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Quality of Higher Education in EU Countries Assessed by Constructing a Composite Quality Index

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Abstract

Improving the quality of higher education is an increasingly important objective of any country's economic policy. Therefore, the evaluation of quality in higher education became important for the policy-decision makers and has led to the development of various methodologies by researchers over the years. In our paper we assessed the quality of higher education by constructing a composite index for a 3-year period, 2020-2022, considering ten variables reflected in four dimensions for the EU countries: teaching, research, institutional and economic dimensions.

In order to construct the quality indices, the principal component analysis (PCA) was applied to determine the importance of each variable; the weighting method was used to extract the factor coefficient score matrix loadings. This type of evaluation carried out regularly and objectively could represent an important support for the authorities and the higher education board members to improve the quality of their institution. By applying a panel data analysis, we measured the influence of some economic indicators on these quality indices. Through this study we observed the differences between EU countries in terms of higher education and the importance of each measurement dimension used. These findings can be used to compare the dynamics of higher education quality in each country.

Keywords: quality education, higher education, panel data analysis, composite index

Jel codes: B23, C33, C43, I21, I23



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1. Introduction

The subject of quality in education has been studied since 1948, when education was recognised as a human right by the adoption of the Universal Declaration of Human Rights, alongside health and shelter, and is a subject of great interest and topicality.

The quality of higher education is an important item for the whole world. Education has always faced challenges which it has tackled with the resources at its disposal, depending on economic and social developments, both nationally and globally. This has had a significant impact on the quality of the higher education sector. It is therefore important to continuously assess the quality of higher education in order to determine the level of quality in the light of current economic and social changes.

The need for a unified understanding of quality in education has arisen because there is still no unified definition of quality in education that includes social and academic values. At the same time, this definition should also consider existing educational policies and strategies at national, regional and local levels and take into account contextual and situational factors, as well as the evolution of the concept of "quality" (Iosifescu, 2007).

If in a company producing goods, quality can be quantified by the qualities of the resulting product, as far as education is concerned, on completion of studies, the graduate does not represent the final product, but its human development as added value and skills acquired by it (Popescu and Rusu, 2004).

The quality of education is an important pillar of educational reform both in Europe and in the world, a pillar that must be taken into account in the construction of national management and quality assurance systems (Minculescu, 2017).

Quality education can be seen as a series of descriptions of an educational offer and how it is delivered to meet the expectations of the recipients (Korka, 2009). Students who have found quality education to be very good are likely to exhibit a positive behavioural intention towards the institution (Hill, 1995). Currently, students are more critical of the provision of quality education compared to how it was in the past (Worlu et al., 2016). Thus, assessing student satisfaction is considered vital for higher education administrators when setting strategic goals (Oldfield and Baron, 2000). Various researchers have argued that the domain of educational service quality is a precursor to student satisfaction (Ogunnaikie et al., 2018; Zeithaml et al., 2009; Parasuraman et al., 1988).

Higher education plays an important and multifaceted role in the new global development agenda, which strives to reduce poverty while addressing social needs such as education, health, social protection, employment opportunities, climate change and environmental protection. All these areas and more are reflected in the 17 Sustainable Development Goals (SDGs) outlined by the United Nation in 2015.

The aim of the research is to assess the quality of higher education in the European Union's countries by constructing a composite index, through a multidimensional approach. To meet these objectives, we measured ten variables reflecting four dimensions: teaching, research, institutional and economic dimensions. *Principal Component Analysis* (PCA), a multivariate statistical method used to build composite weighted indices (Munda and Nardo, 2005; Döpke, Knabe, Lang and Maschke, 2017), was applied to identify the main components that explain as much of the original variance in the data as possible. The extraction of principal components is based on Kaiser's criteria and corresponds to eigenvalues greater than 1 and explains the highest percent of the total variance. The variables which explain the principal components extracted are the variables with highest factor loadings. After constructing the quality of higher education indices, in order to assess the influence of the main economic indicators on these indices, we estimate a cross-country time-series panel regression due to the short time period of our data (2020-2022).

The paper is structured as follows: in Section 2, we present a survey of the literature on the quality of higher education and the dimensions by which we can measure this quality. Section 3 describes the data and the methodology that are applied in the empirical study. Section 4, the empirical study, presents the results of constructing the quality indices and the estimated panel data model, while the last section presents the main conclusions.

2. Literature Review

Over time it has been observed that summative assessments and quantitative indicators have become preferred elements of quality control and have led to a focus on easily quantifiable goals of higher education, despite the disadvantages associated with such an approach (De Weert, 1990).

Researchers have ranked service quality as the most important driver of student satisfaction and the end result is student loyalty (Cronin et al., 2000; Patterson and Spreng, 1997). Nowadays, the notion of quality in tertiary institutions is considered very important for the student when deciding which university to attend.

According to Tan and Kek (2004), the quality of education is determined by the degree to which students' wishes and expectations are met.

Another important aspect of quality is quality assurance, which is a complex subject that addresses a variety of issues at both state and university level. Also included in quality assurance are attempts to ensure and improve the quality of teaching and learning through governance and/or management. Based on Tight's (2012) classification of higher education themes, quality assurance is part of the 'academic activity' category (e.g. course evaluation, grading and outcomes, monitoring practices and system standards), which is distinct from the 'institutional management' category (Tight, 2012). Compared to the literature on the field of higher education studies, the aspects that address the subject areas are "knowledge and subject matter aspects", "person or teaching and learning aspects" and "institutional, organisational and governance aspects" (Teichler, 2005).

In recent years, several researchers have studied the quality of higher education in different countries. Moreover, inter-university collaboration, partnerships with the government and civil societies are key factors influencing the quality of higher education (Wu and Shen, 2016). It is also influenced by economic and social factors, such as funding and investment, and the creation of community partnerships (Barlett and Chase, 2004). Although not all institutions engage in all these activities, the core initiatives of higher education effectiveness can be identified as: academic, operational and administrative (Owens, 2017).

For the evaluation of universities and degree programmes, a comprehensive evaluation system has been developed that includes four main dimensions (education, research, external relations, institutional capacity), to which integrated indicators and corresponding weights have been assigned (Miroiu, 2011). In this article we will focus on the evaluation dimensions related to the quality of higher education, namely the teaching dimension, the research dimension, the institutional dimension, and the economic dimension.

The teaching dimension

The teaching dimension addresses both teaching and learning at the level of each institution. The teaching dimension will also explore how learning and teaching is student centred as it plays an important role in stimulating motivation, self-reflection and student engagement in the learning process. This requires a careful analysis of the design and delivery of curricula, but also the assessment of teaching outcomes.

Some research specifies the ways in which the quality of teaching can be objectively measured using tools such as student evaluations, student interviews, administrative evaluations, learning outcomes assessments, teaching portfolios, and curriculum review (Berk, 2005; Chen & Hoshower, 2003; Hoyt & Perera, 2000).

In academic environment, there is a consensus to consider the ratio of the number of students to the number of teaching staff as an indicator to measure the quality of higher education from a teaching perspective. It is assumed that the smaller the number of students for whom a teacher is responsible for, the higher the quality of time in relation to each student (Murias, 2008).

Various studies (Hénard, 2010; OECD, 2008) recommend that universities should do more to develop quality teaching, especially in terms of improving pedagogy, supporting student learning and continuous teacher training.

The research dimension

The research dimension analyses the work carried out by academics, students and researchers in terms of innovation and contribution to the development of knowledge in the fields in which they work.

Higher education and research occupy an important place in all countries of the world. It is worth noting that research is at the forefront of funding and investment, and many emerging countries have started to pay more attention to this area in recent years, such as India, China, Malaysia and Brazil. This is leading to an increase in universities' interest in developing research centres. China has recently become the second largest country after the United States in terms of higher education, creativity and scientific innovation (Massoudi, 2018).

A good researcher is one who can understand and analyse problems that arise in his or her discipline and tries to formulate implementable solutions or experiments for them. It is necessary to search the existing literature, to select it, to analyse it, to read between the lines and to interpret it in order to make one's own original contribution through research papers, presentations or scientific experiments. While it is advisable for a researcher to be good at both, as it reflects the multifaceted and comprehensive nature of their academic excellence, it should not be the only metric by which a researcher is evaluated. It is highly plausible that a good academic is a good communicator and has the best mastery over his subject but is still not a very confident researcher and fails to blend his academic teachings with doctrinal and empirical ones (Naikade, 2020).

It can be understood that the performance of an institution or a department is based on the combined performance in research and teaching (Bliss and Fahrney, Steffy, 1996).

The institutional dimension

The institutional dimension is focused on the efforts made by universities to attract the students and to make the transition from high school to university easier. The institutional dimension of higher education is made up of the tools used by each university to support the well-being of its students by offering facilities to help them in their professional development. This dimension also includes universities' concerns for internationalisation, both by attracting foreign students and by offering mobility opportunities for students and staff. Support from higher education institutions can come in different forms, such as offering places in dormitories or scholarships.

The economic dimension

The economic dimension analyses the influence of economic factors on the quality of higher education. The links between education and economic growth have been studied over time. It has been found that higher levels of education in the population are positively associated with economic growth. Education promotes productivity, innovation and technological advances, which are essential for economic growth. For example, countries such as Japan, South Korea and Taiwan have experienced remarkable economic growth over the last few decades due to investment in human capital development, primarily education. One of the studies contributing to this area of research was conducted by Aghion et al. (2009). The authors constructed models that account for the effect of investment in education on GDP and introduced effects such as skilled labour migration into their models. In conclusion, the paper finds support for the hypothesis that investment in education does indeed boost economic growth.

3. Data & Methodology

In the paper we construct a composite index for each of the EU countries in order to assess the quality of higher education. We use the main indicators to record the quality in higher education, for each of the four dimensions (teaching, research, institutional and economic dimensions). According to the methodology presented by OECD (2008), we apply the principal components analysis (PCA) in order to select the components which explain the most important percent of the total variance and then to select the significant variables which explain each component extracted, based on the factor loadings.

For constructing the indices, ten variables were selected to be analysed for the period 2020-2022. Datasets were collected for the 27 European Union countries, by consulting different databases such as the OECD, EUROSTAT, UNESCO Institute for Statistics, Scimago Journal & Country Rank.

Table 1: Description of variables

Variables	Definition
Number of papers cited	Number of documents cited at least once in the three previous years
Ratio_number of papers published _R&D personnel	The ratio of number of papers published to the R&D personnel by higher education sector
Citations per Document	Average citations per document in a 2-year period. It is computed considering the number of citations received by a journal in the current year to the documents published in the two previous years, --i.e. citations received in year X to documents published in years X-1 and X-2.
International Collaboration (%)	Document ratio whose affiliation includes more than one country address
H index	The h index is a country's number of articles (h) that have received at least h citations
Skills Activation	Skills Activation includes indicators of the transition from education to work, together with labour market activity rates for different groups of the population, to identify those which have a greater or lesser representation in the labour market.
Employment rate (%)	The percentage of total population employed (resident population concept - LFS) from 20 to 64 years
Early leavers from education and training (age 18-24) (%)	The percentage of population, aged 18 to 24 years, that leaves education and training
Skills Development	Represents the training and education activities of the country and the immediate outputs of that system in terms of the skills developed and attained. Sub-pillars are included to distinguish compulsory education, and other education and training (lifelong learning) activities.
Tertiary educational attainment (%)	The percentage of tertiary educational attainment from 25 to 34 years

In order to assess the influence of the main economic indicators on these indices, we then estimate, due to the short time period of the data, a simple pooled OLS model with country fixed effects.

The econometric specification for using panel data is as follows:

$$Quality_indices_{i,t} = \beta_0 + \beta_1 Gov_allocation_RD_{i,t} + \beta_2 GDP_{i,t} + \beta_3 Ratio_universities_ranking_{i,t} + \varepsilon_{i,t}$$

where $Gov_allocation_{i,t}$ is the percentage of GDP (%) allocated for research and development, $GDP_{i,t}$ is the GDP per capita (US\$) and $Ratio_universities_ranking_{i,t}$ is the ratio of number of universities in Academic Ranking of World Universities (Shanghai Ranking) to the total number of higher education institutions in country (%).

The coefficients β_i , $i = 1,2,3$ are the coefficients associated with the explanatory variables and the term ε is the error term, i indicates the countries and t the time period.

4. Results

The results of the empirical study concern the values obtained for the quality of higher education indices constructed for each of the EU countries and the estimations of the panel data model.

Construction of quality of higher education indices

Principal component analysis (PCA) was used to analyze the 10 variables and to extract the factor coefficient score matrices. Of these, four principal components were used for further analysis. Principal component analysis was applied using Varimax rotation of the axes. Factors for which eigenvalues are greater than 1 were selected. Each sub-indicator was assigned weights using the PCA weighting method to obtain a composite index for each country. Through the PCA method, we were able both to calculate the weight of the variables' importance in explaining the factors and to identify the importance of the factors in the total variation.

After determining the importance of the variables in explaining each factor, we proceeded with the calculation of the weight of the importance of variables and factor loadings were obtained. Each sub-indicator has been assigned weights, as shown in Table 2, using the PCA weighting method to obtain a composite index for each country.

Table 2: Weights of importance of the variables in explaining each factor for 2020, 2021, 2022

2020				2021				2022			
F1	F2	F3	F4	F1	F2	F3	F4	F1	F2	F3	F4
0.0000	0.4988	0.0001	0.0000	0.0000	0.4966	0.0001	0.0000	0.0000	0.4689	0.0002	0.0001
0.0036	0.0034	0.0000	0.4860	0.0022	0.0063	0.0000	0.4431	0.0061	0.0116	0.0000	0.4489
0.2653	0.0016	0.0003	0.0002	0.2881	0.0007	0.0010	0.0001	0.2720	0.0000	0.0003	0.0020
0.3103	0.0001	0.0079	0.0006	0.2747	0.0002	0.0103	0.0011	0.2980	0.0001	0.0105	0.0015
0.0024	0.4757	0.0000	0.0000	0.0017	0.4690	0.0000	0.0000	0.0010	0.4721	0.0000	0.0000
0.0043	0.0004	0.4024	0.0029	0.0046	0.0002	0.4107	0.0023	0.0029	0.0001	0.4311	0.0013
0.0000	0.0000	0.5879	0.0000	0.0000	0.0000	0.5773	0.0000	0.0000	0.0000	0.5577	0.0000
0.0006	0.0052	0.0013	0.5102	0.0002	0.0066	0.0005	0.5532	0.0003	0.0157	0.0002	0.5450
0.2842	0.0000	0.0000	0.0001	0.3011	0.0000	0.0000	0.0001	0.2942	0.0001	0.0000	0.0012
0.1293	0.0149	0.0000	0.0000	0.1273	0.0204	0.0000	0.0000	0.1256	0.0314	0.0000	0.0000

Source: Authors' calculations

Using the factor loadings from the previous table and the weighting of importance of the variables in explaining each factor, we were able to calculate the values of the indices for each country, shown in Tabel 3.

Table 3: Sub-index values for each country over a 3-year period

Country	Sub-index values		
	2020	2021	2022
Austria	0.4211	0.3785	0.3666
Belgium	0.2451	0.1795	0.1807
Bulgaria	-0.7791	-0.7980	-0.8583
Croatia	-0.9000	-0.8880	-0.8310
Cyprus	0.3892	0.3231	0.3382
Czechia	-0.1059	-0.1297	-0.1317
Denmark	0.5812	0.6601	0.6470
Estonia	0.1240	0.1339	0.2030
Finland	0.3555	0.3591	0.3477
France	0.3512	0.3433	0.2462
Germany	0.8662	0.9354	0.9243
Greece	-0.7701	-0.7643	-0.6407
Hungary	-0.1904	-0.1688	-0.1991
Ireland	0.2021	0.2531	0.2988
Italy	0.0871	0.0220	-0.0219
Latvia	-0.5025	-0.6102	-0.4997
Lithuania	-0.4325	-0.3923	-0.4266
Luxembourg	0.4859	0.5623	0.4406
Malta	-0.0165	0.0413	0.0334
Netherlands	0.8700	0.8467	0.8177
Poland	-0.5719	-0.4454	-0.4413
Portugal	-0.1506	-0.2259	-0.2273
Romania	-0.7245	-0.6864	-0.5898
Slovakia	-0.6225	-0.6540	-0.6837
Slovenia	-0.1996	-0.2305	-0.2070
Spain	0.1066	0.0295	-0.0041
Sweden	0.8810	0.9257	0.9184

Source: Authors' calculations

In order to emphasize the differences between EU countries based on the values from the previous table, we represent the next diagram (Figure 1).

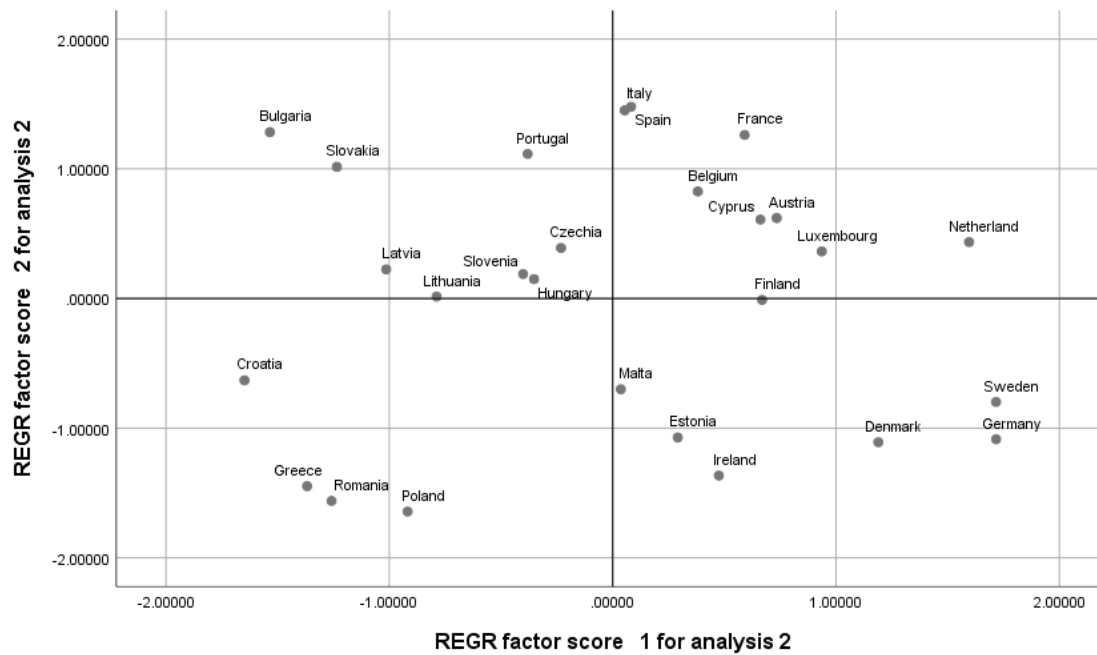


Figure 1. Composite indices comparison between EU countries

Source: Authors' calculations using SPSS software

The diagram in *Figure 1* shows the important differences between Croatia, Bulgaria, Greece, Slovakia, Latvia, Romania, on the one side, and Germany, Sweden, and the Netherlands, on the other side.

We can also conclude that the countries from the first group can be considered as the group with a lower quality of higher education, while the other countries can be interpreted as having a higher quality of the tertiary education system.

Panel data estimations

By considering as dependent variable the quality of higher education indices, we estimate a pooled OLS model using country fixed effects. We choose this model to capture heterogeneity between countries through the individual intercept value. The estimations are presented below.

Table 4: Coefficients for the panel data model using as dependent variable the quality of higher education indices

Variables	Coefficients
Constant	-0.217*** (0.063)
Gov_allocation _t	0.050 (0.081)
GDP _t	0.410*** (0.094)
Ratio_universities_ranking _t	0.453* (0.247)
Adjusted R ²	0.997
F-statistic	1028.902
Observations	81

Standard errors in parentheses.

***p<0.01; **p<0.05; *p<0.1.

Source: Authors' calculations using E-Views software

The estimations show the statistically significant influence of GDP per capita and the ratio of the universities in academic rankings on the quality of higher education indices. The quality of higher education indices reacts positively to increasing GDP per capita and the ratio of the universities in academic rankings among EU countries.

5. Conclusions

The multidimensional approach to the quality of higher education was achieved by considering four dimensions through which higher education can be analysed: teaching, research, institutional and economic dimensions. For each dimension, the most relevant variables were selected, according to the literature, data availability and the specificities of the countries in the European Union for the period 2020-2022.

First, we used principal components analysis to calculate the quality of higher education indices for each country. We obtained four principal components of the constructed model. Then we assigned weights to the 10 sub-indicators using the Varimax method of principal components analysis to construct an index of higher education quality.

By applying the principal component analysis, we obtained the factor loadings, which were used for calculating the weights of each variable contributing to the composite index values. Thus, it was possible to determine an index for each of the countries analysed and for each year. Based on these results we made a comparative analysis and ranking of the quality of higher education between European Union's countries.

By considering as dependent variable the quality of higher education indices, we estimate a pooled OLS model using country fixed effects and we obtained that the GDP per capita and the ratio of the universities in academic rankings have a positive influence on the quality of higher education.

Enhancing the quality of higher education requires each stakeholder within the system to consider their role in contributing to improvement. The complexity of the system necessitates the use of various indicators to assess its quality. Therefore, all ten variables analysed can greatly influence the overall quality of higher education. Strong performance in specific dimensions of higher education does not necessarily translate to an overall improvement in quality. Germany, Netherlands and Sweden have the highest indices across the 3-year period and for these three countries the research, teaching and institutional dimensions have the highest weights out of the 27 countries analysed when we constructed the composite quality indices.

The establishment and advancement of higher education undergoes a perpetual and extensive evolution, with a harmonious and secure progression leading to the creation of a superior higher education framework that subsequently enhances societal progress.

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