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## The significance of the absorption of EU funds in the socio-economic development of the subregions of Poland, the Czech Republic, and Slovakia

### INTRODUCTION

The most important financial instruments of the EU cohesion policy are the Structural Funds as well as the Cohesion Fund, which in the economic practice and in the subject literature are often termed as “EU funds”. The main principle of spending the EU funds is achieving social, economic and territorial cohesion, mainly through supporting growth and creating new workplaces in the weakest developed states and regions (Matsuura, 2015; Albuлесcu, Goyeau, 2014). In relation to the abovementioned, regions subcategorised as NUTS II level whose GDP per capita in the case of Structural Funds is lower than 75% of the whole EU average, and in the case of the Cohesion Fund – states of GDP per capita amounting to less than 90% of the average for the whole EU that were implementing the program directed at meeting the economic convergence criteria are all eligible to obtain financial support (Beugelsdijk et al., 2018).

The means originating from the general EU budget were to contribute to the increase in the regional dynamics due to which high hopes were linked with them, ascribing them the role of *capo di tutti capi*<sup>2</sup> of the socio-economic changes of the EU regions, especially in its poorer part, i.e. Central Eastern Europe. The first empirical examination suggested that the impact of those means on the economy will be extremely important<sup>3</sup> (Dreyer et al., 2006; Florida, 2002). The subsequent

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<sup>2</sup> From Italian: a person highest in the ranking, the most significant factor.

<sup>3</sup> For example, the first analyses using the HERMIN and MaMoR3 models conducted by the Institute of Research on the Market Economy, and the Wrocław Agency of the Regional Development indicated that the EU funds should impact the GDP level to as high an extent as 11.2%.

compilations demonstrated, however, that the impact of the EU funds on GDP growth is significantly lower than was originally expected<sup>4</sup> (Shikverdiev et al., 2019; Jašková, Havierníková, 2020).

In light of the abovementioned, the presentation of the significance of the EU absorptions in socio-economic development has become the basis for taking up the research area mentioned above. The goal of the article is to attempt to specify the correlations between the variation in the Structural Funds and the Cohesion Fund absorption in Poland, the Czech Republic, and Slovakia<sup>5</sup> and the changes in the level of socio-economic development in the regional dimension. The level of regional development was specified within the dimension of factors (subcomponents) of the development, subcategorising: the society, the economy, and the natural environment. In the compilation, the “absorption” notion is understood as the amount of means actually spent in projects co-financed from the EU funds, realised within the EU cohesion policy in the subregions researched, and used interchangeably with the notions: “commitment” as well as “the use”. In the research, projects co-financed from EU funds were realised between 2007–2019. The change in the level of development was established for the years 2010–2021. A certain time delaying the impact of the results of the EU projects on economic development was taken into consideration. The authors of other research most often specify a two- or three-year delay in the impact of the EU funds on the economy (Baklanov, 2020; Goryachikh, Kravchenko, 2020).

The article undertakes to verify the hypothesis according to which the absorption of EU funds has impacted the development of “the economy” subcomponent to the largest extent.

The research procedure was conducted in three stages. In the first one, the level of socio-economic development in Poland, the Czech Republic, and Slovakia was established in the subregional dimension – at the level of the NUTS-3 units. For that purpose, an original synthetic gauge of the level of socio-economic development based on Eurostat data as well as the national statistical offices was created. The research was conducted on the level of the subregions, on one hand, in order to obtain the highest level of detail, and on the other – with respect to the accessibility of empirical data. In the second stage, spatial differentiation of EU fund absorption in the NUTS-3 units in Poland, the Czech Republic, and Slovakia was presented using data extracted from teleinformatics systems of the Ministries responsible for spending the EU funds and/or the realisation of the EU cohesion policy in Poland, the Czech Republic, and Slovakia. In the third stage, the correlations between the extent of the absorption and the changes in the level of development within the arrangement of the factors of development were based on regression analysis.

<sup>4</sup> Most often, it was indicated that the EU funds impacted the GDP level at around 2.5%.

<sup>5</sup> The spatial scope of the study results from the subject of the research grant carried out by the author.

METHODOLOGY

The variation in the level of regional development is a natural phenomenon that results from imbalanced access to the means of production, such as: labour, capital, or natural resources (Feldman, 1999; Khasanova et al., 2020). The differences in the potential of the regions converge with most theories of regional development (Naydenov, 2019; Yun et al., 2017). However, the theories originating from different scientific orientations explain the variation in the socio-economic processes in a different manner. The first group of theories originating from the neoliberal trend assumes the minimisation of state interventionism, and the free market treats the regulatory mechanisms irreplaceable (Krugman 1998). The second group of theories representing neo-Keynesian economic thought acknowledges state interventionism as necessary and the most important regulatory mechanism of socio-economic development (Diebolt, Hippe, 2019; De Castro et al., 2018).

In order to specify the variation in the level of the socio-economic development of the NUTS-3 units in Poland, the Czech Republic, and Slovakia, a synthetic gauge of distance from the established pattern was used. The research procedure consisted of four subsequent stages (Spychała, 2020): the selection of variables being the basis for creating the indicators, a reduction of multi-feature space, the specification of the level of socio-economic development of the subregions as well as the classification of all 95 NUTS-3 units on the scale of the regional development.

**Table 1. Indicators considered in the analysis specifying the level of development**

Factor of the development	Indicators
<i>1</i>	<i>2</i>
Society (11 variables)	The birth rate per 1,000 inhabitants; the migration balance per 1,000 inhabitants; the feminisation coefficient in total; the percentage of people at the production age in the total number of people; the share of people at the pre-production age in the total number of people; the share of people at the post-production age in the total number of people; the number of people at the post-production age per 100 people at the pre-production age; the number of people at the non-production age per 100 at the production age; median age of the population; the average age of women giving birth; birth rate in total.
The natural environment (10 variables)	The share of farmland as well as natural green areas in the total space; the share of farmers-farm owners in farms below the age of 35 in the total number of farm owners; the share of farms below 5 ha in the total number of farms; road transport of products measured in tonnes per 1,000 inhabitants; registered offences and crimes connected with the natural environment per 1,000 inhabitants; the use of the electrical energy for the purpose of cooling inhabitable areas (as the EU average); the use of the electrical energy for the purpose of heating inhabitable areas (as the EU average); urban waste per 1 inhabitant; number of accommodation places per 1,000 inhabitants; detoxifying urban waste per 1 inhabitant.

1	2
The economy (10 variables)	The share of microenterprises in the total number of economic entities; the coefficient of new enterprise creation; the share of the employed in the financial sector in the total number of the employed; the share of the employed in farming in the total number of the employed; the share of the employed in the sector of professional services in the total number of the employed; the share of the employed in the sector of information and communication in the total number of the employed; the quantity of consumer goods per 1 million inhabitants; Gross GDP per 1 million inhabitants (as the EU average).

Source: own compilation based on research conducted.

In the first stage of the research procedure, a matrix of geographical information was created based on 31 indicators (Table 1), which specified the changes in the socio-economic development of the NUTS-3 units in the years 2010-2021 in relation to the following factors of development: “the society” (comprising, among others, the changes in the size and quality of human and social capital), “the economy” (comprising, among others, the structure of employment, the level of entrepreneurship as well as the level of innovativeness), as well as “the natural environment” (comprising, among others, spatial planning, the energy consumption of the economy as well as activities harmful to the environment). The abovementioned factors (components) of the development have been identified based on the literature review conducted (Naydenov, 2019; Yun et al., 2017; Feldman, 1999; Khasanova et al., 2020; Spychała, 2020; Diebolt, Hippe, 2019; De Castro et al., 2018; Krugman, 1998; Baklanov, 2020; Goryachikh, Kravchenko, 2020). Subsequently, Pearson’s linear correlation coefficients were calculated between the researched departure indicators for their change in the years 2010–2021. Variables selected for the synthetic gauge should thus be weakly correlated with one another in order for their information capacity to be different (Balcerzak, 2016). The correlation coefficient matrices constructed were the basis for conducting departure variable reduction using Z. Hellwig’s method (i.e. for the separation of those indicators that shall be taken into account in further procedures). The variable reduction procedure was conducted four times: separately for the general socio-economic level and separately for the level of development of each of the three subcomponents, which were the factors of that development.

At the next stage of the research procedure, the pattern and the antipattern of the regional development were established, and subsequently, a taxonomic distance of each subregion was researched from the established pattern of development. In the last part of the research conducted for each NUTS-3 unit, a synthetic gauge was established as an indicator of socio-economic development.

RESULTS – VARIATION IN THE LEVEL OF THE DEVELOPMENT  
OF THE NUTS-3 UNITS IN POLAND, THE CZECH REPUBLIC,  
AND SLOVAKIA IN THE YEARS 2010–2021

A synthetic gauge of the level of development assumes values from 0 to 1. The higher the value, the higher the level of development of the phenomenon considered. Based on the indicators calculated for 95 NUTS-3 units in Poland, the Czech Republic, and Slovakia, 5 groups were subcategorised: a very high, high, average, low and very low change in the level of socio-economic development in the years 2010–2021.

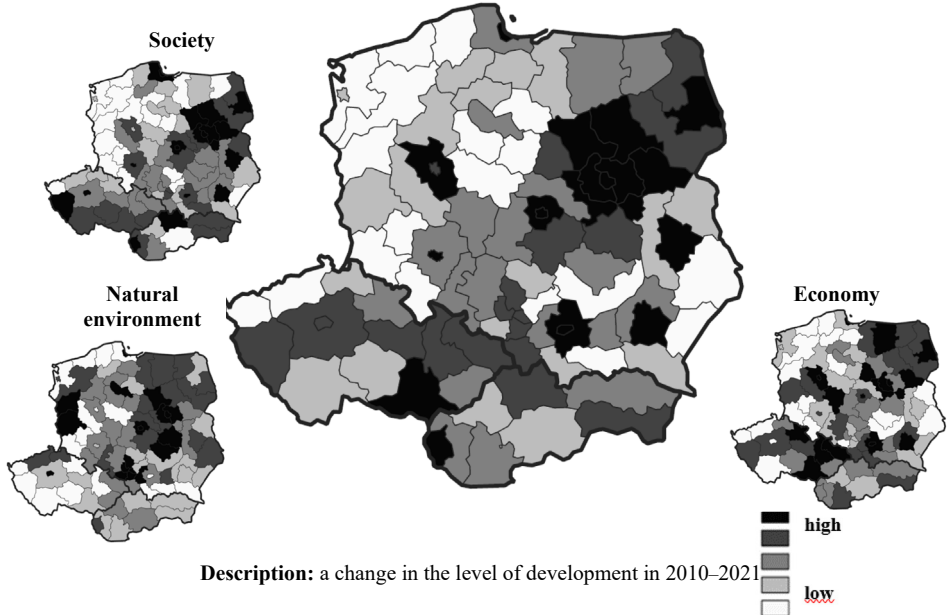
**Table 2. Extreme values of the synthetic gauge within the respective factors of the socio-economic development in 2010–2021**

The highest values of the synthetic gauge (the period between 2010–2021)			The lowest values of the synthetic gauge (the period between 2010–2021)		
Item	The NUTS-3 subregion	Value	Item	The NUTS-3 subregion	Value
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>
Society					
1	Miasto Warszawa (PL)	0.571	95	Szczecinecko-pyrzycki (PL)	0.226
2	Warszawski wschodni (PL)	0.542	94	Legnicko-Głogowski (PL)	0.243
3	Miasto Kraków (PL)	0.540	93	Jeleniogórski (PL)	0.261
4	Warszawski zachodni (PL)	0.530	92	Włocławski (PL)	0.261
5	Białostocki (PL)	0.526	91	Koszaliński (PL)	0.279
The natural environment					
1	Bytomski (PL)	0.672	95	Nowosądecki (PL)	0.346
2	Miasto Warszawa (PL)	0.666	94	Słupski (PL)	0.383
3	Trójmiejski (PL)	0.638	93	Leszczyński (PL)	0.416
4	Katowicki (PL)	0.631	92	Jeleniogórski (PL)	0.430
5	Gliwicki (PL)	0.627	91	Nowotarski (PL)	0.464
The economy					
1	Miasto Warszawa (PL)	0.552	95	Gorzowski (PL)	0.274
2	Trójmiejski (PL)	0.537	94	Koszaliński (PL)	0.279
3	Miasto Kraków (PL)	0.490	93	Ústecký kraj (CZ)	0.286
4	Jihomoravský kraj (CZ)	0.489	92	Wałbrzyski (PL)	0.289
5	Pócki (PL)	0.488	91	Legnicko-Głogowski (PL)	0.293

1	2	3	4	5	6
The general level of economic development					
1	Miasto Warszawa (PL)	0.590	95	Jeleniogórski (PL)	0.329
2	Trójmiejski (PL)	0.550	94	Legnicko-Głogowski (PL)	0.329
3	Warszawski zachodni (PL)	0.534	93	Koszaliński (PL)	0.340
4	Białostocki (PL)	0.513	92	Szczecinecko-pyrzycki (PL)	0.347
5	Miasto Kraków (PL)	0.497	91	Ślupski (PL)	0.354
6	Warszawski wschodni (PL)	0.493	90	Wałbrzyski (PL)	0.359
7	Rzeszowski (PL)	0.492	89	Gorzowski (PL)	0.367
8	Jihomoravský kraj (CZ)	0.483	88	Szczeciński (PL)	0.368
9	Łódzki (PL)	0.483	87	Karlovarský kraj (CZ)	0.374
10	Miasto Łódź (PL)	0.482	86	Nowosądecki (PL)	0.376

Source: own research conducted on the basis of Eurostat data “General and regional statistics”.

### THE CHANGE IN THE LEVEL OF DEVELOPMENT BETWEEN 2010–2021



**Figure 1.** Spatial variation in the level of the socio-economic development and its aspects in Poland, the Czech Republic, and Slovakia within the arrangement of the NUTS-3 units

Source: own research conducted on the basis of Eurostat data “General and regional statistics”.

In Figure 1, as well as in Table 2, the results of the research conducted were presented. Table 2 presents subregions of the highest and the lowest values of the synthetic gauge within the respective subcomponents of socio-economic development. Figure 1 contains choropleths representing the spatial variation of the changes in the socio-economic development of 95 NUTS-3 units in Poland, the Czech Republic, and Slovakia in the period of 2010–2021. The biggest change in the level of the society subcomponent has been observed in the subregions located near Warszawa, Prague and Bratislava, the economy subcomponent – around large cities such as Poznań, Warszawa, Kraków, Łódź, Gdańsk and the eastern subregions of the Czech Republic, and the natural environment subcomponent – in the śląskie, lubuskie and świętokrzyskie subregions. A high variation was also observed within the changes of the socio-economic level in total, and its highest changes were registered in big regional centres, such as: Warszawa, Trójmiasto, Kraków, Białystok, Rzeszów, Łódź, Wrocław, Poznań, Bratislava and Brno.

#### THE USE OF EU FUNDS IN POLISH, CZECH AND SLOVAKIAN SUBREGIONS

At the second stage of the research procedure, the extent and structure of the absorption of the EU funds in Poland, the Czech Republic, and Slovakia were specified at the level of the NUTS-3 units. The basis for implementing the EU cohesion policy in the respective member states were: National Strategic Frameworks for the financial perspective as of 2007–2013, as well as a Partnership Agreement for the operational period as of 2014–2020 concluded between the member state government authorities and the representatives of the EU institutions. The strategic documents presented specified the priorities and activities for the state regional policies. In the abovementioned documents, an assumption was made that the Structural Funds (among which there are to be found: the European Fund of Regional Development as well as the European Social Fund) as well as the Cohesion Fund formed the main source of funding the regional policy in the EU member states.

In the years 2007–2019, within the EU cohesion policy, over 180,000 projects co-funded from the EU funds were realised, and the total value of the co-funding obtained by the beneficiaries for the purpose of the realisation of those projects amounted to around EUR 69 billion. In the Czech Republic, in the researched period, over 120,000 EU projects were realised, for a total amount of around EUR 32 billion of the EU co-funding. In Slovakia, however, in the years 2007–2019, over 53,000 projects were co-funded from EU funds, for the realisation of which around EUR 15 billion were obtained. In each of the 95 researched subregions in Poland, the Czech Republic, and Slovakia, projects co-financed from the EU

funds were realised. On average, in one NUTS-3 unit, 4,776 of such undertakings were realised, with a proviso that large discrepancies in the respective states were observed: in Poland for one subregion, 3,816 projects were relevant for one subregion, in Slovakia – 6,662, and in the Czech Republic as many as 8,704. The fewest projects were realised in Szczecin (1,065), and the most in the Stredoceský kraj subregion (15,038), Moravskoslezský kraj (14,977) and Jihomoravský kraj (14,704). The highest amount of the EU funds were involved in the realisation of projects in the capital city of Warsaw (EUR 7.1 billion) and the lubelski subregion (EUR 3.3 billion), and the lowest value of the total co-funding paid out in one NUTS-3 subregion was registered in the świecki and chojnicki subregions (EUR 0.4 billion each).

**Table 3. Subregions of the highest and the lowest values of the EU fund absorption per capita calculated for the respective factors of the development**

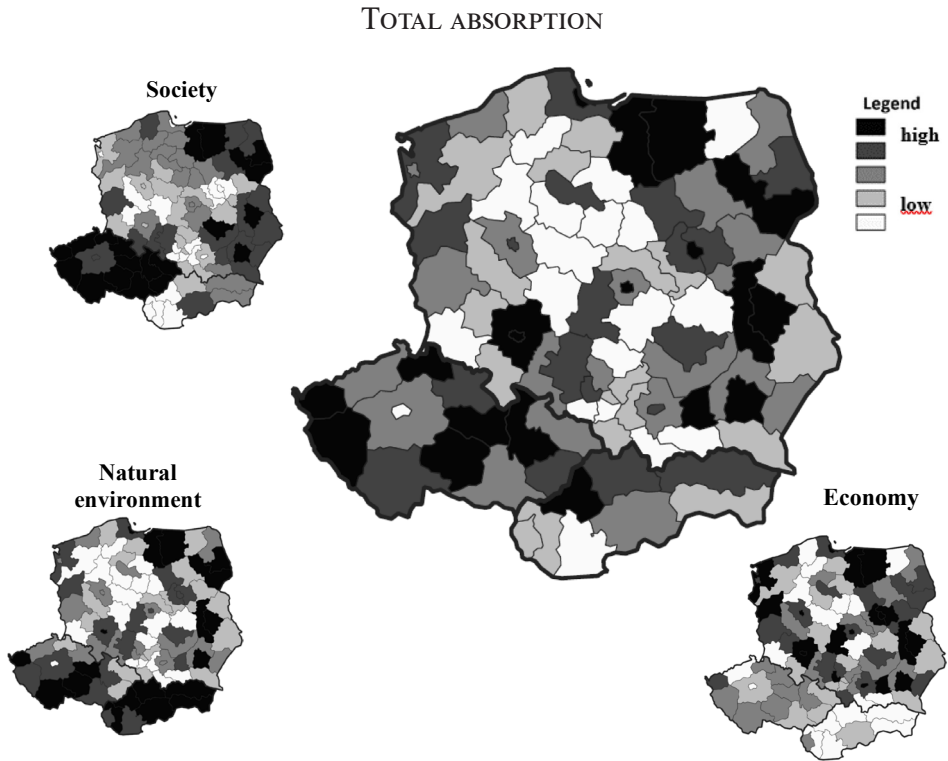
The highest values of the EU fund absorption (in EUR per capita)			The lowest values of the EU fund absorption per capita (in EUR per capita)		
No.	Subregion NUTS-3	Value	No.	Subregion NUTS-3	Value
1	2	3	4	5	6
Society					
1	Karlovarský kraj (CZ)	3257.19	95	Bratislavský kraj (SK)	262.84
2	Liberecký kraj (CZ)	2259.12	94	Miasto Warszawa (PL)	280.46
3	Pardubický kraj (CZ)	1959.43	93	Trenciansky kraj (SK)	320.10
4	Kraj Vysocina (CZ)	1945.80	92	Trnavský kraj (SK)	346.46
5	Královéhradecký kraj (CZ)	1864.92	91	Warszawski wschodni (PL)	351.53
The natural environment					
1	Trenciansky kraj (SK)	3699.38	95	Koniński (PL)	270.58
2	Zilinský kraj (SK)	2030.73	94	Hlavní mesto Praha (CZ)	294.47
3	Presovský kraj (SK)	1888.73	93	Płocki (PL)	306.31
4	Banskobystrický kraj (SK)	1305.36	92	Pilski (PL)	308.01
5	Olsztyński (PL)	1198.26	91	Nowotarski (PL)	310.65
The economy					
1	Elbląski (PL)	3098.74	95	Trenciansky kraj (SK)	432.67
2	Miasto Wrocław (PL)	3059.83	94	Hlavní mesto Praha (CZ)	578.18
3	Miasto Warszawa (PL)	3058.77	93	Pilski (PL)	639.88
4	Trójmiejski (PL)	3047.42	92	Nowotarski (PL)	646.25
5	Rzeszowski (PL)	2892.18	91	Presovský kraj (SK)	685.81



1	2	3	4	5	6
Total absorption					
1	Karlovarský kraj (CZ)	5349.33	95	Nowotarski (PL)	1456.75
2	Olsztyński (PL)	5209.35	94	Koniński (PL)	1457.45
3	Elbląski (PL)	5085.49	93	Pilski (PL)	1510.93
4	Rzeszowski (PL)	5052.22	92	Plocki (PL)	1664.52
5	Lubelski (PL)	4718.96	91	Nowosądecki (PL)	1670.89
6	Trenciansky kraj (SK)	4452.15	90	Jeleniogórski (PL)	1676.13
7	Kraj Vysocina (CZ)	4367.84	89	Hlavní mesto Praha (CZ)	1685.15
8	Miasto Wrocław (PL)	4269.74	88	Kaliski (PL)	1689.78
9	Trójmiejski (PL)	4209.22	87	Włocławski (PL)	1705.52
10	Miasto Warszawa (PL)	4038.84	86	Tyski (PL)	1709.75

Source: own research conducted on the basis of Eurostat data “General and regional statistics”.

The comparison of the size and structure of the absorption of the EU funds within the interregional arrangement required the introduction of data relativisation. For that purpose, the number of people was used, and the respective data was calculated in the per capita dimension. The most EU projects per 10,000 inhabitants were realised in the subregions of warmińsko-mazurski: olsztyński (247) as well as elbląski (204), and the fewest – in Szczecin (26) and in Warsaw (29). It is well worth noting the fact that most subregions with the highest number of projects per 10,000 inhabitants are located in North-Eastern Poland – within the area of the warmińsko-mazurskie province. The abovementioned situation is an offshoot of several factors: first – the regional authority has assumed the principle of preferring a larger number of projects of relatively lower values; second – within the area of the province in the researched years, relatively high unemployment was registered; therefore, more projects concerning human capital and the job market were realised within the area; third – beneficiaries from the warmińsko-mazurskie province were entitled to also apply for the co-funding from the operational programs concerning the development of Eastern Poland; fourth – the province is one of the few regions which were allowed the access to the means from the so-called initiative to the benefit of employing young people. All the abovementioned factors impacted the relatively high number of EU projects per 10,000 inhabitants.



**Figure 2. EU fund absorption per capita in Poland, the Czech Republic, and Slovakia within the arrangement of the NUTS-3 units**

Source: own research conducted on the basis of Eurostat data “General and regional statistics”.

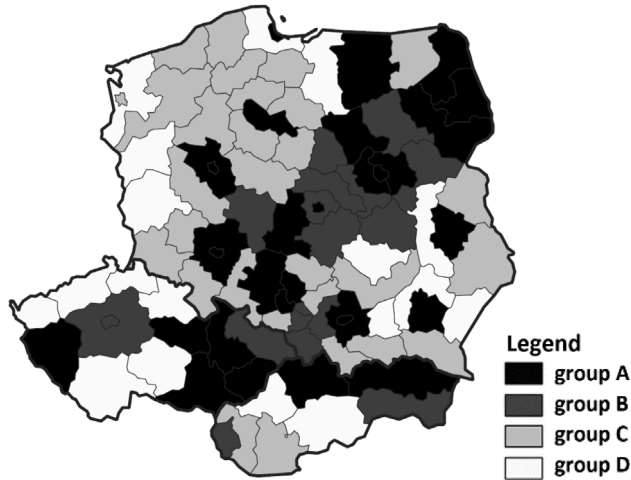
The next scope of the analysis of the stage was the specification of the spatial variation of the EU fund absorption in relation to the factors – the components of socio-economic development: the society, the economy and the natural environment. The results of the research conducted formed the basis for specifying the correlations between the EU fund absorption and the change in the level of socio-economic development. Means from the European Social Fund were used for the development of the society subcomponent, the development of the economy was funded above all from the funds of the European Regional Fund, and the development of the natural environment factor was allowed thanks to financing mainly from the Cohesion Fund. Based on the research conducted, it was established that in the states researched in the years 2007–2019, the most means – 43.0% – were directed to the benefit of the economy. The following 36.9% of the value of the EU funds were used for the benefit of society, and 20.1% of the funds made accessible were devised for the benefit of the protection of the natural environment.

The results of the research conducted are presented in Figure 2 as well as in Table 3. Table 3 presents the NUTS-3 units of the highest and the lowest values of EU fund absorption per capita. Figure 2 contains choropleths representing the spatial variation of the absorption in Poland, the Czech Republic, and Slovakia in the subregional dimension. It is well worth noting the fact that the respective states specialised in spending the EU funds for the respective components of growth. The EU funds devoted towards the development of the society, as calculated for 10,000 inhabitants, were used to the largest extent in the Czech subregions. Slovakian subregions, however, specialised above all in obtaining EU funds for the benefit of environmental protection. In the case of the Polish subregions, the EU funds devoted towards the support of the economy were the most significant.

#### THE SIZE OF THE ABSORPTION AND THE LEVEL OF THE DEVELOPMENT WITHIN THE ARRANGEMENT OF THE NUTS-3 UNITS

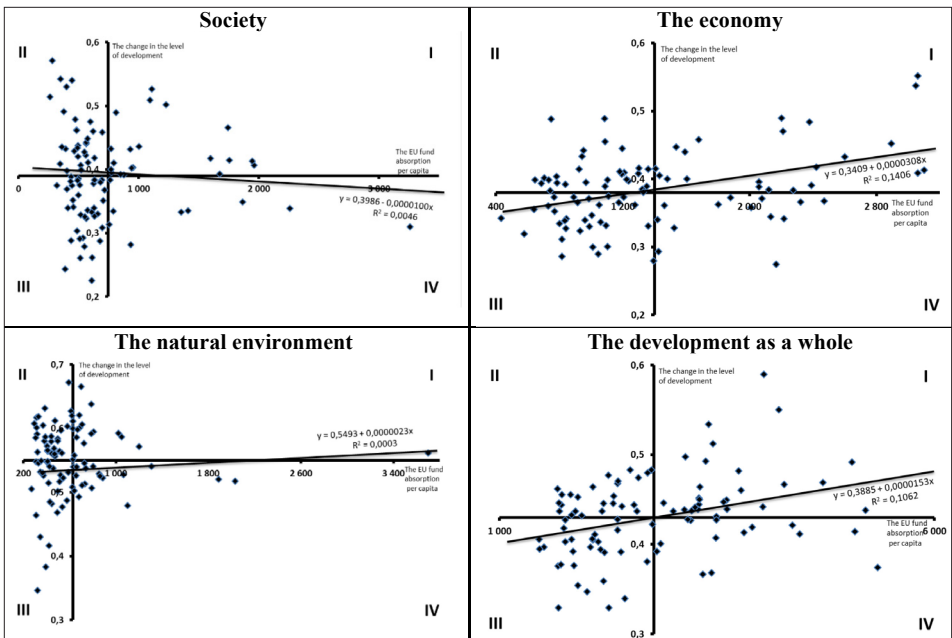
At the last stage of the research conducted, a correlation between the size of the EU fund absorption and the level of socio-economic development was established in 95 NUTS-3 units in Poland, the Czech Republic, and Slovakia. The abovementioned relations were researched separately for each subcategorised unit (a subcomponent) of the development as well as for the socio-economic development in total. Based on the average value of the synthetic gauge specifying the change in the development as well as the average value of the particular EU factor of the development support fund absorption per capita, the subregions researched were subdivided into four groups (Figure 3 and Figure 4):

- Group 1: NUTS-3 units were subcategorised in which an above-average change in the level of a particular factor was registered as well as an above-average EU fund absorption;
- Group 2: Subregions were calculated in which an above-average change in the level of the development was observed, but the EU fund absorption was below average;
- Group 3: NUTS-3 units were calculated in which a change in the level of the development of a particular factor was below average, along with below-average EU fund absorption;
- Group 4: NUTS-3 unit subregions were classified in which a below-average change in the level of the development of a particular factor was observed, as well as high EU fund absorption devoted to the development of a researched factor.



**Figure 3. Charts of the EU fund absorption as well as the changes in the level of the socio-economic development of the NUTS-3 units in Poland, the Czech Republic, and Slovakia**

Source: own research conducted on the basis of Eurostat data “General and regional statistics”.



**Figure 4. Charts of the EU fund absorption dispersion, as well as the changes in the level of the socio-economic development of the NUTS-3 units in Poland, the Czech Republic, and Slovakia**

Source: own research.

Group 1 thus contains those subregions in which the biggest change in the level of the development of a particular factor was observed in the years 2010–2021 and, at the same time, high absorption of the EU funds devoted to the development of a particular factor. Group 2 includes those NUTS-3 units in which a significant change in the development of the researched capital occurred despite a relatively low EU fund absorption towards the development of the factor. Group 3 was composed of the NUTS-3 subregions with a relatively low EU fund absorption supporting the development of a researched factor as well as a relatively low synthetic gauge. Group 4 included units of the lowest efficiency of the Community means used – despite the above average EU fund absorption, the development of a particular factor within the years 2010–2021 was completed to a low degree.

At the next step of the research, simple linear regression models between the variables were researched within the respective factors of the development (Table 4). A positive direction correlation was observed between the extent of the EU fund absorption supporting the development and the changes in the level of development as of 2010–2021 in the case of the natural environment, the economy, as well as the development as a whole (Table 5). In the case of the “society” subcomponent, a negative correlation was registered.

**Table 4. Linear regression models between the researched variables**

Factor of development	The pattern of the regression model
Society	$y = 0.3986 - 0.0000100 * x$
The natural environment	$y = 0.5493 + 0.0000023 * x$
The material capital	$y = 0.3409 + 0.0000308 * x$
Total socio-economic development	$y = 0.3885 + 0.0000153 * x$

Source: own research.

Based on the selected statistics of the models obtained based on the classical method of the smallest squares, the explanatory value of the regression functions received was assessed as relatively low (alternatively average). The highest value of the R<sup>2</sup> determination coefficient was obtained in the case of the model specified for the economy (0.14). In the case of this factor of development, the changeability of the dependent variable has thus been explained through the independent variable in 14%. One may thus conclude that the direction of EU fund intervention supporting the development of the economy was correct, and the proper direction of the EU fund intervention in the development of the economy has been confirmed by means of a high EU fund absorption devised for that purpose, a large number of the innovative enterprises established as well as the modern solutions implemented in the economy. The best quality of the regression model calculated for the “economy” factor is also confirmed by the fact

that the explanatory value turned out to be significant already at a very low level of significance of 0.02% (the  $p$ -value for the parameter and the F-Snedecor statistics (Nowak, 2018) – the likelihood of making a mistake). One may thus conclude that in the case of the “economy” development subcomponent, a regression model states the correct–positive correlation between the EU fund absorption and the change in the development of that factor.

**Table 5. Parameters stating the quality of regression models within the arrangement of the respective factors of the socio-economic development**

Description	Society	The natural environment	Material capital	The development as a whole
The correlation: absorption vs development	negative	positive	positive	positive
The R <sup>2</sup> determination coefficient	0.46%	0.03%	<b>14.06%</b>	10.62%
Value p for the F test	51.2%	86.38%	<b>0.02%</b>	0.13%
The standard error of a statistic	7.15%	5.56%	4.96%	<b>4.24%</b>
The sum total of residual squares	47.58%	28.71%	22.88%	<b>16.76%</b>
The residual variability coefficient	18.29%	10.09%	12.92%	<b>9.85%</b>
Akaike’a information criteria	<b>-229.58</b>	-277.57	-299.13	-328.72

Source: own research.

A synthetic gauge of the empirical value dispersion around the theoretical values is the standard variation of the residual component. It informs about the average variable of the empirical values of the explanatory value from the theoretical values received from the regression functions. The higher the values of the standard variation of the residual component, the statistical “goodness” of the matching of a particular regression function to empirical data decreases (Nowak, 2018). In the research conducted, positive residuals and negative residuals were identified. Positive residuals indicate that the observed size of the explanatory variable is higher than the expected one, resulting from the model; the negative residual, however, proves the reverse situation. The lowest value of the standard error of the residual is registered in the case of the model assessed for the level of socio-economic development in total (4.24%). Relatively short distances of the trend line observation, and through that, quite a good matching of the model is proved by the fact that the sum of residual squares constitutes only 16.76% of the average for the change in the level of development in total. Moreover, the model may be considered to be relatively well-matching as the value of its coefficient was 9.85%<sup>6</sup> (such a part of the average value of the explanatory variable constitutes

<sup>6</sup> In the subject literature, the regression model is considered to be admissible when the residual variability coefficient assumes a value lower than 20%.

its standard residual variability). The real change in the level of socio-economic development in total in the NUTS-3 units in Poland, the Czech Republic, and Slovakia – apart from a few cases – is that the value obtained is not much different from the value obtained from the regression model.

## CONCLUSIONS

Summarising the research conducted in this article concerning the impact of the spatial variation of the EU fund absorption on the changes in the level of socio-economic development as well as the respective factors of the development in the subregional dimension, i.e. within the arrangement of the NUTS-3 units in Poland, the Czech Republic, and Slovakia, one may thus conclude that a positive correlation between the extent of the EU fund absorption per capita and the change in the level of development was identified in the case of the natural environment, the economy as well as the development in total. In the case of the society, a negative correlation is registered. One may thus note that the absorption of the EU funds has positively impacted the development of those factors (the subcomponents of the development), within which the most EU fund allocations were made accessible, which is related to at least the economies of scale. A negative impact was registered in the case of those factors in which the intervention turned out to be relatively low, and the means have been wasted to a large extent.

Among all the regression functions, the best quality is the model built within the framework of the analysis of the level of development of the economy, which was characterised as the best match, and the explanatory variable turned out to be significant already at a very low level of significance of 0.02%. A satisfactory quality of the model may also result from a liberal approach to the manner of characterising the factor of the development as well as its broad indirect indexing. Based on the analysis of the residuals, a model built within the analysis of the socio-economic development in total was considered to be the one best matching reality, in the case of which the respective coefficients assumed the lowest values. Summarising the research conducted, one should thus conclude the absorption of the EU funds to the largest extent impacted the changes in the level of the development of the economy in the researched subregions of the NUTS-3 level. It attests to the correct direction of the EU fund intervention, the funds which were devised for the purpose of the development of the economy. For the specific factor of the development, most funds from the general EU budget were directed (43% of the funds accessible), and the results of the EU economy support fund absorption are visible in a relatively short period of time, a phenomenon that is not experienced in the case of the society factor, within which the results of EU fund implementation are visible only in the long-term perspective.

In relation to the abovementioned, it is well worth concluding that in the context of the research conducted, one may not single-handedly point to the correlation between the EU fund absorption and the change in the level of the socio-economic development, and the results of the research procedure conducted are based solely on a statistical dependency, thus their interpretation must be approached with care.

It is beyond doubt that EU funds made a positive impact on the socio-economic development of the subregions in Poland, the Czech Republic, and Slovakia. It is very difficult to specify in a definite manner the scale of the impact as the development registered in research resulted from the interplay of different kinds of stimuli and many other factors (such as, for example, the COVID-19 pandemic). Moreover, it is well worth noting that in the case of the society, within which a negative correlation was observed, the results of projects co-funded from the EU funds shall be visible in a longer time period; therefore, they have not been fully considered in the research conducted. Furthermore, measuring the state of the natural environment is difficult, at least with respect to a lack of widely accessible objective indicators that would relate to the indicated factor of the development directly.

With respect to the specificity of spending the means from the EU general budget, it is well worth considering the extension of the research period in order to take into consideration the long-term impact of the EU support funds. Moreover, the authors of the further stages of the research project intend to expand their scope, first to Hungary to analyse the entire Visegrad Group, and then to include additional countries of Central and Eastern Europe: Romania, Bulgaria, Lithuania, Latvia and Estonia. The results of the conducted research procedure could, for example, be used by European Union institutions in planning the next programming period in terms of allocating EU funds between European regions.

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### Summary

Within the EU cohesion policy, higher and lower developed regions, taking into account only GDP *per capita*, are subcategorised. Based on that, areas qualifying for obtaining support from aid programs of the general EU budget are established. The aim of the article is to attempt to specify the co-dependency between the absorption of EU funds and the changes in the level of

socio-economic development in the regional dimension. The research was conducted at the level of 95 NUTS-3 units in Poland, the Czech Republic, and Slovakia in three stages. In the first stage, the level of the development of the subregions in Poland, the Czech Republic, and Slovakia is exhibited, subcategorising three factors of that growth based on 31 indicators: “the society”, “the economy”, or “the natural environment”. In the second stage, the variation in the absorption of EU funds in the researched units is demonstrated. In the third stage, the co-dependencies between the extent of the absorption and the changes in the development within the arrangement of the factors of that development are specified. In the article, a hypothesis is verified according to which the absorption of the EU funds impacted, above all, the development of “the economy” component. As a result of the examination conducted, it has been concluded that the absorption of EU funds impacted the changes in the level of the development of the “economy” sector to the largest extent. It confirms the proper direction of the EU fund intervention, which was made accessible above all to the benefit of the development of that factor.

*Keywords:* EU funds, socio-economic development, synthetic gauge.

## **Znaczenie absorpcji funduszy Unii Europejskiej w rozwoju społeczno-gospodarczym podregionów Polski, Czech i Słowacji**

### *Streszczenie*

W ramach polityki spójności UE wyodrębnia się regiony lepiej i gorzej rozwinięte biorąc pod uwagę jedynie wartość PKB *per capita*. Na tej podstawie ustala się m.in. obszary kwalifikujące się do uzyskania wsparcia z programów pomocowych budżetu ogólnego UE. Celem artykułu jest próba określenia zależności pomiędzy absorpcją funduszy unijnych a zmianami poziomu rozwoju społeczno-gospodarczego w ujęciu regionalnym. Badania przeprowadzono na poziomie 95 jednostek NUTS-3 w Polsce, Czechach i Słowacji w trzech etapach. W pierwszym etapie określono poziom rozwoju podregionów w Polsce, Czechach i Słowacji, wyodrębniając na podstawie 31 wskaźników trzy czynniki tego rozwoju: „społeczeństwo”, „gospodarkę” oraz „środowisko naturalne”. W drugim etapie przedstawiono zróżnicowanie absorpcji funduszy unijnych w badanych jednostkach. W trzecim etapie określono zależności pomiędzy wielkością absorpcji a zmianami poziomu rozwoju w układzie czynników tego rozwoju. W artykule postanowiono zweryfikować hipotezę, według której absorpcja funduszy unijnych wpłynęła przede wszystkim na rozwój składowej „gospodarka”. W rezultacie przeprowadzonego badania stwierdzono, że absorpcja funduszy unijnych w największym stopniu wpłynęła na zmiany poziomu rozwoju „gospodarki”. Potwierdza to właściwy kierunek interwencji środków UE, które były udostępniane przede wszystkim na rozwój tego czynnika rozwoju.

*Słowa kluczowe:* fundusze unijne, rozwój społeczno-gospodarczy, miernik syntetyczny.

JEL: O11, O20, O47.