions were formulated:

RQ1: What were the development inequalities among the EU27 countries before the COVID-19 pandemic?

RQ2: What were the disparities in development among the EU27 countries during the 2nd year of the pandemic?

1. Methods and material

The research tools used in the article included literature studies, descriptive analysis and multivariate comparative analysis, and in particular Hellwig taxonomic measure of development as well as standard deviations' method. Statistical information provided by EUROSTAT and Central Statistical Office was used for the analysis.

Multidimensional methods of comparative analysis were useful due to the fact that 27 economies were subject to comparisons and in addition to that a great number of diagnostic variables had to be applied. The following eleven diagnostic variables were taken into consideration: X₁ – GDP growth, X₂ – GDP per capita PPP, X₃ – share of service sector in value added, X₄ - general government sector balance (deficit/surplus), X₅ – general government sector debt, X₆ – employment rate, X₇ – unemployment rate, X₈ – natural growth rate, X₉ – infant mortality rate, X₁₀ – population aged 30-34 with tertiary education, X₁₁ - gross expenditure on research and development as % GDP.

The research was based on Hellwig taxonomic measure of development [11; 16, 24]. After selecting the set of diagnostic variables, the character of each of the

variables was determined. The variables were standardized and development model was constructed – a model unit, where diagnostic of variables have been determined according to the rule, where: $z_{0j} = \max_i(z_{ij})$ for stimulants and $z_{0j} = \min_i(z_{ij})$ for destimulants. The distance of i-unit from the development model was calculated using Euclid's measure: $d_{oi} = \sqrt{\sum_{j=1}^m (z_{ij} - z_{0j})^2}$. Taxonomic measure of development (TMD) was calculated according to the formula:

$$\text{TMD}_i = 1 - \frac{d_{oi}}{d_o}, \quad i=1,2, \dots, n \quad \text{where: } d_o = \bar{d}_o + 2S_0 \quad \text{and: } \bar{d}_o = \frac{1}{n} \sum_{i=1}^n d_{oi}$$

$$S_0 = \sqrt{\frac{1}{n} \sum_{i=1}^n (d_{oi} - \bar{d}_o)^2}, \quad \text{while: } \text{TMD}_i \in [0; 1].$$

Thanks to the implementation of Hellwig taxonomic measure of development, making a hierarchy of the analysed EU27 economies from the most developed one to the least developed one was possible.

Moreover, the application of cluster analysis for the research resulted in grouping of the analysed subjects – 27 EU Member States – in four clusters according to the level of economic development in 2019 and 2020. A selected method of grouping of linearly ordered objects, namely the method of standard deviations was used for this purpose. 27 EU Member States were divided into four groups, according to the following rules [13]:

$$G_1 : s_i < \bar{s} - S(s),$$

$$G_2 : \bar{s} > s_i \geq s_i - S(s),$$

$$G_3 : \bar{s} + S(s) > s_i \geq \bar{s},$$

$$G_4 : s_i \geq \bar{s} + S(s),$$

2. Research results

The initial analysis of the of the situation in EU27 Member States before the outbreak of the COVID-19 pandemic, i.e. in 2019 indicated:

- GDP growth ranged from 0.3% in Italy to 5.5% in Ireland (with the EU27 average amounting to 2.6%);
- GDP per capita (current prices) ranged from only EUR 8680 in Bulgaria to EUR 102200 in Luxembourg with the EU 27 average amounting to EUR 31444, while GDP per capita PPP ranged from 55 in Bulgaria to 251 in Luxembourg with the EU27 average 100;
- General government sector deficit was recorded in 13 out of 27 EU states, it was the highest in Romania (-4.3% GDP) and Greece (-7.5% GDP). 14 EU states reported general government sector surplus, it was the highest in the case of Denmark (+4.1% GDP);
- General government sector debt ranged from only 8.5% GDP in Estonia to as much as 180.6% GDP in Greece;
- The highest employment rate was characteristic for Sweden (82.1%), while the lowest employment rate was noted in Greece (61.2%);

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- Unemployment rate ranged from 2.0% in Czechia to 17.3% in Greece;
- Natural growth rate ranged from minus 6.6 in Bulgaria to 6.2 in Ireland.
- The lowest infant mortality rate was noted in Estonia (1.6 per 1000 life births), and the highest one was observed in Romania (6.0 per 1000 life births);
- The share of population aged 30-34 with tertiary education attainment level ranged from 25.8% in Romania to 58.8% in Luxembourg;
- The highest level of gross expenditure on research and development (GERD) was noted in Sweden (3.39% GDP) and the lowest GERD was observed in Romania (0.48% GDP).

When it comes to the situation in EU27 during the second year of the pandemic, i.e. 2021, the analysis initial analysis showed considerable differences:

- GDP growth ranged from 2.9 % in Germany to 13.5% in Ireland;
- GDP per capita (current prices) ranged from only EUR 14700 in Croatia to EUR 114370 in Luxembourg, while GDP per capita PPP ranged from 64 in Greece to 268 in Luxembourg with the EU27 average 100;
- General government sector deficit was recorded in 25 out of 27 EU states, it was the highest in Malta (-7.8% GDP) and Greece (-7.5% GDP). Only 2 EU states reported general government sector surplus, namely Denmark (+3.6% GDP) and Luxembourg (+0.8 %GD);
- General government sector debt ranged from only 17.6% GDP in Estonia to as much as 194% GDP in Greece;
- The highest employment rate was characteristic for the Netherlands (81.7%), while the lowest employment rate was noted in Greece (62.6%);
- Unemployment rate ranged from 2.8% in Czechia to 14.8% in Spain and 14.7% in Greece;
- Natural growth rate ranged from minus 6.6 in Lithuania to 4.7 in Ireland.
- The lowest infant mortality rate was noted in Estonia (1.6 per 1000 life births), and the highest one was observed in Malta (6.7 per 1000 life births);
- The share of population aged 30-34 with tertiary education attainment level ranged from 24.8% in Romania to 62.5% in Luxembourg;
- The highest level of gross expenditure on research and development (GERD) was noted in Sweden (3.36% GDP) and the lowest GERD was observed in Romania (0.47% GDP).

The conducted multidimensional comparative analysis with the application of Hellwig taxonomic measure of development made it possible to make a hierarchy of EU 27 countries according to development measured by TMD. Tables 1 and 2 present the results for 2019 (the last pre-pandemic year) and for 2021 (the latest data available).

In 2019 Luxembourg took the leading position (TMD for Luxembourg equaled 0.565). TMD above 0.5 was characteristic for the following EU economies: Denmark, Netherlands, Ireland and Sweden. The last position was taken by Greece (TMD amounting to 0.070). A really low value of TMD was also characteristic for: Romania, Italy, Bulgaria and Croatia (TMD for those EU economies amounted to 0.200 or even less). Luxembourg kept its leading position in regard to socio-economic development measured by TMD in 2021 (TMD for Luxembourg was 0.568). In the case of Denmark and Ireland TMD was also higher than 0.5. Sweden and the Netherlands were also

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classified among the top 5 EU economies in 2021 according to TMD. Greece remained the least developed EU economy according to TMD in 2021 (TMD for Greece amounted to 0.088 in 2021). Romania, Italy and Spain were characterized by a very low level of TMD in 2021 (TMD for those EU economies ranged from 0.093 to 0.178).

Tab. 3 EU countries according to development measured by TMD in 2019 [Own calculations]

Position	Country	TMD	Position	Country	TMD
1	Luxembourg	0.565	15	Belgium	0.359
2	Denmark	0.530	16	Lithuania	0.356
3	Netherlands	0.520	17	Poland	0.324
4	Ireland	0.517	18	Portugal	0.288
5	Sweden	0.491	19	Latvia	0.276
6	Cyprus	0.455	20	Hungary	0.246
7	Austria	0.441	21	Slovakia	0.244
8	Estonia	0.426	22	Spain	0.203
9	Malta	0.392	23	Croatia	0.200
10	Slovenia	0.373	24	Bulgaria	0.188
11	Germany	0.373	25	Italy	0.118
12	Czechia	0.373	26	Romania	0.091
13	France	0.365	27	Greece	0.070
14	Finland	0.360			

Tab. 4 EU countries according to development measured by TMD in 2021 [Own calculations]

Position	Country	TMD	Position	Country	TMD
1	Luxembourg	0.568	15	Malta	0.307
2	Denmark	0.519	16	Lithuania	0.304
3	Ireland	0.516	17	Portugal	0.294
4	Sweden	0.481	18	Czechia	0.291
5	Netherlands	0.476	19	Croatia	0.251
6	Estonia	0.419	20	Hungary	0.237
7	Cyprus	0.410	21	Latvia	0.214
8	Belgium	0.378	22	Bulgaria	0.205
9	Slovenia	0.367	23	Slovakia	0.196
10	France	0.365	24	Spain	0.178
11	Austria	0.361	25	Italy	0.135
12	Finland	0.350	26	Romania	0.093
13	Germany	0.340	27	Greece	0.088
14	Poland	0.310			

Tab. 5 Division of EU countries into classes in 2019 and 2021 [Own calculations]

2019						2021					
Position	Country	Class	Position	Country	Class	Position	Country	Class	Position	Country	Class
1	Luxembourg	G4	15	Belgium	G3	1	Luxembourg	G4	15	Malta	G2
2	Denmark	G4	16	Lithuania	G3	2	Denmark	G4	16	Lithuania	G2
3	Netherlands	G4	17	Poland	G2	3	Ireland	G4	17	Portugal	G2
4	Ireland	G4	18	Portugal	G2	4	Sweden	G4	18	Czechia	G2
5	Sweden	G4	19	Latvia	G2	5	Netherlands	G4	19	Croatia	G2
6	Cyprus	G3	20	Hungary	G2	6	Estonia	G3	20	Hungary	G2
7	Austria	G3	21	Slovakia	G2	7	Cyprus	G3	21	Latvia	G2
8	Estonia	G3	22	Spain	G2	8	Belgium	G3	22	Bulgaria	G2
9	Malta	G3	23	Croatia	G1	9	Slovenia	G3	23	Slovakia	G2

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10	Slovenia	G3	24	Bulgaria	G1	10	France	G3	24	Spain	G1
11	Germany	G3	25	Italy	G1	11	Austria	G3	25	Italy	G1
12	Czechia	G3	26	Romania	G1	12	Finland	G3	26	Romania	G1
13	France	G3	27	Greece	G1	13	Germany	G3	27	Greece	G1
14	Finland	G3				14	Poland	G2			

Additionally, standard deviations' method of linearly ordered subjects' classification was applied in order to group 27 EU countries into classes (according to the level of their socioeconomic development). As a result, the studied 27 EU countries were grouped into four classes, where class G4 included countries with the highest TMD (TMD amounting to at least arithmetic mean of TMD plus standard deviation of TMD), and class G1 included economies with the lowest TMD (for those economies TMD was lower than arithmetic mean of TMD minus standard deviation of TMD). The results of analysis with the application of standard deviations' method of classification of linearly ordered subjects are presented in table 3 (both year 2019 and year 2021).

In 2019 class G4 was formed by: Luxembourg, Denmark, Netherlands, Ireland, and Sweden. while Greece, Romania, Italy, Bulgaria and Croatia created a 4-element class G1. In 2021 class G4 included five EU economies, namely: Luxembourg, Denmark, Ireland, Sweden and the Netherlands, while class G1 embraced four EU economies: Greece, Romania, Italy and Spain.

It is worth noting here that the gap between the least developed economy and the most developed was slightly reduced between 2019 and 2021. However, the disparities between the best and the least developed EU economies remained enormous. In 2021 TMD for Greece was only 15.49% of TMD for Luxembourg. In 2019 TMD for Greece was 12.39% of TMD for Luxembourg.

Luxembourg's top position was largely due to the highest level of GDP per capita PPP, as well as the largest share of the service sector in value-added creation and a very low level of public debt, an existing budget surplus, as well as high natural growth rate and a very high rate of people with tertiary education in the 30-34 age group. By far Greece's lowest ranking was due in large part to its highest - incredibly high - level of public debt to GDP, lowest employment rate and very high unemployment rate. In addition to that, Greece had almost the lowest level of GDP per capita PPP and almost the highest level of general government deficit. Moreover, strongly negative natural increase rate (minus 4.3 ‰) remained a major problem in Greece.

Conclusion

The EU has had to face numerous challenges and threats since the beginning of the 21st century. Undoubtedly the COVID-19 posed an unprecedented challenge for all EU Member States [14; 15]. Multidimensional comparative analysis indicated that before the outbreak of the COVID-19 pandemic, i.e. in 2019 the highest level of development measured by TMD was characteristic for: Luxembourg, Denmark and the Netherlands. Two years later, in 2021 Luxembourg, Denmark and Ireland formed the top three EU countries with the highest level of socio-economic development measured by TMD. The group of EU countries with the lowest level of socio-economic development expressed in TMD included: Greece, Romania and Italy both in the last pre-pandemic year of 2019 and in 2021. The application of standard deviations' method indicated that Luxembourg, Denmark, Ireland, Sweden and the

Netherlands formed a 5-element G4 class both in 2019 and 2021. G1 class was formed by 5 EU countries in 2019 (Greece, Romania, Italy, Bulgaria and Croatia) and by EU 4 countries in 2021 (Greece, Romania, Italy and Spain) in 2021.

The COVID-19 pandemic continued in 2022. Moreover, the year 2022 brought yet another huge threat for the EU and its member states: war in Ukraine. The war resulted in the imposition of sanctions by the EU on the Russian Federation [European 4]. It also posed energy crisis, rise of inflation, geopolitical instability, migrant and refugee crisis in the EU [3; 8]. Further research should focus on long-term effects of the pandemic for the EU27 also in terms of disparities in development. It should also include the implications of the war and geopolitical instability on socio-economic inequalities in the EU. The EU's ability to develop greater resilience to crises as well as reduce disparities appear to be crucial to its future and positioning in Europe and the global economy.

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