

The role of universities as the institutional drivers of innovation at the regional level

Peter Čajka

Matej Bel University in Banská Bystrica, Slovakia, e-mail: peter.cajka@umb.sk

Andrea Čajková

University of Ss. Cyril and Methodius in Trnava, Slovakia, e-mail: andrea.cajkova@ucm.sk

Pavel Krpálek

University College Prague, Czech Republic, e-mail: krpalek@ucp.cz

Citation: Čajka P., Čajková A., Krpálek P. (2023). The role of universities as the institutional drivers of innovation at the regional level. *Terra Economicus* 21(1), 94–107. DOI: 10.18522/2073-6606-2023-21-1-94-107

This work assesses and scrutinizes the specific position of the universities and their relevance in fostering the regional development within the context of the globalized economy of the 21st century based on the relevant economic theories as well as the outcomes of the related research studies. Being both the educational as well as the research institutions, universities represent the important drivers that occupy an important position in knowledge-based and innovation-based society with a view to sustainable development at local, regional, national, and global levels. However, the society is sometimes not very much aware of the spectre and variety of services universities provide, or rather the way how the universities help to solve societal or local problems using their position and their activities. With the active cooperation of universities with local and regional governments in place, students have the opportunity to participate in identifying the problems of society and finding appropriate solutions by applying their theoretical knowledge. It is precisely the universities that, as the basis of an innovation system, should be the key for the regional innovation centres. We use a case study of Slovakia to demonstrate how universities can boost the innovative potential and foster the economic success in the competitive and globalized world economy.

Keywords: universities; institutional change; innovation; regional development; Slovakia

Funding: This paper was supported by the Grant VEGA No. 1/0320/21 “The role of universities in building a knowledge economy”.

JEL codes: I23, O30, R58

Роль университетов как институциональных драйверов инноваций на региональном уровне

Чайка Петер

Университет Матей Бела в Банска-Бистрице, Словакия, e-mail: peter.cajka@umb.sk

Чайкова Андреа

Университет св. Кирилла и Мефодия в Трнаве, Словакия, e-mail: andrea.cajkova@ucm.sk

Крпалек Павел

Университетский колледж Праги, Чешская Республика, e-mail: krpalek@ucpr.cz

Цитирование: Čajka P., Čajková A., Krpálek P. (2023). The role of universities as the institutional drivers of innovation at the regional level. *Terra Economicus* 21(1), 94–107. DOI: 10.18522/2073-6606-2023-21-1-94-107

Мы анализируем роль университетов в поддержке развития регионов в глобализированной экономике XXI века на основе соответствующих экономических теорий, а также обзора результатов исследований, полученных разными учеными. Будучи как образовательными, так и исследовательскими учреждениями, университеты представляют собой важный элемент институциональной среды, а также движущую силу развития общества, основанного на знаниях и инновациях, с целью устойчивого развития на местном, региональном, национальном и глобальном уровнях. Иногда общество не очень хорошо осведомлено о спектре и многообразии услуг, предоставляемых ему университетами, а точнее, о том, как деятельность университетов помогает решать общественные или локальные проблемы. При активном сотрудничестве университетов с местными и региональными органами власти студенты имеют возможность участвовать в выявлении проблем общества и поиске решений, применяя свои теоретические знания. Именно университеты как основа функционирующей инновационной системы рассматриваются как ключевые для региональных инновационных центров. Мы используем опыт Словакии, чтобы продемонстрировать, как университеты могут повысить инновационный потенциал и способствовать экономическому успеху в конкурентной и глобализированной мировой экономике.

Ключевые слова: университеты; институциональные изменения; инновации; региональное развитие; Словакия

Финансирование: Работа выполнена при поддержке Гранта VEGA № 1/0320/21 «Роль университетов в построении экономики знаний».

Introduction

In the age of globalization, the knowledge is considered to be a strategic commodity. It also plays a particularly important role in the knowledge economy. The discussion about the recent globalization and internationalization of higher education has been ongoing in order to set a place and the role of education in the globalized world (Scott, 2006).

Within the context of the globalization of higher education, Castells (2000) identified the sources of competitiveness in the global economy of four different processes: i) technological capacity;

ii) access to a large, integrated, and rich market; iii) the difference between profit and production costs; and iv) a production package. In terms of education, more universities and higher educational institutions (HEIs) cooperate with selected companies and enterprises (Jiroudková et al., 2015; Strielkowski et al., 2020).

This paper examines the role of universities as institutional drivers of innovation at the regional level, emphasizing the potential of higher education to enhance regional competitiveness. The paper specifically explores the impact of the knowledge economy on identifying opportunities for higher education to increase competitiveness, with a focus on Slovakia and other regions around the world. We describe the role and position of universities and their importance in supporting the development of regions in the globalized economy of the 21st century, based on the relevant theories and results of literature review. Our main effort was to point out the possibilities of how universities can, in the context of regional development, contribute to economic and social growth. According to Lina (2019), understanding the significance of research and educational pursuits is crucial, as they play a vital role in fostering innovation and enhancing human capital skills. By disseminating knowledge to the business landscape, these activities can facilitate the growth and development of enterprises.

The paper is structured as follows: Section 2 presents the literature review encompassing the theoretical background of the knowledge economy, competitiveness, and its linkages through the potential of higher education with the Tripple/Quadruple/Quintuple Helix Innovation System Framework. It also features a detailed discussion about the universities' opportunities in regional innovation initiatives. Section 3 outlines a contextualization of regional innovation within multi-level systems employing the country's case study of Slovakia. Finally, the last section summarizes the conclusions, draws the implications, and provides the closing remarks.

Our research methodology was based on the critical content analysis of the qualitative data and literature from the various data bases and information sources: EBSCO Information Services, Google Scholar, WoS, as well as Scopus database. We use such research methods as the analysis, synthesis, deduction, and induction, supplemented by the case study methods. In addition, we employ the case study of Slovakia and use the data from the Regional Innovation Scoreboard (RIS), the innovation dimensions that measure the performance in innovation, in comparison with the gross domestic expenditure on R&D. Our analysis allows us to assess the importance of universities for promoting innovativeness at universities that enables the establishment of the cross-sectoral networks and thereby to increase competitiveness.

Literature review

The idea of globalization encompasses the knowledge of economy, regionalization, information, and communication technologies (e.g., Rýsová and Dobřík, 2013; Rainnie and Grant, 2018; Zeibote et al., 2019). In order to keep pace with the trend of internationalization, students should develop the international awareness and intercultural communication skills required to survive in a global world. The recent COVID-19 pandemic clearly showed how important those skills are and why they need to be developed and properly nourished (Korneeva et al., 2022).

Unprecedented and growing demand for the international higher education around the world has led to a growing expansion of academic mobility and the exceptional development of cross-border education (Knight, 2008). The internationalization of higher education is based on drawing the institutional arrangements between policymakers, governments, universities, and educational agents that enables the provision of higher education services in various countries.

Globalization has an impact on higher education systems as well as the higher educational institutions (HEIs). The globalization is distinguished by the increasingly integrated world economy, novel information and communication technologies, as well as the emergence of the multinational companies. Globalization is seen as an economic, political and social force that is transforming 21st century higher education towards greater international involvement. (Molnárová and Rošteková,

2020) Free trade stimulates international academic mobility. In this sense, international higher education is considered a commodity that is and can be freely traded.

Nowadays, our world is dealing with the global knowledge economy and an information-based society (Kim, 2020; Liu et al., 2021; Peráček, 2020; Szostak, 2021). Thence, the quality, efficiency, and the relevance of the university system are directly connected to the ability of people, society, and institutions to evolve and to constantly adapt to the new conditions. Within the context of the technological revolution as well as the breakthrough in the communication, universities are becoming central actors in the scientific and technological change. The importance of universities is also centred around many other aspects, such as the ability to train a workforce prepared for the new challenges in the production and management. Universities are also becoming a critical source of balancing opportunities and democratizing society by giving people equal opportunities. It is not only a contribution to economic growth, but also a contribution to social equality, or at least to lower inequality. The ability of universities to develop new cultures is another factor – to be a source of cultural renewal and cultural innovations associated with the new life forms we are entering. Finally, the university was dramatically affected by the technological changes themselves. Their own information and communication technologies profoundly influence the functioning and culture of the university, sometimes without full knowledge of what is happening and without control over these processes (Castells, 2017).

The term “university” itself is linked to the first known medieval university represented by the University of Bologna in today’s Italy which was founded in 1088. The first universities were the communities with administrative autonomy, study programs, publicly recognized degrees, and research tasks that differed markedly from the religious institutions that had previously dominated it (De Ridder-Symoens and Rüegg, 1992). They also were the places where the representatives of the ruling elites could meet each other and strike strategic alliances (Nureev et al., 2020). In several centuries, universities have spread around the world in an almost equal form and played an important part in the entrepreneurial revolution through the development of legal institutions (Cantoni and Yuchtman, 2014), as well as during the industrial revolution when they were involved in building, developing, and disseminating the knowledge (Mokyr, 2002).

The role of universities in regional innovation systems

In 1900, only 1% of the world’s young people were enrolled in university (Schofer and Meyer, 2005). Over the centuries, it has exploded to 20% as the recognition of the value of such education has spread. It turns out that the expansion of higher education since the 1950s has not only been a product of growing wealth but has also contributed to economic growth worldwide. (Valero and Van Reenen, 2019)

In the middle of the 20th century, higher education lost its elitist status. The emergence of the global economy, technical and technological expansion, the growth and economic importance of knowledge production have transformed higher education into a mass phenomenon directly responsible for the development of society.

At the beginning of the 21st century, a cultural transformation takes place in the academic environment (Malik, 2018). This generated in the last twenty years – according to Loprieno (2018), the new university institutional model of autonomy does not diminish the financial reliance on the political context. However, it emphasizes the institutional role, which increases the significance of institutional goals and strategic plans, thereby defining the organization’s new vision and value system.

The knowledge economy is driven by knowledge, which is the product of education, with higher education being the epicentre of knowledge creation. Higher education, therefore, plays a key role in the knowledge economy by acquiring knowledge through the research and “production” of graduates who have the knowledge and experience in managing this economy.

According to the World Bank¹, the norms, values, attitudes, ethics, and knowledge that tertiary institutions can provide to students constitute the social capital needed to build healthy civil societies and socially cohesive cultures. The role of universities in building a knowledge economy is, therefore:

- to develop the strategic thinking needed for young people and researchers to find solutions to the problems facing our world and to develop innovative study and joint research programs;
- to reduce human insecurity and provide teacher training programs to educate the next generation of teachers;
- to provide professionals with opportunities for continuous development as well as opportunities for lifelong learning; to promote public involvement, social well-being, and active civic skills.

Higher education plays an important role in teaching and research, including the commercialization and transfer of knowledge in line with the requirements to support innovation. In addition, it also shapes up the need to address the challenges behind the education system. Such challenges/problems currently include inadequate access to higher education; insufficient funding; human capacity deficit; insufficient number/low quality of pedagogical staff; poor policy implementation; insufficient resources; shortcomings in ICT equipment; curriculum shortcomings; brain drain in many countries; weak leadership and management and academic corruption.

In the over-globalized 21st century, knowledge became the essential part of the regional development and innovation. New and innovative solutions are required for fostering the development processes. Within this context, the so-called “knowledge triangle” constitutes a framework for spatial research in which the actors entangled together in the mutual interactions in education, research, as well as innovations (Scott, 2015). Therefore, the place of the scientific research and HEIs in the innovative social and economic policies aimed at promoting regional development is becoming gradually more important (Horváthová and Čajková, 2018). The institutions that generate knowledge contribute to tackling the global challenges as well as the economic and technological development and social progress of local communities and regions. The entrepreneurial thinking which includes the identification of all the needs and their fulfilment, leads to openness, innovation, dissemination of knowledge, experience, and cooperation, needs to be supported by the relevant stakeholders. This is why the business-oriented knowledge institutions tend to rely upon the individuals and their innovative approaches. It needs to be mentioned that the stimulating entrepreneurial mindset is quite mundane and is widely recognized as being essential for promoting innovations. Nevertheless, the local and regional dimensions of innovation processes and policies become especially relevant in the post-Fordist era. This leads to the emergence of the “triple helix”, a holistic system where universities, governments, and industries combine their efforts to create a common advantage that would be otherwise hard to obtain if acting individually (Lu ka, 2017). According to Gunasekara (2006: 104), “with the key elements of the regional innovation system (regional agglomeration, or clustering of industry, human capital formation, associative governance, regional cultural norms) universities can play a generative role and a developmental role”. In the global competition universities have to assume not only a „third mission”, but a „third role”. This role is about maintaining regional innovation systems „smart and effective” (Markkula and Kune, 2015).

The “triple helix” model emerged from an analysis of academic research on the restructuring of the Boston economy in the 1930s through collaboration between universities, industry, and government (Etzkowitz, 2002). The “triple helix” concept can work well especially in specific regions with advanced world-class universities. However, these links are weak in backward, peripheral regions (Pugh, 2016).

It can be shown that within the triple helix model, the government (exogenous approach) initially played a leading role, followed by the industry (endogenous approach), and the society based on knowledge and knowledge institutions (holistic approach) in cooperation with the economy and

¹ World Bank (2000). *Higher education in developing countries: Peril and promise*. Report of the Independent World Bank/UNESCO Task Force on Higher Education and Society. Washington, D.C. <https://documents.worldbank.org/en/publication>

government. In order to satisfy broader social needs, regional development should foster the economic development as well as the development of non-economic spheres. In many countries and regions, citizens are becoming increasingly aware of the relevance of the knowledge economy in general and the role of universities in this economy in particular. The idea of the importance of the public as the fourth “party” in the system has already been proposed by Mehta (2005) at an international workshop on science, technology, and society in Singapore. Mehta suggested that the science and innovation system involve the public as a “quadruple helix” model, given its impact and important role in adopting and sustaining new technologies/innovations (Reichert, 2006; Arnkil et al., 2010). The public can thus be the fourth “party” whose interests and ideas must be taken as seriously as the interests and ideas of others. One could really say that knowledge regions form a four-dimensional helix system (Lučka, 2017).

According to Lew et al. (2018), the aim was to bridge the gap between innovation and civil society. According to the triple helix model, new technologies do not always meet the requirements and needs of society, thus limiting their potential impact. It is thus clear that civil society has become more prominent, and Caruso (2018: 383) identifies four dimensions related to the voice of society, namely customer expectations, product improvements, collaborative innovation, and new organizational patterns (Steenkamp, 2019).

The five-fold spiral “quintuple helix” adds as a fifth spiral the natural environment, more specifically socio-ecological interactions – application to sustainable development. Global warming is an area of ecological interest to which the innovative quintuple helix model can be applied with greater potential.

Universities make a significant contribution to economic development by providing university graduates. They have been one of the most valuable contributions to society in developing the needs of the population in the fields of education, health care, and social services. Universities are part of the “creative class” in our society, which, according to Florida (2022), is the key to economic growth. He argues that regional economic growth is fostered by the localization choice of the creative people (e.g. holders of creative capital) who prefer places that are diverse, tolerant, as well as open to the new ideas.

Moreover, universities contribute to economic development not only by providing graduates but also by expertise and various forms of direct assistance, which maintain safe and healthy communities, improve the performance of public administration, and support a vibrant community.

According to Lina (2019), the engagement of universities in the regional smart specialization process can enhance their ability to undertake the “third mission” through various activities that primarily focus on the following aspects:

- continuing education, by providing services for lifelong learning to address workforce demands;
- technology transfer and innovation, by enhancing their administrative competence for conducting technology transfer activities;
- social involvement, by engaging in local administration decision-making, as well as collaborating with the business community.

In their paper, Garcia-Alvarez-Coque et al. (2021) examine interactions between the presence of top-ranked universities and other conditions that encourage regional competitiveness. Huggins et al. (2008) assert that universities and research centres serve as critical institutions in shaping and transferring innovation. Compagnucci and Spigarelli (2018) add that synergy of universities and innovation centres as the actors with whom companies are most engaged is grounded on collaboration agreements to enhance technology transfer. In addition, universities and business companies tend to collaborate in order to compete for public tenders and R&D grants. It often happens that business companies collaborate with the local universities due to their proximity and the costs of logistics, as well as the expenses related in using their R&D departments. Regarding the above, Carayannis et al. (2012) outline a framework of the investment in education sustainability in Quintuple Helix (Fig. 1).

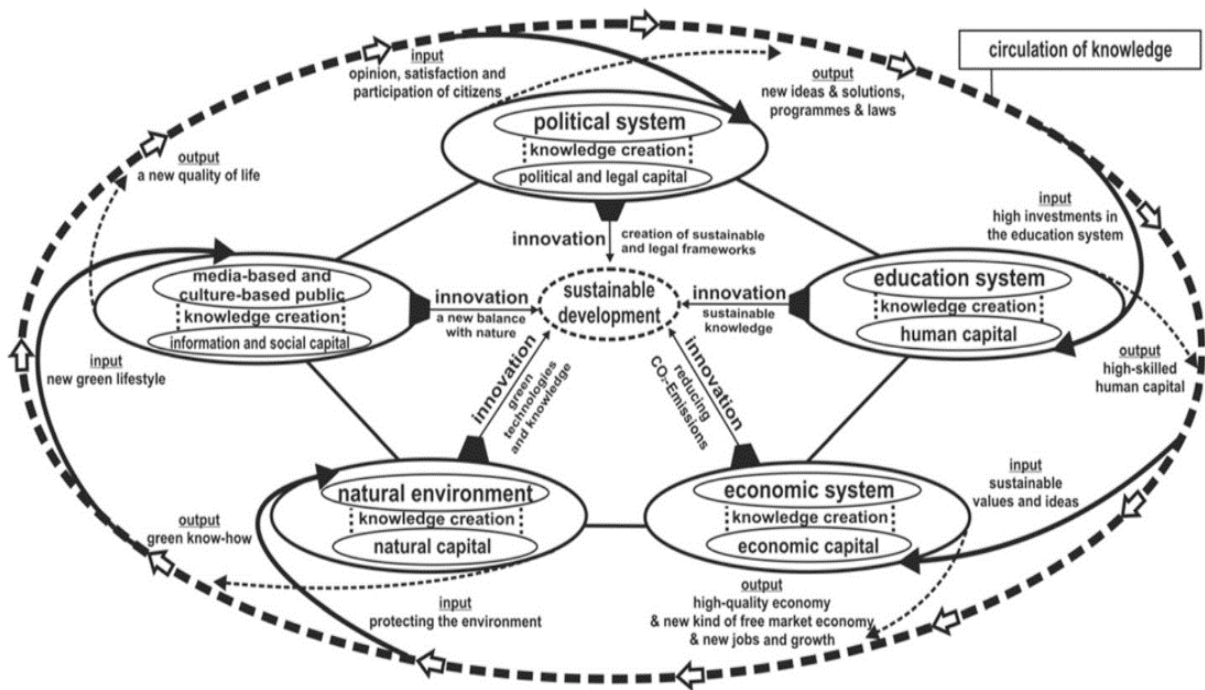


Fig. 1. Investment in education sustainability in Quintuple Helix

Source: Carayannis et al. (2012)

In some cases, the company establishes its own physical space within the university building to maximise the link between academia and business, nurturing the talent of young graduates and researchers. As Lopes and Farinha (2018) recall, in a more territorial approach, the regional competitive advantage is based on the capability in attracting development opportunities and capturing high-technology companies and talent, ensuring a greater wealth creation and employability. Furthermore, Peris-Ortiz et al. (2016) draw the multiple helix ecosystem for sustainable competitiveness (Fig. 2).

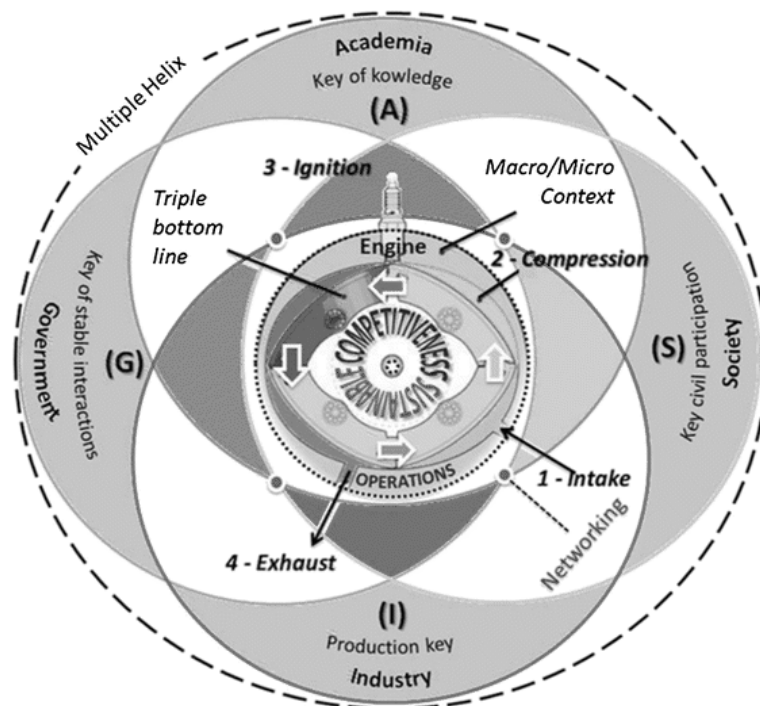


Fig. 2. Multiple helix ecosystem for sustainable competitiveness

Source: Peris-Ortiz et al. (2016)

The Regional Innovation Scoreboard (RIS) represents a tool aiming at performance assessment of regional innovation systems, across the EU countries. In total, 27 indicators are grouped into four main types (Framework conditions, Investments, Innovation activities, and Impacts), and 10 innovation dimensions that measure the performance in innovation (Zabala-Iturriagagoitia et al., 2007). This RIS 2020 employs the same measurement framework as the European Innovation Scoreboard (EIS) but is limited to using regional data for 18 of the 27 indicators used in the EIS.

Universities as the institutional drivers of innovation: a case study of Slovakia

Slovakia is an industrial country, where industry still significantly contributes to employment, GDP creation, and other economic as well as social indicators. The industry of Slovakia in the first 20 years of the 21st century was dominated by engineering and electrical engineering, led by the automotive industry. It can be said that the automotive industry is the driving force of the Slovak economy and the generator of the creation of a significant number of jobs and GDP growth (Pavlínek, 2019). Although according to Mišúnová and Korec (2019), the automotive industry is a generally accepted driving force of the Slovak economy and creates a significant number of highly qualified jobs, graduates of technical universities. In comparison with other industries, the automotive industry requires a significantly higher number of qualified (university-educated) technical workers (Fig. 3). However, one of the problems and threats to the development of this industry in Slovakia is precisely the regional availability of a workforce with appropriate education (see Table 1).

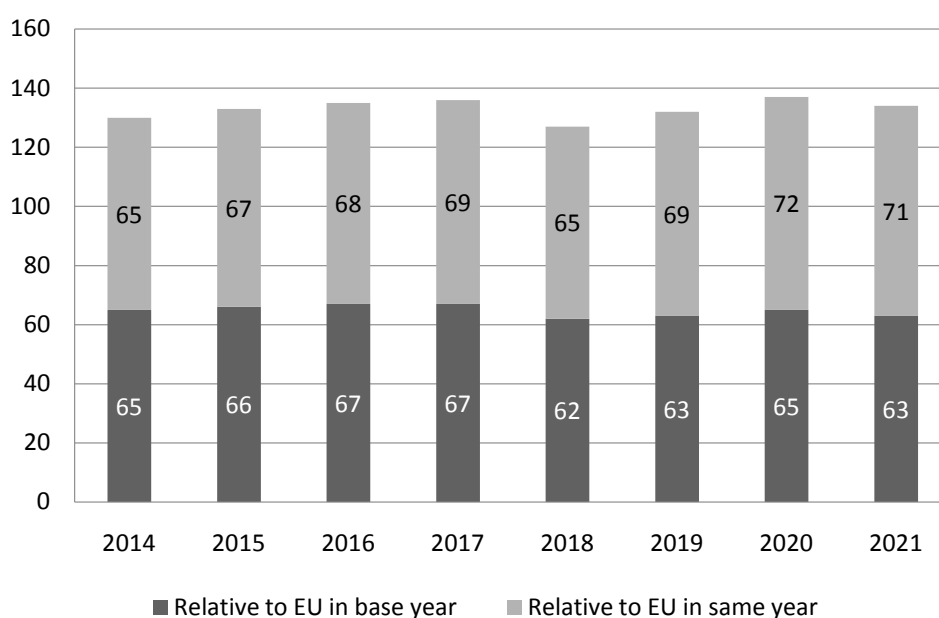


Fig. 3. Slovakia's innovation performance relative to the EU (2014–2021)

Source: Own results based on RIS (2021). https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

The long-standing opinion in society that the two basic tasks of a university are education and research. Nowadays, primarily as a result of integration and globalization, even at the national level, the scope of activities carried out at the university goes beyond these two primary functions and into the foreground the demand for the role of universities in the economic development of the state and regional development is shifting (Belvončíková, 2021; Huggins et al., 2020).

According the RIS (2021) one can see that though in Slovakia in recent years performance increases for Tertiary education, International scientific co-publications, Most-cited publications, Venture capital, Government support for business R&D, ICT specialists, and Environment related technologies (Bielínska-Dusza and Hamerska, 2021), have been offset by reduced performance for Digital skills,

Enterprises providing ICT training, Design applications, and Sales of innovative products, Slovakia is declining in comparison with other EU countries in the field of innovation (Table 1). Slovakia has above average shares of non-innovators and is showing below average scores on the Climate change related indicators. More recently, between 2020 and 2021, performance has declined for seven Member States, including France, Ireland, Latvia, Luxembourg, Netherlands, Portugal, and Slovakia.

Table 1

Regional Innovation Scoreboard for Slovakia (2020)

Slovakia	Relative to EU 2021 in 2021	Relative to EU 2014 in	
		2014	2021
Summary Innovation Index	63.1	65.1	71.0
Human Resources	74.9	70.9	79.4
Doctorate graduates	87.0	111.5	77.0
Population with tertiary education	98.7	49.6	127.3
Lifelong learning	27.3	25.6	30.3
Attractive research systems	56.5	36.8	63.5
International scientific co-publication	77.1	62.4	101.1
Most cited publications	42.6	15.7	41.8
Foreign doctorate students	51.6	48.3	61.3
Digitalisation	81.2	94.7	112.3
Broadband penetration	80.8	94.9	122.5
People with basic overall digital skills	81.8	94.4	100.0
Finance and support	25.5	31.1	30.4
R&D expenditures in the public sector	36.4	50.9	35.1
Venture capital expenditures	14.9	11.3	25.0
Government support for business R&D	24.1	17.9	27.8
Firm investments	48.2	55.6	58.2
R&D expenditure in the business sector	28.4	22.0	31.5
Non-R&D innovation expenditures	93.0	103.5	105.7
Innovation expenditures per employee	42.1	50.6	55.6
Use of information technologies	83.8	73.8	96.8
Enterprises providing ICT training	73.3	80.0	73.3
Employed ICT specialists	92.9	66.7	123.8
Innovators	27.2	49.1	37.2
Product innovators (SMEs)	29.9	36.1	42.2
Business process innovators (SMEs)	24.6	60.6	32.8

Source: Based on RIS (2021). https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

In terms of global competitiveness, Slovakia continues to decline. In the Global Competitiveness Report of 2019, published by the World Economic Forum (WEF), the Slovak Republic ranked 42nd out of 141 countries. With a score of 66.8 points out of 100, it worsened its position by one place compared to the previous year. Except for Hungary, Slovakia lags behind its neighbours: the Czech Republic finished in 32nd place, Poland in 37th place and Austria in 21st place.

Slovakia has slightly improved in terms of infrastructure quality and IT use. The level of job skills and the efficiency of the labour market have also increased. In addition, the country's macroeconomic stability is positively perceived. However, given the current state of public finances, Slovakia could lose this advantage in the future. Of the 12 pillars assessed, chronic problems related to the

business environment prevent Slovakia from growing. In addition, Slovakia received the lowest score in the innovation capacity segment, 46 out of 100. The country lags behind other countries in other pillars as well. Slovakia is the worst when comparing goods markets, where it finished in 89th place. The intricate tax and customs system, as well as special tax regimes and subsidies, are hindering entrepreneurs and damaging the competitive environment. Additionally, barriers to the employment of foreigners pose a challenge. The third pillar, which is the quality of public institutions and ranks at 61st place, is lagging behind. This aspect is mainly hindered by high regulatory burdens, inadequate law enforcement, a lack of independence in the judiciary and police, and an unclear long-term economic plan by the government, which has a negative impact on competitiveness². All in all, Slovakia's emerging innovators are marked by the performance level well below the EU average.

One of the key indicators showing the relevance of the universities in the national economy is yielded by the gross domestic expenditure on R&D. As the available data show when comparing the percentage of R&D expenditures within the Visegrad Group (V4) countries compared to the EU27 average, the Slovak Republic is the only country to record only a minimal percentage increase in the last 5 years (2016–2020) and has stagnated in R&D expenditures for a long time (see Fig. 4). Compared to the Czech Republic, for example, this is only half of R&D expenditure.

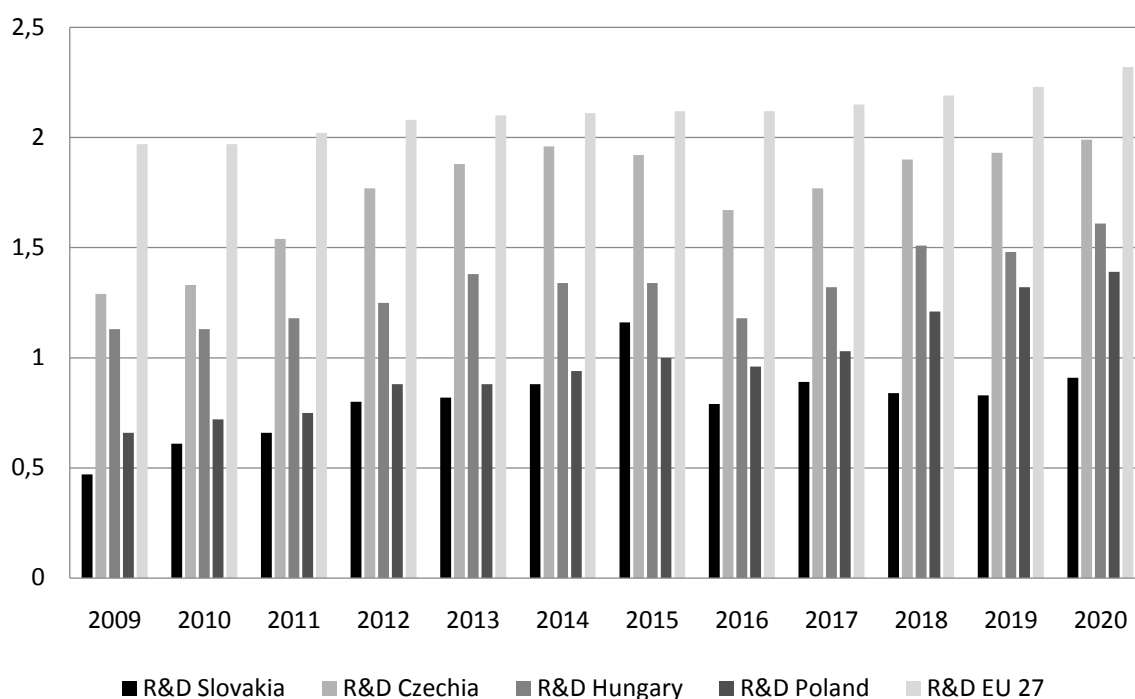


Fig. 4. R&D expenditure as a percentage of GDP

Source: Own results based on Eurostat (2022). <https://ec.europa.eu/eurostat>

The aim of promoting innovativeness at universities is to establish cross-sectoral networks in which not only scientists but also practitioners are involved in order to link innovations creation with not only research but also praxes. The stakeholders should be working to improve cross-sectoral cooperation through assessments and measures at the system level to improve health and promote equity and social justice (Valencia et al., 2019) and thereby promoting also regional development. In order to involve stakeholders, one must clearly define the benefits each partner can expect from working together. One should try to understand the incentives and constraints of the partners and articulate her or his own to ensure that their partnership balances the needs of each to maximize progress to-

² The Slovak Spectator (2019). EC: Slovakia lags in several fields. <https://spectator.sme.sk/c/22063957/ec-slovakia-lags-in-several-fields.html>

ward common goals. Governments often express a desire to create jobs or to improve livelihoods in a particular region or sector of economy (Szostak and Sułkowski, 2020).

Most countries are now increasingly transforming into a knowledge-based economy from traditional economies based primarily on natural resources. Unlike traditional economies, where capital and natural resources form the core of economic development, knowledge-based economies are built on the knowledge that underpins science, technology, and innovation. It is clear that universities will continue to play a key role in achieving the knowledge economy in any country. Their role goes beyond the traditional teaching and basic research and will involve the increasing commercialization and transfer of knowledge in line with government requirements to support research, development, and innovation to increase the country's global competitiveness.

Conclusions

Overall, it becomes clear that competitiveness constitutes a fundamental goal of every country. The creation and use of knowledge in economic activities create goods and services with higher added value, thus increasing the likelihood of economic success in this competitive and globalized world economy. Technical progress, which is also the result of research and development activities, is a major source of productivity growth and effective environmental protection. We cannot neglect ICT innovation, which is making a significant contribution to the recent development of international markets.

A well-educated and qualified population is essential for the effective creation, acquisition, and use of knowledge. Tertiary as well as lifelong learning increase competitiveness, as they are crucial for the development of human capital, which is an essential source of a country's competitiveness.

As stated, for example, by Xing and Marwala (2017), higher education constitutes a “*complex, dialectical and exciting opportunity*” in the Fourth Industrial Revolution that can potentially transform society for the better. Since the Fourth Industrial Revolution is thought to be driven mainly by the artificial intelligence (AI), it would be capable of transforming the traditional workplace from the task-based characteristics to the human-centred ones. Due to the convergence of man and machine, it would be able to further reduce the subject distance between the humanities and the social science as well as between science and technology (Lee and Lim, 2021). Therefore, it would help to attract research innovation to the regions that need it in the first place. This process would necessarily require heavier loads of interdisciplinary teaching, research, as well as innovation. As a result, the educational experience would be augmented rather than degraded (Xing and Marwala, 2017).

A high-quality education sector is one of the important factors that contribute to a country's strength in international relations. Growing internationalization brings more direct links between education, international relations, and foreign policy. The importance of education in international prestige and the country's position has increased significantly in recent years, mainly due to fundamental transformations in the global economy and the corresponding shift in values. Not only is knowledge growing exponentially, but it is also spreading rapidly globally. In order to catch up with this global knowledge race, education beyond the labour market is needed, reflecting a shift towards post-materialist values, and these effects can be a source of a country's attractiveness to the world economy.

References

- Arnkil, R., Järvensivu, A., Koski, P., Piirainen, T. (2010). *Exploring Quadruple Helix outlining user-oriented innovation models*. Työraportteja Working Paper No. 85
- Belvončíková, E. (2021). Univerzitné patenty v EU28: priestorová dimenzia EU15 verus EU13. *XXIV International colloquium on regional sciences*, pp. 41–28. DOI: 10.5817/CZ.MUNI.P210-9896-2021-5
- Bielińska-Dusza, E., Hamerska, M. (2021). Methodology for calculating the European innovation scoreboard-proposition for modification. *Sustainability* **13**(4), 2199. DOI: 10.3390/su13042199

- Cantoni, D., Yuchtman, N. (2014). Medieval universities, legal institutions, and the Commercial Revolution. *The Quarterly Journal of Economics* **129**(2), 823–887. DOI: <http://doi.org/10.1093/qje/qju007>
- Carayannis, E., Barth, T., Campbell, D. (2012). The Quintuple Helix innovation model: Global warming as a challenge and driver for innovation. *Journal of Innovation and Entrepreneurship* **1**(1), 1–12. DOI: 10.1186/2192-5372-1-1
- Caruso, L. (2018). Digital innovation and the fourth industrial revolution: Epochal social changes? *AI & Society* **33**, 379–392. DOI: 10.1007/s00146-017-0736-1
- Castells, M. (2000). Materials for an exploratory theory of the network society. *The British Journal of Sociology* **51**(1), 5–24. DOI: 10.1111/j.1468-4446.2000.00005.x
- Castells, M. (2017). *The role of universities in development, the economy and society*. In: Muller, J., Cloete, N., van Schalkwyk, F. (eds.) *Castells in Africa: Universities and Development, African Minds*. University of the Western Cape, pp. 57–65. DOI: 10.5281/zenodo.1067363
- Compagnucci, L., Spigarelli, F. (2018). Fostering cross-sector collaboration to promote innovation in the water sector. *Sustainability* **10**, 4154. DOI: 10.3390/su10114154
- De Ridder-Symoens, H., Rüegg, W. (1992). *A History of the University in Europe*. Cambridge: Cambridge University Press.
- Etzkowitz, H. (2002). *MIT and the rise of entrepreneurial science*. London: Routledge.
- Florida, R. (2002). *The Rise of the Creative Class*. New York: Perseus Books.
- Garcia-Alvarez-Coque, J., Mas-Verdú, F., Roig-Tierno, N. (2021). Life below excellence: Exploring the links between top-ranked universities and regional competitiveness. *Studies in Higher Education* **46**(2), 369–384. DOI: 10.1080/03075079.2019.1637843
- Gunasekara, C. (2006). Reframing the role of universities in the development of regional innovation systems. *The Journal of Technology Transfer* **31**(1), 101–113. DOI: 10.1007/s10961-005-5016-4
- Horváthová Z. and Čajková A. (2018). Social and Economic Aspects of the EU's Education Policy. *Integration of Education* **22**(3), 412–425. DOI: 10.15507/1991-9468.092.022.201803
- Huggins, R., Johnston, A., Steffenson, R. (2008). Universities, knowledge networks and regional policy. *Cambridge Journal of Regions, Economy and Society* **1**(2), 321–340. DOI: 10.1093/cjres/rsn013
- Huggins, R., Prokop, D., Thompson, P. (2020). Universities and open innovation: The determinants of network centrality. *The Journal of Technology Transfer* **45**, 718–757. DOI: 10.1007/s10961-019-09720-5
- Jiroudková, A., Rovná, L., Strielkowski, W., Šlosarčík, I. (2015). EU accession, transition and further integration for the countries of Central and Eastern Europe. *Economics and Sociology* **8**(2), 11–25. DOI: 10.14254/2071-789X.2015/8-2/1
- Kim, S. (2020). Exploitation of shared knowledge and creative behavior: The role of social context. *Journal of Knowledge Management* **24**(2), 279–300. DOI: 10.1108/JKM-10-2018-0611
- Knight, J. (2008). The internationalization of higher education: Are we on the right track? *Academic Matters: The Journal of Higher Education* **52**, 5–9.
- Korneeva, E., Strielkowski, W., Krayneva, R., Sherstobitova, A. (2022). Social health and psychological safety of students involved in online education during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health* **19**(21), 13928. DOI: 10.3390/ijerph192113928
- Lee, C. and Lim, C. (2021). From technological development to social advance: A review of Industry 4.0 through machine learning. *Technological Forecasting and Social Change* **167**, 120653. DOI: 10.1016/j.techfore.2021.120653
- Lew, Y., Khan, Z., Cozzio, S. (2018). Gravitating toward the quadruple helix: International connections for the enhancement of a regional innovation system in Northeast Italy. *R&D Management* **48**(1), 44–59. DOI: 10.1111/radm.12227

- Lina, D. (2019). The role of universities in regional innovation systems. One-step further in assuming the third mission. *EURINT* **6**, 288–310.
- Liu, G., Tsui, E., Kianto, A. (2021). Revealing deeper relationships between knowledge management leadership and organisational performance: A meta-analytic study. *Knowledge Management Research & Practice* **20**(2), 251–265. DOI: 10.1080/14778238.2021.1970492
- Lopes, J., Farinha, L. (2018). Measuring the performance of innovation and entrepreneurship networks. *Journal of the Knowledge Economy* **9**, 402–423. DOI: 10.1007/s13132-017-0487-8
- Loprieno, A. (2018). *European academies and University: How to Generate Trust in Knowledge Societies?* Sofia: Allea General Assembly, Bulgarian Academy of Sciences.
- čka, L. (2017). Universities, knowledge networks and local environment for innovation-based regional development: case study of the university of Maribor. *Geografický Časopis* **69**(4), 361–383.
- Malik, R. (2018). Educational challenges in 21st century and sustainable development. *Journal of Sustainable Development Education and Research* **2**(1), 9–20. DOI: 10.17509/jsder.v2i1.12266
- Markkula, M., Kune, H. (2015). Making smart regions smarter: Smart specialization and the role of universities in regional innovation ecosystems. *Technology Innovation Management Review* **5**(10), 7–15. DOI: 10.22215/timreview/932
- Mehta, M. (2005). Regulating biotechnology and nanotechnology in Canada: A post-normal science approach for inclusion of the fourth helix. *International Journal of Contemporary Sociology* **42**(1), 107–120.
- Mišúnová, E., Korec, P. (2019). Univerzity ako aktér regionálneho rozvoja: teoretické poznámky. *Acta Geographica Universitatis Comenianae* **63**(2), 193–215.
- Mokyr, J. (2002). *The Gifts of Athena: Historical Origins of the Knowledge Economy*. Princeton: Princeton University Press.
- Molnárová, E., Rošteková, M. (2020). Educational policy of the Slovak republic in the context of changes in the labour market: Media discourse analysis. *Politické Vedy* **23**(4), 47–64. DOI: 10.24040/politickevedy.2020.23.4.47-64
- Nureev, R., Volchik, V., Strielkowski, W. (2020). Neoliberal reforms in higher education and the import of institutions. *Social Sciences* **9**(5), 79. DOI: 10.3390/socsci9050079
- Pavlínek, P. (2019). Restructuring and internationalization of the European automotive industry. *Journal of Economic Geography* **19**(1), 1–33. DOI: 10.1093/jeg/lby070
- Peráček, T. (2020). The perspectives of European society and the European cooperative as a form of entrepreneurship in the context of the impact of European economic policy. *Online Journal Modelling the New Europe* **34**, 38–56. DOI: 10.24193/OJMNE.2020.34.02
- Peris-Ortiz, M., Ferreira, J., Farinha, L., Fernandes, O. (eds.) (2016). *Multiple Helix Ecosystems for Sustainable Competitiveness. Innovation – Technology Management*. Cham: Springer.
- Pugh, R. (2016). Universities and economic development in lagging regions: ‘Triple helix’ policy in Wales. *Regional Studies* **51**, 1–12. DOI: 10.1080/00343404.2016.1171306
- Rainnie, A., Grant, J. (2018). *New Regionalism in Australia*. London: Routledge.
- Reichert, S. (2006). The rise of knowledge regions: emerging opportunities and challenges for universities. EUA Publication. November 2006. https://www.reichert-consulting.de/wp-content/uploads/2021/11/The_Rise_of_Knowledge_Regions.pdf
- Rýsová, L., Dobřík, M. (2013). Regional development basic theoretical approaches. *Politické Vedy* **16**(2), 98–109.
- Schofer, E., Meyer, J. (2005). The worldwide expansion of higher education in the twentieth century. *American sociological review* **70**(6), 898–920. DOI: 10.1177/000312240507000602
- Scott, A. (2006). Creative cities: Conceptual issues and policy questions. *Journal of Urban Affairs* **28**(1), 1–17. DOI: 10.1111/j.0735-2166.2006.00256
- Scott, R. (2015). *Higher Education Institutions in the Knowledge Triangle*. Paris: OECD IHME.

- Steenkamp, R. (2019). The quadruple helix model of innovation for Industry 4.0. *Acta Commercii* **19**(1), a820. DOI: 10.4102/ac.v19i1.820
- Strielkowski, W., Volchik, V., Maskaev, A., Savko, P. (2020). Leadership and effective institutional economics design in the context of education reforms. *Economies* **8**(2), 27. DOI: 10.3390/economies8020027
- Szostak, M. (2021). Post-communist burden influence on the perception of creative identities: Consequences for managers and leaders. *European Research Studies Journal* **25**, 282–302. DOI: 10.35808/ersj/2354
- Szostak, M., Sułkowski, Ł. (2020). Manager as an artist: creative endeavour in crossing the borders of art and organizational discourse. *Creativity Studies* **13**(2), 351–368. DOI: 10.3846/cs.2020.11373
- Valencia, S., Simon, D., Croese, S., Nordqvist, J., Oloko, M., Sharma, T., Buck, N., Versace, I. (2019). Adapting the Sustainable Development Goals and the New Urban Agenda to the city level: Initial reflections from a comparative research project. *International Journal of Urban Sustainable Development* **11**(1), 4–23. DOI: 10.1080/19463138.2019.1573172
- Valero, A., Van Reenen, J. (2019). The economic impact of universities: Evidence from across the globe. *Economics of Education Review* **68**, 53–67. DOI: 10.1016/j.econedurev.2018.09.001
- Xing, B., Marwala, T. (2017). Implications of the fourth industrial age on higher education. *arXiv preprint*. arXiv:1703.09643. DOI: 10.48550/arXiv.1703.09643
- Zabala-Iturriagoitia, J., Voigt, P., Gutiérrez-Gracia, A., Jiménez-Sáez, F. (2007). Regional innovation systems: How to assess performance. *Regional Studies* **41**(5), 661–672. DOI: 10.1080/00343400601120270
- Zeibote, Z., Volkova, T., Todorov, K. (2019). The impact of globalization on regional development and competitiveness: Cases of selected regions. *Insights into Regional Development* **1**(1), 33–47. DOI: 10.9770/ird.2019.1.1(3)