"Assessing the impact of higher education competitiveness on the level of socio-economic development of a country"

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ASSESSING THE IMPACT OF HIGHER EDUCATION COMPETITIVENESS ON THE LEVEL OF SOCIO-ECONOMIC DEVELOPMENT OF A COUNTRY

Abstract

The study is devoted to the investigation of the educational determinants as components in shaping the level of socio-economic development of countries around the world, including assessment of the impact of national higher education system development indicators on the determinants of economic development, in particular macroeconomic, innovation, and technology determinants.

Based on the grouping of 50 countries, a matrix of relationships between the Universitas 21 index and global competitiveness index was constructed. It is determined that despite the close correlation between the indices as a whole (0.96), there is a certain differentiation of influence in groups. The high impact of education on global competitiveness (0.76) was found in the group of countries with a medium level of competitiveness, moderate impact (0.54) – in the group of highly competitive countries, weak impact (0.38) – in the group of countries with a low level of competitiveness. Based on the correlation-regression analysis, the study proposes a structural-logical graph of the relationship between educational and economic indicators and quantifies it accordingly. The results show that the level of higher education competitiveness is closely correlated with such indicators as the level of global innovation development (0.8 over the period 2012-2020), the level of the knowledge intensity of GDP (0.73), and the level of socio-economic development (0.75). The results will allow changes in education indicators to be taken into account in the context of their impact on economic development and global development strategies.

Keywords	higher education system, global competitiveness, global innovation level, U21 ranking

JEL Classification	I25, O10, C10

INTRODUCTION

One of the defining features of modern world economy in the context of globalization is a constant strengthening of competition between the national economies of the world, which occurs due to the transition to an innovative model of development and the formation of a new model of economic development – the "knowledge-based economy". The characteristic features of these trends are the increasing role of information and communication technologies in the production and development of highly intelligent services. It is largely conditioned by the growing importance of the higher education system as one of the main factors of growth in the quality of human capital, a generator of new ideas, and a significant factor in the dynamic socio-economic development of countries at this stage.

Nowadays higher education is largely determined by the state and development of the national economy. On the other hand, quantitative and qualitative indicators of the development of the national higher education system are the markers of socio-economic and innovative

development; they form the level of international competitiveness. In this aspect, interdisciplinary research in the field of higher education-economics, especially in measuring and predicting the quantitative and qualitative effects, despite their high prevalence, does not lose relevance.

Higher education institutions are significant elements of the modern global economic system (Marchenko & Sydorenko, 2019); they determine trends in human development and create opportunities for implementing lifelong learning (Levchenko et al., 2017), which within a changing economic environment is the main condition for adaptation to changes. The quality of educational services, the ability to provide effective training of personnel affects the socio-economic potential of the country (Rokanuzzaman, 2016; Castro & Tomàs-Folch, 2015).

Thus, it is necessary to take into account the speed of changes occurring both in the educational and global economic environment, especially in conditions of instability and increased risks. The issues of assessing the patterns of educational systems, especially the higher education system, and indicators that reflect them, including trends in the socio-economic development of countries and regions, require further research.

1. LITERATURE REVIEW

Impact of higher education on the overall economic situation of the country and the well-being of the population is widely covered in the literature. At the same time, the tools of statistical analysis and economic and mathematical modeling in the aspect of quantitative measurement of the impact of educational indicators on economic development are most often used as methodological tools. Based on the literature review, it can be concluded that it is possible to identify several general areas of research, in particular: education as a factor of economic growth and development; education as an element of innovative development; education as a factor of competitiveness; and education as a factor of security, sustainability, and sustainable development.

The first line focuses on evaluating the educational system as a factor of economic growth. On the examples of different countries or their groups, the specifics of effects of education are determined. Using the example of 16 developing countries, the relationship between the gross education rate and economic growth (educational indicators) was evaluated, taking into account gender differences, in particular the difference in the impact of female and male education rates on economic growth. The evaluation allowed concluding that economic growth plays an important role in the development of education that does not affect economic growth, although there are certain differences, respectively, in some countries of the sample, the

impact of male education on economic growth was found (Bektur & Aydin, 2020).

In the same aspect, but using the example of ASEAN-5 countries, the role of education in the economic systems of countries is determined. The nonlinear regression models were used to prove the existence of a nonlinear influence. Namely, the time-series kink and the panel kink regressions were considered. Educational indicators used in the models were government spending on the higher education per student, admission rates of all levels of education, skilled human recourses, and employment rates with advance deduction. As a result, it is proved that secondary education is mainly a factor of economic growth, while higher education acts as a factor of future growth and sustainability (Maneejuk & Yamaka, 2021).

The specifics of the impact of education are evaluated at the macroeconomic level. Thus, using the example of Spain, the impact of secondary and higher education, quantified by secondary and tertiary enrollment rates, on the economic development of countries (assessed by the GDP indicator) was evaluated. It also proves that there is a non-linear relationship between indicators and the significant impact of higher education on the dynamics of economic growth (Marquez-Ramos & Mourelle, 2019).

Based on thorough research of the educational systems of European countries, in particular,

the Czech Republic and Norway (Kohoutek et al., 2017), Croatia, Slovenia, and Hungary (Stimac et al., 2015), it was noted that the higher education system, represented by a set of higher educational institutions that should interact with each other in the field of educational and research activities, is a significant element of the national innovation system. Effective development of education creates a competitive inspiring climate that affects the growth of the national economy, ensures an increase in the level of well-being and quality of life.

Accordingly, the second area of research in this sphere is the assessment of education as an element of the innovation system, a factor in ensuring innovative and technological development and growth. Among such studies, it is worth mentioning the comparative analysis of the impact of ICT and education on the development of various groups of countries, in particular the Middle East and OECD countries (34 countries) using OLS fixed-effect and GMM methods (Habibi & Zabardast, 2020). Among the educational indicators, only one is taken into account – the gross enrollment ratio; the remaining indicators mainly characterize the level of information technology and the overall digitalization rate. Thus, it was noted that in countries with better access to the education system, the development of information and communication technologies contributes most to economic growth.

Bileviciute et al. (2019) proved the hypothesis of the significant role of higher education institutions in ensuring economic growth and creating a contemporary knowledge-based economy. It was determined that higher education, in particular higher education institutions as its main elements, acts as generators of innovative ideas and developments, which contribute to the creation of new jobs, ensure technological growth and progress. At the same time, attention is focused on the fact that an effective management system for a modern educational institution and innovative technologies used in education, in turn, create the foundations for a high level of international competitiveness

The third direction is the study of education as a factor in the formation of competitiveness. Thus, Lopez-Leyva and Rhoades (2016) used the exam-

ple of two groups of countries (Asian and Latin American countries) to assess the relationship between the Global Competitiveness Index and its some sub-components that directly characterize higher education. By quantifying relationships, differences among countries and their causes were identified.

Bilbokaite and Bilbokaitė-Skiauterienė (2018) studied the importance of higher education in the formation of regional competitiveness analyzing the impact of university activities on the development of regional economy. It was determined that the impact of higher education on the region should mainly manifest itself through the formation of human capital, professional development of the labor force, present conditions for continuous learning as well as the introduction of knowledge and innovation in the region against the background of close cooperation with business.

According to Neamtu and Burac (2015), increasing the level of competitiveness and maintaining it at a sufficient level seems possible through effective investment in the higher education system by both state and private investors. The return on investment in higher education correlates with the rate of economic growth (McMahon, 2018).

The fourth direction can be noted in the assessment of education from the point of view of the foundation for economic security, sustainable development, and sustainability. In particular, education can act as a component of socio-economic security (Bulatova & Hrybinenko, 2020). Such educational indicators as government expenditure on education in GDP, local enrollment rates, and education indices as a component of the Human Development Index were considered. Their impact on the level of social security was assessed while determining groups by the level of danger of development in the educational sphere.

Krstić et al. (2020) investigated the higher education system in the context of sustainable development. Using correlation and the regression analysis, several hypotheses on the example of 32 European countries were explored: whether higher education acts as a determinant of competitiveness; whether higher education provides prerequisites for achieving sustainable develop-

ment; and how the quality of higher education determines the advantages of the national economic system as a whole. As the basis of quantitative performance meters, the global competitiveness index of WEF and sub-pillar "Future Orientation of Government" were used. The explanatory was expressed by the skills of graduates, critical thinking in the teaching process, academic works, publicity of research institutes, total government expenses on higher education, patent requests, basic digital skills, and international cooperation. As a result of the analysis, the importance of higher education in the formation of sustainable development of national economies in Europe was emphasized.

In terms of achieving sustainable development goals, education is evaluated by Adeniyi et al. (2021), who used the example of West African countries. The role of all parts of the educational system in inclusive growth using the ARDL modeling approach was determined. Primary and secondary school entries and human capital index are used as educational indicators, and level of inflation, foreign direct investment (percent of GDP), public consumption (percent of GDP), GDP per person employed, and labor force participation rate are used as indicators of economic development. The results revealed the impact of primary education on the possibility of sustainable economic growth in both the short and long term, while secondary education to a lesser extent in the majority of least developed countries in Africa determines the prospects for sustainable growth.

Based on the above, the following general features can be summarized:

1) Focus on a specific country (macro level), a group of countries united on a regional or integration basis, or the level of socio-economic development (international level). It is the choice of the object of research that determines the nature of conclusions and affects the evaluation of results.

2) Use as educational indicators of individual quantitative indicators that reflect only a single aspect of the development of the education system per its level: primary, secondary, and higher.

3) Use of correlation and regression modeling tools in combination with a meaningful analysis of trends in the development of the educational system, which allows confirming certain hypotheses based on quantitative calculation results.

Education is an important driver of social and economic development, a powerful tool for reducing poverty, improving health, and promoting gender equality, peace, and stability. Education provides large consistent returns in terms of income and acts as a factor for equality of opportunity. For the individual, education promotes employment, higher income, a better quality of life; for society, it promotes long-term economic growth, increased innovation, strengthened institutions, and social cohesion (World Bank, 2021a).

The level of education determines not only intellectual potential of a person and level of competitiveness in the labor market. It also forms the intellectual and production-economic potential of the national economic system as a whole, acts as a factor in the growth of welfare, quality of life, level of competitiveness and innovativeness of the country and its position in the world economic space.

The level of development of the education system, in particular higher education, in which not only the educational but also the research component occupies an important place, determines the innovative potential of the country and forms the level of the innovative national economic system as a whole. For the economy, the development of higher education is an important factor in promoting global value chains beyond simple production processes and products, increasing the level of competitiveness within the global economic system. Universities can accumulate research potential, contributing to the development, implementation, and use of innovations in different areas of economic life. Education develops in close correlation with the labor market, hence ensures the renewal of the workforce following the needs of the market, increases the level of youth involvement in the working population, and promotes the level of professionalism and qualifications.

2. AIM AND OBJECTIVES

The study aims to determine the role of educational components in shaping the level of socio-economic development of countries around the world, including assessment of the impact of national higher education system development indicators on the determinants of economic development, in particular macroeconomic and innovation and technology.

The research objectives are:

- Systematization of educational and economic indicators of development of countries;

- Development of a logical and structural scheme that reflects the key relationships between educational and economic indicators of the development of countries around the world;

- Grouping countries by the level of development of the higher education system and the level of global competitiveness; combining the results of grouping and identifying clusters of countries that will be characterized by different states of the higher education system and the level of international competitiveness;

- Conducting economic and mathematical analysis and modeling, which allows quantifying the impact of the level of competitiveness of the higher education system on the system of socio-economic indicators of the country.

3. METHODOLOGY

The study is based on the following assumptions and using the following methods:

- The state of the higher education system from the point of view of quantitative assessment criteria is systematically and comprehensively characterized not by individual indicators but by complex integral ones. Among the latter, there is higher education competitiveness index, which was chosen as a key influence factor in the study (an explanatory feature in regression models);

- Countries have different levels of development of higher education, on the one hand, and, accordingly, different levels of international competitiveness, on the other hand. As a result, before assessing the relationship between educational and economic indicators, it is worth considering these differences and dividing countries into groups according to their belonging to different levels. For this purpose, the study used *statistical grouping tools*. According to the higher education competitiveness index (U21) and global competitiveness index (GCI), three groups were formed according to the level (low, medium, and high). Index intervals are determined by grouping with equal intervals.

- The study used *sampling methods*, in particular, the sample included 50 countries, which is taken into account in the international rating Universitas 21.

- The use of *correlation and regression analysis and modeling tools* by sampling countries allows determining the features of relationships, their nature, and dynamics of change.

The *information base* of the study consists of data from the international ranking Universitas 21 (higher education competitiveness index), the international ranking of countries by the level of competitiveness by WEF (global competitiveness index), the international ranking of countries innovation development by Cornell INSEAD WIPO (global innovation index), and World Bank indicators (R&D expenditure, labor force participation rate for youth, labor force with advanced education, GDP per capita, GDP growth, medium and high-tech industry, high-technology exports, unemployment, youth).

4. RESULTS AND DISCUSSION

The international ranking Universitas 21 (U21) has been assessing the competitive position of national education systems in 50 countries since 2012. It is designed as a benchmark for governments, educational institutions, and the public; it aims to identify the importance of creating a strong environment for higher education insti-

Table 1. Countries with the highest level of higher education competitiveness in 2012–2020

Country	2012		2013		2014		2015		2016		2017		2018		2019		2020	
	score	rank	score	rank	score	rank	score	rank	score	rank	score	rank	score	rank	score	rank	score	rank
United States	100	1	100	1	100	1	100	1	100	1	100	1	100	1	100	1	100	1
Switzerland	80	5	82	3	82	6	87	2	87	2	87	2	88	2	89	2	90	2
Denmark	80	6	80	5	83	3	85	3	85	3	84	4	82	5	83	5	86	3
Singapore	76	11	77	9	76	10	80	9	81	8	81	6	80	9	81	7	85	4
Sweden	84	2	85	2	87	2	85	5	82	5	83	5	82	4	83	4	84	5
United Kingdom	77	10	75	10	79	8	81	8	84	4	86	3	83	3	85	3	84	6
Canada	83	3	80	4	83	4	83	6	80	9	80	7	80	8	82	6	83	7
Finland	81	4	79	6	88	5	85	4	82	6	80	9	80	6	80	9	83	8
Australia	78	7	77	8	78	9	77	10	78	10	80	10	79	10	81	8	82	9
Netherlands	77	8	78	7	80	7	82	7	82	7	80	8	80	6	80	10	82	10
Ukraine	59	24	49	36	44	43	44	41	42	42	48	35	47	38	45	38	48	36

tutions, their contribution to the socio-economic and cultural development of countries, and the provision of high-quality educational services and research (Universitas 21, 2021a). The U21 assessment of higher education consists of four components (performance, resources, connections, and environment), which are the main determinants of their competitiveness and determine the position of a country in the global educational space.

The dynamics of the competitiveness indexes of the higher education system and rating assessments of countries that are the main leaders in 2020 data are presented in Table 1. The table also shows changes in the level of competitiveness of the higher education system of Ukraine.

In the U21 rankings, the USA remains the unchanged leader (with the highest score and the first place in the rankings). Switzerland (12.5% increase, moving from 5th to 2nd place), Denmark (7.5% increase, from 6th to 3rd), Singapore (11.8% increase, from 11th to 4th), and the UK (9.1% increase, from 10th to 6th) improved their positions in 2021 comparing to 2020 results. On the contrary, Sweden (from 2nd to 5th), Canada (from 3rd to 7th), Finland (from 4th to 8th), Australia (from 7th to 9th), and the Netherlands (from 8th to 10th)

weakened their positions. It should be noted that the competitiveness index of these countries has increased or remained unchanged. Ukraine shows a significant deterioration in its ranking over the period 2012-2020 from 24th to 36th place and a decrease of 18.6% in the index score.

The relationship between education and socio-economic development through a system of quantitative measurement and impact indicators is presented in Figure 1.

According to the logic of relationships presented in Figure 1, a quantitative assessment of the impact of higher education on socio-economic development was conducted in the study using the tools of correlation and regression analysis.

The results of grouping countries by the level of competitiveness of the higher education system (U21) and level of global competitiveness are presented in Table 2.

The results show that 50% of the sample countries are characterized by a low level of competitiveness of the higher education system, while only 20% of countries have a low level of competitiveness. 30% and 32% of the sample countries, respectively, are assigned to the group
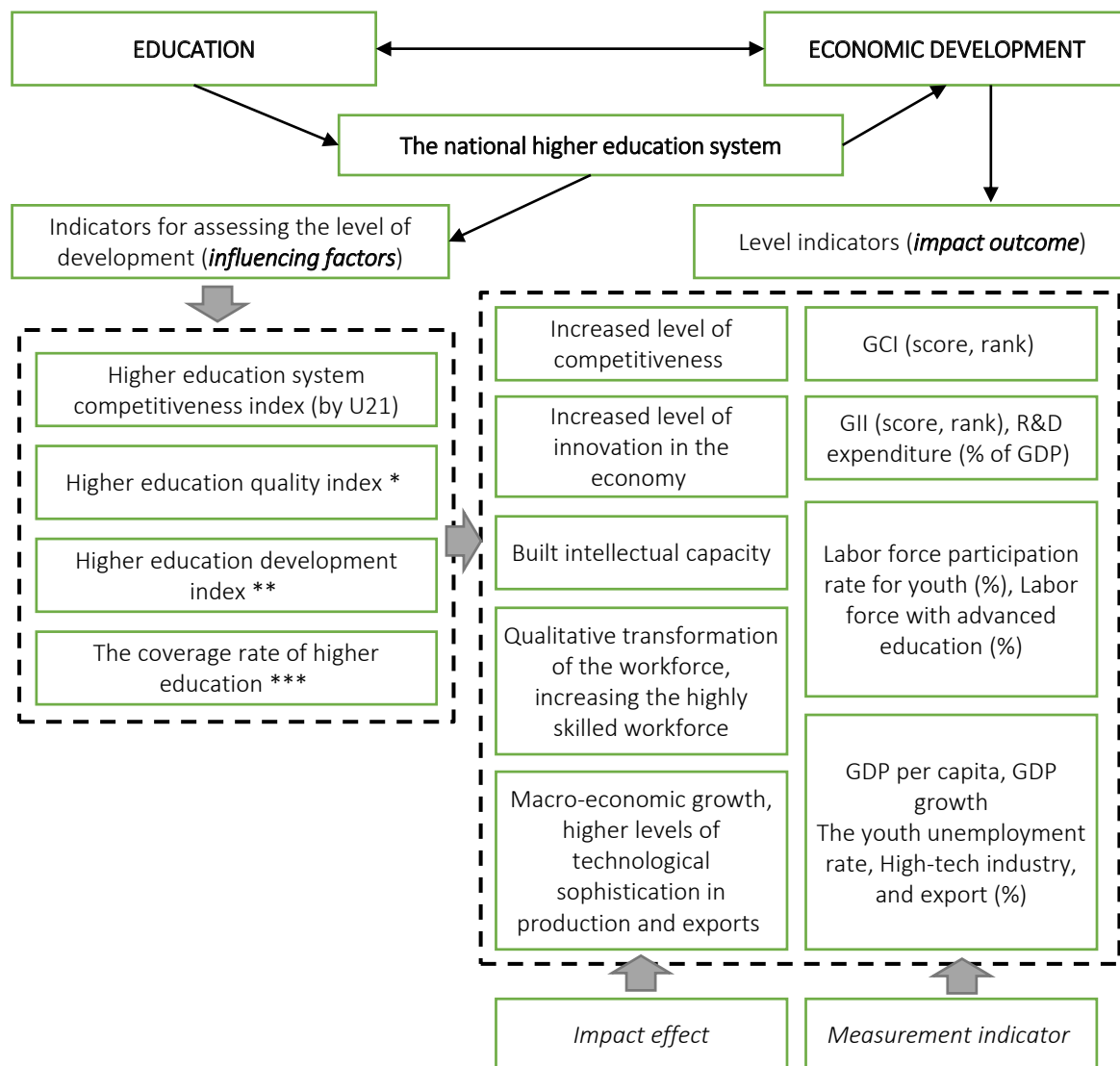
Note: * means a component of the Global Competitiveness Index (GCI) until 2017 (5th pillar: Higher education and training, 5.03 Quality of the education system); ** means a component of the Global Innovation Index (GII, P2. Human capital and Research, 2.2. Tertiary education); and *** means enrollment rates, tertiary education (% gross).

Figure 1. Structural and logical relationships in the system for assessing the impact of education system development and economic security

Table 2. Grouping of countries by U21 and GCI

Group by level	U21 (2019)		Number	Share, %	GCI, 2019		Number	Share, %
Low	33.5	55.7	25	50	53	63.6	10	20
Medium	55.7	77.8	15	30	63.6	74.2	16	32
High	77.8	100.0	10	20	74.2	84.8	24	48

with an average level of competitiveness of both the higher education system and the national economy as a whole. 20% of the sample countries have a high level of higher education competitiveness, while 48% are highly competitive in the global dimension.

From the point of view of statistical assessment, the differences in the distribution of countries by indicators are explained as follows:

- The level variation is the largest for the index of higher education competitiveness. Thus, the

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quadratic coefficient of variation is 27.2% versus 11.7% for the GCI variation. Consequently, countries are more differentiated precisely in terms of the development of educational competitiveness.

- The asymmetry in the distribution over the two indices is significant in magnitude, but opposite in direction. Thus, according to the U21 index, the asymmetry coefficient is 0.47, which indicates left-hand (positive) asymmetry, that is, most countries have a lower-than-average educational competitiveness index. According to GCI, the situation is opposite: the asymmetry is −0.31 (right-hand, positive), respectively, most countries have an above-average level of global competitiveness.

Table 3 shows combination of both distributions resulted in a matrix of countries based on the relationship between educational and global competitiveness.

Relying on the results, the following conclusions are made:

- Four clusters of countries are identified. L-L (10 countries with both a low level of global competitiveness and a low level of higher education competitiveness). L-M (the largest group of 14 countries with an average level of global competitiveness, while the level of higher education competitiveness is low. H-M (13 countries with a high level of global competitiveness and an average level of higher education competitiveness). H-H (10 countries with both a high level of global competitiveness and higher education competitiveness).

- As a result of the assessment of the close relationship, the presence of a close correlation (r = 0.958) between the indexes of educational competitiveness and global competitiveness for a set of countries as a whole was deter-

Table 3. Country distribution matrix based on the relationship between the level of higher education competitiveness and global competitiveness

Source: Authors' elaboration.

		Higher education competitiveness (U21 score 2019) (r = 0.958)			Correlation index
		Low (L)	Medium	High	
Global competitiveness (GCI score 2019)	Low (L)	(10) India, Iran, Croatia, Turkey, Serbia, Brazil, Argentina, Ukraine, Greece, South Africa (r = 0.376)	–	–	(r = 0.376)
	Medium	(14) Indonesia, Mexico, Thailand, Romania, Bulgaria, Hungary, Russian Federation, Slovak Republic, Chile, Poland, Italy, Slovenia, Czech Republic, China (r = 0.750)	(2) Portugal, Saudi Arabia	–	(r = 0.763)
	High	(1) Malaysia	(13) Spain, Korea, Taiwan, Japan, Ireland, Israel, France, Germany, Hong Kong SAR, New Zealand, Belgium, Austria, Norway (r = −0.116)	(10) Netherlands, Finland, Australia, Singapore, Canada, Denmark, Sweden, United Kingdom, Switzerland, United States, (r = 0.443)	(r = 0.543)
Correlation index		(r = 0.699)	(r = 0.282)	(r = 0.443)	–

mined. At the same time, a significant differentiation in the tightness of influence across different groups of countries was revealed.

- The high impact of education on the level of global competitiveness (r = 0.763) was found in the group of countries with an average level of competitiveness, moderate impact (r = 0.543) – in the group of highly competitive countries according to GCI, weak impact (r = 0.376) – in the group of countries with a low level of competitiveness.

- For different groups in terms of the higher education competitiveness, the greatest impact, measured by a correlation coefficient of 0.699, on the level of global competitiveness was found among countries with a low level of development of the higher education system.

- According to the selected clusters of countries, the most significant correlation between the indexes was found in the L-M Group (r = 0.750). For these countries, an increase in the level of educational competitiveness can be considered as a significant driving force for the growth of global competitiveness.

- For the cluster of leading countries in both H-H indexes, no significant correlation was found (r = 0.443). Respectively, if a high level of development of the higher education system is achieved, its impact on ensuring high positions in global competitiveness goes to secondary positions.

Thus, the growth of the level of competitiveness is due to the influence of the level of higher education development, while in countries with the highest level of global competitiveness, higher education does not act as the main determinant of the growth of competitive advantages, but the basis for the development of other components.

Based on the graph of relationships (Figure 1) for a sample of countries (Group H-N + Ukraine), a quantitative assessment of the level and intensity of correlation between the index of higher education competitiveness (factor attribute, impact indicator) and indicators of socio-economic development (effective signs, indicators of change) was carried out, the results of which are presented in Table 2.

The results show that the level of higher education competitiveness is strongly correlated (r > 0.7) with indicators such as the level of competitiveness (GCI), the level of innovation development (GII), the level of the knowledge intensity of GDP (R&D expenditure in GDP), and the level of socio-economic development (GDP per capita). In addition, all of these indicators are characterized by a pattern of increasing intensity of the impact of the educational components on their change. Thus, the correlation index between U21 and GCI increased by 35%, between U21 and GII by 51%, between U21 and R&D expenditure by 22%, and between U21 and GDP per capita by 56%.

A moderate relationship, increasing in intensity by a factor of 2.52, was found between the U21 Index and the labor force participation rate for youth

Table 4. Dynamics of correlation indices between the U21 higher education competitiveness index and selected economic development indicators

Indicators	2012	2013	2014	2015	2016	2017	2018	2019	2020	2012–2020
GCI (score)	0.68	0.81	0.87	0.91	0.93	0.93	0.93	0.92	–	0.87
GII (score)	0.56	0.79	0.84	0.86	0.90	0.83	0.80	0.84	0.85	0.80
R&D expenditure (% of GDP)	0.61	0.71	0.81	0.76	0.76	0.73	0.75	–	–	0.73
Labor force participation rate for youth (%)	0.23	0.34	0.43	0.50	0.53	0.53	0.54	0.57	0.58	0.48
Labor force with advanced education (%)	−0.55	−0.48	0.21	0.21	0.31	0.32	0.25	0.50	–	0.21
GDP per capita (USD)	0.55	0.69	0.71	0.79	0.83	0.82	0.83	0.86	–	0.75
GDP growth, %	0.11	0.21	0.76	0.88	−0.12	−0.09	−0.28	−0.50	–	0.35
Medium and high-tech industry, %	0.09	0.11	0.24	0.39	0.44	0.43	0.44	–	–	0.31
High technology exports (%)	0.12	0.23	0.15	0.25	0.34	0.26	0.24	0.13	–	0.20
Unemployment, youth (%)	0.08	−0.05	−0.34	−0.50	−0.68	−0.57	−0.60	−0.62	−0.61	−0.43

Note: Pearson correlation coefficients are calculated for a sample of 11 countries, by year separately.

and, on the other hand, an inverse, increasing in intensity, a moderate relationship was found with the youth unemployment rate.

The remaining economic indicators correlate weakly with the level of higher education competitiveness; however, it should be noted:

- In some periods (2014 and 2015), a significant impact on economic growth was identified, despite a low estimate of the overall impact (0.35);

- A significant increase in the intensity of the impact on the level of manufacturability of production activities was identified (by a factor of 4.9 over the study period, maximum correlation in 2016 and 2018 – 0.44).

The results confirm the empirical evidence, including that the countries with the highest positions in the competitiveness ranking of higher education systems are countries with a high level of socio-economic development, international competitiveness, and innovative development, and a sufficient level of knowledge-intensive GDP (Table 3).

Thus, the surveyed countries (except for Ukraine) are among the 20 most competitive and innovative countries in the world. Their level of socio-economic development in terms of GDP per capita is 4-7 times higher than the average for the world economy. Half of the countries in the sample have a science-intensive GDP indicator above the global average. There is also a correlation between the

change over the period between the ranking positions of the higher education system and the decrease or a corresponding increase in the positions and scores of economic indicators.

The results of modeling the impact of changes in the competitiveness index of higher education on changes in economic development indicators are presented in Figure 2.

It can be stated that an 84.68% change in the country's global competitiveness index can be explained by a change in the competitiveness index of higher education, with a 1-point change in the U21 index causing a 0.53 increase in the GCI. The 71.46% change in global innovation score is due to a variation of the U21 index, whose 1 unit change causes a 0.54 change in the GII score. The level of higher education competitiveness determines the level of socio-economic development by 73.31%, the GDP per capita increases by $1,270.5 with the growth of the U21 index. The 55.61% variation in R&D expenditure is correlated with changes in the level of educational competitiveness.

Similar calculations were made with other educational impact factors (Figure 1), namely, the correlation of socio-economic indicators with the integral index of higher education quality (Table 4) and the integral index of higher education development (Table 5) was assessed.

As indicated by the coefficients obtained, in addition to the fact that higher education quality sub-score in the GCI has a strong correlation

Table 5. Economic development indicators for the sample countries

Source: World Bank (2021b), World Economic Forum (2020), Global Innovation Index (2020).

Countries	GCI (rank)		GII (rank)		GDP per capita (current USD)			R&D expenditure (% of GDP)		
	2012	2019	2012	2020	2012	2019	Growth rate, %	2012	2018	Growth rate, %
United States	7	2	10	3	51,611	65,298	26.5	2.68	2.84	5.8
Switzerland	1	5	1	1	83,538	81,994	−1.8	3.19	3.37	5.9
Denmark	12	10	7	6	58,508	60,170	2.8	2.98	3.06	2.8
Singapore	2	1	3	8	55,546	65,233	17.4	1.92	1.94	1.3
Sweden	4	8	2	2	58,038	51,615	−11.1	3.28	3.34	1.9
United Kingdom	8	9	5	4	42,463	42,330	−0.3	1.59	1.72	8.2
Canada	14	14	12	17	52,678	46,195	−12.3	1.78	1.57	−11.8
Finland	3	11	4	7	47,711	48,783	2.2	3.42	2.77	−18.9
Australia	20	16	23	23	68,012	55,060	−19.0	2.18	1.87	−14.0
Netherlands	5	4	6	5	50,073	52,331	4.5	1.92	2.16	12.9
Ukraine	73	85	63	45	3,855	3,659	−5.1	0.75	0.47	−37.3
World	–	–	–	–	10,607	11,442	7.9	2.04	2.27	11.3
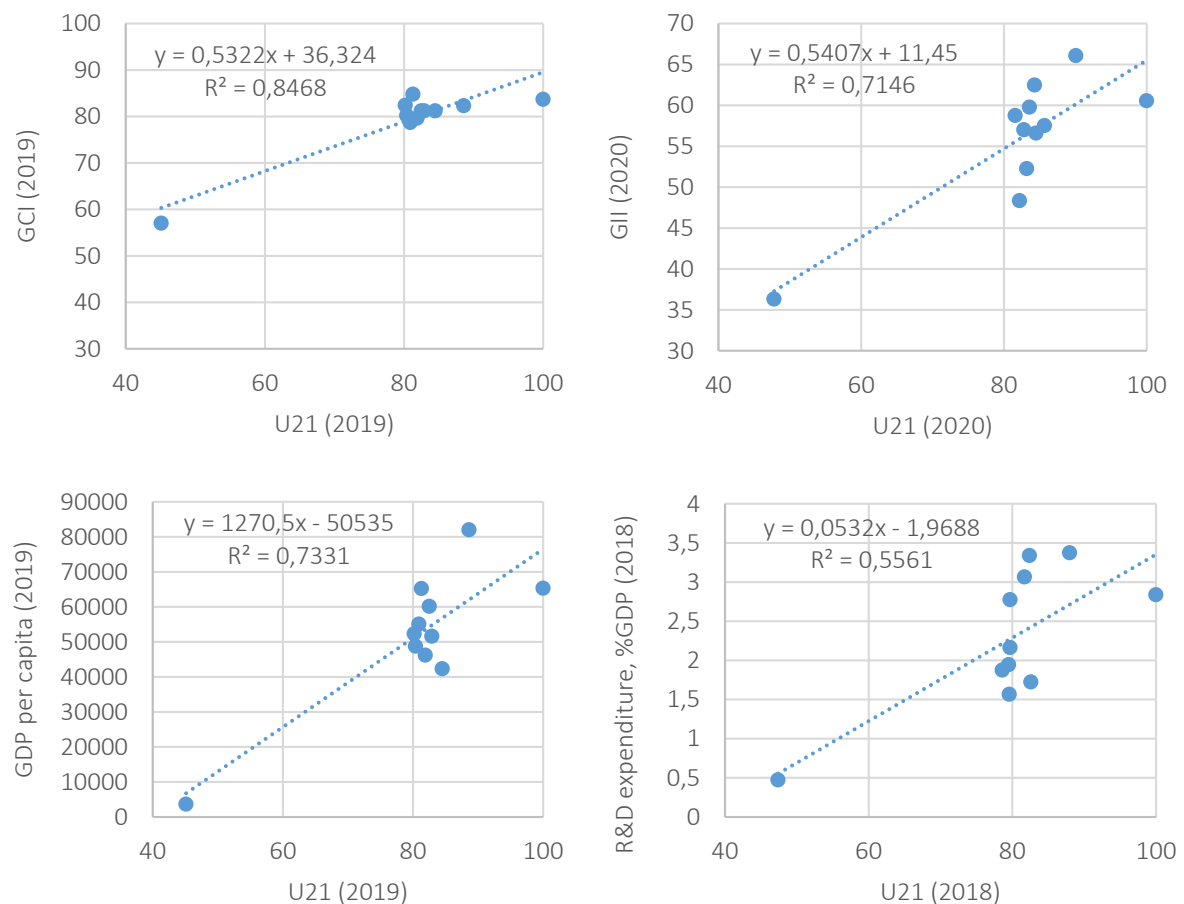
Figure 2. Correlation between the level of competitiveness of U21 higher education systems and socio-economic development indicators

Table 6. Correlation indices between the quality index of higher education (GCI component) and selected indicators of economic development

Indicators	2012	2013	2014	2015	2016	2017	2012–2017
GCI (score)	0.85	0.82	0.76	0.74	0.75	0.81	0.79
GII (score)	0.85	0.75	0.66	0.67	0.65	0.68	0.71
R&D expenditure (% of GDP)	0.64	0.54	0.47	0.50	0.44	0.58	0.53
Labor force participation rate for youth (%),	0.28	0.26	0.30	0.36	0.39	0.42	0.33
Labor force with advanced education (%)	−0.16	−0.20	0.18	0.13	0.16	0.05	0.07
GDP per capita (USD)	0.79	0.73	0.68	0.71	0.80	0.83	0.73
GDP growth, %	0.03	0.21	0.52	0.46	0.15	0.26	0.30
Medium and high-tech industry, %	0.48	0.42	0.61	0.55	0.65	0.62	0.54
High technology exports (%)	0.50	0.48	0.50	0.53	0.56	0.34	0.47
Unemployment, youth (%)	−0.40	−0.38	−0.58	−0.51	−0.65	−0.52	−0.51

Note: Pearson correlation coefficients are calculated for a sample of 11 countries, by year separately.

with the level of socio-economic development (GDP per capita) and the level of innovation development (GII), a moderate correlation with indicators of innovation and technological development of countries, in particular with the level of science intensity of the GDP (R&D expenditure in the GDP), the level of technology in production and export, and a moderate inverse relationship with youth unemployment rate was detected.

Table 7. Correlation indices between the higher education development index (GII component) and selected indicators of economic development

Indicators	2012	2013	2014	2015	2016	2017	2018	2019	2020	2012–2020
GCI (score)	0.20	0.19	0.26	0.23	0.21	0.14	0.07	0.23	–	0.18
GII (score)	0.24	0.08	0.12	0.10	0.10	−0.01	0.03	0.07	−0.06	0.08
R&D expenditure (% of GDP)	0.05	0.17	−0.01	−0.01	−0.10	−0.14	−0.20	–	–	−0.02
Labor force participation rate for youth (%),	−0.62	−0.61	−0.43	−0.37	−0.35	−0.25	−0.24	−0.29	−0.10	−0.35
Labor force with advanced education (%)	0.15	0.24	0.31	0.28	0.30	0.31	0.37	0.28		0.23
GDP per capita (USD)	0.11	0.09	0.15	0.17	0.18	0.19	0.17	0.23	–	0.14
GDP growth, %	0.47	0.41	0.37	0.18	0.57	0.50	0.19	−0.55	–	0.25
Medium and high-tech industry, %	0.65	0.61	0.74	0.73	0.77	0.68	0.69	0.70	–	0.67
High technology exports (%)	0.65	0.70	0.64	0.59	0.63	0.50	0.50	–	–	0.58
Unemployment, youth (%)	−0.23	−0.12	−0.32	−0.16	−0.27	−0.09	−0.02	0.01	−0.02	−0.14

Note: Pearson correlation coefficients are calculated for a sample of 11 countries, by year separately.

If the level of higher education development is taken into account in the GII sub-sample, the correlation indices show no significant correlation of the indicator with key macroeconomic indicators. In general, this component has little correlation with the overall index of global innovation. However, there is a clear correlation (close in some periods) with innovation-technology indicators, in particular with the level of industrial technology (0.67 on average) and high-tech exports (0.58 on average).

CONCLUSION

The study proposes a logical-structural approach to a comprehensive quantitative assessment of the relationships between the system of higher education development indicators and the determinants of socio-economic development, including indicators of competitiveness, innovation and technological development, macroeconomic indicators, and indicators of human, intellectual, and labor potential development.

The results showed that 50% of the sample countries are characterized by a low level of higher education competitiveness, while only 20% of countries have a low level of competitiveness. In contrast, 20% of the sample countries have a high level of higher education competitiveness, while 48% are highly competitive in the global dimension. From the point of view of static analysis, these differences are due to the varying degree of variation and asymmetry of the development of countries according to the studied indexes.

A matrix of relationships between the level of educational and global competitiveness of countries is obtained, the assessment of which made it possible to determine in general the presence of a close correlation (0.958) with significant differentiation of the tightness of influence in different groups of countries. The close impact of education on the level of global competitiveness (r = 0.763) was found in the group of countries with an average level of competitiveness, moderate impact (r = 0.543) – in the group of highly competitive countries, weak impact (r = 0.376) – in the group of countries with a low level of competitiveness. The greatest impact (r = 0.699) of education on the level of global competitiveness was found among countries with a low level of development of the higher education system. It is noted that for these countries with low educational competitiveness and an average level of global competitiveness, the higher education system can be considered as a significant driving force for the growth of global competitiveness. For the leading countries in both indexes, no significant correlation was found (r = 0.443). Respectively, if a high level of development of the higher education system is achieved, its impact on ensuring high positions in global competitiveness goes to secondary positions.

Using the tools of correlation, regression analysis, and modeling, these relationships have been assessed based on a sample of countries whose national higher education systems are the most competitive in the world. The results confirm the conclusion that countries with high competitiveness of higher education systems have correspondingly high levels of socio-economic development, international competitiveness and innovative development, and sufficient levels of knowledge-intensive GDP.

The calculations confirm the dependence of high-tech production and exports on the quality of the higher education system, as well as the dependence of the labor market, in particular in terms of youth employment, on the competitiveness of the education system.

The study supports the hypothesis that the educational component is important for economic growth and strengthening of competitive positions in the global economic space. Accordingly, further studies should focus on assessing the strengths and weaknesses in shaping the level of higher education competitiveness. This will allow identifying areas for improvement in an unstable economic environment and constant transformational changes in the professional and educational space, and correlating them with the conditions for sustainable socio-economic development and growth.

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