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Determinants of Leadership in Higher Education in European Countries

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Abstract: *Rapid technological development, globalization, digitalization, the COVID-19 pandemic, and many other factors cause significant transformations in education, which requires regular updating of forecasts of short-term and long-term trends in the development of the educational services market, determination of labour market needs, updating of strategies for training qualified specialists, etc. The research aims to identify the main determinants that determine the leadership of 31 European countries in higher education for 2017-2021. The following research methods were used to achieve the goal of the research: analysis and synthesis, comparison and grouping, induction and deduction, abstraction and logical generalization, tabular and graphic method, factor analysis (principal component method), cluster analysis (hierarchical, Ward's method). The input data array includes fifteen different indicators (official statistical data of Eurostat and the European Commission) characterizing the development of higher education. The factor analysis was carried out using the principal component method proved that the most significant determinants determining the leadership of European countries in higher education are the number of students enrolled in higher education institutions, the number of new entrants, the number of teachers and scientific and pedagogical workers in higher education, state and private expenses for higher education, financial assistance to students of higher education, number of graduates by level of higher education. These variables are the basis of a hierarchical cluster analysis using Ward's method. It made it possible to identify five clusters among European countries that differ in the determinants that determine the country's leadership in higher education. All calculations were made in the STATA/SE 18.0 software package. Modelling found that funding is a determinant of leadership in higher education for the United Kingdom, France and Germany. Turkey is the leader in the number of students enrolled in higher education in 2017 and 2021. At the same time, for most of the studied countries, indicators of financing higher education and indicators characterizing the number of participants in the educational process tended to decrease in 2021 compared to 2017. The obtained results can be used by state and local authorities, as well as other interested parties, to harmonize the reforming of the higher education market, and higher education institutions to improve the quality of educational services and their compliance with the needs of the labour market.*
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Introduction

In the modern world, higher education plays a key role in the development of society and the country's economy, because it forms qualified workers, middle and higher-level personnel for the labor market and raises the level of workforce qualification. Higher education also contributes to the development of science and innovation, which affects the country's economic development and international competitiveness (Kuzior & Kuzior, 2020). Higher education as a separate branch of the economy is also subject to the market mechanism laws, which forms the market of higher education or the market of educational services within the limits of higher education.

Despite its special nature and social importance, the higher education market is also considered using market principles and categories. Thus, the demand for higher education is determined by people's need to acquire specific knowledge and skills for further personal and professional development. The offer of higher education includes all educational services that are available to students, also regarding the competences of the future (Kuzior et al., 2023). The influence of various factors, such as the cost of education, competition between educational institutions, and the balance between supply and demand in the market shapes the price of education. Applying market principles to education helps to understand how various factors affect the development of this field and what factors determine the availability and quality of education. This approach helps to more effectively meet the educational needs of society and promote the development of the field of higher education.

According to a study by the European Commission, the sudden transition to emergency distance learning caused by the COVID-19 pandemic created material and technical problems for educational institutions, teachers and students. Significant challenges include Ensuring online learning quality, supporting faculty and students in adapting to online teaching/learning, and preventing disengagement and dropout. Ober & Kochmańska (2022) show that the sudden change in the organization of higher education caused by the Covid-19 pandemic and its effectiveness depended on many factors, such as: the condition and availability of the university's technological infrastructure, digital competences of lecturers and digital competences of students.

The European University Association, in the study by Erhardt & von Kotzebue (2016), noted that the pandemic has prompted reflection on the contribution of higher education to society, especially in the light of economic and social changes and considerations of sustainable development. In addition, it has forced higher education institutions to change their activities, and some of these changes can be preserved. This includes changes in learning and teaching that emphasise student well-being and engagement and developing a capacity for virtual mobility that complements physical mobility. It is worth noting that even in the current conditions of cancellation of the pandemic status, the world is in a vulnerable position because new stamps of the virus, which contain a potential threat, are constantly being recorded. That is why, based on a comprehensive study of the higher education market, European countries must be ready for new challenges in the future.

General recommendations for the formation of potential strategic documents in the context of reforming and strengthening the market of higher education can be:

- the continuation of the digital transformation of education, which will involve ensuring the availability and quality of distance education, investing in technologies and infrastructure that will allow students and teachers to work effectively in an online environment and form flexible hybrid learning models;
- ensuring safety and psychological support, which involves implementing a general strategy and protocols for safety and risk management at the level of higher education institutions and psychological and social support programs for students and teachers.

Literature Review

In his study, Kaleniuk (2011) understands the market of educational services as a complex system where different parties interact in the production, promotion, implementation and consumption of educational services. In the work of Kuzurza (2011), the market of educational services is considered “an economic environment that creates significant elements of national wealth, such as knowledge, intellectual development,

abilities and skills of individuals". These definitions can also be applied to higher education to form a conceptual and categorical apparatus for this study. In the works of Nair et al. (2023), Baranivskyi (2013), and Kaleniuk (2003), it is noted that the higher education market should be considered as a complex integrated system with many sub-subjects and components, including:

- the educational process is the process of learning and acquiring knowledge and skills by students, including lectures, seminars, practical classes and exams in higher education institutions in other educational providers;
- educational institutions and providers: universities, institutes and other higher educational institutions and educational centers that provide educational services;
- educational programs as a set of subjects and courses that students choose to get an education in a specific field (more relevant for formal education);
- participants in the educational process, including scientific and pedagogical staff who provide training and conduct research in universities and other institutions, administrative staff, persons who receive education in educational institutions and those who finance education, etc.

In the study of Kukurudza (2011), it is noted that one of the unique features of education is that the individual who is studying is a consumer of educational products and a co-participant in their production. He/she actively interacts with teachers, other students and the educational process, which makes education a personal and developing process. The authors (Kuzior & Krawczyk, 2021) draw attention to the need to manage the internationalization of universities. An important aspect of education is currently also related to the use of artificial intelligence in educational processes (Tkachenko et al., 2019).

In the works of Akhnovsky (2018) and Baranivskyi (2013), it is determined that it is appropriate to note that during the educational process, an educational product (as a material form) or an educational service (an immaterial form) is formed and provided, being the object of numerous studies by scientists. In particular, educational goods may include the results of educational institutions in the form of textbooks, study guides, monographs, methodical materials, scientific articles, publications and other scientific and educational resources. These resources have high intellectual value and can be used as teaching and research tools.

In the study of Kaleniuk (2011), it is emphasized that education is aimed at transferring and acquiring knowledge, abilities and skills to students. Thus, the main goal of education is to develop and expand the intellectual, cultural and practical potential of an individual. In the works of Vitlinskyi et al. (2008), Hrytsyuk & Ostapchuk (2008), and Luginin (2008), summarizing the above statements, one should note that the educational service has several rather specific features, which should include:

- intangibility: educational services cannot be felt physically; they consist in the transfer of knowledge, skills and educational experience;
- inseparability from subjects: occurs due to the interaction between educational providers and learners;
- the duration of the educational process: education is a process that usually takes a long period and takes place at different levels and in different forms;
- inconsistency of quality: the quality of educational services can vary depending on many factors, such as the qualifications of teachers, teaching materials, infrastructure and others;
- impossibility of preservation: knowledge acquired during training may be forgotten over time, and information may become outdated due to scientific and technical progress development. This requires constant learning (throughout life) and professional development;
- high intellectual capacity: education involves the student's active participation and ability to learn information and skills. It requires a lot of working memory and intellectual effort;
- non-resaleability: educational services cannot be resold or transferred to another person after receipt, as they are related to individual learning and the process of assimilation of knowledge.

The works of Burdenko (2015) and Kotler et al. (2000) stated that educational services play a critical role in preparing the workforce, transforming the acquired knowledge, skills and abilities of students into a valuable intellectual resource that contributes to the development of the economy and society. It is important to consider that the quality of this transformation also depends on the active role of the student himself, his abilities and

internal motivation, which affect his success in further work and life. Ulewicz (2014) emphasizes the need for continuous monitoring and evaluation of the quality of educational services at universities.

Methodology

The posed question of identifying the main determinants that determine the leadership of 31 European countries in higher education for 2017-2021 requires a thorough analysis of the formation of an array of input data. The higher education services market is a rather complex and complex category with different measurement options. Within the scope of this study, it is proposed to focus on such indicators of the higher education market as:

- participants of the educational process, in particular students, teachers and scientific and pedagogical workers, their ratio, graduates;
- financial support of the educational process at the expense of state and private funds;
- and the results of the educational process at the expense of employment in the labour market.

Their general characteristics, units of measurement and notations are shown in Table 1. In particular, the input data array includes fifteen different indicators characterizing the higher education market. For this, publicly available data were used, particularly on the official Eurostat data portal, which is the statistical service of the European Union responsible for collecting, processing and distributing statistical information. In particular, Eurostat has a comprehensive set of indicators on various aspects of the social and economic life of EU member states and other European countries, including education.

Table 1. Description of the Input Data Array

Blocks	Indicator	Units of measurement	Database	Conventional designation
Participation in education	Number of students enrolled in higher education institutions	un.	Eurostat	*x1*
	The number of new entrants to institutions of higher education	un.		*x2*
	The level of participation of adults in the educational process (aged 25 to 64)	%		*x3*
Staff of higher education institutions	The number of teachers and scientific and pedagogical workers in higher education	un.		*x4*
	The ratio of students and teachers in higher education	%		*x5*
	The percentage of women among teachers in higher education	%		*x6*
Funding of education	State spending on higher education	million EUR		*x7*
	Private expenses for higher education	Million EUR		*x8*
	Financial assistance to students of higher education	%		*x9*
Characteristics of higher education graduates	Number of graduates by level of higher education	un.		*x10*
	Number of graduates by level of higher education in science, mathematics, computing, engineering, production, construction	% per 1000 population aged 20-29		*x11*
	The number of women among graduates by level of higher education	% of women per 100 men		*x12*
Employment of higher education graduates	Share of the population with a higher education level	% among the population aged 15-64		*x13*
	Unemployment rate among the population with higher education	% among the population aged 15-64		*x14*
	The level of employment among the population with higher education	% among the population aged 15-64		*x15*

Source: Eurostat

The sample consists of the following 31 European countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom.

The study period is five years, namely 2017-2021, for which the necessary data are available. The collection of data and their grouping in the table was carried out with the help of Microsoft Excel. All calculations within the scope of this study were carried out in the STATA/SE 18.0 software complex, which contains the appropriate modules for qualitative analysis. In particular, STATA provides extensive capabilities for performing various types of statistical analysis, including variance, factor, correlation-regression analysis, cluster analysis, and many others.

Table 2 shows the main descriptive statistics characterizing the array of input data, in particular, average values (mean), maximum and minimum values (max and min), standard deviation (sd), and indicators of kurtosis and asymmetry (skew).

Table 2. Descriptive Statistics for x1-x15

Stats	Mean	Min	Max	SD	Skewness	Kurtosis
x1	855190.90	7043.00	8280595.00	1473353.00	1.27	1.97
x2	122858.10	1053.00	781397.00	175195.80	1.94	1.71
x3	12.02	0.90	34.70	8.32	0.87	0.90
x4	55644.94	954.00	472418.00	85780.91	1.05	1.44
x5	15.10	4.40	49.10	5.60	1.13	1.62
x6	45.23	34.30	59.10	5.54	-0.08	1.62
x7	7082.66	141.80	47206.90	10473.25	1.25	1.59
x8	1632.34	0.80	26748.00	4748.96	1.53	1.28
x9	15.83	0.90	66.50	12.96	1.95	1.84
x10	180381.30	1725.00	1167119.00	264707.70	1.88	0.43
x11	17.85	3.80	40.30	6.25	0.62	0.64
x12	144.20	94.24	212.70	23.42	0.25	1.03
x13	30.29	15.30	45.20	7.76	-0.24	1.84
x14	4.76	1.00	18.70	3.44	1.87	1.26
x15	84.55	68.00	92.90	4.83	-1.22	0.39

Source: Compiled by the authors

The given data indicate a different measurement of the selected indicators and a significant range of variation. This shows that the countries included in the sample have their peculiarities regarding forming and developing the higher education market. The kurtosis and asymmetry indicators have minor deviations from the norm, which indicates a slight positive skewness for some indicators. We dwell in more detail on the first indicator (x1), which characterizes the number of students enrolled in higher education institutions. The average figure is approximately 855,000 people.

Analyzing other indicators, it is worth noting that, on average, for the sample countries, there is an insignificant participation of adults in the educational process (an average of 12% among the population, a maximum of 34% for Sweden). The ratio of students to teachers in higher education is, on average, 15.1%, and the share of women among teachers is 45.2%. For all countries, the state funding of higher education prevails, at 7082.66 million euros on average. The share of the population with a higher education level is, on average, 30.2%, and the average unemployment rate among the population with a higher education is 4.76% (the maximum value is observed in Greece). The first step within the model of comprehensive research of the higher education market in European countries is the selection of the most significant factors characterizing the research object. For this, factor analysis was used, which is a statistical method used in data analysis to identify and explore underlying patterns, structures, or latent variables that may influence a set of observable variables.

In the works of Maringe (2015), Yong & Pearce (2013) and Vlasyuk & Fastovets (2021), the classic factor analysis model assumes that each observed variable (X1, X2, ..., Xp) is a linear function of the basic factors (F1, F2, ... , Fm) and a unique residual term (ej). The model is aimed at reproducing the maximum correlations between the observed variables by finding factor loadings (aj1, aj2, ..., ajm) that capture the relationships between variables and factors (formula 1):

$$X_j = a_{j1}F_1 + a_{j2}F_2 + .. a_{jr}F_m + e_j, \quad j = \overline{1,p} \tag{1}$$

The main steps of factor analysis can be summarized as follows:

- selection of the method of selection of factors aimed at reducing the number of factors while maintaining as much variance as possible in the initial data;
- selection of the method of "rotation" or rotation of factors for maximum clarity of their interpretation;
- interpretation of the obtained results, in particular factor loadings, and evaluation of the quality of the model.

Various factor extraction methods are used to identify the basic structure of multidimensional data, the most common of which are listed in Table 3. All extraction methods of factor analysis are aimed at computing a set of orthogonal components or factors that, in combination, reproduce the observed correlation matrix. These components or factors are the primary latent constructs that explain the correlation patterns between the observed variables. This step involves identifying latent factors that account for the total variance shared by the observed variables. These latent factors are believed to represent unobserved constructs that explain correlation patterns between observed variables.

“Rotation” of factors is an important step of factor analysis, which allows the selection of the most optimal and adequate number of factors during the analysis. Factor rotation aims to find a new set of factor loadings that facilitate the interpretation of the underlying factors. Within this work, the most popular and simple method of principal components with orthogonal rotation “varimax” was chosen, which aims to simplify the factor structure by maximizing the variance of squared loadings for each factor from the study of Maringe (2015). Additional criteria for selecting the optimal number of selected factors are:

- Kettel's criterion or the stony scree graph, a graphical method that allows you to track the point where the eigenvalues for each factor drop sharply, forming a “scree”. The number of factors that need to be saved will be up to this point;
- Kaiser criterion involves keeping factors with eigenvalues greater than one because they explain more variance in the data than one variable. Additionally, it is recommended that the share of dispersion be at least 70%.

As a result of these actions, factor loadings are obtained for each variable, representing the relationships between the observed variables and the main factors. High factor loadings indicate a strong relationship between the variable and the factor, while low loadings indicate a weaker relationship. To evaluate the quality of the model, separate fit indicators are used, in particular, the Kaiser-Meier-Olkin (KMO) measure, which determines the proportion of the variance of the observed variables that the main hidden factors can cause, as well as Bartlett's sphericity test, which determines whether the correlation matrix of the variables is significantly different from identity matrix, indicating the presence of sufficient shared variance between the variables.

In the research of Zhivko & Kukharska (2019), the second step within the framework of the model of comprehensive research of the higher education market in European countries is their clustering according to selected variables. Cluster analysis is a statistical technique used in data analysis to identify groups or clusters in a data set based on similarities or differences between data points. The main purpose of cluster analysis is to separate a set of data points into meaningful and homogeneous groups, where data points within one group are more similar than points in other groups. The clustering process by the Ward method, which is chosen within the scope of this study, includes merging clusters at each step in such a way as to reduce the within-group sum of squared deviations, that is, to minimize the internal variance of each cluster. This leads to the fact that objects close to each other are combined into one cluster. This approach helps identify groups of objects with similar characteristics and makes the data structure more understandable and interpretable.

In general, cluster analysis includes several generalized steps for identifying and grouping similar data points into clusters:

- determination of the clustering method (hierarchical or non-hierarchical) and its type;
- selection of the measure of distances.

Synyakov (2018) states that a distance or similarity measure quantifies the separation or difference between two data points in a multidimensional space. This indicator helps to determine the compactness or cohesion of a cluster, which is a crucial aspect of evaluating the quality of clusters formed during the clustering process.

The closer the data points in a cluster are to each other, the better the cluster quality. The most common measures of distance are Euclidean distance, Manhattan distance, squares, cosine similarity, and others). Thus, combining factor analysis using the principal component method will allow for the formation of an optimal list of the most significant factors, and hierarchical cluster analysis using the Ward method will allow for conducting a qualitative comprehensive study of the higher education market in European countries.

Results

At the first step of factor analysis, results were obtained for fifteen factors corresponding to the number of variables analyzed in the model. The results are shown in Table 3. The first four factors can be considered optimal because the cumulative variance for them is more than 80%, the eigenvalues satisfy the Kaiser criterion.

Table 3. Results of the First Step of Factor Analysis (Before Rotation)

Factor	Eigenvalue	The difference value	Proportional share of variance	Cumulative variance
Factor 1	5.508	2.054	0.367	0.367
Factor 2	3.454	1.812	0.230	0.597
Factor 3	1.642	0.427	0.110	0.707
Factor 4	1.215	0.414	0.081	0.788
Factor 5	0.801	0.026	0.053	0.841
Factor 6	0.775	0.310	0.052	0.893
Factor 7	0.465	0.113	0.031	0.924
Factor 8	0.353	0.066	0.024	0.948
Factor 9	0.287	0.101	0.019	0.967
Factor 10	0.185	0.019	0.012	0.979
Factor 11	0.166	0.078	0.011	0.990
Factor 12	0.088	0.044	0.006	0.996
Factor 13	0.045	0.032	0.003	0.999
Factor 14	0.013	0.009	0.001	1.000
Factor 15	0.004	.	0.000	1.000

Source: Compiled by the authors

Table 4 shows the factor loadings on the four selected factors. In the context of factor analysis, uniqueness refers to the amount of variance of an observed variable that is unique to that variable and not shared with other variables. In general, the level of uniqueness varies between 10-50% and is the largest for *x11*.

Table 4. Factor Loadings Within the First Step of Factor Analysis (Before Rotation)

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Uniqueness
x1	0.858	-0.359	0.027	-0.070	0.130
x2	0.966	-0.054	0.143	-0.054	0.042
x3	-0.069	0.568	-0.546	0.233	0.321
x4	0.837	0.160	0.066	-0.309	0.173
x5	0.220	-0.669	0.066	0.464	0.285
x6	-0.208	0.096	0.756	0.191	0.340
x7	0.812	0.456	0.036	-0.123	0.116
x8	0.662	0.495	0.254	0.206	0.210
x9	0.540	0.578	0.122	0.269	0.287
x10	0.954	-0.015	0.141	-0.018	0.069
x11	0.292	0.456	-0.042	0.291	0.621
x12	-0.514	-0.021	0.689	0.298	0.172
x13	-0.095	0.652	-0.284	0.521	0.214
x14	0.381	-0.729	-0.253	0.409	0.093
x15	-0.488	0.753	0.149	-0.251	0.110

Source: Compiled by the authors

The next step is to rotate the factors using the varimax method, which helps to make the factors more understandable and meaningful. Table 5 shows the final results that allowed us to identify four factors with a cumulative variance of more than 80%, the eigenvalues also satisfying the Kaiser criterion. The first factor explains the largest share of variance – 36.1%, the second – 19.9%, etc.

Table 5. Results of the Second Step of Factor Analysis (After Rotation)

Factor	Dispersion	The difference value	Proportional share of dispersion	Cumulative dispersion
Factor 1	5.076	2.157	0.338	0.338
Factor 2	2.919	0.816	0.195	0.533
Factor 3	2.103	0.383	0.140	0.673
Factor 4	1.720	.	0.115	0.788

Source: Compiled by the authors

In addition, we will present a scree plot according to Kettel's criterion (Fig. 2), which was obtained from the STATA/SE 18.0 software complex and confirms the previous conclusions about the optimal allocation of four factors.

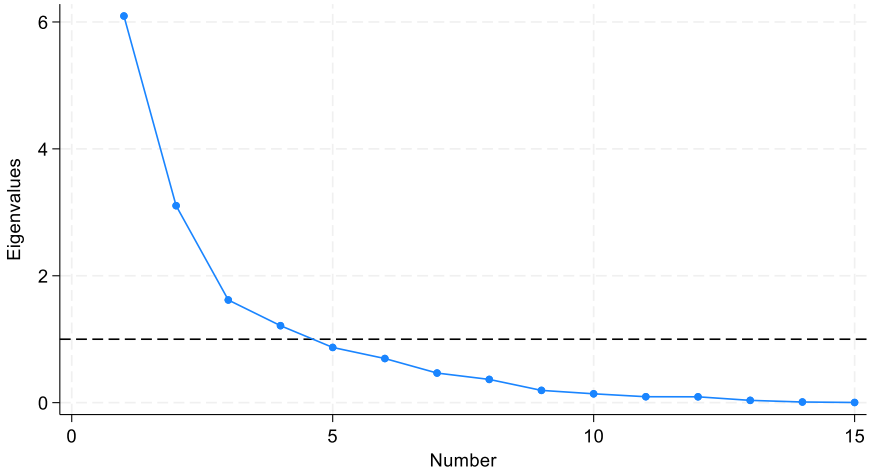

Figure 1. Scree Plot According to the Kettel Criterion Within the Second Step of the Factor Analysis (After Rotation)

Source: Compiled by the authors

Table 6 shows the factor loadings for the selected four factors and their level of uniqueness. Significant factor loadings with high coefficients within each factor are highlighted in bold.

Table 6. Factor Loadings Within the Second Step of Factor Analysis (After Rotation)

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Uniqueness
x1	**0.722**	0.498	-0.260	-0.183	0.130
x2	**0.925**	0.294	-0.099	-0.085	0.042
x3	-0.088	-0.231	**0.698**	-0.362	0.321
x4	**0.871**	-0.037	-0.128	-0.225	0.173
x5	-0.002	**0.820**	-0.095	0.185	0.285
x6	-0.004	-0.152	-0.067	**0.795**	0.340
x7	**0.891**	-0.159	0.196	-0.163	0.116
x8	**0.776**	-0.088	0.377	0.196	0.210
x9	**0.642**	-0.133	0.516	0.130	0.287
x10	**0.919**	0.281	-0.050	-0.068	0.069
x11	0.338	-0.081	**0.507**	0.037	0.621
x12	-0.346	-0.091	-0.045	**0.835**	0.172
x13	-0.060	-0.184	**0.865**	-0.004	0.214
x14	0.060	**0.936**	-0.059	-0.155	0.093
x15	-0.198	**-0.883**	0.220	0.148	0.110

Source: Compiled by the authors

To visualize the obtained results, we plot the distribution of factor loadings between the first two factors, leading in the share of explanatory variance (Fig. 2). The graph also shows the factor loadings that have the largest influence on Factor 1 and Factor 2.

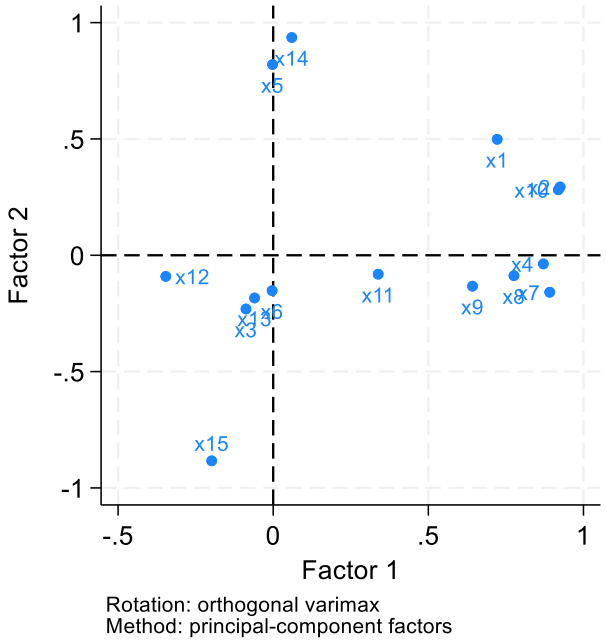

Figure 2. Graph of Factor Loadings Between Factor 1 and Factor 2

Source: Compiled by the authors

Additionally, to check the adequacy of the conducted factor analysis, Bartlett's test for sphericity (significant result) and Kaiser-Mayer-Olkin sampling adequacy criterion (significant result) were analyzed. The obtained results regarding the grouping of variables by factors can be presented in Table 7. All factors can be conditionally characterized as follows. Factor 1 included quantitative indicators of higher education, particularly the number of students, graduates and teachers, and directed financial resources. Factor 2 contains indicators on the ratio of higher education to the labour market and also includes an indicator of the ratio of students to teachers in higher education. Factor 3 mainly has qualitative characteristics of the educational process, particularly the share of the population with higher education, the participation of adults, and the specificity of graduates. Factor 4 contains gender indicators characterizing the educational process.

Table 7. Characteristics of the Variables Included in the Selected Factors Within the Factor Analysis

Factor 1		**Factor 2**		**Factor 3**		**Factor 4**	
x1	Number of students enrolled in higher education institutions	*x5*	The ratio of students and teachers in higher education	*x3*	The level of adult participation in the educational process	*x6*	The percentage of women among teachers in higher education
x2	The number of new entrants to institutions of higher education	*x14*	Unemployment rate among the population with higher education	*x11*	Number of graduates by level of higher education in science, mathematics, computing, engineering, production, construction	*x12*	The number of women among graduates by level of higher education
x4	The number of teachers and scientific and pedagogical workers in higher education	*x15*	The employment level among the population with higher education	*x13*	Share of the population with a higher education level		
x7	State spending on higher education						
x8	Private expenses for higher education						
x9	Financial assistance to higher education students						
x10	Number of graduates by higher education level						

Source: Compiled by the authors

As part of the second step of the comprehensive research of the higher education market in European countries, their clustering was carried out according to the selected variables included in the first factor. For a more thorough analysis, it was decided to compare how the distribution of clusters changed between the selected countries in 2017 and 2021. Ward's hierarchical and non-hierarchical k-means methods were chosen for the analysis; the results are shown below. Figures 3 and 4 show dendrograms based on the Ward's cluster analysis of the higher education market in European countries for 2017 and 2021.

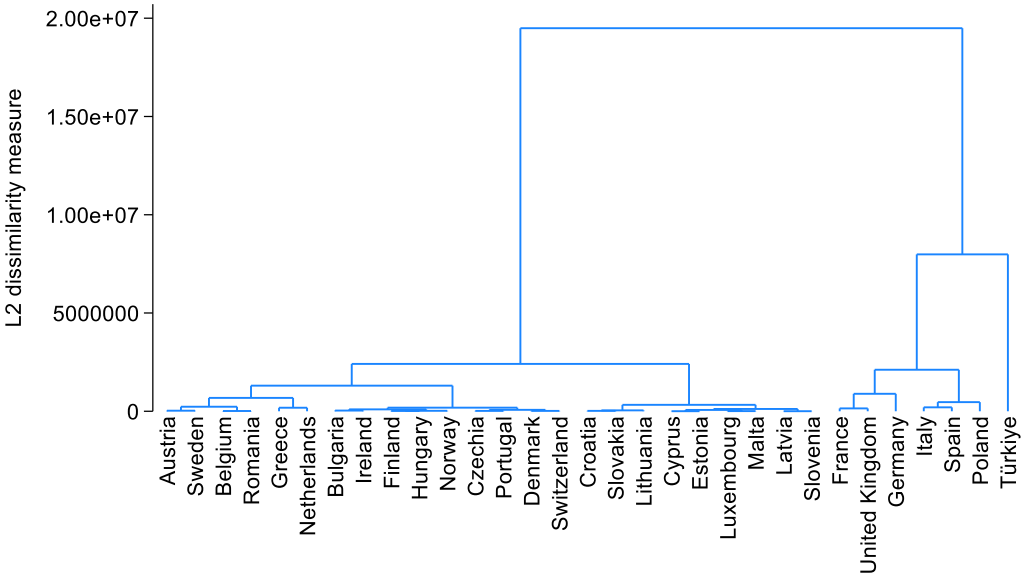

Figure 3. Dendrogram Based on the Results of Ward's Cluster Analysis of the Higher Education Market in European Countries for 2017

Source: Compiled by the authors

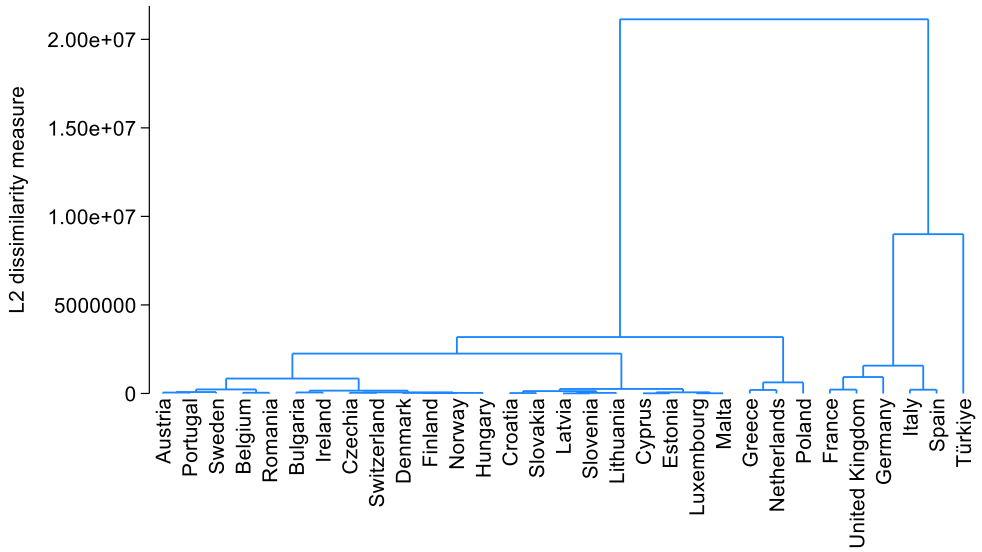

Figure 4. Dendrogram Based on the Results of Ward's Cluster Analysis of the Higher Education Market in European Countries for 2021

Source: Compiled by the authors

According to the results, five clusters were formed among European countries, which differ in the level of development of the higher education market. Their composition is shown in Table 8.

Table 8. Characteristics and Changes of Five Clusters Among European Countries that Differ in the Level of Development of the Higher Education Market for 2017 and 2021

	First cluster	Second cluster	Third cluster	Fourth cluster	Fifth cluster
2017	Hungary Switzerland Sweden Portugal Finland Czech Republic Austria Greece Netherlands Ireland Belgium Norway Bulgaria Romania Denmark	Cyprus Malta Estonia Luxembourg Lithuania Latvia Croatia Slovenia Slovakia	United Kingdom of France Germany	Italy Spain Poland	Turkey
2021	Romania Czech Republic Finland Switzerland Portugal Hungary Belgium Ireland Norway Austria Bulgaria Denmark Sweden	Luxembourg Slovenia Latvia Croatia Cyprus Estonia Malta Lithuania Slovakia	Poland Netherlands Greece	Italy UK France Spain Germany	Turkey

Source: Compiled by the authors

As one can see, the clusters are formed unevenly. The first cluster is the largest; it includes 15 countries in 2017 and 13 in 2021. The the fifth cluster is the smallest; it includes one country - Turkey, which differs from the rest of the countries in terms of geographical location and socio-economic development. It is separated into a separate cluster both in 2017 and in 2021. The conducted analysis proved that the composition of clusters has undergone certain changes over time. The preliminary construction of a mathematical model for a comprehensive study of the higher education market in 31 European countries based on factor analysis and clustering of the studied countries made it possible to identify five clusters, which made it possible to confirm the presence of structural differences in the development of their higher education markets and trace the peculiarities of their changes in the period before the pandemic and after.

In particular, this made it possible to prove that there are specific regional differences in the functioning of the European higher education market. In particular, the countries that in 2017 were part of Cluster 3 and in 2021 moved to Cluster 4 (the main participants are the United Kingdom, France, and Germany) have the most significant financial support for higher education. They also differ in the level of socio-economic development among other European countries. Turkey, which belongs to cluster 5, is the leader in the number of students enrolled at the higher education level in both 2017 and 2021. The most numerous 1st cluster, containing most of the countries of the European Union and their partners, has below-average indicators in terms of the number of students and teachers involved in higher education and its funding. The second cluster includes countries with a similar development path because they experienced the transition from a communist or socialist regime to a democracy and a market economy. They have the smallest number of students and teachers involved in higher education, and the most minor amounts are allocated for financing from both budgetary and private sources. It is worth noting that the average values for the number of students enrolled in higher education institutions and new entrants for 2017 (before the pandemic) and for 2021 (during the pandemic) decreased significantly; the increase was observed only in cluster 5 (Turkey).

Conclusions

This study aims to determine the determinants of leadership in higher education based on factor and cluster analysis. For this purpose, based on official statistical data of Eurostat, data on direct participants in the educational process (students, teachers, and graduates), peculiarities of education financing at the expense of state and private costs, employment of graduates of higher education, etc. have been collected. The data was collected for 31 European countries for five years, namely 2017-2021. All calculations within the scope of this study were performed in the STATA/SE 18.0 software package.

The factor analysis carried out using the method of principal components made it possible to identify the most significant variables characterizing the higher education market in the selected countries, in particular, the number of students enrolled in higher education institutions, the number of new entrants, the number of teachers and scientific and pedagogical workers in higher education, state and private expenses for higher education, financial assistance to students of higher education, number of graduates by level of higher education. These variables are the basis of a hierarchical cluster analysis using Ward's method, which made it possible to identify five clusters among European countries that differ in the higher education market's development level. This made it possible to highlight the countries that pay the most attention to the financial support of the higher education market (the main participants are the United Kingdom, France, and Germany).

Still, for most countries that are members of the European Union and their partners, the indicators of funding and the number of participants in the educational process had a downward trend in 2021 compared to 2017. The obtained results can be used by state and local authorities, as well as other interested parties, to harmonize the processes of reforming the higher education market and higher education institutions to improve the quality of educational services and their compliance with the needs of the labor market.

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