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COMPARISON OF INNOVATION LEVEL IN EDUCATION IN SELECTED EU COUNTRIES

KOMPARÁCIA INOVAČNEJ ÚROVNE V OBLASTI VZDELÁVANIA VO VYBRANÝCH KRAJINÁCH EÚ

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Abstract:
Innovations are considered to be the engine of economic development worldwide. Universities and companies are the main subjects in society that predetermine the quality of human potential and development of knowledge based economy. The huge disparities in the quality of universities are often caused by unequal use of innovation, exponential growth of e-learning opportunities and other factors. Higher education in Slovakia and the worldwide have much in common. These innovation proposals are based on the outcomes of various international educational reports and researches and own comparison of innovation measuring indicators in selected EU countries. In our research we confirmed, those trends like increasing number of scientific researcher and follow-up development of science and research can lead to improvement of the economic situation and country's competitiveness. The best positions in the innovation performance are achieving Germany and United Kingdom.

Key words: innovations, school system, knowledge, research, education, universities

Abstrakt:
Inovácie sú považované za motor ekonomického rozvoja na celom svete. Univerzity a firmy sú hlavnými subjektami spoločnosti, ktoré determinujú kvalitu ľudského života a rozvoj ekonomiky založenej na vedomostiach. Veľké rozdiely v kvalite univerzít sú často zapríčinené nerovnomerným využitím inovácií, exponenciálnym nárastom možností v online vzdelávaní a iných faktorov. Vysoké školstvo na Slovenku má veľa spoločného s celosvetovým vývojom vysokého školstva. Tieto návrhy inovácií sú založené na výsledkoch mnohých zahraničných štúdií a výskumov v oblasti vzdelávania, ako aj vlastného porovnania indikátorov, ktoré podporujú vznik inovácií vo vybraných krajinách EU. V našom výskume sa potvrdilo, že trendy ako zvyšovanie počtu vedeckých pracovníkov a následný rozvoj vedy a výskumu môže viesť k zlepšeniu ekonomickej situácie a konkurencieschopnosti krajiny. Najlepšiu pozíciu v rámci inovačnej výkonnosti dosahujú Nemecko a Veľká Británia.

Kľúčové slová: inovácie, školstvo, vedomosti, výskum, vzdelávanie, univerzity

JEL: I20, I21, O30

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1 Introduction

An innovation is any new or substantially improved good or service which has been commercialised, or any new or substantially improved process used for the commercial production of goods and services. Innovation defines something that 'adds value'. In general, innovation is only regarded to have occurred if it has been implemented or commercialised in some way. The creation of abstract knowledge, or the invention of new products, processes or let's say innovative techniques in teaching which would improve the overall educational process, is not normally considered innovation until it has been productively incorporated into the enterprise's activities. This means that innovative activity is not something that can occur separate from the university's core activities, rather it must involve the coordination of various inventive, learning and implementation skills.

All around the world, businesses and governments are facing two main problems: high levels of youth unemployment and a shortage of job seekers with critical generic skills. Leaders everywhere are aware of the possible consequences, which could possibly result from youth unemployment, particularly in the form of social and economic distress, when too many young people believe that their future is compromised. But still, governments are incapable to develop effective responses or even to define what they need to know.

In terms of school systems, innovation is relatively common and regular process. But since worldwide education is not one single complex, which is developing equally, mainly in the higher education the disparities are deepening and solving this trend is becoming crucial. The amount of students, who decide to continue study and apply for university, is still high, even though in some regions it's declining. In the same time, employers mostly agree, that having a university degree is not as important as it was in the past and fresh graduates are lacking basic generic skills.

The Oslo Manual, created by the OECD, aims to set a benchmark for innovation surveys and research for its members. The Oslo Manual decides to concentrate on the first two Schumpeter categories, which it claims are relatively easier to define and measure. The Manual clarifies the definition of the two categories. A technological product innovation can involve either a new or improved product whose characteristics differ significantly from previous products. In our case, the product refers to the educational services offered by universities and their quality.

The quality of nowadays school systems is determined by the use of innovation. The innovation indicators determine the whole innovation environment of each state and therefore this significantly contribute to increasing quality of research and development, education, employment and also the overall economic growth.

Conditions for implementing innovation depend on each state and to describe the differences, we compared the primary education-connected indicators in Slovakia, Czech Republic, United Kingdom and Germany, which was the main objective of our research.

2 Literature Review

Innovation is everywhere. In the world of goods (technology) certainly, but also in the realm of words: innovation is discussed in the technical and scientific literature, in social sciences like history, sociology, management and economics, but as well in the humanities, arts and education. Innovation is also a central idea in the popular imaginary, in the media, in public policy and is part of everybody's vocabulary. Briefly stated, the innovation has become the emblem, the integral part of our lives, of the modern society, a panacea for resolving many problems, and a phenomenon to be studied. As H. Nowotny defines our epoch: "It is a fascination and quest for innovation" (Gibbons M. – Nowotny H. 1994 (2008; 2006)).

There are various definitions of "innovation" that appear in the literature. The purpose of this section will by a comparison of some of the major definitions. One of the 20th century's great economic and political thinkers Joseph Schumpeter is well known for his theory explaining the activities that lead to economic growth in capitalist economies. (Faferberg J. 2002) He is often thought of as the first

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economist to draw attention to the importance of innovation. Schumpeter argues that "competition among market participants leads to a desire to seek out new ways to improve technology, new ways to do business and other types of advantages that would increase profit margins and directly impact the entrepreneur's standard of living." In our case, *market participants* are universities, either state or private, and *the business* is teaching students and preparing them, as future graduates, for being successful at labour market.

Sustaining or transformative uses of technology do not depend on technology alone; they also depend on the intended use of technology in specific educational contexts. Often, specific technologies prioritise certain uses and hence can be used more easily for sustaining or transformative purposes. However, such prioritisation is not deterministic. Further the characteristic that most influences the choice and development ICT in school education is the pedagogical decision making of the teacher. These, in turn, are determined by the curriculum goals and training and pedagogical competence of that teacher (Pierson, 2001, Webb & Cox, 2004).

Innovation is widely recognised as an important engine of growth. The underlying approach to innovation has been changing, shifting away from models largely focused on Research and Development (R&D) in knowledge- based globalised economies and giving more emphasis to other major sources of the innovation process. Understanding how organisations build up resources for innovation has thus become a crucial challenge to find new ways of supporting innovation in all areas of activity (Innovative Workplaces - OECD 2010).

According to Innovation Union Scoreboard 2014 - In the innovation rankings of EU countries, Slovakia fell from 18th to 23rd rank between 2009 and 2010. But after Europe 2020 strategy come into force, it has improved the position to 20th rank. The positive change in innovation performance between 2010 and 2012 is equal to 19.9 percent, which makes Slovakia the most progressive country since the launch of the Europe 2020 strategy."

"Slovak investments into education, research and development rank among the lowest in OECD. The number of foreign students in Slovakia is negligible, while the flow of students out of Slovakia is among the highest in OECD" (Higher Education to 2030 - OECD 2010)

As far as the educational system is concerned, Slovakia is lagging behind all of the V4 countries. Based on the results form OECD's PISA (Programme for International Student Assessment) report 2012, Poland and Hungary are taking average positions in international evaluation of students over a longer time, while Slovakia is below the average and even decreasing in last six years.

The need for fundamental change in educational system is also mentioned in the McKinsey&Company's report: "School the systems on the way from average to good, are in general characterized by less well trained teachers, who strictly control the educational process because the minimization of differences among classes and schools is a key performance driver at this stage. On the other hand, systems moving from good to excellent, characterized by more experienced teachers, offer usually only more general frameworks and syllabi, because the creativity of teachers, sharing of ideas and innovations within and among schools are the engine for further improvements." Slovakia has an ambition to create an excellent educational system, but it is trying to achieve these goals using tools more adequate to less developed systems.

3 Methodology and Methods of Research

One part of logic behind the paper methodology was to obtain as much as possible data about innovation of selected countries. All of the data respected and well-known institutions and reports such as in results part, where we used statistical data of McKinsey Global Institute, Babson study, International World Bank and surveys from OECD, Eurostat and ProInno for external point of view about education in selected countries in EU. Our goal was to collect appropriate range of information, which we afterwards processed to pinpoint only the most important points about potential threats, but as well opportunities as far as the education is concerned.

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Main goal of the article is to compare innovation performance of countries in the field of education, science and R&D based on selected indicators, for which we have used comparative method and statistical collections of Eurostat science database, education and technology indicators, but as well data from Innovation Union Scoreboard 2014, Science-Metrix, Scopus Elsevier and Community Innovation Survey. From these sources we chose indicators which are closely connected with innovations in education. For research we have chosen four countries of EU: Slovakia, Czech Republic, United Kingdom and Germany. In most of the cases we could observe year-to-year growth. We connected these outcomes with description of each of the indicators and explanation of their importance for general improvement of innovation in school systems.

Knowing of innovation indicators in education, science and research a joining these results with the economic and innovation situations as well as with selected universities' ranking generated a picture of dependency between quality of education and economic results of the country.

4 Results and Discussion

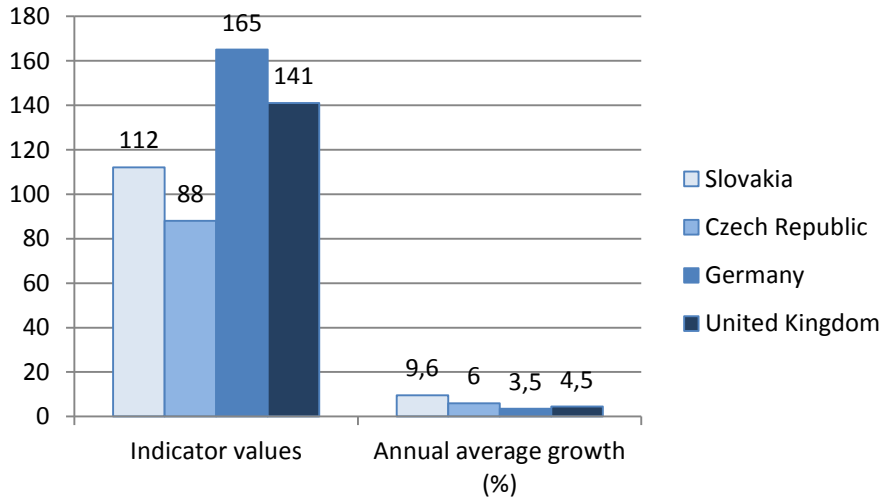
Each year the annual Innovation Union Scoreboard report provides a comparative assessment of the situation within the research and innovation performance of the EU27 Member States and the relative strengths and weaknesses of their research and innovation systems. This report is an instrument of the European Commission, developed under the Lisbon Strategy and revised after the adoption of the Europe2020 strategy, and in conjunction with Regional Innovation Scoreboard made every second year; it is considered to be the best innovation evaluating method.

To assess the environment of school systems' innovations we chose four countries. Firstly we picked United Kingdom, because it is the cradle of European education having several of its universities among best universities worldwide. Secondly, we chose Germany, because of its highly developed industrial innovations and strong research and development environment. The Czech Republic and Slovakia were chosen based on the fact, that till 1992 they formed one state and even now they are often compared as they are neighboring countries and have more or less the same conditions for development.

For evaluation of the innovation background in mentioned countries we used the values from latest Innovation Union Scoreboard 2014. From the list of indicators we selected those which are connected to research and development, education and employment. These areas we also used afterwards as the basis for survey which was focused on evaluation of educational innovations by startups from mentioned counties.

Performance of each state was measured relatively to the EU where the EU = 100.

Fig. 1: New doctorate graduates (ISCED 6) per 1000 population aged 25-34



Source: Innovation Union Scoreboard 2014, own elaboration

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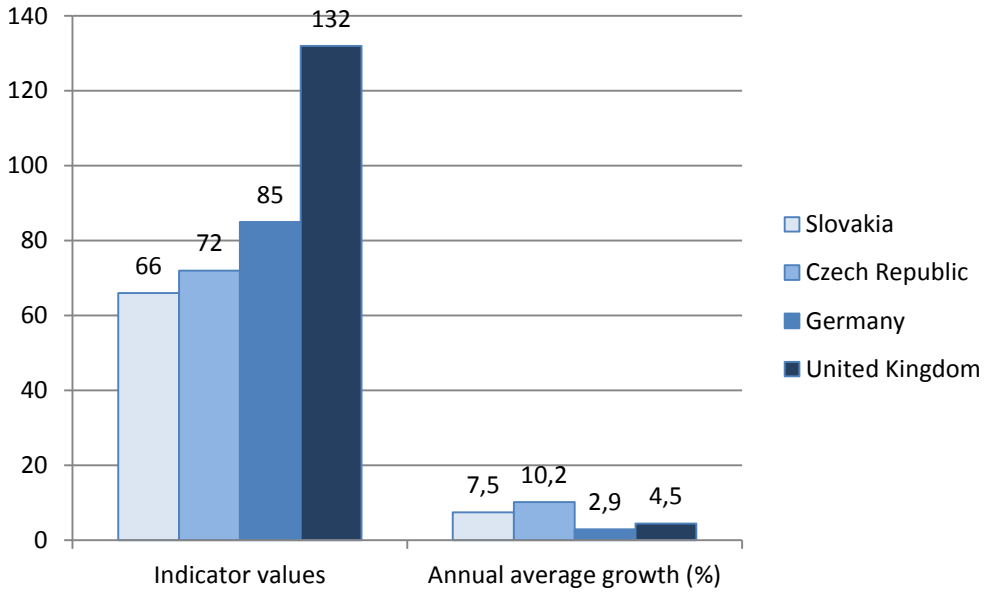
The indicator is a measure of the supply of new second-stage tertiary graduates in all fields of training. For most countries ISCED 6 captures PhD graduates only (except from Finland, Portugal and Sweden). In our case, we can see that most of the second-stage graduates comparing these 4 countries come from Germany, but the highest growth is in Slovakia, which means, that it should have been very well prepared as far as the national knowledge base is concerned. When we compare the annual growth rates, we can see, that since year 2013 the number of New doctorate graduates increased by 9,6 percent in Slovakia, which is a huge step forward in this area, but the growth has slowed down in comparison with 23 percent between 2012 and 2013.

Fig. 2: Percentage population aged 30-34 having completed tertiary education



Source: Innovation Union Scoreboard 2014, own elaboration

This is a general indicator of the supply of advanced skills. It is not limited to science and technical fields because the adoption of innovations in many areas, in particular in the service sectors, depends on a wide range of skills. International comparisons of educational levels however are difficult due to large discrepancies in educational systems, access, and the level of attainment that is required to receive a tertiary degree. The indicator focuses on a narrow share of the population aged 30 to 34 and it will more easily and quickly reflect changes in educational policies leading to more tertiary graduates. From the graph we can see, that most of the population aged 30-34 having completed tertiary education is in United Kingdom, however, the highest annual growth among these four countries, which was twice as high as in the UK, was recorded in the Czech Republic.

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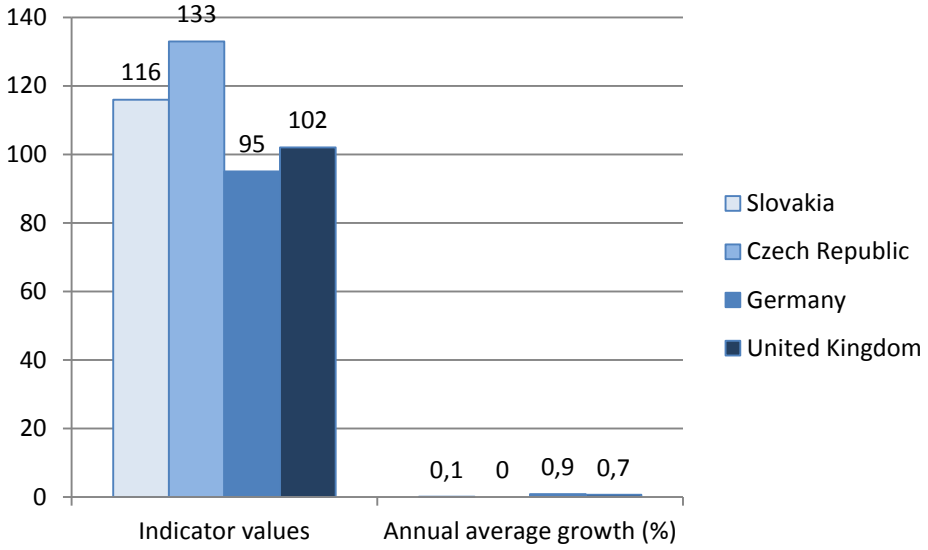
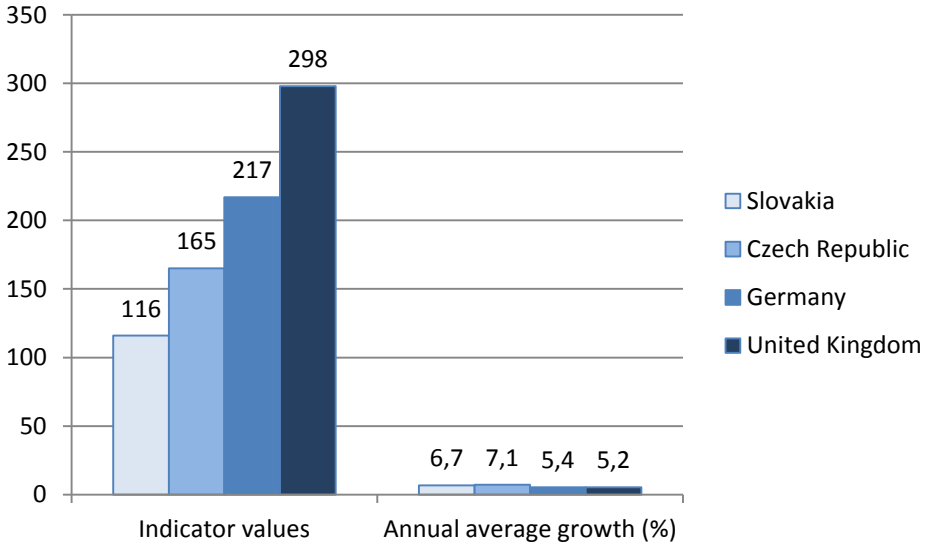
Fig. 3: Percentage youth aged 20-24 having attained at least upper secondary education



Source: Innovation Union Scoreboard 2014, own elaboration

The indicator measures the qualification level of the population aged 20-24 years in terms of formal educational degrees. It provides a measure for the "supply" of human capital of that age group and for the output of education systems in terms of graduates. Completed upper secondary education is generally considered to be the minimum level required for successful participation in a knowledge-based society and is positively linked with economic growth. We can see that highest rate is measured in the Czech Republic, while the highest average growth is in Germany.

Fig. 4: International scientific co-publications per million population



Source: Innovation Union Scoreboard 2014, own elaboration

International scientific co-publications are so called "proxies" for the quality of scientific research as collaboration increases scientific productivity. From the graph we can see, that the number of International scientific co-publications is highest in the United Kingdom, it is three times higher than in Slovakia and it is as well closely connected with the next indicator.

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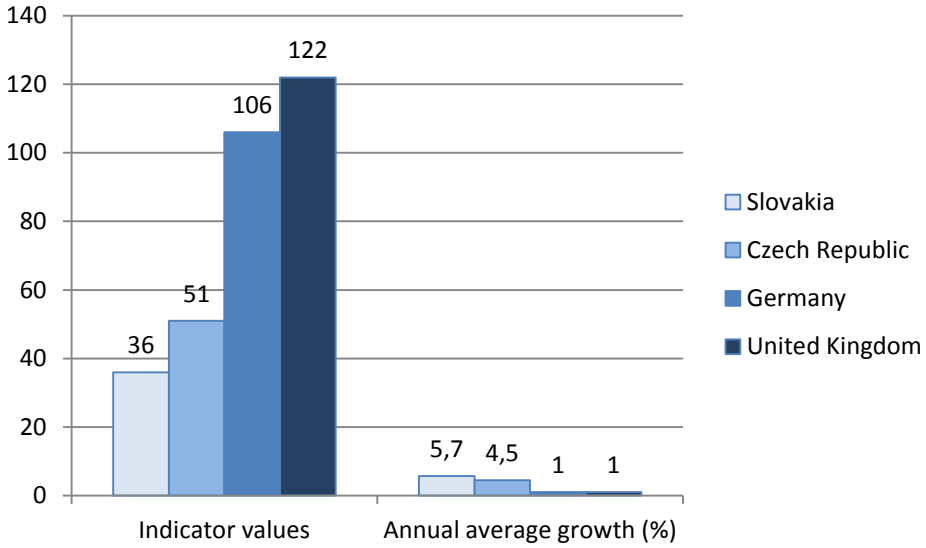
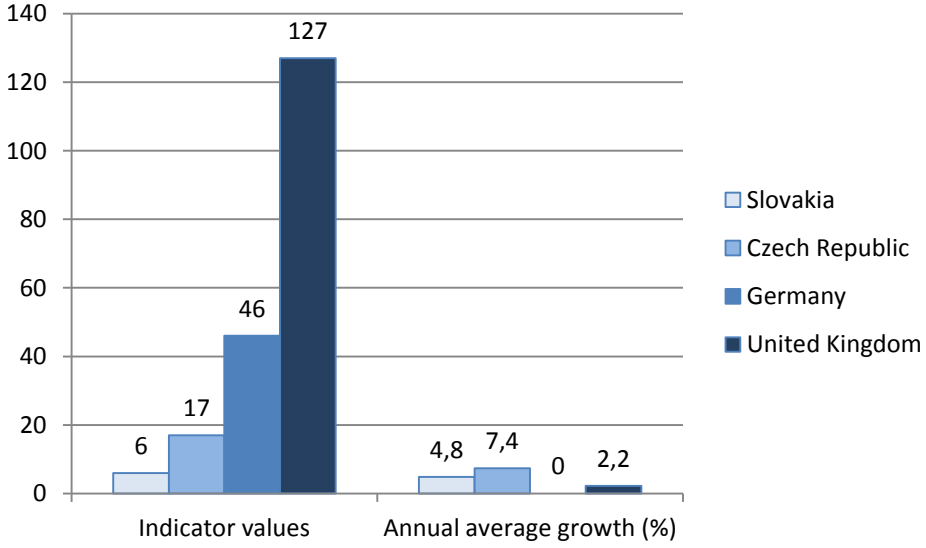
Fig. 5: Scientific publications among the top-10% most cited publications worldwide as % of total scientific publications of the country



Source: Innovation Union Scoreboard 2014, own elaboration

This indicator is often considered to be a proxy for the efficiency of the research system as highly cited publications are assumed to be of higher quality. There could be a bias towards small or English speaking countries given the coverage of Scopus' publication data, which is a bibliographic database containing abstracts and citations for academic journal articles. Countries like France and Germany, where researchers publish relatively more in their own language, are more likely to under-perform on this indicator as compared to their real academic excellence, but for the comparison, these data are enough. We can estimate, from the graph, that in Slovakia there is lack of publications among the top-10% most cited publications, even though the 5,7% growth is highest among compared countries.

Fig. 6: Non-EU doctorate students as a % of all doctorate holders



Source: Innovation Union Scoreboard 2014, own elaboration

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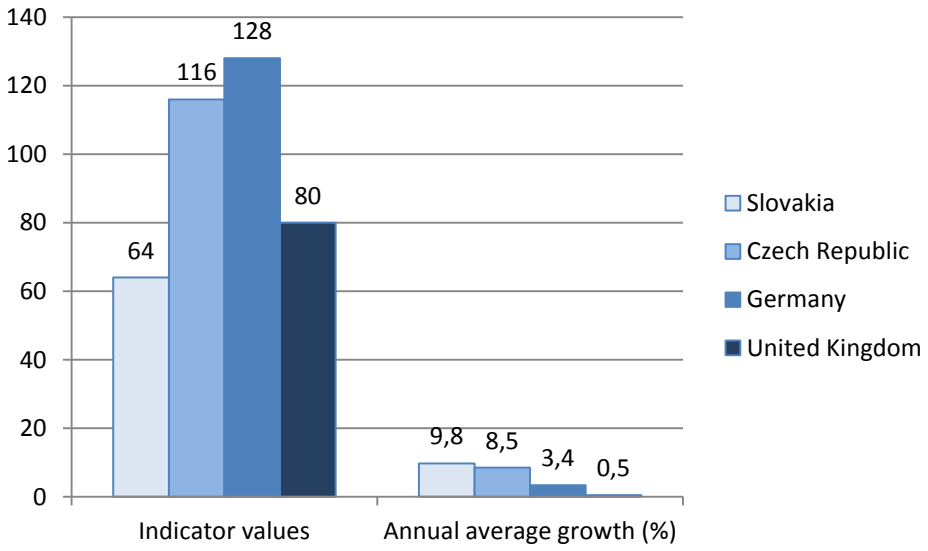
The share of non-EU doctorate students reflects the mobility of students as an effective way of diffusing knowledge. Attracting high-skilled foreign doctorate students will add to creating a net brain gain and will secure a continuous supply of researchers.

According to University World News, at EU level, policies strongly focus on advancing Europe as a centre of excellence in education and training: "These developments are considered to be vital for the EU to be a realistic competitor to other student migration receiving countries, such as the US and Canada." The main problem often is the low number of "entirely-in-English-taught" international courses. Regarding the study, some 75% of international courses in The Netherlands are taught entirely in English. The availability of study in English is also well developed in Sweden. Other countries including Finland, Lithuania, Poland, Slovak Republic, Slovenia and Spain have identified this as a priority area in their national strategies. Only Hungary and Latvia have no national policy on international students.

R&D expenditure represents one of the major drivers of economic growth in a knowledgebased economy. As such, trends in the R&D expenditure indicator provide key indications of the future competitiveness and wealth of the EU. Research and development spending is essential for making the transition to a knowledge based economy as well as for improving production technologies and stimulating growth.

So far, even the investments into the Research and Development were quite low, but based on the information we have found out, we are moderately optimistic. Several firms have announced investments in R&D area many universities are as well involved. For example, in 2012 IBM decided to open a laboratory in Slovakia and it has secured financial resources and several universities are participating there. The Slovak University of Technology in Bratislava closely cooperates with Volkswagen Slovakia is ready to invest in a similar IT Lab project along with the current cooperation.

Fig. 7: R&D expenditure in the public sector



Source: Innovation Union Scoreboard 2014, own elaboration

Slovaks often criticise foreign firms for not investing enough in research in Slovakia. But imagine you are an investor with companies all over the world and you arrive to a new country which you do not know very well; you certainly do not locate the most sensitive part of your business there. Certainly, the first step is to create some kind of branch, then to launch regular operations so that the firm develops its business and nurtures human capital in line with its corporate culture, and then after it is tested over several years it decides to make further investments. This is exactly what Volkswagen has done. After 20 years the time has come to take a braver step. There will be other firms that will invest in research but they first must create the groundwork and see that we do not live in trees and that society is ready for the next step.

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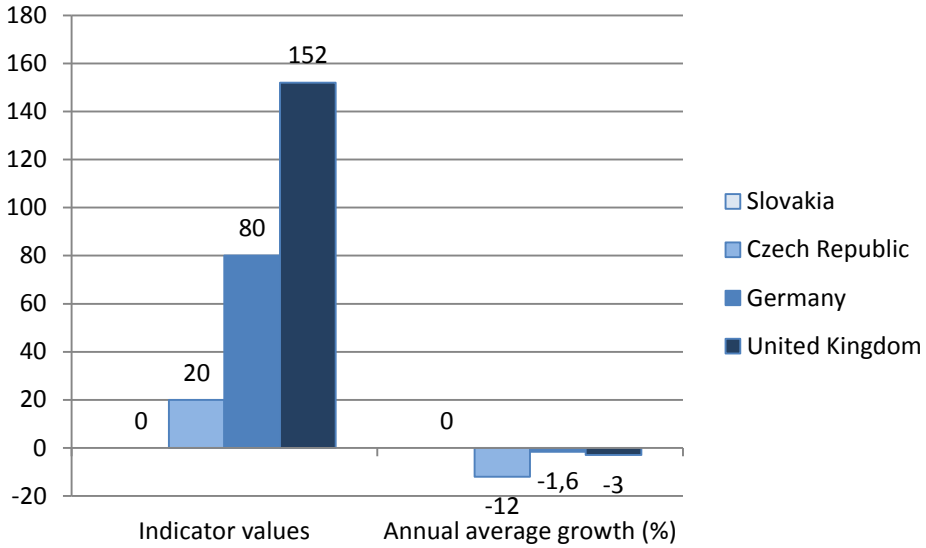
Fig. 8: Venture capital



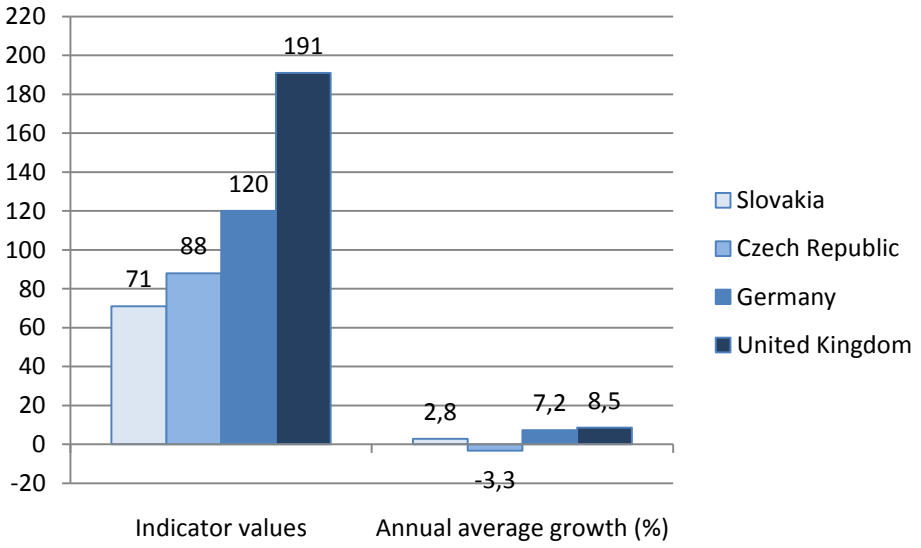
Source: Innovation Union Scoreboard 2014, own elaboration

The amount of venture capital is a proxy for the relative dynamism of new business creation and measure of innovation mostly within the economic sector, but as well in education. In particular for enterprises using or developing new (risky) technologies venture capital is often the only available means of financing their (expanding) business.

Since 1995, the Slovak Venture Capital and Private Equity Association is established, but from our personal point of view, is not visible as it should be. Comparing to Neulogy, this is involved nearly in every start-up event throughout the Slovakia. Recently Neulogy even broaden the cooperation to universities like Slovak Academy of Sciences, Slovak University of Technology, Comenius University or Academy of Fine Arts and Design. Based on this, Slovakia has a great potential for future growth regarding the venture capital.

For instance in the USA, there are nearly 2 million businesses created every year, and 600– 800 get venture capital funding. According to study done by the National Venture Capital Association in 2011, 11% of private sector jobs come from venture backed companies and venture backed revenue accounts for 21% of US GDP.

Fig. 9: Innovative SMEs collaborating with others



Source: Innovation Union Scoreboard 2014, own elaboration

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This indicator measures the degree to which SMEs are involved in innovation cooperation. Complex innovations, in particular in ICT, often depend on the ability to draw on diverse sources of information and knowledge, or to collaborate on the development of an innovation. This indicator measures the flow of knowledge between public research institutions and firms and between firms and other firms. The indicator is limited to SMEs because almost all large firms are involved in innovation co-operation.

5 Discussion and conclusions

Innovations are considered to be the engine of economic development worldwide. Universities and companies are the main subjects in society that predetermine the quality of human potential and development of knowledge based economy. The huge disparities in the quality of universities are often caused by unequal use of innovation, low level of cooperation between education providers and employers, exponential growth of e-learning opportunities and other factors. Higher education in Slovakia and worldwide have much in common.

As for the comparison of the school systems' innovation indicators, it is clear, that the United Kingdom is traditionally a high-performing country in international rankings of education and there was no difference even in our analysis of innovation indicators, where the United Kingdom ranked at the first positions nearly in every indicator, which we compared mainly in International scientific co-publications, Innovative SMEs collaborating with others and New doctorate graduates. It is not a surprise, because UK historically remains a cradle of European education, giving periodically lots of its resources on Research & Development each year, and is the only country from Europe having 3 of its universities in Top 10 Worldwide University rankings. What is more interesting is, that its annual growth is slowing down each year. The UK has stagnated in recent years even in such rankings as the Programme for International Student Assessment (PISA) tests in 2013, for reading and maths the country as a whole stood in the middle-rankings.

When we analysed the innovation potential between the Czech Republic and Slovakia, we've found out, that the Czech Republic performed better in every indicator, but for Slovakia, it is a good step forward as it has higher growth in the most important indicators like R&D expenditure in the public sector (% of GDP), Scientific publications among the top-10% most cited publications worldwide and New doctorate graduates according to ISCED 6. When we look at where Slovakia is lagging behind the most, we would find, that there is a need to firstly more connect Slovak education with business environment, either through different types of cooperation with business sector, or through venture capital investments as well there's a need to improve the promotion of Slovak education abroad, where we should focus on attracting high-skilled foreign doctorate students, which are creating a net brain gain and will secure a continuous supply of researchers.

Germany is performing well above the EU average, especially for International scientific co-publications, new doctorate graduates and Non-R&D innovation expenditures. We can see relative weaknesses only as far Non-EU doctorates students and Venture capital investments are concerned. As for the strong increases in growth, they are observed in the indicator of Innovative SMEs collaborating with others.

Despite the relatively high number of mentioned indicators, we would like to stress on two of them, which we assume are essential for future viable development of innovation environment at universities worldwide. Venture capital as the main driving force for innovation and job growth is beneficial for communities throughout the states, as they allow building rapidly expanding businesses and creating increased employment. Non-EU doctorate students are one of the most important indicators, but as well most underestimated one. It is not very often mentioned in the international statistics, but it definitely contributes to knowledge based economy and secures a continuous supply of researchers.

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