The Impact of Higher Education on Global Competitiveness: A Panel Data Analysis for OECD Countries

Kadir SAİN
Gazi University, Education of Philosophy Group, Ankara, Turkey.
ORCID: 0000-0002-6923-5268
e-mail: sainkadir33@gmail.com

Kurtuluş BOZKURT
Aydın Adnan Menderes University, Söke Faculty of Management, Department of Economics, Aydın, Turkey. ORCID: 0000-0002-9098-9208
e-mail: kurtulus.bozkurt@adu.edu.tr

Eren Alper YILMAZ*
Aydın Adnan Menderes University, Söke Faculty of Management, Department of Public Administration, Aydın, Turkey. ORCID: 0000-0002-5137-4948
e-mail: alpery@adu.edu.tr

Received: 17 December 2022; Accepted: 19 March 2024.

Summary: In this article, the impact of higher education on global competitiveness in the Organization for Economic Cooperation and Development (OECD) countries has been analyzed empirically. For this purpose, a dataset consisting of 18 OECD countries, including the period 2004–2018, was formed by using databases obtained from the OECD, World Bank (WB), World Economic Forum (WEF), and the United Nations Educational and Scientific and Cultural Organization (UNESCO). In the application phase, Elena I. Dumitrescu and Christophe Hurlin's (2012) Granger Panel Causality Test was used to reveal whether there is a short-term relationship between each variable representing higher education and the variable representing global competitiveness (Global Competitiveness Index), whereas Joakim Westerlund's (2007) Panel Cointegration Test was used to reveal whether there is a long-term relationship. Consequently, it has been determined that there is a causality relationship between each variable representing higher education and the Global Competitiveness Index in the short term and a cointegration relationship in the long term.
Keywords: Higher education, Global competitiveness, Panel data analysis.
JEL: I23, F60, C23

Introduction

Higher education fulfills many important roles for countries to achieve global competitiveness. However, examining the literature on global competition, the factors affecting global competitiveness are mostly technology, innovation, research and

* Corresponding author

development (R&D), domestic–foreign trade volume, import–export balance, and exchange rate. Although higher education activates many important factors affecting global competitiveness, studies on the effect or relationship of higher education on global competitiveness have been very limited. In addition, it has been observed that most of the studies on global competitiveness are conducted in areas such as economics, econometrics, business administration, finance, international relations, and public administration. In the fields of education and sociology, the relevant subject has not been sufficiently emphasized. However, the phenomenon of global competitiveness has a structure that can be explained by the combination of different disciplines.

In this study, the effect of higher education on global competitiveness in the OECD countries including Turkey between the years 2004–2018 was analyzed. The study is serious in terms of revealing the leading and determining role of higher education in global competitiveness; analyzing the impact of each of the unique variables representing higher education on global competitiveness; using panel data analysis (causality and cointegration tests), which is an econometric method; and focusing on an interdisciplinary approach that brings education, sociology, economics, and econometrics together. In this direction, it was aimed to put forward some suggestions to guide researchers, educators, and policymakers on the impact of higher education on global competitiveness in OECD countries.

The first chapter of the article focuses on the globalization of competition and the definition of the concept of global competitiveness. The second chapter presents the main factors that provide competitiveness advantage (2.1) and the factors affecting global competitiveness according to WEF (2.2). The third chapter emphasizes how higher education affects global competitiveness. The fourth chapter presents the literature. The fifth chapter presents the dataset, method, and application results of the article. Finally, the sixth chapter shows the results and recommendations.

1. Globalization of Competition and the Concept of Global Competitiveness

While competition is previously seen between limited companies, sectors, and countries over limited products and services, it has now reached a dimension that covers societies globally, where globalization has reached a dizzying speed, with the effect of developments in information, communication, and transportation technologies. Moreover, the increasing international mobility of goods, services, and people; abolishing or stretching the terms of agreements limiting international trade; economic integration in the world at an increasing rate; and increasing tendencies of liberalization, deregulation, and privatization have brought a global dimension to competition.

Different definitions of global competitiveness have been made in the literature. According to Jan Fagerberg (1988), global competitiveness is the ability of a country to realize its basic economic policy goals, especially economic growth and employment increase, without causing balance of payments problems. According to Michael E. Porter (1990), it is the effort of a country to gain the ability to compete

against rival countries by using its existing resources efficiently and effectively. According to James R. Markusen (1992), it is the ability of a country to maintain a real national income growth equal to that of its trading partners by keeping its foreign trade in balance under free foreign trade conditions. According to Karl Aiginger (1998), it is the ability of a country to sell a targeted number of products and services to world markets, in an environment that will satisfy the people of the country economically, socially, and environmentally, by obtaining the desired factor income today and in the future.

According to Stephane Garelli (2005), it is the ability of a country to establish and maintain an environment that creates more value for its firms and sustains greater prosperity for its people. According to the WEF (2018), it is a set of factors, policies, and institutions that determine the productivity level of a country. According to Çoşkun C. Aktan and İstiklal Y. Vural (2004), it is the struggle of a country to produce products and services in the desired quantity and quality in accordance with the standards and demands of international markets. Finally, according to Yusuf Bayraktutan and Hanife Bıdırdı (2016), it is the ability of a country to increase its level of employment, raise the life quality to an acceptable level, and increase its international market share, as well as maintain its foreign trade balance.

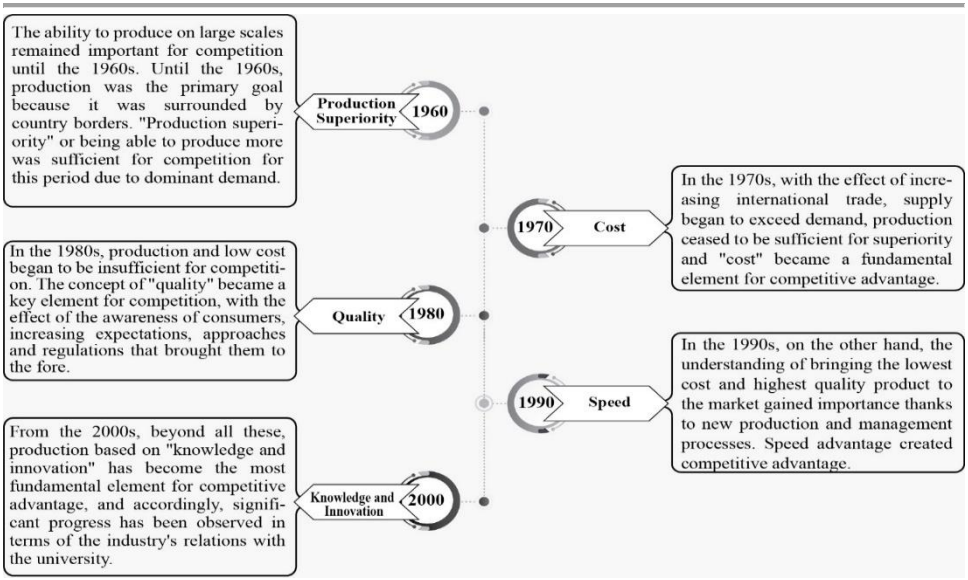
In the most general sense, global competitiveness is a country's struggle to obtain a central position in the global world system. In this context, global competitiveness is the struggle of countries to get a desired factor income, to create satisfactory economic and social conditions for the people of the country, to increase the real income and living standards of its citizens, to raise the productivity and the welfare level, and to produce products and services in desired quantity and quality following standards and demands of the international markets.

2. Getting Power in Global Competitiveness

The ability of countries to compete in the global arena depends on the fulfillment of two interrelated conditions. These are as follows: (1) being aware of the key elements that provide competitive advantage and (2) determining the factors affecting global competitiveness correctly and putting into practice strategies, policies, and practices that can meet emerging needs.

2.1. Key Elements that Provide Competitive Advantage

The main elements that provide a competitive advantage are shown in Figure 1.



Source: Mahmut Kiper (2010). It was created by the researchers using this source.

Figure 1 Key Elements that Provide Competitive Advantage

Accordingly, production superiority, that is, production on large scales in the 1960s; low-cost production in the 1970s; quality production at the lowest cost in the 1980s; putting into the lowest cost and high-quality product in the shortest time in the 1990s; and production based on advanced knowledge, technology, and innovation with high-added value in the 2000s became the main factor that provides a competitive advantage for a country.

2.2. WEF and Factors Affecting Global Competitiveness

In the reports published under the Global Competitiveness Report since 1979, WEF evaluates the global competitiveness of countries included in the index based on multiple criteria, mutually analyzes the strengths and weaknesses of the countries that affect competitiveness, and ranks the countries with a comprehensive and regularly developed methodology.

In 2018, WEF changed its methodology and made it more compatible with the current economic structure. Accordingly, the new index method called “Global Competitiveness Index 4.0” has included and evaluated the characteristics of the Industry 4.0 period, which is an important stage for the global economy.

Examining the report published in 2018, it can be seen that the index is collected under four subheadings. The four subindices, divided into enabling environment,

human capital, markets, and innovation ecosystem, contain a total of 12 subheadings (see Table 1). As a result of the evaluation made within the framework of these headings, countries are scored based on subcriteria, and their rankings are included in different categories. Within the framework of these criteria, an evaluation is made between 0 and 100 points, and country rankings are calculated according to the average of 12 subheadings (WEF, 2018).

The Global Competitiveness Report implemented by the WEF and the index it contains stand out because it benefits from a large dataset published by countries and international organizations, including its scientifically accepted methodology, its coverage of a large number of countries (140 countries in the 2018 report), and its inclusion of the characteristics of the Industry 4.0 era in its criteria.

On the other hand, when the index calculation is examined, it is seen that a total of 98 variables are used in the calculation of 12 subheadings. It should be discussed that only a total of 10 variables were taken as a basis for health (1) and skills (9), whereas 54 variables were taken as a basis for institutions (20), infrastructure (12), labor market (12), and innovation ability (10). Indeed, the human capital created by education (skills) and health is a driving factor for other elements. Qualified and healthy human resources form the basis for a growing and competitive economy.

Table 1 Factors Affecting Global Competitiveness

Enabling Environment	**Markets**
1. Institutions	7. Product market
2. Infrastructure	8. Labor market
3. ICT adoption	9. Financial system
4. Microeconomic stability	10. Market size
Human Capital	**Innovation Ecosystem**
5. Health	11. Business dynamism
6. Skills	12. Innovation capability

Source: WEF (2018).

According to the Global Competitiveness Index 4.0 developed by WEF (2018), 12 main factors affecting the global competitiveness of countries are discussed below.

2.2.1 Institutions

The quality of a country's institutions is vital for its sustainable economic growth and development and for achieving competitiveness in the global arena. The high level of institutionalization of public and private institutions shaping the institutional environment of a country increases the level of investment, production, and productivity of the country and ensures the building of an environment of trust in the country.

2.2.2 Infrastructure

The uninterrupted, effective, and efficient functioning of economic activities in a country is directly linked to its infrastructure opportunities. High-quality transportation networks (highways, railways, seaways, ports, airlines) owned by the country are critical for the safe and timely delivery of goods and services produced into the markets. In addition, the fact that the production centers (enterprises, factories, industry) operating in the country do not face interruptions in the production processes depends on the robustness and comprehensiveness of electricity, water, communication, and telecommunication infrastructures. In short, an advanced infrastructure provides countries with competitiveness by reducing transportation and transaction costs, increasing the mobility of people and goods, and facilitating and accelerating the transfer of information on a local/regional/global scale.

2.2.3 Information and Communication Technologies Adoption

The adoption of information and communication technologies has a significant impact on the reduction of transaction costs in a country, the acceleration of the exchange of information and ideas, the increase in efficiency, and the triggering of innovation. Because information and communication technologies are general-purpose technologies that are increasingly involved in the structure of today's information economy, they have become necessary for all economies as power and transportation infrastructures. In this context, the degree of dissemination and adoption of specific information and communication technologies has been associated with the degree to which countries gain competitive advantage.

2.2.4 Macroeconomic Stability

For a country to make its economic activities sustainable and to gain global competitiveness, it must first establish macroeconomic stability. The establishment of macroeconomic stability is linked to inflation and the sustainability of fiscal policies. Moderate and predictable inflation and sustainable public budgets reduce uncertainties and set return expectations for investments and increase job confidence. As a natural consequence of this, productivity increases. In addition, in an increasingly interconnected world where the flow of capital is accelerating, the decline or loss of confidence in macroeconomic stability can trigger capital flight with destabilizing economic effects.

2.2.5 Health

Health is an indispensable element for the efficiency, productivity, creativity, and competitiveness of the workforce in a country. Health is a prerequisite for individuals to receive education; to acquire the knowledge, skills, and abilities needed in the education process; to transform these gains into social and economic benefits; and to participate actively in the production process. Healthy individuals have more physical and mental abilities than unhealthy individuals: they become more productive and creative. In addition, as the expectation of a healthy life increases, there is a tendency

to invest more in education. Thus, healthier children become adults with stronger cognitive abilities.

2.2.6 Skills

One of the most fundamental factors determining the competitiveness of a country in the global arena is the general skill level of the workforce. What determines the general skill level of the workforce is the quantity and quality of education. Education plays a dominant role in providing the workforce with the necessary skills and competencies. Indeed, higher education has important responsibilities for the highly qualified workforce resource, high value-added production, and innovations needed to increase competitiveness. Highly educated people are more productive because they have more collective ability to perform tasks, transfer knowledge quickly, and create new knowledge and applications.

2.2.7 Product Market

Competition encourages companies to innovate; to increase productivity gains; to update their products, services, and organizations; and to supply the best possible products at the lowest price. The fact that innovative products and services with high-added value are in demand in global markets is an important issue for countries to gain competitiveness. In this context, countries are required to analyze the supply–demand balance and the product–market balance correctly and offer the products and services they have created to the appropriate markets.

2.2.8 Labor Market

The labor market encompasses, in the most general sense, “flexibility” (to what extent human resources can be reorganized) and “talent management” (to what extent human resources are utilized). Well-functioning labor markets increase productivity by matching employees with jobs that best suit their skills and developing their capabilities to reach their full potential. Well-functioning labor markets combine flexibility with the protection of workers' fundamental rights, allowing countries to be more resilient to shocks and reallocate production to emerging segments. In addition, these markets try to motivate, attract, and retain talents while encouraging employees to take risks.

2.2.9 Financial System

The financial system covers the availability and stability of financial products such as credit, equity, debt, and insurance in a country, that is, the reduction of excessive risk-taking and opportunistic behaviors of the financial system. An effective financial system increases productivity in the country and gains competitiveness. An advanced financial system generally promotes productivity in three ways: (1) to convert savings into productive investments; (2) to improve capital allocation to the most promising investments by monitoring debtors, reducing information asymmetries; and (3) to provide an efficient payment system. At the same time, financial institutions need to

be properly regulated to avoid financial crises that may have long-term adverse effects on investments and productivity.

2.2.10 Market Size

Market size refers to the sum of the size of domestic and foreign markets, accessible by the companies of a country, and the consumption, investment, and export values. Larger markets increase productivity through economies of scale: the unit cost of production tends to fall with the amount of output produced. On the other hand, large markets also encourage innovation. In addition, large markets create positive externalities because the accumulation of human capital and the transfer of knowledge increase returns according to the scale built into the creation of technology or knowledge. Due to the aforementioned effects, the size of a country's market has a significant impact on global competitiveness.

2.2.11 Business Dynamism

Business dynamism, in its most general sense, refers to the capacity of the private sector to produce and adopt new technologies and new ways of organizing business through a culture that embraces change, risk, new business models, and administrative rules that allow firms to enter and exit the market easily. An agile and dynamic private sector increases productivity by taking commercial risks, testing new ideas, and creating innovative products and services. In an environment where businesses and sectors are frequently interrupted and redefined, successful economic systems are resistant to technological shocks and can constantly redesign themselves.

2.2.12 Innovation Capability

The innovation capability of a country depends on the quantity and quality of its R&D; the extent to which the country's environment encourages cooperation, creativity, diversity, and different visions; and the capacity to transform ideas into new goods and services. Countries that can build more knowledge and offer better collaborative or interdisciplinary opportunities tend to have more capacity to build innovative ideas and new business models that are considered drivers of economic growth. In particular, the development speed of information technologies and their contribution to the production process give countries competitiveness in terms of innovation.

3. Ways in Which Higher Education Affects Global Competitiveness

The global competitive environment is based on an economic platform in which knowledge, technology, innovation and R&D activities are decisive. The basic condition of having power in this economic platform is to transform the scientific knowledge resulting from scientific studies into new technologies and innovations and to present them to global markets. This new economy (knowledge economy) based on information and digitization has created a great innovation in world trade and economy by paving the way for a global network economy that eliminates borders in trade (Muhittin Adıgüzel, 2011).

Strong and dynamic educational institutions indirectly affect and shape today's economies in many ways. Especially in the information society and economy, where information has become the main production factor, higher education institutions, which are the main production centers of high-quality information with added value, have important duties.

Higher education institutions have become the leader in today's world in revealing and developing a qualified, efficient, productive, healthy, and entrepreneurial workforce that can respond to the conditions, needs, and expectations of the period; in revealing qualified scientific knowledge with an understanding of interdisciplinary education and research; in catching the integrity in the information–technology–innovation chain; in producing high value-added products and services; in increasing efficiency and productivity; in developing R&D activities; in ensuring the development of entrepreneurship culture and its integration into society; in increasing economic and social capital by developing relations with all local, regional and global stakeholders (industry trade business, nongovernmental organizations, public–private institutions); in putting forward strategies, policies, and solutions against economic, ecological, social, cultural, and political problems in local, regional, and global scale; in overcoming the middle income trap; in achieving sustainable economic growth and development; and in indirectly fulfilling many important roles to achieve power and success in global competitiveness.

Higher education institutions indirectly influence and shape global competitiveness in many ways by competing globally by developing strategies, policies, and projects against problems (economic, social, cultural, political) that are becoming more complex and diverse day by day; by introducing advanced technologies and innovations with qualified human resources and high value-added scientific knowledge; by increasing efficiency and productivity; by providing power and functionality to R&D activities; by ensuring that the culture of entrepreneurship is established in the society (Henry Etzkowitz and Loet Leydesdorff, 2000; Pasi Sahlberg 2006; Simon Marginson 2006; Henry Etzkowitz 2008; Philip G. Altbach, Liz Reisberg, and Laura E. Rumbley 2010; Lineta Ramoniene and Marius Lanskoronskis 2011; Malak Reda 2012; Etzkowitz 2013; Marina Ranga and Henry Etzkowitz 2013; David E. Bloom et al. 2014; Sanja Bauk and Jasmin Jusufranic 2014; Alla V. Lapteva and Valerii S. Efimov 2016; João J. Ferreira, Cristina I. Fernandes, and Vanessa Ratten 2016; Labas Istvan, Darabos Eva, and Nagy T. Orsolya 2016; Marzenna A. Weresa 2017; Dimple Sart 2018; WEF 2018; Karahan Kara 2019; Miloš Krstić, José A. Filipe, and José Chavaglia 2020; Kadir Sain and Kurtuluş Bozkurt 2023).

Human capital is a qualified, efficient, productive, entrepreneurial, and healthy manpower equipped with the knowledge, skills, and abilities to meet the needs of the period. Education is the most basic factor that leads to the formation and development of human capital. Among the education levels, higher education is the most important type of investment that develops human capital. It is the most highly specialized form of human capital. For this reason, countries that want to gain power in global competitiveness by accelerating their economic growth and development processes

have taken care to expand and deepen their higher education activities and thus create and develop human capital. According to İlhan Atik (2018), the inability to imitate the quality of human capital and to close the difference it reveals in a short time by competitors has made human capital the most strategic element of the competitive global economic order today, when knowledge and production technologies are rapidly developing.

One of the basic conditions of having power in today's global competitive environment is to achieve economic value by capturing integrity in the information–technology–innovation chain. The first step in achieving this integrity is to produce scientific information with high-added value. The second step is to achieve economic value by transforming high value-added scientific knowledge into high value-added advanced technologies and innovations that are in demand in international markets. Higher education institutions, which are the main information production centers, affect global competitiveness by transforming the information they produce into technology and innovations. It has been observed that countries that have successfully transformed academic value (knowledge) into economic value (products, services, technology, and innovations with high-added value) with the effective cooperation of university–industry–state have achieved sustainable economic growth, accelerated their development processes, survived the middle-income trap and have power in global competitiveness. For this reason, countries that want to have power in global competitiveness need to strengthen the higher education institutions, which are the production centers of scientific knowledge, in terms of quantity and quality, and to increase investment and incentives in technology clusters (technoparks, techno cities, informatics valleys,) where university–industry–state cooperation is intense.

R&D: It covers scientific studies conducted to produce a new product, to raise product quality or standard, to apply new techniques in a cost-reducing and standard-increasing manner, to develop new production technologies, to adapt a new technology to the conditions of the country, to improve existing technologies, and to adapt new ones to them (Ali R. Erdem 2016). The first step of these systematic scientific studies is to carry out "research" activities to reveal new and different products and services. The second step is to carry out "development" activities to reveal new and different products and services. Demands and expectations for existing products, service, process, management, and marketing approaches are changing at the same pace in today's global competitive environment where change is happening at a dizzying pace. Higher education institutions affect global competitiveness by introducing new products, services, technologies, and innovations that can meet constantly renewed demands and expectations with their qualified R&D activities and by developing innovative management and marketing approaches.

While aiming to create innovation, creativity, and change, on the other hand, entrepreneurship, which requires taking risks, being a pioneer, and having the ability to think competitively, has great importance in increasing performance, efficiency, and competitiveness for all kinds of organizations regardless of the size and type of organizations (Yılmaz Odabaşı 2007). Competitive, innovative, and pioneering

institutions that cooperate with today's higher education institutions, other social institutions, and organizations with entrepreneurial qualities reveal and develop the potential of the region they are in (agriculture, industry, tourism, trade); provide the information they produce to economic value; provide social benefits; mobilize economic, social, cultural, political and social dynamics; and have a decisive role in shaping local-, regional-, and global-scale events. These institutions make an important contribution to the formation, establishment, and development of an entrepreneurial culture, both through their own entrepreneurial activities and the entrepreneurs they have trained. This culture has an important impact on the emergence of entrepreneurial academics and students who take all kinds of risks that may arise during the transformation of academic value into economic value. This culture paves the way for the establishment of technology giants such as Apple, Amazon, Google, Microsoft, Samsung, Huawei, Foxconn, and Dell, whose brand value is more than the national income of many countries. These companies, which create economies on a global scale and have high competitiveness, create economic growth and development by creating great employment opportunities in their regions, ensuring the participation of the workforce in the production process, and increasing productivity and productivity.

The diversity and complexity of economic, ecological, social, cultural, and political problems on a local, regional, national, and global scale is increasing day by day. Higher education fulfills many important roles in solving social problems by putting forward strategies, policies, projects, and solutions to these problems. Higher education affects global competitiveness by revealing the basic elements that provide competitive advantage for the present and future of global competition, by correctly reading the dynamics that shape the competitive environment, by correctly identifying the factors affecting competition, and by putting in place strategies, policies, and practices that can respond to the needs that arise in this direction. Today, a decisive factor for global competitive advantage may not be decisive for tomorrow, the dynamics that shape today's global competitive environment may lose their effects in tomorrow's global competitive environment, and the main factors affecting competition today may remain in the background in tomorrow's competition. At this point, higher education affects global competitiveness by correctly reading the process of change and transformation, making correct predictions, and putting into practice the strategies, policies, and practices necessary for the present and future of global competition.

Another way in which higher education affects global competitiveness is to increase efficiency and productivity. Productivity, an indicator of output per input used, is an indicator of more value-added production using fewer resources, without compromising quality. Productivity is directly related to cost. Productivity increases lead to a decrease in costs, whereas a decrease in efficiency leads to an increase in costs. Considering that social resources are limited, the importance of effective management of existing limited resources emerges. At this point, higher education has important duties. All kinds of innovative products, services, processes, management, and marketing types and approaches that higher education will put forward for

resource management strategies and policies at the company, sector, and national level increase social welfare by managing resources more effectively in all institutions, leading to an increase in efficiency, productivity, efficiency, and a decrease in costs (Sart 2018).

4. Literature Review

The increasing importance of information in the knowledge economy has brought qualified human resources to the fore, and the increasing importance of qualified human resources has increased the importance of strong and dynamic educational institutions. Higher education institutions, which constitute the highest level of specialized human resources and are the centers of high value-added knowledge production, have become the favorite institutions of today's knowledge economies. As a matter of fact, the basic condition of sustainable economic growth and development and global competitiveness in the global knowledge economy is qualified human resources and scientific information with high-added value.

Higher education institutions indirectly influence and shape global competitiveness in many ways by competing globally by developing strategies, policies, and projects against problems (economic, social, cultural, political) that are becoming more complex and diverse day by day; by introducing advanced technologies and innovations with qualified human resources and high value-added scientific knowledge; by increasing efficiency and productivity; by providing power and functionality to R&D activities; by ensuring that the culture of entrepreneurship is established in the society (Etzkowitz and Leydesdorff 2000; Sahlberg 2006; Marginson 2006; Etzkowitz 2008; Altbach, Reisberg, and Rumbley 2010; Ramoniene and Lanskoronskis 2011; Etzkowitz 2013; Ranga and Etzkowitz 2013; Bloom et al. 2014; Bauk and Jusufranic 2014; Lapteva and Efimov 2016; Ferreira, Fernandes, and Ratten 2016; Istvan, Eva, and Orsolya 2016; Weresa 2017; Kara 2019).

Although higher education institutions activate many dynamics affecting global competitiveness, studies on the effect of higher education on global competitiveness (or its relationship with) have been very limited in the empirical literature (Reda 2012; Condition 2018; Krstić, Filipe, and Chavaglia 2020; Sain and Bozkurt 2023). In this limited literature, limited aspects of higher education are included in the analysis. Reda (2012) focused on education and the workforce; Sart (2018) focused on the global competitiveness of higher education; Krstić, Filipe, and Chavaglia (2020) focused on the skills of graduates in higher education, critical thinking in teaching, the importance of research institutions, scientific publications, and expenditures; and Sain and Bozkurt (2023) focused on the transformation of knowledge into economic value in higher education.

A summary of the empirical literature is presented below.

In a study conducted by Reda (2012), the effect of labor, education, and innovation factors on global competitiveness was analyzed using panel data analysis methods (Fixed and Random Effects Model). In the study covering the period 2005–2011, 25 countries were examined. In the study in which the Global Competitiveness

Index was used as an indicator of global competitiveness, it was determined that there was a positive relationship between labor, education and innovation, and global competitiveness.

In another study conducted by Sart (2018), it was statistically analyzed whether the global competitiveness of countries was affected by the global competitiveness level of higher education. In the study conducted in 138 countries, nonparametric Kruskal–Wallis and Mann–Whitney U tests were applied using the data obtained from the Global Competitiveness Index 2017–2018 Report. According to the application results of the research, as the level of global competitiveness in higher education (on average) changes, the overall global competitiveness of countries also changes statistically. Accordingly, as the level of global competitiveness in higher education increases, the global competitiveness of countries also increases.

In the study conducted by Krstić, Filipe, and Chavaglia (2020), the relationship between higher education and competitiveness and sustainable development was analyzed. In the correlation and regression analysis conducted in EU member states and candidate countries, a strong relationship was found between higher education and competitiveness and sustainable development.

Sain and Bozkurt (2023) analyzed the impact of higher education on global competitiveness in the context of the transformation of knowledge into economic value for 25 OECD countries. Based on the 2006–2017 period, a panel dataset was established, and Granger Panel Causality Test was applied. As a result of the application, a two-sided causality relationship was found between the Global Competitiveness Index, which represents the global competitiveness of countries, and each variable representing higher education (R&D, university–industry cooperation, education system quality, quality of scientific research institutions, scientific publication performance) in the short term.

When the variables related to higher education in OECD countries are examined comprehensively, it is seen that these variables act together with global competitiveness (see Appendices Table 1A and Table 2A). In this study, a total of 14 variables showing the employment and unemployment status of the higher education population, the distribution of the higher education graduate population according to the programs, higher education public expenditures, higher education R&D expenditures, the number of R&D personnel, and scientific publication performance were used to reveal the higher education situation in OECD countries in a broad way. Thus, whether higher education has a short- and long-term relationship with global competitiveness, it was tested by panel data analysis methods.

5. Dataset and Method

Within the scope of the study, 18 OECD countries, including Turkey, were analyzed. For the 18 countries in question, reliable data could be obtained from the Statistical Databases of WEF, OECD, WB, and UNESCO. The 2004–2018 period was analyzed, and a panel dataset covering this period was created. The logarithmic forms of the series were used. The 18 OECD countries are as follows: (1) Austria, (2) Belgium, (3)

Czech Republic, (4) Denmark, (5) Estonia, (6) Finland, (7) Hungary, (8) Ireland, (9) Italy, (10) Latvia, (11) Norway, (12) Portugal, (13) Slovak Republic, (14) Slovenia, (15) Spain, (16) Sweden, (17) Turkey, and (18) the United Kingdom.
Information on the variables used in the study is presented in Table 2 below.

Table 2 Information on the Variables Used in the Study

Category	Variable	Abbreviation	Source
Global competitiveness	Global Competitiveness Index	gci	WEF
Higher education	Proportion of the population aged 20–24 who are not involving in education, training, or employment	x1	OECD
	Employment rate of the population aged 25–64 graduted from higher education	x2	OECD
	Unemployment rate of the population aged 25–64 graduated from higher education	x3	OECD
	Proportion of population aged 25–64 graduated from higher education	x4	OECD
	Number of scientific and technical journal articles	x5	WB
	Proportion of higher educated people graduated from education programs	x6	UNESCO
	Proportion of higher educated people graduated from science, technology, engineering, and mathematics programs	x7	UNESCO
	Proportion of higher educated people graduated from social sciences, journalism, and informatics programs	x8	UNESCO
	Proportion of higher educated people graduated from information and communication technologies programs	x9	UNESCO
	Proportion of higher educated people graduated from business, management, and law programs	x10	UNESCO

Proportion of higher educated people graduated from health and well-being programs	x11	UNESCO
Education expenditures (as % of GDP)	x12	WB
R&D expenditures (as % of GDP)	x13	WB
Number of R&D personnel	x14	WB

Source: Edited by the authors.

In this study, which aims to analyze the relationship between higher education and global competitiveness, Dumitrescu and Hurlin's (2012) Granger Panel Causality test were used to reveal whether there is a short-term relationship between each variable representing higher education (x1 to x14) and the variable representing global competitiveness (GCI), and Westerlund's (2007) Panel Cointegration test was used to reveal whether there is a long-term relationship.

In this study, it was examined whether the series included cross-sectional dependence. At this point, the Trevor S. Breusch and Adrian R. Pagan's (1980) LM test was used.

On the other hand, the homogeneity test recommended by Mohammad H. Pesaran and Takashi Yamagata (2008) was made. The test hypotheses are expressed as follows:

H0: $\beta i=\beta$ for all i ve H1: $\beta_i \neq \beta_j$ (1)

$(\widehat{\Delta})$ ve $(\widetilde{\Delta}_{adj})$ are calculated as follows:

$$\widehat{\Delta} = \sqrt{N}\left(\frac{N^{-1}\hat{S}-k}{\sqrt{2k}}\right) \text{ and } \tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\hat{S}-E(\tilde{Z}_{iT})}{\sqrt{Var(\tilde{Z}_{iT})}}\right) \quad (2)$$

In the study, Mohammad H. Pesaran's (2007) CADF Panel Unit Root test was used. In the next stage, Dumitrescu and Hurlin's (2012) Panel Granger Causality test was conducted. This test is performed against the null hypothesis that there is no causal relationship and also against the alternative hypothesis that there is a causal relationship in at least one cross-section, and the following model is considered (Pınar Göktaş, Aytaç Pekmezci, and Bozkurt 2018; Pekmezci and Bozkurt 2019):

$$y_{it} = \propto_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \quad (3)$$

In Equation 3, it is $\beta_i = (\beta_i^{(1)}, \ldots\ldots, \beta_i^{(K)})$. Wald statistics is used to test the null hypothesis.

$$W_{N,T}^{Hnc} = \frac{1}{N}\sum_{i=1}^{N} W_{i,T} \quad (4)$$

Dumitrescu and Hurlin (2012) suggested using the "number 5" standardized test statistics shown below for small values of T:

$$\tilde{Z}_{N,T}^{Hnc} = \frac{\sqrt{N}[W_{N,T}^{Hnc} - \sum_{i=1}^{N} E(\widetilde{W}_{i,T})]}{\sqrt{\sum_{i=1}^{N} Var(\widetilde{W}_{i,T})}} \quad (5)$$

Dumitrescu and Hurlin (2012), as a result of their simulations, stated that the $\tilde{Z}_{N,T}^{Hnc}$ test statistic gave very good results. In fact, they emphasized that this test developed by Dumitrescu and Hurlin (2012) can be applied for unbalanced panels and

panels having heterogeneous lag lengths of the units. In this context, they stated that it would be appropriate to use the test statistic expressed in Equation 6 instead of the test statistic expressed in Equation 5 (Bozkurt, Hatice A. Tekin, and Zeliha C. Ergün 2021).

$$\tilde{Z}_{N,T}^{Hnc} = \frac{\sqrt{N}[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} E(\widetilde{W}_{i,T})]}{\sqrt{N^{-1}\sum_{i=1}^{N} Var(\widetilde{W}_{i,T})}} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} K_i \times \frac{(T_i - 2K_i - 1)}{(T_i - 2K_i - 3)}\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} 2K_i \times \frac{(T_i - 2K_i - 1)^2 \times (T_i - K_i - 3)}{(T_i - 2K_i - 3)^2 \times (T_i - 2K_i - 5)}}} \quad (6)$$

In the last stage of the application, panel cointegration analysis was performed. Considering the cointegration tests used in panel data econometrics, it is seen that the tests are based on testing the hypothesis "H_0: There is no cointegration" (Bozkurt 2012; Pekmezci and Bozkurt 2021).

In this study, Westerlund's (2007) cointegration test, which tries to eliminate the deficiencies of Peter Pedroni's (1999, 2004) cointegration tests, was used. Westerlund's (2007) test is based on the error correction model, as shown in Equation 7.

$$\Delta Y_{i.t} = \delta_i d_t + \alpha_i Y_{i,t-1}\lambda_i x_{i,t-1} + \sum_{j=1}^{p_i} \alpha_{i,j}\Delta Y_{i,t-j} + \sum_{j=0}^{p_i} \lambda_{i,j}\Delta x_{i,t-j} + e_{i,t} \quad (7)$$

For Westerlund's (2007) test, based on the error correction model (7) given above, four basic statistics are proposed for all horizontal sections under the null hypothesis: "There is no cointegration." At this point, as shown in Equations 8 and 9, the group calculates the mean statistics (Bozkurt and Özgür Yanardağ 2017; Özgür Balmumcu and Bozkurt 2020).

$$G_r = \frac{1}{N}\sum_{i=1}^{N} \frac{\propto_i}{st(\propto_i)} \sim N(0,1) \quad (8)$$

$$G_\propto = \frac{1}{N}\sum_{i=1}^{N} \frac{T\propto_i}{\propto_i(1)} \sim N(0,1) \quad (9)$$

In the second stage, the error correction Equation 10 given below is estimated by EKK, and panel statistics are calculated (Göktaş, Pekmezci, and Bozkurt 2018).

$$\Delta Y_{i.t} = \delta_i d_t + \lambda_i x_{i,t-1} + \sum_{j=1}^{p_i} \alpha_{i,j}\Delta Y_{i,t-j} + \sum_{j=0}^{p_i} \lambda_{i,j}\Delta x_{i,t-j} + e_t \quad (10)$$

$$Y_{i.t-1} = \delta_i d_t + \lambda_i x_{i,t-1} + \sum_{j=1}^{p_i} \alpha_{i,j}\Delta Y_{i,t-j} + \sum_{j=0}^{p_i} \lambda_{i,j}\Delta x_{i,t-j} + \varepsilon_t$$

After the estimation of the error correction in Equation 10, the error correction coefficient and the standard error of the error correction coefficient given in Equations 11 and 12 are calculated (Göktaş, Pekmezci, and Bozkurt 2018).

$$\propto_i = \left[\sum_{i=1}^{N}\sum_{t=2}^{T} \tilde{Y}_{i,t-1}^2\right]^{-1} \sum_{i=1}^{N}\sum_{t=2}^{T} \frac{1}{\propto_i(1)} \tilde{Y}_{i,t-1}\Delta\, \tilde{Y}_{i,t} \quad (11)$$

$$st(\propto_i) = \left[(\hat{S}_N^2 \sum_{i=1}^{N}\sum_{t=2}^{T} \tilde{Y}_{i,t-1}^2\right]^{-1/2} \quad (12)$$

In the last stage, under the null hypothesis, "There is no cointegration for all horizontal sections," the panel cointegration statistics in Equations 13 and 14 given below are calculated (Göktaş, Pekmezci, and Bozkurt 2018).

$$P_r = \frac{\propto}{st(\propto)} \sim N(0,1) \quad (13)$$

$$P_\propto = T \propto \sim N(0,1) \quad (14)$$

As a result of panel cointegration analysis, considering the determination of a long-term relationship between these variables, short- and long-term relationships are tried to be estimated by various methods. These methods include the Fully Modified Ordinary Least Squares Method (FMOLS) developed by Peter C. B. Phillips and Hyungsik R. Moon (2000) and Pedroni (2000), the Panel Dynamic Ordinary Least Squares Method (PDOLS) developed by James H. Stock and Mark W. Watson (1993), the Pooled Mean Group Estimator (PMGE) developed by Pesaran, Yongcheol Shin and Ron P. Smith (1999), the Mean Group Estimator (MGE), and the Dynamic Fixed Effects Estimator (DFE) developed by Pesaran and Smith (1995).

FMOLS and PDOLS methods can only predict long-term parameters, whereas PDOLS, PMGE, MGE, and DFE methods can predict both short- and long-term parameters. In this study, the MGE method, which provides the opportunity to predict both short- and long-term parameters, was applied.

5.1 Application Results

Within the scope of the study, descriptive statistics were examined, and the statistics are shown in Table 3 below.

Table 3 Descriptive Statistics

Variables	Number of Observations	Mean	Standard Error	Minimum	Maximum
gci	270	1.57565	0.0995272	1.302913	1.783391
x1	270	2.813278	0.3768935	1.769855	3.906206
x2	270	4.430509	0.0439514	4.297966	4.505571
x3	270	1.398779	0.4963413	0.1310283	2.701361
x4	270	3.288549	0.3793716	2.266958	3.84887
x5	270	9.226658	1.215286	5.685483	11.50908
x6	270	2.343488	0.3728061	1.19274	3.105226
x7	270	3.114864	0.2055832	2.42934	3.470371
x8	270	2.209086	0.2651274	1.464731	2.702336
x9	270	1.216161	0.4602996	−0.085427	2.090977
x10	270	3.119617	0.270554	2.590452	3.807478
x11	270	2.635244	0.4296101	1.35642	3.360041
x12	270	1.645926	0.2443521	0.7793249	2.147048
x13	270	0.4112817	0.5271656	−0.915965	1.321444
x14	270	8.100299	0.539144	6.225623	8.995399

Source: Authors' calculations.

In the second stage of the study, it was tested whether the series in question included cross-sectional dependence. As seen in Table 4, the Breusch and Pagan's (1980) LM test was used for this purpose.

Table 4 Cross Section Dependency Test Results

Variables	Breusch Pagan LM Test Statistics	Probability Value
gci	1466.51	0.0000
x1	1095.15	0.0000
x2	1148.62	0.0000
x3	955.23	0.0000
x4	1766.91	0.0000
x5	1837.79	0.0000
x6	835.14	0.0000
x7	1009.04	0.0000
x8	518.51	0.0000
x9	709.80	0.0000
x10	1060.28	0.0000
x11	1388.61	0.0000
x12	1211.11	0.0000
x13	1624.77	0.0000
x14	1695.07	0.0000

Source: Authors' calculations.

Looking at Table 4, it was concluded that the whole series group included cross-sectional dependence, since the probability level obtained according to Breusch and Pagan's (1980) LM test statistic was lower than the 1% significance level.

After the Breusch and Pagan's (1980) LM test, Pesaran and Yamagata's (2008) Slope Heterogeneity test was applied to determine whether the established model of each country included slope heterogeneity. Here, the slope homogeneity null hypothesis was tested.

Table 5 Slope Heterogeneity Test

	Value
$\tilde{\Delta}$	2.052***
$\tilde{\Delta}\,adj$	3.350***

Note: ***1% refers to the significance level. **Source:** Authors' calculations.

According to the results presented in Table 5, the slope homogeneity null hypothesis is rejected; therefore, the slope of the model is heterogeneous.

In the fifth stage of the application, because the cross-section dependence was determined for all series, it was examined whether the series were stationary using the CADF Panel Unit Root tests of Pesaran, one of the second-generation unit root tests. These results are given in Table 6 below. As a result of the analysis, it was determined that the x2, x4, x5, x6, x7, and x8 series were stationary at the 5% significance level. On the other hand, it was concluded that the gci, x1, x3, x9, x10, x11, x12, x13, and

x14 series groups were not stationary at the level; however, when the values of the series were taken with a delay, the CADF tests were significant at 1%, and the series became stationary with a delay.

Table 6 Panel Unit Root (CADF) Test Results

Variables		Z[t-bar]	Probability Value
gci	Level	−1.023	0.153
	First-difference	10.066	0.000
x1	Level	−0.719	0.236
	First-difference	11.620	0.000
x2	Level	−1.821	0.034
x3	Level	1.054	0.854
	First-difference	9.920	0.000
x4	Level	−3.292	0.000
x5	Level	−2.132	0.017
x6	Level	−3.366	0.000
x7	Level	−2.098	0.018
x8	Level	−2.031	0.021
x9	Level	0.429	0.666
	First-difference	10.866	0.000
x10	Level	0.043	0.517
	First-difference	9.329	0.000
x11	Level	−1.096	0.136
	First-difference	11.572	0.000
x12	Level	−1.427	0.077
	First-difference	10.960	0.000
x13	Level	1.347	0.911
	First-difference	10.745	0.000
x14	Level	0.223	0.588
	First-difference	12.532	0.000

Source: Authors' calculations.

In the sixth stage, Dumitrescu and Hurlin's (2012) Panel Granger Causality test was conducted to determine the causality relationship between gci and 14 x variables. The results were presented in Table 7.

Table 7 Dumitrescu and Hurlin's (2012) Granger Panel Causality Test Results

	Lag Order = 1			Lag Order = 2			Lag Order = 3		
	$W_{N,T}^{Hnc}$	$Z_{N,T}^{Hnc}$	Z_{N}^{Hnc}	$W_{N,T}^{Hnc}$	$Z_{N,T}^{Hnc}$	Z_{N}^{Hnc}	$W_{N,T}^{Hnc}$	$Z_{N,T}^{Hnc}$	Z_{N}^{Hnc}
x1 → gci	4.21	9.64***	6.14***	5.58	7.60***	3.28***	10.09	12.29***	2.16**
gci → x1	2.74	5.23***	3.13***	4.20	4.66***	1.72*	11.25	14.30***	2.65***
x2 → gci	8.63	22.91***	15.23***	8.82	14.47***	6.92***	15.24	21.20***	4.34***
gci → x2	0.80	−0.58	−0.85	3.16	2.46**	0.55	5.24	3.88***	0.10
x3 → gci	5.28	12.86***	8.35***	4.75	5.83***	2.34**	12.04	15.65***	2.98***
gci → x3	3.60	7.82***	4.90***	5.22	6.85***	2.88***	9.08	10.54***	1.73*
x4 → gci	4.47	10.41***	6.67***	4.66	5.66***	2.25**	9.42	11.13***	1.87*
gci → x4	3.10	6.30***	3.85***	3.81	3.85***	1.29	7.88	8.46***	1.22
x5 → gci	7.27	18.81***	12.42***	6.63	9.84***	4.46***	9.70	11.62***	1.99*
gci → x5	2.26	3.78***	2.13**	5.63	7.71***	3.34***	9.81	11.80***	2.04**
x6 → gci	5.52	13.57***	8.83***	7.26	11.17***	5.17***	15.58	21.79***	4.48***
gci → x6	1.58	1.76*	0.74	2.29	0.61	−0.42	4.87	3.23***	−0.05
x7 → gci	6.78	17.34***	11.41***	4.06	4.37***	1.56	12.20	15.94***	3.05***
gci → x7	1.31	0.93	0.18	5.33	7.08***	3.01***	4.86	3.22***	−0.05
x8 → gci	2.91	5.74***	3.47***	4.07	4.39***	1.58	8.96	10.33***	1.68*
gci → x8	1.39	1.19	0.36	4.98	6.34***	2.61***	9.03	10.45***	1.71**
x9 → gci	2.02	3.06***	1.64*	3.16	2.48**	0.56	7.96	8.60***	1.25
gci → x9	14.01	39.01***	26.25***	2.58	1.24	−0.08	5.49	4.32***	0.21
x10 → gci	6.34	16.03***	10.52***	10.68	18.42***	9.02***	15.48	21.62***	4.44***
gci → x10	5.87	14.63***	9.56***	1.92	−0.15	−0.83	4.01	1.75**	−0.41
x11 → gci	9.16	24.49***	16.31***	10.25	17.52***	8.54***	13.12	17.54***	3.44***
gci → x11	4.06	9.18***	5.83***	2.06	0.13	−0.67	3.62	1.09	−0.58
x12 → gci	4.51	10.53***	6.75***	10.43	17.88***	8.73***	10.25	12.56***	2.22**
gci → x12	2.85	5.56***	3.35***	3.51	3.22***	0.95	5.07	3.58***	0.03
x13 → gci	7.26	18.80***	12.41***	10.93	18.95***	9.30***	14.08	19.20***	3.85***
gci → x13	19.34	55.03***	37.21***	4.35	5.01***	1.91*	4.94	3.37***	−0.02
x14 → gci	6.45	16.37***	10.75***	15.14	27.87***	14.03***	17.92	25.84***	5.48***
gci → x14	21.35	61.07***	41.35***	3.57	3.34***	1.02	6.79	6.57***	0.76

Note: shows statistical significance at level of ***1%, **5%, and *10%. **Source:** Authors' calculations.

Looking at Table 7, it is seen that a causal relationship from each x variable to gci variable has been determined, that is, the Global Competitiveness Index expressed by the gci for each x variable is the cause of Granger. On the other hand, in the causality analyses made from the gci variable towards the x variables, it was determined that there is a causality relationship from the gci variable to all the other variables except x2, x7, and x8 variables. It was concluded that all other x variables except x2, x7, and x8 variables of the Global Competitiveness Index expressed with gci are the cause of Granger. The short-term causality relationships in question are summarized in Table 8 below.

Table 8 Summary of Short-Term Relationships

	Varibles	**Findings (Causality)**
Global Competitiveness Index	Proportion of the population aged 20–24 who are not involving in education, training, or employment (x1)	**Finding 1** There is bilateral causation.
	Employment rate of the population aged 25–64 graduated from higher education (x2)	**Finding 2** There is causality from only x2 to gci.
	Unemployment rate of the population aged 25–64 graduated from higher education (x3)	**Finding 3** There is bilateral causation.
	Proportion of population aged 25–64 graduated from higher education (x4)	**Finding 4** There is bilateral causation.
	Number of scientific and technical journal articles (x5)	**Finding 5** There is bilateral causation.
	Proportion of higher educated people graduated from education programs (x6)	**Finding 6** There is bilateral causation.
	Proportion of higher educated people graduated from science, technology, engineering, and mathematics programs (x7)	**Finding 7** There is causality from only x7 to gci.
	Proportion of higher educated people graduated from social sciences, journalism, and informatics programs (x8)	**Finding 8** There is causality from only x8 to gci.
	Proportion of higher educated people graduated from information	**Finding 9** There is bilateral causation.

	and communication technologies programs (x9)	
	Proportion of higher educated people graduated from business, management, and law programs (x10)	**Finding 10** There is bilateral causation.
	Proportion of higher educated people graduated from health and well-being programs (x11)	**Finding 11** There is bilateral causation.
	Education expenditures (as % of GDP) (x12)	**Finding 12** There is bilateral causation.
	R&D expenditures (as % of GDP) (x13)	**Finding 13** There is bilateral causation.
	Number of R&D personnel (x14)	**Finding 14** There is bilateral causation.

Source: Authors' calculations.

Westerlund's (2007) Panel Cointegration test was performed to analyze whether there is a long-term relationship between GCI and each x variable. The null hypothesis of the test is "There is no cointegration," and the results are presented in Table 9 below.

Table 9 Westerlund's (2007) Panel Cointegration Test Statistics Results

	Statistic	**Value**	**z-value**	**p-value**
gci and x1	G_t	−52.057	−239.86	0.000
	G_a	−9.522	−1.817	0.035
	P_t	−8.090	−1.810	0.035
	P_a	−14.390	−9.278	0.000
gci and x2	G_t	−24.443	−108.089	0.000
	G_a	−14.197	−5.477	0.000
	P_t	−25.861	−19.353	0.000
	P_a	−20.330	−14.770	0.000
gci and x3	G_t	−30.381	−136.424	0.000
	G_a	−9.862	−2.083	0.019
	P_t	−18.366	−11.954	0.000
	P_a	−23.762	−17.944	0.000
gci and x4	G_t	−23.636	−104.236	0.000
	G_a	−10.608	−2.667	0.004
	P_t	−17.700	−11.297	0.000

	P_a	−5.673	−1.218	0.112
gci and x5	G_t	−135.671	−638.884	0.000
	G_a	−9.372	−1.700	0.045
	P_t	−12.406	−6.074	0.000
	P_a	−16.146	−10.901	0.000
gci and x6	G_t	−8.146	−30.315	0.000
	G_a	−5.030	1.700	0.956
	P_t	−20.078	−13.644	0.000
	P_a	−25.077	−19.159	0.000
gci and x7	G_t	−7.709	−28.233	0.000
	G_a	−16.797	−7.513	0.000
	P_t	−32.636	−26.041	0.000
	P_a	−29.614	−23.355	0.000
gci and x8	G_t	−33.160	−149.690	0.000
	G_a	−10.788	−2.808	0.000
	P_t	−15.553	−9.177	0.000
	P_a	−20.698	−15.111	0.000
gci and x9	G_t	−74.384	−346.414	0.000
	G_a	−8.806	−1.256	0.105
	P_t	−13.424	−7.075	0.000
	P_a	−19.053	−13.590	0.000
gci and x10	G_t	−36.143	−163.924	0.000
	G_a	−15.399	−6.418	0.000
	P_t	−10.571	−4.259	0.000
	P_a	−22.701	−16.963	0.000
gci and x11	G_t	−56.016	−258.761	0.000
	G_a	−14.256	−5.523	0.000
	P_t	−17.630	−11.227	0.000
	P_a	−12.635	−7.655	0.000
gci and x12	G_t	−27.682	−123.546	0.000
	G_a	−12.066	−3.809	0.000
	P_t	−27.593	−21.063	0.000
	P_a	−20.466	−14.896	0.000
gci and x13	G_t	−79.560	−371.115	0.000
	G_a	−11.130	−3.075	0.001
	P_t	−4.814	1.424	0.923
	P_a	−10.370	−5.561	0.000
gci and x14	G_t	−18.836	−81.333	0.000
	G_a	−12.745	−4.340	0.000
	P_t	−14.490	−8.128	0.000
	P_a	−17.910	−12.533	0.000

As a result, as can be seen in Table 9, it has been determined that there is a cointegration relationship between gci and each x variable, that is, a long-term relationship.

In the last stage of the application, because a long-term relationship was determined between these variables as a result of panel cointegration analysis, short- and long-term relationships were tried to be estimated using MGE method.

Table 10 Short- and Long-Term Parameters According to MGE (Dependent Variable: gci)

Independent Variables		**Parameters (MGE)**
	Error Correction (ec)	−1.056***
x1	Short Term	−0.050**
	Long Term	0.015
	Error Correction (ec)	−1.092***
x2	Short Term	−0.411**
	Long Term	0.792***
	Error Correction (ec)	−1.083***
x3	Short Term	−0.041***
	Long Term	−0.002
	Error Correction (ec)	−1.148***
x4	Short Term	−0.139
	Long Term	0.078***
	Error Correction (ec)	−1.103***
x5	Short Term	−0.068
	Long Term	−0.143**
	Error Correction (ec)	−1.132***
x6	Short Term	0.057
	Long Term	−0.003
	Error Correction (ec)	−1.013***
x7	Short Term	−0.054
	Long Term	0.022
	Error Correction (ec)	−0.994***
x8	Short Term	0.027
	Long Term	−0.061
	Error Correction (ec)	−1.102***
x9	Short Term	0.0102
	Long Term	0.029**
	Error Correction (ec)	−1.076***
x10	Short Term	0.011
	Long Term	−0.007

	Error Correction (ec)	−1.050***
x11	Short Term	0.012
	Long Term	−0.016
	Error Correction (ec)	−1.056***
x12	Short Term	0.059
	Long Term	0.008
	Error Correction (ec)	−1.065***
x13	Short Term	0.004
	Long Term	0.005
	Error Correction (ec)	−1.087***
x14	Short Term	0.045
	Long Term	0.045

Note: shows statistical significance at level of ***1%, **5%, and *10%

Looking at Table 10, analyzing the MGE estimate of each variable representing higher education (from x1 to x14), it is seen that the error correction parameter is negative and significant at the 1% significance level. Therefore, there is a long-term relationship between each x variable and gci variable. Accordingly, for each variable x, all imbalances that occur in one period are corrected in the following period, and long-term balance is reached.

6. Result and Concluding Remarks

After the 1980s, the increasing globalization of markets; the increase in the mobility of products, services, and people at the international level; the rise of digital technologies; the abolition of agreements restricting international trade; liberalization in the economy; the acceleration of the deregulation trend in regulations; the rapid increase in privatizations; and the increasing economic integration of the world have added a global dimension to competition.

The global competitive environment is based on an economic platform in which knowledge, technology, innovation, and R&D activities are decisive. The basic condition of having power in this economic platform is to transform the scientific knowledge resulting from scientific studies into new technologies and innovations and to present them to global markets. This new economy (knowledge economy) based on information and digitization has created a great innovation in world trade and economy by paving the way for a global network economy that eliminates borders in trade (Adıgüzel, 2011).

Strong and dynamic educational institutions indirectly affect and shape today's economies in many ways. Especially in the information society and economy, where information has become the main production factor, higher education institutions, which are the main production centers of high value-added information, have important duties.

Entrepreneurial and innovative higher education institutions of the 21st century have become important and decisive elements of global competitiveness by creating

human capital and producing qualified scientific information; taking a leading role in the transformation of knowledge into economic value; transforming information into effective advanced technologies and innovations; producing high value-added products and services; adding strength to R&D activities; increasing efficiency and productivity; increasing economic, social, and intellectual capital in collaboration with other social stakeholders such as industry, commerce, business world, and nongovernmental organizations; ensuring that entrepreneurship settles on a social basis and becomes a culture, revealing and developing the potential of the region (industry, trade, agriculture, tourism) in order to ensure regional development; developing strategies, policies, and solutions against economic, ecological, social, cultural, and political problems, the diversity and complexity of which are increasing day by day by; and developing and activating the dynamics that will achieve sustainability in economic growth and social development.

Although higher education institutions indirectly activate many dynamics affecting global competitiveness, studies on the effect of higher education on global competitiveness (or its relationship with) have been very limited in the empirical literature. In this study, which is thought to contribute to the limited literature, the effect of higher education on global competitiveness was analyzed by panel data analysis methods. With the data obtained from the databases of WEF, OECD, WB, and UNESCO, a panel dataset was established for 18 OECD countries covering the period 2004–2018 and where reliable data can be accessed. In the application phase, Dumitrescu and Hurlin's (2012) Granger Panel Causality test were used to reveal whether there is a short-term relationship between each variable (from x1 to x14) representing higher education and the variable representing global competitiveness (Global Competitiveness Index), whereas Westerlund's (2007) Panel Cointegration test was used to reveal whether there is a long-term relationship. Consequently, it has been determined that there is a causality relationship between each variable (from x1 to x14) representing higher education and the Global Competitiveness Index in the short term and a cointegration relationship in the long term. This result is largely in parallel with the results of studies conducted by Reda (2012), Sart (2018), and Krstić, Filipe, and Chavaglia (2020), and Sain and Bozkurt (2023).

As a result of the analysis, while highlighting the higher education factor for global competitiveness in OECD countries, it has brought global competitiveness to the fore for strong, dynamic, and productive higher education institutions. They can build stronger, more dynamic, and productive higher education institutions by realizing the sustainable growth and development of economies with high global competitiveness and investing more in quality education and R&D activities. In the same way, higher education institutions can bring global competitiveness to economies by creating advanced technologies and innovations with qualified human resources and high value-added scientific knowledge, providing an increase in efficiency and productivity, providing power and functionality to R&D activities, ensuring the establishment of entrepreneurship culture in the society, strategizing against problems

(economic, social, cultural, political) that are becoming more complex and diverse day by day, and developing and mobilizing policies and projects.

In this regard, some suggestions are put forward for countries that want to use education policies as a tool by structuring them in development and global competitive strategies according to the conditions and needs of the 21st century:

- The number of entrepreneurial, innovative, strong, and dynamic higher education institutions should be increased. In this regard, the population with higher education should be raised considering the supply–demand balance and should be employed in jobs suitable for specialization.
- The population that is not involved in education and employment should be trained by providing them with the necessary knowledge, skills, and abilities in line with the needs of the country, and they should be integrated in the production process.
- Health activities should be strengthened besides education in order to increase the efficiency and productivity levels of human capital. Because receiving education; acquiring the knowledge, skills, and abilities needed during the education proces; and participating in the production process actively and uninterruptedly as well as transforming the knowledge into economic and social benefits depend on being healthy.
- Scientific research infrastructures of higher education institutions should be strengthened. In this regard, qualified scientific information should be produced with an interdisciplinary education and research approach.
- With the awareness that expenditures for qualified education and research have consumption characterisic in the short term and investment feature in the long term, the resources allocated to education and research should be increased, and these resources should be used effectively and appropriately.
- R&D activities should be strengthened. In this regard, the resources allocated to both general R&D activities and R&D activities carried out by higher education should be increased, and the number of R&D personnel should be raised.
- Higher education institutions should be given an entrepreneurial identity. In this regard, entrepreneurship should be integrated into society, be developed, and become a culture.
- Higher education institutions should cooperate with other social stakeholders and act jointly in terms of solving social problems (economic, ecological, social, cultural, political).
- Higher education institutions should be ensured to take a leading and decisive role in revealing and developing the potential of the region in which they are located (agriculture, industry, trade, tourism).
- Mechanisms that can transform knowledge into economic value should be developed with effective university–industry–state collaboration. In this direction, the integrity of the information–technology–innovation chain should be achieved by increasing the number of technoparks, technocities, informatics valleys, technology transfer centers, and university–industry joint research centers.

- It should be investigated how innovation-centered economies (such as South Korea, Japan, Singapore, Germany, England, U.S.A.) create innovation awareness and develop national innovation systems through cooperation with strong and dynamic higher education institutions. National innovation awareness and systems should be developed and strengthened in cooperation with higher education institutions, considering the results obtained and the country's dynamics.
- Higher education institutions should be ensured to take a leading role in reading the global change process correctly, making accurate predictions and putting sufficient strategies, policies, and practices in this direction.

References

Adıgüzel, Muhittin. 2011. *Bilgi Toplumu ve Küreselleşme Bağlamında Küresel Rekabet Ortamı.* Ankara: Nobel Akademik Yayıncılık.

Aiginger, Karl. 1998. "A Framework for Evaluating the Dynamic Competitiveness of Countries." *Structural Change and Economic Dynamics*, 9(2): 159–188. https://doi.org/10.1016/S0954-349X(97)00026-X

Aktan, Çoşkun C., and İstiklal Y. Vural. 2004. *Rekabet Gücü ve Rekabet Stratejileri.* Ankara: Türkiye İşveren Sendikaları Konfederasyonu.

Altbach, Philip G., Liz Reisberg, and Laura E. Rumbley. 2010. *Trend in Global Higher Education: Tracking an Academic Revolution*. Netherlands: Sense Publishers. https://doi.org/10.1163/9789004406155

Atik, İlhan. 2018. "Nitelikli işgücü için etkin mesleki eğitim konusuna çözüm olarak fen, teknoloji, mühendislik, matematik (FTMM) eğitimi." *Yükseköğretim ve Bilim Dergisi*, 8(2): 254–263.

Balmumcu, Özgür, and Kurtuluş Bozkurt. 2020. "Gelişmekte Olan Ülkelerde Ekonomik Büyüme ve Cari İşlemler Dengesi Üzerine Bir Panel Veri Analizi." *Ekonomi Politika ve Finans Araştırmaları Dergisi*, 5(2): 292–307. https://doi.org/10.30784/epfad.770074

Bauk, Sanja, and Jasmin Jusufranic. 2014. "Competitiveness in Higher Education in Terms of the Level of Students' Satisfaction With E-Learning in Blended Environment." *Montenegrin Journal of Economics*, 10(1): 25–42.

Bayraktutan, Yusuf, and Hanife Bıdırdı. 2016. "Teknoloji ve Rekabetçilik: Temel Kavramlar ve Endeksler Bağlamında Bir Değerlendirme." *Akademik Araştırmalar ve Çalışmalar Dergisi*, 8(14), 1–24.

Bloom, David E., David Canning, Kevin Chan, and Dara L. Luca. 2014. "Higher Education and Economic Growth in Africa." *International Journal of African Higher Education*, 1(1): 23–57. https://doi.org/10.6017/ijahe.v1i1.5643

Bozkurt, Kurtuluş, and Özgür Yanardağ. 2017. "Enerji Tüketimi ve Ekonomik Büyüme: Gelişmekte Olan Ülkeler İçin Bir Panel Eşbütünleşme Analizi."

Yönetim ve Ekonomi Araştırmaları Dergisi, 15(1): 194–213. https://doi.org/10.11611/yead.306823

Bozkurt, Kurtuluş, Hatice A. Tekin, and Zeliha C. Ergün. 2021. "An investigation of demand and exchange rate shocks in the tourism sector." *Applied Economic Analysis*, 29 (86), 171–188.

Bozkurt, Kurtuluş. 2012. "Dışsal Ekonomik Şokların Gelişmekte Olan Ülkelerin Ekonomik Büyüme Sürecine Etkileri." PhD diss. Muğla Sıtkı Koçman University.

Breusch, Trevor S., and Adrian Rodney Pagan. 1980. "The Lagrange Multiplier Test and Its Applications to Model Specification Tests in Econometrics." *The Review of Economic Studies*, 47(1): 239–253. https://doi.org/10.2307/2297111

Dumitrescu, Elena I., and Christophe Hurlin. 2012. "Testing for Granger Non-Causality in Heterogeneous Panels." *Economic Modelling*, 29(4): 1450–1460. https://doi.org/10.1016/j.econmod.2012.02.014

Erdem, Ali R. 2016. "Üniversite Anlayışındaki Değişim: Birinci Nesil Üniversiteden Dördüncü Nesil Üniversiteye." *TYB Akademi Dil Edebiyat ve Sosyal Bilimler Dergisi*, 16(16): 21–52.

Etzkowitz, Henry, and Loet Leydesdorff. 2000. "The Dynamics of Innovation: From National Systems and Mode 2 to A Triple Helix of University-Industry-Government Relations." *Research Policy*, 29(2): 109–123. https://doi.org/10.1016/S0048-7333(99)00055-4

Etzkowitz, Henry. 2008. *The Triple Helix: Industry-University-Government Innovation in Action*. New York: Routledge.

Etzkowitz, Henry. 2013. "Anatomy of the Entrepreneurial University." *Social Science Information*, 52(3): 486–511. https://doi.org/10.1177/0539018413485

Fagerberg, Jan. 1988. "International Competitiveness." *The Economic Journal*, 98: 355–374. https://doi.org/10.2307/2233372

Ferreira, João J., Cristina I. Fernandes, and Vanessa Ratten. 2016. "Entrepreneurship, Innovation and Competitiveness: What is the Connection?" *International Journal of Business and Globalisation*, 18(1): 73–95. https://doi.org/10.1504/IJBG.2017.081030

Garelli, Stephane. 2005. *IMD World Competitiveness Yearbook 2005*. Switzerland: IMD International.

Göktaş, Pınar, Aytaç Pekmezci, and Kurtuluş Bozkurt. 2018. *Ekonometrik Serilerde Uzun Dönem Eşbütünleşme ve Kısa Dönem Nedensellik İlişkileri*, Türkiye: Gazi Kitabevi.

Istvan, Labas, Darabos Eva, and Nagy T. Orsolya. 2016. "Competitiveness-Higher Ecucation." *Studia Universitatis Economics Series*, 26(1): 11–25. https://doi.org/10.1515/sues-2016-0002

Kara, Karahan. 2019. "Ulusal Yenilik, Ulusal Rekabet ve Ulusal Yükseköğretim Başarı Ilişkisi: Panel Veri Analizi." PhD diss. Çanakkale Onsekiz Mart University.

Kiper, Mahmut. 2010. *Dünyada ve Türkiye'de Üniversite-Sanayi İşbirliği ve Bu Kapsamda Üniversite-Sanayi Ortak Araştırma Merkezleri Programı (ÜSAMP)*. Ankara: Türkiye Teknoloji Geliştirme Vakfı.

Krstić, Miloš, José A. Filipe, and José Chavaglia. 2020. "Higher Education as a Determinant of the Competitiveness and Sustainable Development of an Economy." *Sustainability*, 12(16), 6607. https://doi.org/10.3390/su12166607

Lapteva, Alla V., and Valerii S. Efimov. 2016. "New Generation of Universities: University 4.0." *Journal of Siberian Federal University Humanities & Social Sciences*, 11(9): 2681–2696. https://doi.org/10.17516/1997-1370-2016-9-11-2681-2696

Marginson, Simon. 2006. "Dynamics of National and Global Competition in Higher Education." *Higher Education*, 52: 1–39. https://doi.org/10.1007/s10734-004-7649-x

Markusen, James R. 1992. *Productivity, Competitiveness, Trade Performance and Real Income: The Nexus Among for Concepts.* Ottawa: Canada Communication Group.

Odabaşı, Yılmaz. 2007. "21. Yüzyılın Üniversite Modeli Olarak Girişimci Üniversiteler." In *Değişim Çağında Yüksek Öğretim: Global Trendler – Paradigmal Yönelimler,* ed. Çoskun C. Aktan, 117-133. İzmir: Yaşar Üniversitesi.

OECD. 2021. "Education and Training." https://stats.oecd.org/ (accessed September 12, 2022).

Pedroni, Peter. 1999. **"**Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors." *Oxford Bulletin of Economics and Statistics*, 61(S1): 653–670.

Pedroni, Peter. 2000. "Fully Modified Ols for Heterogeneous Cointegrated Panels." https://web.williams.edu/Economics/wp/pedroniaie.pdf (accessed March 8, 2023).

Pedroni, Peter. 2004. "Panel Cointegration: Asymptotic and Finite Aample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis." *Econometric Theory*, 20(3): 597–625.

Pekmezci, Aytaç, and Kurtuluş Bozkurt. 2019. "Energy Consumption and Economic Growth: An Econometric Analysis for OECD Countries." In *Handbook of Energy and Environment Policy*, ed. Celil Aydın and Burak Darıcı, 55–70. Berlin: Peter Lang.

Pekmezci, Aytaç, and Kurtuluş Bozkurt. 2021. "COVID-19 Pandemisinin Petrol Fiyatları Üzerine Etkisinin Ekonometrik Bir Analizi." In *Pandemi Sonrası Ekonomik ve Politik Dönüşüm,* ed. Gülbahar Atasever, 79-94. Ankara: Gazi Kitapevi.

Pesaran, Mohammad H. (2007). "A Simple Panel Unit Root Test in the Presence of Cross-Section Dependence." *Journal of Applied Econometrics*, 22(2): 265–312. https://doi.org/10.1002/jae.951

Pesaran, Mohammad H., and Ron P. Smith. 1995. **"**Estimation of Long-run Relationships from Dynamic Heterogeneous Panels." *Journal of Econometrics*, 68: 79–114. https://doi.org/10.1016/0304-4076(94)01644-F

Pesaran, Mohammad H., and Takashi Yamagata. 2008. "Testing Slope Homogeneity in Large Panels." *Journal of Econometrics*, 142 (1): 50–93. https://doi.org/10.1016/j.jeconom.2007.05.010

Pesaran, Mohammad H., Yongcheol Shin, and Ron P. Smith. 1999. "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels." *Journal of the American Statistical Association*, 94: 621–634. https://doi.org/10.2307/2670182

Phillips, C. B. Peter, and Hyungsik R. Moon. 2000. "Nonstationary Panel Data Analysis: An Overview of Some Recent Developments." *Econometric Reviews*, 19(3): 263–286. https://doi.org/10.1080/07474930008800473

Porter, Michael E. 1990. *The Competitive Advantage of Nations*. New York: The Free Press.

Ramoniene, Lineta, and Marius Lanskoronskis. 2011. "Reflection of Higher Education Aspects in the Conception of National Competitiveness." *Baltic Journal of Management*, 6(1): 124–139. https://doi.org/10.1108/17465261111100932

Ranga, Marina, and Henry Etzkowitz. 2013. "Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society." *Industry and Higher Education*, 27(4): 237–262. https://doi.org/10.5367/ihe.2013.0165

Reda, Malak. 2012. *Enhancing Egypt's Competitiveness: Education, Innovation and Labor*. Cairo: Egyptian Center for Economic Studies.

Sahlberg, Pasi. 2006. "Education Reform for Raising Economic Competitiveness." *Journal of Educational Change*, 7(4): 259–287. https://doi.org/10.1007/s10833-005-4884-6

Sain, Kadir, and Kurtuluş Bozkurt. 2023. "Transformation of Knowledge into Economic Value in Higher Education and Global Competitiveness: A Panel Causality Analysis on OECD Countries." *Educational Policy Analysis and Strategic Research*, 18(3): 223–251. https://doi.org/10.29329/epasr.2023.600.11

Sart, Gamze. 2018. *OECD Ülkelerinde Küresel Rekabet Gücü ve Yüksek Öğrenimin Rolü*. Ankara: Nobel Akademi Yayıncılık.

Stock, H. James, and Mark W. Watson. 1993. **"**A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems." *Econometrica*, 61(4): 783–820. https://doi.org/10.2307/2951763

UNESCO. 2021. "Science, Technology and Innovation." http://data.uis.unesco.org/ (accessed October 24, 2022).

UNESCO. 2022. “Education.” http://data.uis.unesco.org/ (accessed September 13, 2022).

WB. 2021a. “DataBank, Education Statistics.” https://databank.worldbank.org/source/education-statistics-%5e-all-indicators (accessed October 17, 2022).

WB. 2021b. “Scientific and Technical Journal Articles.” https://data.worldbank.org/indicator/ (accessed October 17, 2022).

WB. 2022. “Research and Develepment.” https://data.worldbank.org/indicator/ (accessed October 14, 2022).

WEF. 2018. *The Global Competitiveness Report 2018*. Switzerland: Word Economic Forum. https://www3.weforum.org/docs/GCR2018/05FullReport/TheGlobalCompetitivenessReport2018.pdf (accessed September 15, 2022).

Weresa, Marzenna A. 2017. “Innovation, Human Capital and Competitiveness in Central and Eastern Europe with Regard to the Challenges of a Digital Economy.” https://www.etui.org/sites/default/files/Chapter%203_5.pdf (accessed September 13, 2022).

Westerlund, Joakim. 2007. “Testing for Error Correction in Panel Data.” *Oxford Bulletin of Economics and Statistics*, 69(6): 709–748. https://doi.org/10.1111/j.1468-0084.2007.00477.x

Appendix

Table 1A Higher Education Status of the Population in OECD Countries (2018)

Countries	In education in the 20–24 age group, proportion of population not in education or employment	In the 25–64 age group proportion of population with higher education	In the 25–64 age group Employment rate of the population with higher education	In the 25–64 age group Proportion of unemployed population with higher education	Proportion of graduates from training programs	Proportion of graduates from science, technology, engineering, and mathematics programs	Proportion of graduates from social sciences, journalism, and informatics programs	Proportion of graduates from information and communication technology programs	Proportion of graduates from business, management, and law programs	Proportion of graduates from heath and welfare programs
Austria	12.46	32.71	86.28	2.97	11.59	31.03	7.25	4.39	24.34	8.42
Belgium	14.61	40.64	86.1	3.16	7.88	16.99	10.2	2.1	20.32	28.79
Czech Republic	8.82	24.26	87.26	1.14	11.39	26.12	10.95	4.93	19.88	12.17
Denmark	13.48	39.45	86.61	4.03	5.23	22.2	10.01	4.76	25.65	20.88
Estonia	12.21	41.13	85.07	3.57	7.29	27.73	8	6.66	22.79	12.52
Finland	14.2	45.19	86.71	4.16	6.76	28.12	7.12	7.03	18.85	21.93
Hungary	15.44	25.1	85.79	1.34	14.15	22.52	10.23	4.59	25.42	8.6
Ireland	13.55	46.94	85.07	3.52	5.68	25.23	6.29	6.98	24.97	17.1
Italy	28.35	19.32	81.15	5.77	6.94	24.2	14.25	1.27	17.65	14.49
Latvia	14.02	33.94	89.07	3.69	7.72	20.17	8.85	4.69	28.47	17.48
Norway	10.26	43.58	89.05	2.2	15.8	22.1	10.45	3.69	18.58	19.29
Portugal	16.79	24.98	88.4	4.72	4.81	29.09	10.94	1.92	19.36	17.41
Slovak Republic	14.68	24.58	82.64	2.84	13.66	22.07	11.78	3.95	20.07	16.51
Slovenia	12.03	32.46	88.88	3.56	11.13	27.23	9.27	3.51	20.48	12.11
Spain	22.01	37.25	81.63	8.43	17.01	22.27	6.97	3.92	19.33	16.8
Sweden	10	43.25	89.83	3.53	12.98	26.64	11.8	4.27	16.4	23.22
Turkey	31.22	20.78	74.33	9.84	9.28	19.44	7.83	1.67	30.81	12.83
United Kingdom	14.19	45.78	86.12	2.17	9.25	26.32	11.89	3.62	22.04	13.43
OECD Average	15.46	34.51	85.55	3.92	9.91	24.41	9.67	4.1	21.96	16.33

Source: (OECD 2021; UNESCO 2022)

Table 2A Education Expenditures, R&D and Global Competitiveness Status in OECD Countries (2018)

Countries	Total public expenditure on education (in % of GDP)	Total public expenditure on higher education (in % of GDP)	R&D Expenditures (in % of GDP)	R&D expenditure by higher education (in % of GDP)	Number of R&D personnel (per million people)	Number of scientific and technical journal articles (per million people)	Global competitiveness	
							Score (0–100)	Order (Within 140 countries)
Austria	5.36	1.71	3.05	0.68	5.388	1.4	76.3	22
Belgium	6.41	1.45	2.7	0.53	4.730	1.38	76.6	21
Czech Republic	3.85	0.7	1.79	0.35	3.682	1.47	71.2	29
Denmark	7.82	2.45	3.05	0.98	7.925	2.41	80.6	10
Estonia	4.97	1.14	1.29	0.51	3.543	1.07	70.8	32
Finland	6.38	1.66	2.76	0.69	6.722	1.92	80.3	11
Hungary	4.67	0.8	1.35	0.18	2.922	0.69	64.3	48
Ireland	3.51	0.97	1.17	0.31	5.401	1.48	75.7	23
Italy	4.04	0.75	1.38	0.32	2.314	1.19	70.8	31
Latvia	4.4	0.69	0.51	0.24	1.785	0.74	66.2	42
Norway	7.91	2.11	2.09	0.71	6.350	2.22	78.2	16
Portugal	5.02	0.8	1.33	0.56	4.368	1.39	70.2	34
Slovak Republic	3.94	0.79	0.88	0.22	2.416	0.98	66.8	41
Slovenia	4.78	0.95	1.87	0.21	4.479	1.55	69.6	35
Spain	4.21	0.93	1.21	0.33	2.856	1.17	74.2	26
Sweden	7.57	1.79	3.4	0.84	7.383	2.01	81.7	9
Turkey	4.2	0.83	0.96	0.32	1.379	0.41	61.6	61
United Kingdom	5.44	1.45	1.7	0.39	4.341	1.47	82	8
OECD Average	5.24	1.24	1.81	0.47	4.332	1.14	73.17	-

Source: (UNESCO 2021; WB 2021a, 2021b; WB 2022).