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## **CONTINUING VOCATIONAL TRAINING AT ENTERPRISES IN EU COUNTRIES: AN EMPIRICAL ANALYSIS BASED ON EUROSTAT DATA**

*Contemporary socio-economic transformations in the countries of the European Union, driven by technological change, digitalisation, and structural economic restructuring, necessitate a rethinking of the role of continuing vocational training within enterprises as a key instrument for human capital development and economic growth. Under conditions of increasing labour market requirements, enterprise-based training of employees serves as an important factor in enhancing labour productivity, workforce adaptability, and the competitiveness of national economies. The purpose of this article is to classify European Union countries according to the level of development of continuing vocational training within enterprises based on indicators from the Continuing Vocational Training Survey (CVTS) for 2010 and 2020, to analyse the dynamics of changes in the structure of the identified clusters, and to assess the relationship between the development of vocational training and indicators of economic development measured by gross domestic product per capita. The study applies a multidimensional comparative analysis, including the standardisation of statistical indicators, the calculation of a synthetic index of continuing vocational training development, and cluster analysis using agglomerative and k-means methods. The empirical basis of the study consists of official statistical data from the Statistical Office of the European Union (Eurostat), which ensure cross-country comparability and enable the analysis of dynamic structural changes. The findings indicate that during the period 2010-2020, relatively stable clusters of European Union countries emerged based on the level of development of continuing vocational training within enterprises, differing in training intensity, employee coverage, and organisational characteristics of training processes. Inter-cluster mobility of individual countries was identified, reflecting the dynamic nature of vocational training systems and the presence of partial convergence processes. It is demonstrated that countries with higher levels of vocational training development generally exhibit higher levels of economic development, while the most pronounced economic effects of investments in employee training are*

*observed in countries with a medium level of economic development. The development of continuing vocational training within enterprises constitutes an important factor in economic dynamics and convergence within the European Union. The obtained results have practical significance for shaping human capital development policies, particularly for Ukraine as a candidate country for EU membership, in the context of post-crisis and post-war economic recovery. Further research should focus on extending the temporal scope of the analysis and applying alternative indicators of economic development.*

**Keywords:** *continuing vocational training; human capital; Continuing Vocational Training Survey; economic development; European Union countries; labour market.*

*(статтю подано мовою оригіналу)*

The current stage of socio-economic development of the European Union countries is characterized by the increasing role of human capital as a key factor of economic growth, enhanced competitiveness, and sustainable development. Under conditions of technological change, digitalization, and structural transformations of the economy, continuing vocational training at enterprises gains particular importance, as it ensures the adaptation of the workforce to new labour market requirements and contributes to higher labour productivity.

Continuing vocational training of employees is regarded as an important instrument for implementing the concept of lifelong learning and as an integral component of the economic policy of EU countries. Enterprises play a leading role in this process by investing resources in the development of employees' professional competencies. At the same time, the level of development, intensity, and organizational forms of vocational training differ significantly across European Union countries, which necessitates a systematic comparative analysis.

An important source of empirical data for analysing the development of continuing vocational training at enterprises is the Continuing Vocational Training Survey (CVTS), conducted by the European Statistical Office (Eurostat). This survey provides a standardized and cross-country comparable information base on the extent of enterprise participation in vocational training, the intensity and organizational forms of training activities, as well as the level of employee coverage by such programmes. This creates the prerequisites for the application of quantitative analytical methods and the implementation of cross-country comparisons.

Despite a substantial body of research devoted to issues of human capital and vocational training, the dynamic aspect of the development of continuing vocational training at enterprises in EU countries remains insufficiently explored. In particular, there is a limited number of studies that classify countries according to the level of vocational training development over time and analyse the relationship between changes in the respective country groups and indicators of economic development.

The study of the dynamics of continuing vocational training is especially relevant in the context of European integration and post-crisis economic recovery. For Ukraine, which has the status of a candidate country for EU membership, analysing the experience of European Union countries in the development of

enterprise-based vocational training is important for shaping effective human capital development policies, adapting the labour market, and ensuring long-term economic resilience.

In academic research, human capital is traditionally regarded as one of the key factors of long-term economic growth and increased labour productivity. The theoretical foundations of this approach were laid in the works of Gary Becker (G. Becker), who substantiated the interpretation of education and vocational training as investments that ensure income growth and economic efficiency [1]. These ideas were further developed within the framework of endogenous economic growth theories, where the accumulation of human capital is considered an internal driver of technological progress and economic dynamics [2; 3].

Within this theoretical framework, continuing vocational training at enterprises is viewed as an important mechanism for updating employees' skills in response to technological change, digitalization, and structural transformations of the economy. Classical empirical studies at the micro level confirm the positive impact of employee training on labour productivity, wage levels, and firm competitiveness [4; 5]. At the same time, it is emphasized that the magnitude of these effects varies significantly depending on the institutional environment, the structure of the economy, and the role of enterprises in developing employees' skills [6].

Recent studies conducted over the past years have substantially expanded these conclusions by combining the analysis of vocational training with macroeconomic indicators. In particular, it has been found that in European Union countries higher shares of enterprises providing employee training correlate with increased labour productivity and economic growth rates, alongside such factors as investment in research and development and the capital-labour ratio [7; 8]. Informal and job-related forms of training financed by employers have a particularly strong impact, as they foster total factor productivity growth more rapidly than formal increases in educational attainment [8; 9].

A separate strand of the contemporary literature focuses on the role of enterprise-based training in fostering innovation-driven development and economic dynamics. Empirical studies based on EU country data indicate that corporate investments in employee vocational training positively affect innovation activity, measured in particular through composite innovation indices, which subsequently translates into growth in gross domestic product [10; 11; 12]. In this context, vocational training is regarded as a factor that enhances the returns on human capital and innovation investments [7; 13].

A significant number of recent publications also concentrate on the analysis of lifelong learning policies and the role of enterprises in the functioning of European Union labour markets. It is emphasized that corporate training is a key instrument for addressing skills shortages, increasing employment, and adapting the workforce to the challenges of the digital and "green" transition [9; 14; 15]. At the same time, substantial cross-country differences in employee participation in vocational training are highlighted, resulting from differences in national skill formation systems and the role of employers [8; 13].

An important source of empirical data for analysing these differences is the Continuing Vocational Training Survey (CVTS), conducted by the European Statistical Office. Studies based on CVTS data demonstrate significant differentiation among EU countries in terms of employee participation in training, the number of training hours, and the structure of enterprise expenditure on skill development [8; 16]. However, most existing works are predominantly static in nature and focus on the analysis of individual survey waves, paying insufficient attention to dynamic changes over time [16].

At the same time, contemporary literature actively investigates the issue of economic convergence within the European Union. It has been shown that differences in the quality of human capital and the development of vocational training systems significantly affect the persistence or reduction of economic disparities among EU member states [11; 17]. Nevertheless, the results of such studies indicate an uneven impact of vocational training on convergence processes and the persistence of stable structural differences between groups of countries [7; 13].

Some comparative and cluster-based studies devoted to the analysis of vocational training systems in European countries make it possible to identify typologies of countries according to the level of enterprise involvement in skill development and the alignment of training with labour market needs [13; 15; 18]. However, such studies are largely focused on the institutional characteristics of vocational education and training systems and pay less attention to their economic outcomes in a dynamic perspective.

Thus, despite the existence of a solid theoretical and empirical foundation, the dynamic aspects of the development of continuing vocational training at enterprises in European Union countries, as well as the relationship between changes in country typologies based on vocational training indicators and macroeconomic outcomes, remain insufficiently explored in the contemporary academic literature. These gaps determine the scientific relevance of conducting a dynamic classification of EU countries based on CVTS data for 2010–2020 and assessing the relationship between the development of enterprise-based vocational training and economic development.

The purpose of the article is to classify European Union countries according to the level of development of continuing vocational training at enterprises based on CVTS indicators for 2010 and 2020, to analyse the dynamics of changes in the structure of the resulting clusters, and to assess the relationship between the development of vocational training and indicators of economic development measured by gross domestic product per capita.

*Theoretical and methodological framework of the study.*

The information base of the study consists of data from the Continuing Vocational Training Survey (CVTS), conducted by the European Statistical Office (Eurostat) since 2005 at five-year intervals within the framework of lifelong learning (LLL) statistics. The CVTS collects standardized and cross-country comparable information on enterprise investments in continuing vocational training of

employees, which within the survey is defined as education and training activities financed fully or partially by enterprises. The study uses country-level aggregated data for 27 European Union countries as well as Norway for 2010 and 2020. For some countries, partial missing values are present; however, these do not affect the overall logic of cross-country comparisons.

To address the research questions, a Multidimensional Comparative Analysis (MCA) is applied. This approach is widely used in economics and social sciences to analyse complex multifactor phenomena and to classify objects based on a set of interrelated indicators [20]. The application of this method made it possible to conduct a simultaneous comparison and typology of European Union countries according to the characteristics of the development of continuing vocational training at enterprises, as well as to relate the resulting groups to indicators of economic development measured by gross domestic product (GDP) per capita.

Five indicators derived from CVTS data were selected as diagnostic variables of the development of continuing vocational training at enterprises:

**x1** – share of enterprises providing training (Enterprises providing training), % of all enterprises;

**x2** – duration of training in continuing vocational training courses (Hours spent in CVT courses), hours per 1,000 hours worked;

**x3** – share of enterprises that plan vocational training (Enterprises with CVT planning), %;

**x4** – share of enterprises that assess the outcomes of training activities (Enterprises which assess the outcomes of CVT activities), % of enterprises providing training;

**x5** – share of enterprises that assess their future skill needs (Enterprises which assess their future skill needs), % of all enterprises.

A preliminary analysis of the relationships among the selected indicators indicates a moderate level of internal consistency: the average correlation coefficient for the five variables is approximately 0.501. The highest correlation is observed between indicators **x1** and **x3** (0.87), reflecting the logical link between the practice of providing training and the existence of training planning. The lowest correlation is found between **x1** and **x4** (0.205), indicating the relative autonomy of training outcome assessment practices from the overall scale of training provision.

The empirical analysis procedure comprised three consecutive stages.

**Stage 1** involved the unitarization (normalization) of variables by transforming the values of the indicators to the interval [0;1] according to the formula:

$$z_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \quad (1)$$

All selected indicators are treated as stimulants (i.e., higher values correspond to a higher level of development of continuing vocational training at enterprises).

**Stage 2** consisted in aggregation and the calculation of a synthetic index of the development of continuing vocational training (MCA) as a weighted average of the

normalized indicators:

$$MCA_i = \sum x_{ij} \cdot w_j \quad (2)$$

**Stage 3** comprised cluster analysis aimed at grouping countries according to the similarity of the values of the diagnostic variables and identifying typologies of the development of continuing vocational training. To determine the group structure, a hierarchical agglomerative method was applied with the construction of dendrograms in the Statistica software environment, using Euclidean distance and Ward's method. The final allocation of countries to clusters was refined using the k-means method, which ensured comparability of the cluster structures for 2010 and 2020 and provided a basis for analysing inter-cluster movements.

The obtained synthetic indicator of multidimensional comparative analysis and the normalized values of the diagnostic variables constitute an analytical basis for the empirical assessment of the level and dynamics of the development of continuing vocational training at enterprises in European Union countries. At the subsequent stage of the study, a descriptive and comparative analysis of the main vocational training indicators for 2010 and 2020 was conducted, which makes it possible to identify cross-country differences, general trends of change, and structural features of the development of enterprise training activities. For this purpose, the dynamics of indicators x1–x5 across EU countries are further examined, allowing for the characterization of the initial state of vocational training systems and the identification of prerequisites for the subsequent clustering of countries according to their level of development.

*The state of development of continuing vocational training at enterprises in the eu in 2010 and 2020.*

Table 1 presents selected indicators of continuing vocational training in EU countries in 2010 and 2020. The data have a comparative cross-country and dynamic character, which creates analytical prerequisites for identifying cross-country differences and structural shifts in the development of vocational training.

For each country, five indicators (x1-x5) are reported, covering the prevalence, intensity, and organizational aspects of continuing vocational training. The values are expressed in percentages (%) or hours, depending on the indicator. These data make it possible to assess how the share of enterprises providing vocational training to employees has changed, how the intensity of training has evolved, and how practices related to training planning and evaluation have been transformed. Comparing the values for 2010 and 2020 allows for the observation of both positive and negative changes in the structure of training activities, as well as for the identification of countries that stand out in terms of the dynamics and scale of vocational training.

Table 1

## Indicators of enterprise-based vocational training in EU Countries in 2010 and 2020

Country	<i>x1, %</i>		<i>x2, hours</i>		<i>x3, %</i>		<i>x4, %</i>		<i>x5, %</i>	
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
European Union	63,6	67,4	6,1	6	50	52,5	59,4	52,3	65,2	65,8
Belgium	77,6	82,2	12,5	6,8	54,7	65,3	52,9	45,9	76,7	65,2
Bulgaria	31,2	41,1	3,2	3	14,9	19,5	41,2	34,2	48,6	50
Czechia	72,2	85,9	5,2	5,3	43,9	51,9	36,6	46,2	50,5	68,8
Denmark	90,9	71	10,9	2,2	61,4	45,8	48,5	31,3	88,3	80,9
Germany	72,8	77,2	5,7	8,4	55,2	58,2	47,7	43,1	63	66,1
Estonia	67,7	79,8	4,7	4,6	33,7	41,3	36,9	40,7	48,1	66,1
Ireland*		68,4		7,8		55,9		49,3		82,2
Greece	27,8	17,8	1,7	1,6	22,2	16,7	60,8	57,2	56,6	68,7
Spain*	74,9	73,2	6	2,5	61,2	67,7	59,1		74,1	66,7
France	76,1	75,9	8	7,3	69,2	61,7	90,9	92,1	62,6	60,8
Croatia	57,1	48,2	1,5	3,3	30,7	28,2	31,5	31,3	73	73,2
Italy	55,6	68,9	5,5	8,5	56,9	68,8	52,5	40	83	82,9
Cyprus	71,6	65,7	5,2	3,7	47,9	56	68,1	60,3	76,6	80,4
Latvia	40,4	96,8	2,1	2,4	16,2	18,5	32	24,2	58,1	57,9
Lithuania	51,9	54,1	4	3,6	18,3	21,6	42,4	38,5	62,1	62,3
Luxembourg	70,8	76	10,9	9,2	52,2	59,2	57	49,5	72,6	81,1
Hungary	48,7	37,7	3,5	3,6	24,7	26	48,2	38,3	44,4	41,4
Malta	53,9	45,1	8	4	26,3	38,7	56,2	58,4	64,4	69,4
Netherlands	78,6	76,8	9,2	10,1	52,1	55,7	62	83,1	66	68
Austria	86,9	79,3	6,2	4,4	60,9	56	61,9	35,2	60,2	74,1
Poland	22,5	40,9	4	3,1	16,2	18,3	53,7	34,1	38,2	39,7
Portugal	64,6	75,6	10,3	6	52,8	57,7	58,4	54	74,2	80,3
Romania	24,1	17,5	3,5	3,3	14,4	13,3	53,2	36,5	44,3	41,1
Slovenia	68	78,4	9	6,3	37,3	47,2	39,7	47	62,4	73
Slovakia	69	58,9	7,3	5,3	34,7	33,7	42,6	47,2	70,4	49,1
Finland	74,4	61	5,7	3,5	38,5	52,1	51,2	50,7	67,9	72

Sweden*	87	91,5	7	6,2	62,1	72,5		58,5	72,9	86,2
Norway	96,8	93	9,2	8,7	69,7	69,7	48,4	46,1	69,1	75

\* data is partially missing

During the analysed period, the EU average shows a moderate increase in the prevalence of continuing vocational training at enterprises (x1) and in the share of employees covered by training (x3), alongside relative stability in the average duration of training (x2). This indicates a predominantly extensive pattern of development of vocational training systems.

Countries with traditionally high levels of enterprise-based training development (Belgium, Denmark, the Netherlands, Austria, Sweden, and Norway) have maintained their leading positions in terms of key indicators, although for some of them a decline in training intensity is observed in 2020. At the same time, a number of Central and Eastern European countries (Bulgaria, Poland, Latvia, the Czech Republic, and Lithuania) demonstrate positive dynamics, pointing to a gradual convergence towards average European levels.

Overall, a relatively high degree of internal heterogeneity of indicators and substantial cross-country differences are identified. Even in countries with a high prevalence of training, high intensity or stability across all indicators is not always observed, which confirms the multidimensional nature of continuing vocational training and the relevance of applying a cluster-based approach.

In line with the research design, the first stage involved the standardization of the obtained indicators. Using formula (1), the variables  $x_{iN}$  were normalized to the range [0,1]. The standardized data are presented in Table 2.

Table 2

**Normalized indicators of vocational training in EU countries**

Country	$x1_N$		$x2_N$		$x3_N$		$x4_N$		$x5_N$		MCA		
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	
European Union	0,55	0,63	0,42	0,52	0,64	0,66	0,47	0,41	0,54	0,56	0,52	0,56	↗
Belgium	0,74	0,82	1	0,61	0,73	0,88	0,36	0,32	0,77	0,55	0,72	0,63	↘
Bulgaria	0,12	0,3	0,15	0,16	0,01	0,1	0,16	0,15	0,21	0,22	0,13	0,19	↗
Czechia	0,67	0,86	0,34	0,44	0,53	0,65	0,09	0,32	0,25	0,63	0,37	0,58	↗
Denmark	0,92	0,67	0,85	0,07	0,85	0,55	0,29	0,1	1	0,89	0,78	0,46	↘
Germany	0,68	0,75	0,38	0,8	0,74	0,76	0,27	0,28	0,5	0,57	0,51	0,63	↗
Estonia	0,61	0,79	0,29	0,35	0,35	0,47	0,09	0,24	0,2	0,57	0,31	0,48	↗
Ireland*		0,64		0,73		0,72		0,37		0,91		0,67	

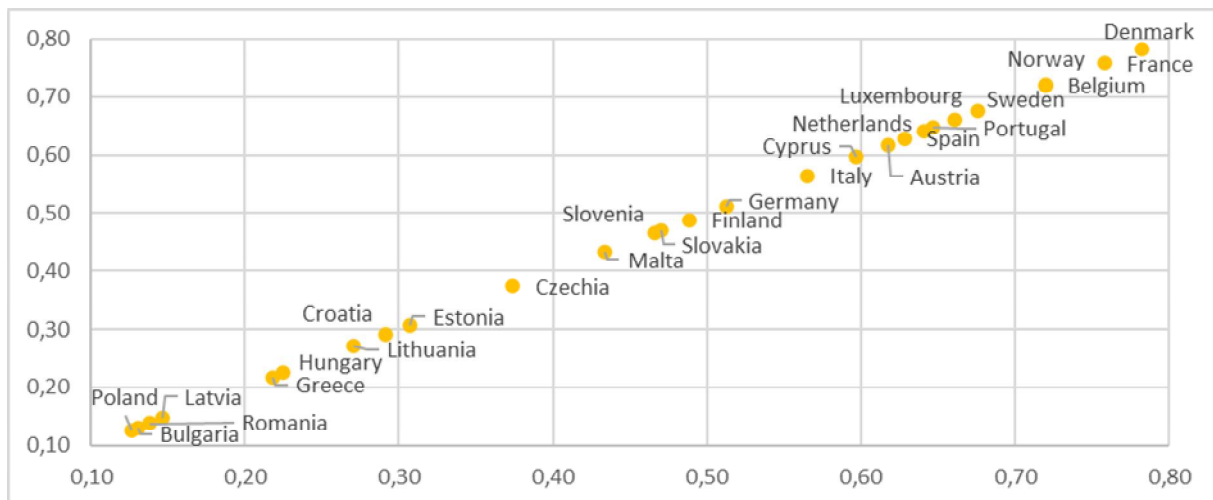
Country	$x1_N$		$x2_N$		$x3_N$		$x4_N$		$x5_N$		MCA		
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	
Greece	0,07	0	0,02	0	0,14	0,06	0,49	0,49	0,37	0,62	0,22	0,23	↗
Spain*	0,71	0,7	0,41	0,11	0,85	0,92	0,46		0,72	0,58	0,63	0,58	↘
France	0,72	0,74	0,59	0,67	0,99	0,82	1	1	0,49	0,45	0,76	0,74	↘
Croatia	0,47	0,39	0	0,2	0,29	0,25	0	0,1	0,69	0,72	0,29	0,33	↗
Italy	0,45	0,65	0,36	0,81	0,77	0,94	0,35	0,23	0,89	0,93	0,57	0,71	↗
Cyprus	0,66	0,61	0,34	0,25	0,61	0,72	0,62	0,53	0,77	0,88	0,6	0,6	↘
Latvia	0,24	1	0,05	0,09	0,03	0,09	0,01	0	0,4	0,39	0,15	0,31	↗
Lithuania	0,4	0,46	0,23	0,24	0,07	0,14	0,18	0,21	0,48	0,49	0,27	0,31	↗
Luxembourg	0,65	0,74	0,85	0,89	0,68	0,78	0,43	0,37	0,69	0,89	0,66	0,73	↗
Hungary	0,35	0,25	0,18	0,24	0,19	0,21	0,28	0,21	0,12	0,04	0,23	0,19	↘
Malta	0,42	0,35	0,59	0,28	0,22	0,43	0,42	0,5	0,52	0,64	0,43	0,44	↗
Netherlands	0,76	0,75	0,7	1	0,68	0,72	0,51	0,87	0,55	0,61	0,64	0,79	↗
Austria	0,87	0,78	0,43	0,33	0,84	0,72	0,51	0,16	0,44	0,74	0,62	0,55	↘
Poland	0	0,3	0,23	0,18	0,03	0,08	0,37	0,15	0	0	0,13	0,14	↗
Portugal	0,57	0,73	0,8	0,52	0,69	0,75	0,45	0,44	0,72	0,87	0,65	0,66	↗
Romania	0,02	0	0,18	0,2	0	0	0,37	0,18	0,12	0,03	0,14	0,08	↘
Slovenia	0,61	0,77	0,68	0,55	0,41	0,57	0,14	0,34	0,48	0,72	0,47	0,59	↗
Slovakia	0,63	0,52	0,53	0,44	0,37	0,34	0,19	0,34	0,64	0,2	0,47	0,37	↘
Finland	0,7	0,55	0,38	0,22	0,44	0,66	0,33	0,39	0,59	0,69	0,49	0,5	↗
Sweden*	0,87	0,93	0,5	0,54	0,86	1		0,51	0,69	1	0,73	0,8	↗
Norway	1	0,95	0,7	0,84	1	0,95	0,28	0,32	0,62	0,76	0,72	0,76	↗

The normalized indicators of vocational training in EU countries make it possible not only to calculate the synthetic MCA index, but also to analyse individual indicators, which allows for a deeper understanding of certain regional specificities. For example, in 2020 only one country (Sweden) recorded two maximum values among the analysed indicators, pointing to the achievement of a very high level of vocational training development. At the same time, Romania exhibits zero values for two indicators in 2020, one of which has remained unchanged since 2010, indicating a persistently low level of enterprise-based vocational training.

Overall, the normalized indicators display an asymmetric distribution with left skewness for  $x_1$ ,  $x_3$ , and  $x_5$ , meaning that most countries record relatively higher values for these indicators. A pronounced positive skewness is observed for indicator  $x_4$ , which points to a generally low level of assessment of training outcomes at enterprises. As regards the number of training hours, a positive symmetry is observed (the mean exceeds the median), indicating that most countries record relatively low numbers of training hours.

Based on the normalized indicators of vocational training activity, a synthetic multidimensional comparative analysis (MCA) index was calculated for each country (Table 2). In 2020, Sweden demonstrated the highest level of the index, increasing by 7 percentage points compared to 2010. The lowest level of the index is observed in Romania, which lost 6 percentage points compared to 2010. The most dynamic growth was recorded in Latvia, which increased its index by 16 percentage points during the analysed period, effectively doubling its value. Denmark, by contrast, showed a substantial decline in the synthetic indicator of vocational training development, from 0.78 to 0.36, mainly due to a decrease in the share of enterprises providing training. This decline may be associated with the outbreak of the COVID-19 pandemic in 2020.

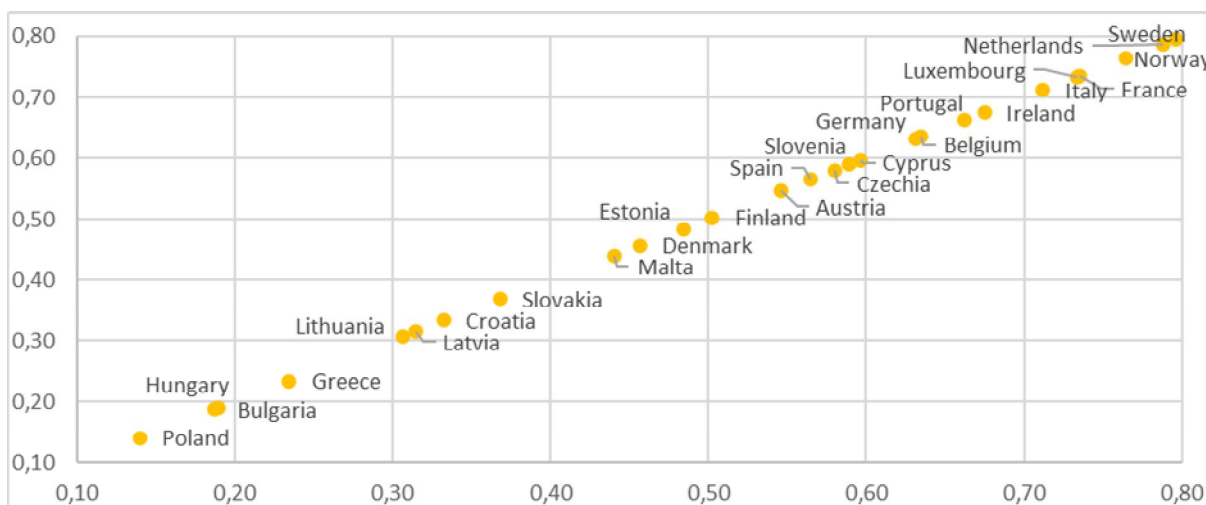
Figures 1 and 2 present the distribution patterns of EU countries according to the synthetic MCA indicator in 2010 and 2020, respectively.



*Figure 1. Dispersion of the synthetic indicator of vocational training development in EU countries in 2010*

The analysis of the distribution graph of the synthetic multidimensional comparative analysis indicator reveals a clear cluster structure among European Union countries, with substantial distances between individual groups. In 2020, an overall upward trend in the level of development of continuing vocational training is observed: an increase in the synthetic indicator was recorded in 18 out of the 28 analysed countries, as well as for the European Union as a whole. The most intensive positive dynamics were demonstrated by Latvia, Estonia, the Czech Republic, and Bulgaria, where the values of the synthetic indicator increased by

approximately 1.5 times or more compared to 2010.



**Figure 2.** Dispersion of the synthetic indicator of vocational training development in EU countries in 2020

The identified tendency towards the expansion of enterprise-based vocational training raises the question of the nature of cross-country shifts and the presence of economic convergence processes within the European Union. In particular, it becomes necessary to determine whether positive changes in vocational training indicators are accompanied by convergence among countries in terms of their level of development, as well as to identify the direction and intensity of such processes.

In order to identify homogeneous groups of countries and analyse inter-cluster dynamics, the study applies cluster analysis based on the k-means method, using a set of indicators that characterize the prevalence and intensity of continuing vocational training at enterprises. The optimal number of clusters was determined based on the analysis of dendrograms constructed in the Statistica software environment using a hierarchical agglomerative method (Euclidean distance, Ward's method).

A visual analysis of the dendrograms presented in Figures 3 and 4 confirms the presence of inter-cluster convergence processes during the analysed period. With the same number of clusters in 2010 and 2020, their internal structure changed: the second cluster, which in 2010 was closer to the first cluster, in 2020 moved significantly closer to the third cluster. This transformation indicates positive dynamics and potential convergence processes between groups of countries. At the same time, full unification of the cluster structure did not occur, which points to the persistence of multilevel differentiation among European Union countries in terms of the development of continuing vocational training at enterprises.

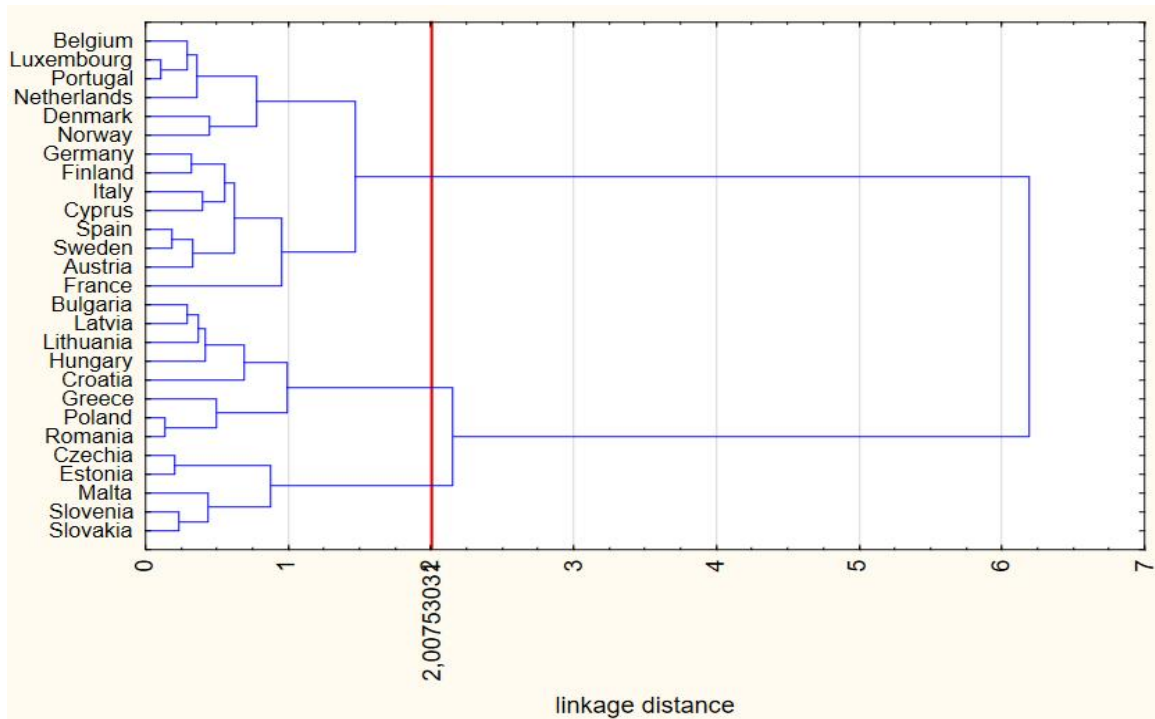


Figure 3. Dendrogram obtained using the agglomerative method based on 2010 data

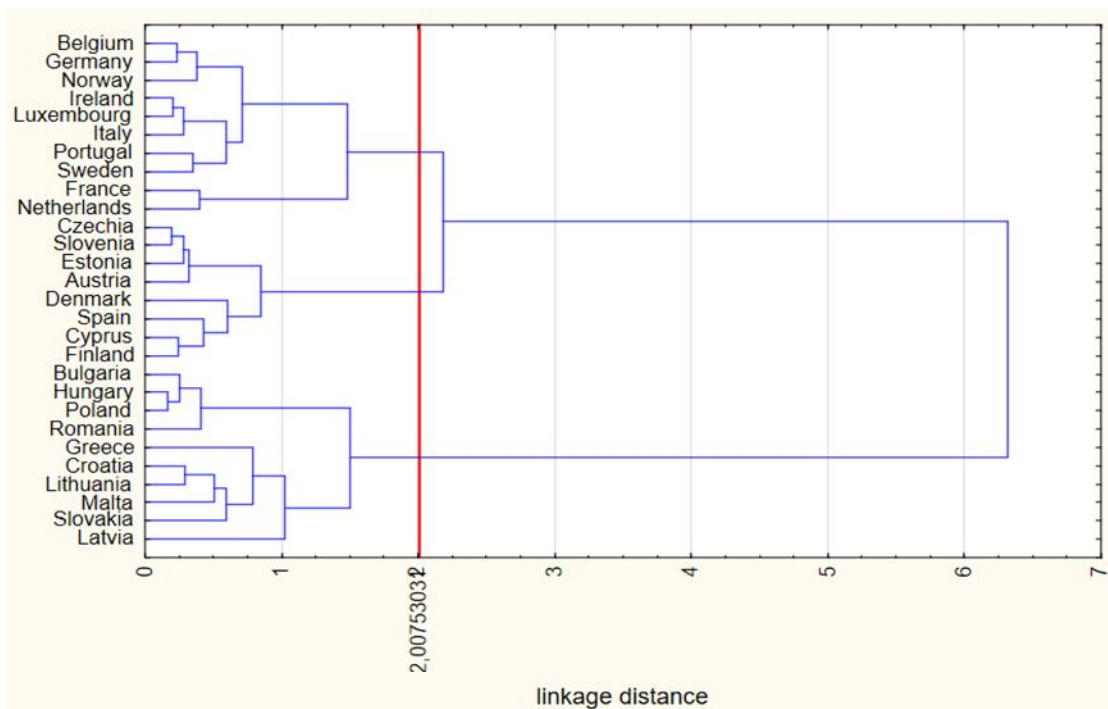


Figure 4. Dendrogram obtained using the agglomerative method based on 2020 data

The overall results of the cluster analysis indicate the presence of a stable multilevel differentiation among European Union countries in terms of the level of

development of continuing vocational training at enterprises in both 2010 and 2020. At the same time, noticeable inter-cluster movements of individual countries were recorded, reflecting the dynamic nature of transformations in national vocational training systems and the uneven pace of their development.

Based on the results of the hierarchical agglomerative analysis, the analysed countries were grouped into three clusters, bringing together countries with the most similar values of the diagnostic indicators of vocational training development.

The results of the k-means clustering based on 2010 data are presented in Table 3. Overall, the obtained cluster structure is consistent with the results of the agglomerative analysis, which confirms the robustness of the identified country typology.

*Table 3*

**Results of country grouping using the k-means method based on 2010 data**

<b>Group</b>	<b>Countries</b>
1 cluster	Czechia, Germany, Estonia, Croatia, Malta, Slovenia, Slovakia, Finland
2 cluster	Bulgaria, Greece, Latvia, Lithuania, Hungary, Poland, Romania
3 cluster	Belgium, Denmark, Spain, France, Italy, Cyprus, Luxembourg, Netherlands, Austria, Portugal, Sweden, Norway

In 2010, the first cluster brought together countries with a medium level of development of continuing vocational training. It included both economically advanced countries (Germany, Finland) and countries with transition economies (the Czech Republic, Estonia, Croatia, Malta, Slovenia, and Slovakia). Such internal heterogeneity of the cluster indicates the existence of different models of vocational training organization despite similar aggregate values of CVTS indicators.

The second cluster comprised countries with the lowest levels of development of enterprise-based vocational training (Bulgaria, Greece, Latvia, Lithuania, Hungary, Poland, and Romania). This group is characterized by limited enterprise participation in employee training and low training intensity, which may be associated with both economic constraints and institutional features of labour markets.

In 2010, the third cluster included countries with a high level of vocational training development (Belgium, Denmark, Spain, France, Italy, Cyprus, Luxembourg, the Netherlands, Austria, Portugal, Sweden, and Norway). These are predominantly economically developed countries of Western and Northern Europe with institutionally embedded systems of corporate training.

The results of clustering based on 2020 data are presented in Table 4. The obtained cluster structure also largely corresponds to the results of the agglomerative analysis, while at the same time demonstrating increased inter-cluster mobility of individual countries.

Table 4

*Results of country grouping using the k-means method based on 2020 data*

<b>Group</b>	<b>Countries</b>
1 cluster	Czechia, Denmark, Estonia, Spain, Croatia, Cyprus, Latvia, Malta, Austria, Slovenia, Finland
2 cluster	Bulgaria, Greece, Lithuania, Hungary, Poland, Romania, Slovakia
3 cluster	Belgium, Germany, Ireland, France, Italy, Luxembourg, Netherlands, Portugal, Sweden, Norway

In 2020, a noticeable restructuring of the first cluster is observed, bringing together countries with medium-to-high and increasing levels of vocational training development (the Czech Republic, Denmark, Estonia, Spain, Croatia, Cyprus, Latvia, Malta, Austria, Slovenia, and Finland). The transition of Denmark, Spain, and Austria into this cluster indicates a convergence of their indicators with countries demonstrating intensive dynamics in vocational training development, rather than merely stable high absolute values of the indicators.

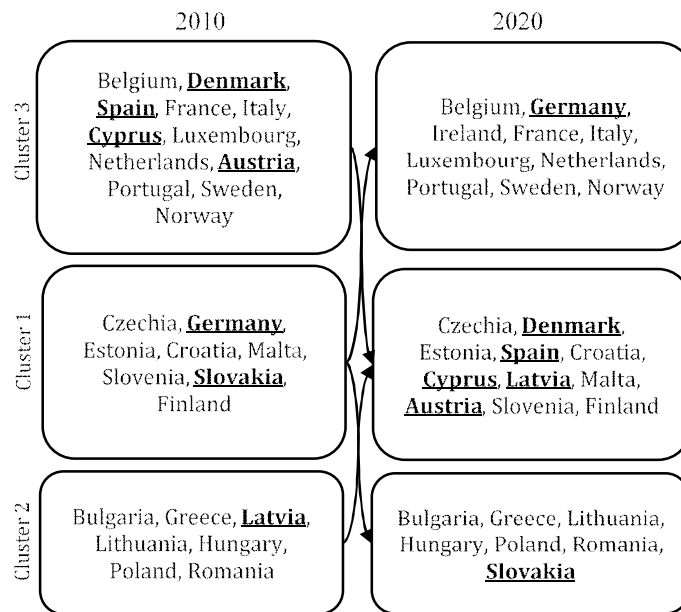
The second cluster in 2020 retained its core of countries with a low level of vocational training development (Bulgaria, Greece, Hungary, Poland, and Romania), although its composition underwent minor changes: Latvia exited the group, while Slovakia entered it. This indicates limited internal mobility among countries with low indicator values and the absence of a significant breakthrough in the development of vocational training systems.

The third cluster in 2020 remains the most stable and economically strong, uniting countries with high and systemic levels of development of enterprise-based vocational training (Belgium, Germany, Ireland, France, Italy, Luxembourg, the Netherlands, Portugal, Sweden, and Norway). The appearance of Ireland in this cluster (in the absence of data for 2010) indicates the strengthening role of corporate training in the country's human capital development strategies and economic competitiveness.

A comparative analysis of the cluster structure of European Union countries in 2010 and 2020 allows several generalizations to be formulated. First, the second cluster demonstrates the highest degree of inertia, indicating the presence of persistent structural constraints on the development of continuing vocational training in countries with lower levels of economic development. Second, the first cluster plays the role of a transitional group, within which the most intensive inter-cluster movements are observed. This allows it to be regarded as a zone of potential economic and educational convergence. Third, the third cluster retains relative stability and concentrates countries with the highest economic outcomes and the most institutionally developed systems of enterprise-based vocational training.

Figure 5

Dynamics of convergence within clusters during 2010–2020



In line with the research objective, the next stage analyses the relationship between the level of development of continuing vocational training and indicators of economic development measured by gross domestic product per capita (Table 5).

Table 5

Average level and dynamics of GDP per Capita by clusters

Cluster	2010, EUR	2020, EUR	Absolute change, EUR	Growth rate, %
1	18 925	27 982	+9 057	+47,9%
2	9 754	14 333	+4 579	+46,9%
3	34 442	39 620	+5 178	+15%

The obtained results indicate a clear differentiation of clusters by the level of gross domestic product per capita. Countries in the third cluster are consistently characterized by the highest GDP levels, which reflects the deep institutional integration of vocational training into broader economic development strategies. At the same time, relatively lower GDP growth rates in this group correspond to the logic of mature economies, in which vocational training primarily performs a stabilizing and supportive function.

The first, transitional, cluster proved to be the most dynamic both in terms of the development of vocational training systems and economic growth indicators. The highest absolute and relative GDP growth rates in 2010–2020 suggest that investments in continuing vocational training at enterprises may act as an important

factor of economic convergence. It is precisely in this group of countries that the development of training is accompanied by noticeable structural changes in the economy.

The second cluster is characterized by a persistent lag in GDP per capita, despite relatively high growth rates in percentage terms. This points to the presence of structural constraints under which the limited development of enterprise-based vocational training systems does not allow economic growth to be transformed into a sustainable process of convergence with more developed countries. The obtained results are consistent with approaches that consider human capital as a necessary, but not sufficient, condition for economic convergence.

The results of the study confirm the existence of a systematic relationship between the level of development of continuing vocational training at enterprises and the economic development of countries, measured by gross domestic product per capita. The cluster structure formed on the basis of CVTS indicators clearly correlates with both the level and the dynamics of GDP in 2010–2020, which is consistent with the premises of human capital theory and the findings of previous empirical research.

The results of the cluster analysis indicate the existence of stable groups of countries according to the level of development of continuing vocational training, while simultaneously confirming the heterogeneity of their development trajectories over time. Inter-cluster mobility during 2010–2020 has an asymmetric character: countries with medium and high levels of vocational training development demonstrate greater flexibility and capacity for transitions between clusters, whereas countries with low levels of vocational training development remain structurally locked into the corresponding cluster.

The analysis of GDP dynamics revealed a non-linear relationship between vocational training and economic growth. The strongest economic effect of the development of continuing vocational training is observed in countries with a medium level of economic development, where investments in training are accompanied by accelerated processes of economic convergence. In contrast, in highly developed economies vocational training primarily performs a stabilizing and supportive function, contributing to the preservation of competitiveness and innovative potential.

The obtained results have important practical implications for shaping human capital development policies in European Union countries, as well as in candidate countries, in particular Ukraine. They highlight the relevance of a differentiated approach to stimulating enterprise-based vocational training, taking into account the level of economic development, institutional characteristics, and structural constraints of national economies.

At the same time, the study has several limitations that should be considered when interpreting the results. First, Ireland was excluded from the analysis of GDP dynamics due to the absence of comparable data for 2010, which makes it impossible to correctly assess changes over the 2010–2020 period. Second, Luxembourg was excluded from the calculation of average GDP values by clusters

because of its extremely small economic size and exceptionally high GDP per capita, which could significantly distort aggregated results and inter-cluster comparisons.

These limitations do not undermine the overall validity of the conclusions but outline directions for further research, in particular the use of alternative indicators of economic development and the extension of the time horizon of the analysis.

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**Глазова Я. В., Глазов М. О., Попова А. С. Неперервне професійне навчання на підприємствах у країнах європейського союзу: емпіричний аналіз на основі даних європейської статистичної агенції.**

Сучасні соціально-економічні трансформації в країнах Європейського Союзу, зумовлені технологічними змінами, цифровізацією та структурною перебудовою економіки, актуалізують переосмислення ролі неперервного професійного навчання на підприємствах як ключового інструменту розвитку людського капіталу та забезпечення економічного зростання. В умовах посилення вимог ринку праці професійне навчання персоналу виступає важливим чинником підвищення продуктивності праці, адаптивності робочої сили та конкурентоспроможності національних економік. Метою статті є здійснення класифікації країн Європейського Союзу за рівнем розвитку неперервного професійного навчання на підприємствах на основі показників дослідження неперервного професійного навчання (Continuing Vocational Training Survey, CVTS) за 2010 та 2020 роки, аналіз динаміки змін у структурі сформованих кластерів і оцінювання взаємозв'язку між розвитком професійного навчання та показниками економічного розвитку, вимірними валовим внутрішнім продуктом на душу населення. У дослідженні застосовано багатовимірний порівняльний аналіз, що включає уніфікацію статистичних показників, розрахунок синтетичного індексу розвитку неперервного професійного навчання та кластерний аналіз із використанням методів агломерації та *k*-середніх. Емпіричну основу дослідження становлять офіційні дані Статистичного управління Європейського Союзу (Eurostat), які забезпечують міжкраїнну порівнюваність та можливість аналізу динамічних структурних змін. Встановлено, що у 2010-2020 роках у країнах Європейського Союзу сформувалися відносно стійкі кластери за рівнем розвитку неперервного професійного навчання на підприємствах, які відрізняються інтенсивністю навчальної діяльності, масштабами охоплення працівників та організаційними характеристиками навчальних процесів. Виявлено міжкластерну мобільність окремих країн, що свідчить про динамічний характер розвитку систем професійного навчання та наявність процесів часткової конвергенції. Доведено, що країни з вищим рівнем розвитку професійного навчання, як правило, характеризуються вищими показниками економічного розвитку, тоді як найбільш виражений економічний ефект інвестицій у навчання персоналу спостерігається в країнах із середнім рівнем економічного розвитку. Визначено, що розвиток неперервного професійного навчання на підприємствах є важливим чинником економічної динаміки та конвергенції в межах Європейського Союзу. Отримані результати мають прикладне значення для формування політики розвитку людського капіталу, зокрема для України як країни-кандидата на вступ до ЄС, у контексті післякризового та післявоєнного відновлення економіки. Подальші дослідження доцільно спрямувати на розширення часових меж аналізу та використання альтернативних індикаторів економічного розвитку.

**Ключові слова:** неперервне професійне навчання, людський капітал, обстеження неперервного професійного навчання, економічний розвиток, країни Європейського Союзу, ринок праці.

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