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Effectiveness of Higher Education in the European Union Countries in Context of National Competitiveness

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Abstract: The main aim of this paper is to present the results of comparative analysis of *higher education effectiveness in the European Union countries in the context of technology adoption and knowledge development. The first part of the paper describes the notion of national competitiveness, the determinants of its improving and methods of its measuring. Enhancing national competitiveness is in fact one of the objectives of higher education in the welfare economies, or should be in the countries that want to become such. That is why our attempt to verify the higher education effectiveness is taken from the perspective of performance, such as competitiveness. Furthermore, the welfare economy will be very difficult to achieve without a well-educated and trained workforce that is able to absorb new knowledge in order to introduce innovations to market. Today's educational systems should thus provide the so-called knowledge workers who endowed with the relevant knowledge resources can apply them in practice. These workers are a strong factor underpinning national competitiveness.*

The second part focuses on the comparison of higher education effectiveness in the 27 European Union countries on the basis of selected indicators presented in the World Economic Forum's annual Global Competitiveness Reports. Our study covers the five years period between 2008 and 2012 and is carried out to evaluate the effectiveness of higher education in European Union countries using indirect measures,

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such as the opinion of entrepreneurs about the quality of higher education, the indicators of knowledge absorption capacity, and the extent of cooperation between universities and business. In this part of the paper our own synthetic index of higher education effectiveness is also presented, which takes into account, according to the main aim of the paper, the issue related to technology adoption and knowledge development.

Introduction

According to N. Rosenberg (1982), the openness to new technologies and the capacity for their assimilation, aside from their origin, is as important as innovativeness and can deliver ideas to domestic enterprises for the improvement of their competitiveness. Furthermore, technology adoption stimulates learning from each other such things as production methods, product design, organizational methods, and gives the knowledge about markets. In this way technology adoption can foster productivity of domestic enterprises. In new theories of economic growth it is stressed that the ability to absorb knowledge from different sources strongly depends on the quality of human capital and in the present economic reality a given level of human capital is a vital source of economic development.

Human capital is very often defined as the set of skills, knowledge, capabilities, ideas, motivation, attitudes and experience of people that cause productive activities and stimulate creativity. Reliability, ability to learn and being innovative, commitment, imagination, work energy, motivation to learn and to share knowledge are all the features describing such kind of human capital which enables a country to pursue growth opportunities and facilitate the utilization of knowledge and other resources. In this respect, it is important how human capital should be developed, not only by higher educational system, to be able to implement technological changes and increase its prosperity.

Therefore, the effectiveness of higher educational system is reflected, among other things, in the productivity of technology adoption, which gives the chance to accelerate the economic development. In other words, a successful absorption of knowledge and later its development depends on the specific domestic circumstances connected with the broadly understood higher educational system and reflects differences in the effectiveness of various kinds learning and training institutions which constitute this system. In this approach, higher educational system is an important factor determining how a given country adapts and uses more advanced and better technologies, which are accessible on the international market to become more competitive and rich (see: Coe, Helpman, Hoffmaister 1997; Majewska-Bator, Jantoń-Drozdowska 2007).

Summing up, strengthening the effectiveness of higher educational system is very significant for economies that want to pass on to the next stages of country's economic development path by the progress in technological sophistication of their national processes and products. Not only the specialists working for the World Economic Forum argue that technological progress requires well-educated workers who are able to perform complex tasks and adapt rapidly to their changing environment and the evolving needs of the economy. According to this approach, educated workers should absorb and adopt new technologies more quickly. This implies that effectiveness of higher education should be measured according to not only indicators of the human capital development, but also indicators of knowledge application and dissemination. It means also that effectiveness of higher educational system is more and more evaluated from the perspective of human capital productivity in the implementation of technological progress, training of suitably qualified staff in terms of industry needs and employees who are able to lead innovative activity, and very popular lately the ability of universities to cooperate with the business sector in the area of R&D. All these factors are simultaneously the determinants of enterprises' competitiveness.

Finally, it is important to note that, in recent years, there has been an increasing interest in varying the reasons of differences across countries in human capital development. However, international comparisons of higher educational levels are difficult, for example, due to great divergences in educational systems and in the required level of attainment to obtain a tertiary degree. But many researchers assume that the performance of higher education across country is comparable (see: Archibugi, Coco 2004; *Regional Innovation Scoreboard 2012, Enterprise and Industry* 2012; *The Global Competitiveness Report 2012-2013* 2012).

The main aim of this paper is to present the results of comparative analysis of higher education effectiveness in the European Union countries in the context of technology adoption and knowledge development. The first part of the paper describes the notion of national competitiveness and the determinants of its improving, the concepts of its measuring. Enhancing national competitiveness is in fact one of the objectives of higher education in the welfare economies or should be in the countries that want to become such. That is why our attempt to verify the higher education effectiveness is taken from the perspective of performance, such as competitiveness. Furthermore, a welfare economy will be very difficult to achieve without a well-educated and trained workforce that is able to absorb new knowledge in order to introduce innovations to the market. Today's educational systems should thus provide the so-called knowledge workers who endowed with the relevant knowledge resources can apply them in practice, which is called the conversion of scientific knowledge into technical knowledge. These workers are strong factor underpinning national competitiveness.

The second part focuses on the comparison of higher education effectiveness in the 27 European Union countries on the basis of selected indicators presented in the World Economic Forum's annual Global Competitiveness Reports. Our study covers the five-year period between 2008 and 2012, and is carried out to evaluate the effectiveness of higher education in European Union countries using indirect measures, such as the opinion of entrepreneurs about the quality of higher education, the indicators of knowledge absorption capacity, and the extent of cooperation between universities and business. In this part of the paper our own synthetic index of higher education effectiveness is also presented, which takes into account, according to the main aim of the paper, the issue related to technology adoption and knowledge development.

Competitiveness – a Methodological Approach

The concept of competitiveness, particularly of the factors defining it and its measures, is not unambiguous. There is no doubt, however, that the category is inextricably connected with the performance of particular companies. When related to the enterprise, competitiveness means the capacity to compete in the global market. In this sense, it is frequently understood as synonymous with the market share and gains of companies with a significant share in the product markets. Such a static approach to competitiveness can in no way be adopted as a yardstick for analysis. The large market share is rather a result of the high competitive position of the company (Jantoń-Drozdowska 1998; Jantoń-Drozdowska 2009).

In relation to the entire economy, however, competitiveness can be defined as the capacity to produce and sell competitive products on the domestic and foreign markets, with the real income growing (Sachwald 1994). The last condition is very important in the dynamic approach to competitiveness, because the economy must retain the capacity to grow and create possibilities for raising the society's standard of living. So, productivity of the employed resources, i.e. labor and capital, is the most important from the point of view of both the companies and the economy. Productivity is the value of output produced by a unit of labor or capital. Its level depends on the product quality and characteristics, as well as the efficiency of production.

Competitiveness cannot be treated as a global category, but its various types or levels should be distinguished. Authors dealing with this problem suggest different approaches (Jantoń-Drozdowska 1998; Porter 1990; Urban 1993; Nezeys 1993). For the purpose of this short study, it seems justifiable to point out the three types of competitiveness, which allow for connecting analysis in the microeconomic (company) and macroeconomic (economy) scale, namely:

- cost-price competitiveness. An organization can gain competitive advantage when it is able to use the productive elements in the most efficient way,
- technological competitiveness, prerequisite for differentiation, is determined by investment and innovation,
- structural competitiveness is most often described as an indicator of general performance which summarizes the set of non-price determinants of competitiveness.

Gaining the competitive advantage in at least one of the three abovementioned areas and assuming good position in the other two constitute a condition for success in the global market. From this article's point of view, one should stress that the competitive advantage in costs and prices is, among others, determined by permanent learning and job training of staff and management which enable increasing of productivity, improvement in the system and operating concepts. Frequently, competitors are not able to lower the costs to the level of those of the leader's by means of a simple increase in the productive capacity - his advantage is related to the time that they need to increase their professional knowledge (Porter 1980).

On the country (national) level, determinants of competitiveness can be presented in M. Porter's model of the "diamond of national advantage" (Porter 1990; Ankli 1992). Porter states that:

- national prosperity is created, not inherited,
- a nation's competitiveness depends on the capacity of its industry to innovate and upgrade,
- innovation is what drives and sustains competitiveness.

Porter argues that the country's competitiveness depends on the competitiveness of their firms. So, a firm must avail itself of all dimensions of competition, which he categorized into four major components of the "diamond" which are in fact the determinants of competition:

- Factor conditions, especially natural resources, which have been very important for ages, but today they are not the only source of competitiveness. What is the most important for Porter is the ability of a nation to create, upgrade and deploy its factors (such a skilled labor), rather than the initial endowment.
- Demand conditions. The degree of firm's health and competitive force must face in its original home market. Firms that can survive and develop in highly competitive and demanding local markets are much more likely to gain the competitive edge. Porter stresses that not only the size of mar-

ket, but also its character (demanding customers) is crucial for continual competitiveness of the firm.

- Related and supporting industries. This condition concerns to the competitiveness of all related industries and suppliers to the firm. A firm may gain and maintain advantages through close working relationships, proximity to suppliers and timeliness of product and information flows.
- Firm strategy, structure and rivalry. This determinant concerns the home conditions that either hinder or aid in the firm's creation and sustaining of international competitiveness.

Porter accents also the role of the state in the creation of national environment elements – education is one of the crucial spheres which may be supported by government. To conclude, the effectiveness of education influences the Porter's set of determinants of competitiveness.

The diversity of competitiveness concepts is accompanied by diversification of methods of its measuring. One of the most popular methodology has been proposed by Institute for Management Development (IMD), which has published for many years the World Competitiveness Yearbook (WCY). The last WCY 2012 provides extensive coverage of 59 economies, which were chosen because of their impact on the global economy and availability of comparable international statistics. The methodology of WCY divides the national environment into four main competitiveness factors and then each of these four factors is broken down into five sub-factors (IMD World Competitiveness Yearbook 2012):

- Economic Performance (78 criteria): domestic economy, international trade, international investment, employment, prices
- Government Efficiency (70 criteria): public finance, fiscal policy, international framework, business legislation, societal framework
- Business Efficiency (67 criteria): productivity, labor market, finance, management practices, attitudes and values
- Infrastructure (114 criteria): basic infrastructure, technological infrastructure, scientific infrastructure, health and environment, education.

To assess education WCY takes into account 16 criteria such as: total public expenditure on education (%), total public expenditure on education per capita, pupil-teacher ratio (primary and secondary education), secondary school enrollment (%), higher education achievement (%), student mobility inbound and outbound, educational assessment (mathematics and sciences), education system, university and management education, literacy (%).

Another definition of competitiveness is proposed by World Economic Forum which defines competitiveness as a set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity sets the level of prosperity that can be earned by an economy and determines the rates of return obtained by investments in an economy, and *ipso facto* its growth rates. In other words, a more competitive economy is one that is likely to sustain growth (*The Global Competitiveness Report 2012-2013* 2012).

As it was indicated above, many determinants drive competitiveness, but more recently attention is turned from physical capital and basic infrastructure to other mechanisms, such as education and training, technological progress, macroeconomic stability, good governance, firm sophistication, and market efficiency, among others. The Global Competitiveness Index (GCI), proposed by the World Economic Forum in annual Global Competitiveness Reports, captures these components, each measuring a different aspect of competitiveness. These components are grouped into twelve pillars of competitiveness (see Table 1).

Table 1. Global Competitiveness Index

Basic requirements Subindex	**Efficiency enhancers subindex**	**Innovation and sophistication factors subindex**
Pillar 1. Institutions	Pillar 5. Higher education and training	Pillar 11. Business sophistication
Pillar 2. Infrastructure	Pillar 6. Goods market efficiency	Pillar 12. Innovation
Pillar 3. Macroeconomic environment	Pillar 7. Labor market efficiency	
Pillar 4. Health and primary education	Pillar 8. Financial market development	
	Pillar 9. Technological readiness	
	Pillar 10. Market size	

Source: *The Global Competitiveness Report 2012-2013* (2012, p. 8).

The results of the twelve pillars are not independent – they tend to reinforce each other, and a weakness in one area often has a negative impact in others.

It should be emphasized that, according to the economic theory of stages of development, the GCI assumes that economies in the first stage are mainly factor driven (pillars 1-4) and compete based on their factor endowments, primarily low-skilled labor and natural resources. As a country becomes more competitive, productivity will increase and wages will rise along with development. Countries will then move into the efficiency driven stage of development (pillars 5-10), when whey must to develop more efficient production processes and increase product quality, because wages have risen and they cannot increase prices. At this point, competitiveness is increasingly driven by higher education and training and technological readiness, and also by efficient goods, labor and financial markets. Finally, as countries move into the innovation driven stage they must compete by producing new and different goods through new technologies and the most sophisticated production processes or business models (pillars 11 and 12) (*The Global Competitiveness Report 2012-2013* 2012).

To summarize, the concept of competitiveness involves static and dynamic components. Although the productivity of a country determines its ability to sustain a high level of income, it is also one of the central determinants of its return to investment, which is one of the key factors explaining an economy's growth potential.

Material and Research Results

At the begging, it should be emphasized that while the variables we have selected capture a number of important aspects of the analyzed phenomenon of higher education effectiveness, it is important to note that we are aware of the limitations of each of the indicators employed. The indicators have been chosen to evaluate the effectiveness of higher education from the business sector point of view and take into consideration also the problem of technology adoption and selected factors facilitating development of knowledge. Therefore, the study covered the following indicators based on survey data included in the rankings of World Economic Forum which constitute five pillars of national competitiveness (see: *The Global Competitiveness Report 2012-2013* 2012):

- the pillar of higher education and training: quality of the educational system, quality of math and science education, quality of management schools, and local availability of specialized research and training services,
- the pillar of technological readiness: availability of latest technologies, and firm-level technology absorption,
- the pillar of business sophistication: production process sophistication,
- the pillar of R&D innovation: quality of scientific research institutions, and university-industry collaboration in R&D.

In Table 2 the positions of European Union countries according to the quality of higher education evaluated by the business community are presented. In this case, the respondents are asked to answer the question: how well does the educational system in your country meet the needs of a competitive economy? The first place achieved by a country means the highest effectiveness of higher education level in comparison to the rest of the researched economies. In addition, in the World Economic Forum's annual Global Competitiveness Reports is measured separately the quality of math and science education and the quality of management schools. For this purpose, respondents give answers how they assess the quality of these fields of study [1 = poor; 7 = excellent – among the best in the world] (see: *The Global Competitiveness Report 2012-2013* 2012).

Table 2. European Union countries' positions according to the quality of higher education

	Overall higher education (1)		**Math and science education (2)**		**Management schools (3)**		**A shift in ranking position in five years**		
	2007-08	**2011-12**	**2007-08**	**2011-12**	**2007-08**	**2011-12**	**1**	**2**	**3**
Austria	8	10	12	16	9	15	-2	-4	-6
Belgium	2	2	2	2	2	2	0	0	0
Bulgaria	24	24	22	23	27	24	0	-1	3
Cyprus	5	9	5	4	17	12	-4	1	5
Czech Republic	12	16	4	24	13	23	-4	-20	-10
Denmark	3	7	9	13	4	10	-4	-4	-6
Estonia	14	14	6	8	12	16	0	-2	-4
Finland	1	1	1	1	5	6	0	0	-1
France	9	13	3	9	1	4	-4	-6	-3
Germany	10	8	19	10	11	13	2	9	-2
Greece	25	26	21	19	24	25	-1	2	-1
Hungary	27	23	16	14	23	21	4	2	2
Ireland	4	3	11	11	8	9	1	0	-1
Italy	26	22	25	22	21	14	4	3	7
Latvia	19	20	24	18	19	20	-1	6	-1
Lithuania	20	15	10	6	20	17	5	4	3
Luxemburg	16	12	23	17	26	18	4	6	8
Malta	11	6	14	5	16	11	5	9	5
Netherlands	7	5	7	3	6	5	2	4	1
Poland	18	19	18	21	18	22	-1	-3	-4
Portugal	22	17	27	26	14	8	5	1	6
Romania	21	25	8	20	25	27	-4	-12	-2
Slovakia	23	27	15	25	22	26	-4	-10	-4
Slovenia	15	18	13	7	15	19	-3	6	-4

Table 2 continued

	Overall higher education (1)		**Math and science education (2)**		**Management schools (3)**		**A shift in ranking position in five years**		
	2007 -08	**2011 -12**	**2007 -08**	**2011 -12**	**2007 -08**	**2011 -12**	**1**	**2**	**3**
Spain	17	21	26	27	3	3	-4	-1	0
Sweden	6	4	17	12	7	7	2	5	0
United Kingdom	13	11	20	15	10	1	2	5	9

Source: own calculation on the base of following data: *The Global Competitiveness Report 2008-2009* (2008, pp. 414-416); *The Global Competitiveness Report 2012-2013* (2012, pp. 442-444).

In improving the quality of higher education, measured by the degree to which the educational system meets the needs of a competitive economy, the best results among the European Union countries in five year period under study were achieved by Lithuania, Malta, Portugal. Finland retains its first place in the quality of overall higher education and in math and science education in 2012, it has dropped one position in the quality of management schools from 5th to 6th since 2008. Belgium maintains its 2nd rank for all three considered categories between 2008 and 2012. In 2012, the third position in the quality of overall higher education was reached by Ireland, Sweden fourth and the Netherlands fifth. The last five ranks for the quality of overall higher education in the order from 23rd to 27th place in 2012 were occupied by Slovakia, Greece, Romania, Bulgaria, Hungary. Of all these five countries, only Hungary improved its position in this category by 4 positions during the researched period.

In the quality of math and science education ranking leaders, next to already mentioned Finland and Belgium, in 2012 there are the Netherlands, Cyprus and Malta, and the last five places are occupied by Bulgaria, the Czech Republic, Slovakia, Portugal, Spain. In 2012 the countries belonging to the top 5 European Union countries in the quality of management are the United Kingdom, Belgium, Spain, France, the Netherlands, and among the five countries classified at the lowest positions there are the Czech Republic, Bulgaria, Greece, Slovakia, Romania. In the five years considered, the largest increase in the quality of math and science education took place in Germany, Malta, Latvia, Italy, Luxembourg, and in the quality of management schools, in the United Kingdom, Luxembourg, Italy, Portugal.

Poland was ranked 19th in terms of the quality of overall higher education in 2012, down only one place in the five-year period. However, in the case of the quality of math and science education Poland dropped 3 places from

18th to 21st, and when it comes to the quality of management schools Poland fell by 4 positions from 18th to 22nd between 2008 and 2012.

In Table 3 the European Union countries' performances in three complements of technological progress are shown, which is treated in this study as indirect indicators of higher education effectiveness. These indicators usually measure the ability of human capital working in enterprises to adopt existing knowledge to enhance the productivity through implementing technological changes. It is reflected in more sophisticated business practices, like for example advanced production processes and unique products, which can spill over into the economy and thus lead to higher productivity. Therefore, the enterprises which have access to knowledge embodied in advanced products and processes and are able to absorb this knowledge, can foster competitiveness through broadening their innovation activity and it is often done at a lower cost.

In order to verify production process sophistication in a given country, the respondents were asked to decide if in this process there are characteristic labor-intensive methods or previous generations of process technology, or if this process is based on the world's best and most efficient technology prevails. When assessing the availability of latest technologies in their countries, the respondents determined whether it is widely available, or not at all. Regarding the third indicator, namely the firm-level technology absorption, what was evaluated was the extent to which businesses in a given country absorb new technology (see: *The Global Competitiveness Report 2012-2013* 2012).

Table 3. European Union countries' positions according to selected complements of technological progress

	Production process sophistication (1)		**Availability of latest technologies (2)**		**Firm-level technology absorption (3)**		**A shift in ranking position in five years**		
	2007-08	**2011-12**	**2007-08**	**2011-12**	**2007-08**	**2011-12**	**1**	**2**	**3**
Austria	7	5	7	7	3	3	2	0	0
Belgium	8	6	9	5	8	10	2	4	-2
Bulgaria	27	26	27	26	27	27	1	1	0
Cyprus	20	22	15	18	17	15	-2	-3	2
Czech Republic	13	13	19	19	14	17	0	0	-3

Table 3 continued

	Production process sophistication (1)		Availability of latest technologies (2)		Firm-level technology absorption (3)		A shift in ranking position in five years		
	2007 -08	2011 -12	2007 -08	2011 -12	2007 -08	2011 -12	1	2	3
Denmark	3	9	3	11	2	5	-6	-8	-3
Estonia	18	18	10	15	11	13	0	-5	-2
Finland	4	2	2	2	4	2	2	0	2
France	5	11	6	9	7	14	-6	-3	-7
Germany	2	1	4	10	5	4	1	-6	1
Greece	21	25	21	21	25	23	-4	0	2
Hungary	23	24	23	20	21	20	-1	3	1
Ireland	10	7	14	13	10	12	3	1	-2
Italy	12	12	22	24	23	24	0	-2	-1
Latvia	25	23	24	23	24	21	2	1	3
Lithuania	24	21	20	16	19	18	3	4	1
Luxemburg	9	8	11	6	12	8	1	5	4
Malta	17	16	12	12	16	11	1	0	5
Netherlands	6	3	8	3	9	6	3	5	3
Poland	22	19	25	25	22	25	3	0	-3
Portugal	16	17	13	8	15	9	-1	5	6
Romania	26	27	26	27	26	26	-1	-1	0
Slovakia	19	14	17	22	13	19	5	-5	-6
Slovenia	15	20	18	17	20	22	-5	1	-2
Spain	14	15	16	14	18	16	-1	2	2
Sweden	1	4	1	1	1	1	-3	0	0
United Kingdom	11	10	5	4	6	7	1	1	-1

Source: own calculation on the base of following data: *The Global Competitiveness Report 2008-2009* (2008, pp. 460-461, 482); *The Global Competitiveness Report 2012-2013* (2012, pp. 488-489, 508).

In 2012, the top 5 European Union countries in the production process sophistication are Germany, Finland, the Netherlands, Sweden, Austria, and among the five countries classified at the lowest positions there are Latvia, Hungary, Greece, Bulgaria, and Romania. According to the availability of latest technologies, the ranking leaders in 2012 were Sweden, Finland, the Netherlands, the United Kingdom and Belgium, and the last five places were occupied by Latvia, Italy, Poland, Bulgaria, Romania. In the researched period, the extent to which businesses absorb new technology was the biggest in Sweden, Finland, Austria, Germany, Denmark, and the smallest in Greece, Italy, Poland, Romania, Bulgaria.

In five considered years, the largest falls in the production process sophistication took place in Denmark, France, Slovenia, Greece, and the biggest advances occurred in the United Kingdom, Luxembourg, Italy, Portugal. In the case of the second complement of technological progress, namely the availability of latest technologies, Luxemburg, the Netherlands and Portugal have improved their ranks the most, by 5 places since 2008. The largest decline in this category took place in Denmark (down 8 places), Germany (down 6 places), Estonia (down 5 places), Slovakia (down 5 places). The largest progress in the obtained ranks for firm-level technology absorption was achieved by Portugal (up 6 places), the Netherlands (up 5 places), Luxemburg (up 4 places), and the biggest drop occurred in France (down 7 places) and Slovakia (down 6 places).

Poland moves up by three positions to 19th place in the production process sophistication in 2012, and maintains its rank for the availability of latest technologies at the 25th place this year. However, Poland fell by three places in the firm-level technology absorption from 22nd to 25th in the researched period. Therefore, Poland is the third from the last position in these two categories among the European Union countries in 2012.

Table 4 displays the rankings of the European Union Countries in the local availability of specialized research and training services, the quality of scientific research institutions, and university-industry collaboration in R&D. These indicators of higher education effectiveness are the examples of factors facilitating development of knowledge. In other words, these factors are the elements of environment that foster technological progress. A significant impact on the effectiveness of this environment is enjoyed by just the higher educational system. For example, high-quality training services and scientific research institutions upgrading of human capital's skills and develop the knowledge needed to build the new technologies, and then intensified collaboration in research and technological developments between universities and industry ensures that much of this knowledge is translated into marketable products. Furthermore, collaboration between universities and industry in different areas usually improves each other's capacities and performances, and decreases the gap between supply and demand of skills required by the market. This results in the growth of higher education quality and causes the increase in productive workers resources (see: *The Global Competitiveness Report 2012-2013* 2012; *Stimulating Economies through Fostering Talent Mobility* 2010).

In the case of assessing the local availability of specialized research and training services, the respondents had to determine to what extent in their countries are available high-quality and specialized training services. Then respondents have to evaluate scientific research institutions in their countries using a scale of 1 meaning very poor quality to 7 denoting the best quality in their field internationally. In order to verify the strength of collaboration between universities and industry in R & D respondents specified the extent of this collaboration again using a scale of 1 meaning a lack of cooperation to 7 denoting the intensive cooperation (see: *The Global Competitiveness Report 2012-2013* 2012).

Table 4. European Union countries' positions according to selected factors facilitating development of knowledge

	Availability of specialized research and training services (1)		**Quality of scientific research institutions (2)**		**University-industry collaboration in R&D (3)**		**A shift in ranking position in five years**		
	2007-08	**2011-12**	**2007-08**	**2011-12**	**2007-08**	**2011-12**	**1**	**2**	**3**
Austria	9	2	10	11	8	10	7	-1	-2
Belgium	8	4	1	2	5	3	4	-1	2
Bulgaria	23	25	23	24	27	26	-2	-1	1
Cyprus	18	22	20	21	20	20	-4	-1	0
Czech Republic	12	11	13	14	10	12	1	-1	-2
Denmark	4	9	7	9	4	9	-5	-2	-5
Estonia	10	17	12	13	11	15	-7	-1	-4
Finland	2	7	4	6	2	2	-5	-2	0
France	6	8	8	8	14	14	-2	0	0
Germany	3	3	2	5	3	6	0	-3	-3
Greece	26	26	22	27	26	27	0	-5	-1
Hungary	24	24	11	10	12	16	0	1	-4
Ireland	11	12	9	7	9	7	-1	2	2
Italy	15	15	27	19	22	22	0	8	0
Latvia	25	23	26	22	25	19	2	4	6
Lithuania	20	20	16	17	18	13	0	-1	5
Luxemburg	17	10	17	16	15	8	7	1	7
Malta	27	19	21	23	23	21	8	-2	2
Netherlands	1	1	5	3	7	5	0	2	2
Poland	19	14	19	20	24	23	5	-1	1
Portugal	14	16	15	12	16	11	-2	3	5
Romania	22	27	25	25	21	25	-5	0	-4
Slovakia	21	18	24	26	19	24	3	-2	-5
Slovenia	13	21	14	15	13	18	-8	-1	-5
Spain	16	13	18	18	17	17	3	0	0
Sweden	5	6	6	4	1	4	-1	2	-3
United Kingdom	7	5	3	1	6	1	2	2	5

Source: own calculation on the base of following data: *The Global Competitiveness Report 2008-2009* (2008, pp. 418, 487, 489); *The Global Competitiveness Report 2012-2013* (2012, pp. 446, 513, 515).

In 2012, among the top 5 European Union countries in the local availability of specialized research and training services there are the Netherlands, Austria, Germany, Belgium, the United Kingdom. In this category the ranking bottom is reached by Latvia, Hungary, Bulgaria, Greece, Romania. In 2012, among the five countries classified at the highest positions in the quality of scientific research institutions there are the United Kingdom, Belgium, the Netherland, Sweden, Germany, and the lowest places are occupied by Malta, Bulgaria, Romania, Slovakia, Greece. According to the university-industry collaboration in R&D ranking, the leaders in 2012 are Finland, Belgium, Sweden, the Netherlands, and the last five places are occupied by Poland Slovakia, Romania, Bulgaria, Greece.

Among the EU countries, the largest progress in the local availability of specialized research and training services took place in Malta (up 8 places), Luxemburg (up 7 places), Austria (up 7 places) in the researched period. The biggest falls in this category occurred in Slovenia (down 8 places), Estonia (down 7 places). In the case of the quality of scientific research institutions Italy (up 8 places) and Latvia (up 4 places) have improved the most their ranks since 2008. The largest drop, by 5 places, in this factor facilitating development of knowledge took place in Greece. The largest advances in the obtained ranks for university-industry collaboration in R&D were achieved in Luxemburg (up 7 places), Latvia (up 6 places), and the biggest falls by 5 places occurred in Denmark, Slovakia and Slovenia.

Poland rised by five positions to 19th place in the local availability of specialized research and training services in 2012, and in the university-industry collaboration in R&D only by one place from the 24th to 23rd. Poland fell slightly by one places in the quality of scientific research institutions between 2008 and 2012, ranked at 20th in 2012. As you can see, Poland copes the worst of these three indicators with the university-industry collaboration in R&D, which is confirmed by study results presented in other rankings. The authors of these rankings think that a low level of university-industry collaboration is one of the most significant innovation challenges in Poland and a very important obstacle to the development of technical knowledge. In other words, the weak collaboration between academic and business sectors delays the country in moving toward the next stage of economic development. Additionally, the condition to increase in Poland the extent of university-industry collaboration is the growth of business expenditure on innovation activity. (see: *Innovation Scorecard. Country Innovation Profiles* 2012; *The Global Competitiveness Report 2012-2013* 2012).

Finally, weighted aggregate index of higher education effectiveness was created, basing on the 7 indicators presented above, divided into three main categories: (1) quality of higher education according to enterprises (2) complements of technological progress, and (3) factors facilitating development of knowledge. In constructing our aggregate index, and thus in the earlier selection of variables, remember of the recommendation that individual indicators should be describing different aspects of the analyzed phenomenon. Furthermore, the components of our own index of higher education effectiveness were weighted separately, which means that is an asymmetrical weighted combined index. In assigning weights, we were guided by our own knowledge about the impact and the relative importance of selected indicators for upgrading the performance of higher education as an important component of national competitiveness which based on knowledge development and technology adoption. The weights attributed to each indicator are:

- 20% the quality of the educational system,
- 15% production process sophistication, availability of latest technologies, firm-level technology absorption, and university-industry collaboration in R&D,
- 10% local availability of specialized research and training services, and the quality of scientific research institutions.

In Table 5, the EU countries were ranked according to the calculated total values of higher education effectiveness index. For a country, the total value was calculated by summing the results of multiplying the average values of indicators presented in the World Economic Forum's annual Global Competitiveness Reports by the weight assigned to them. What was also calculated was the country's average position according to seven selected indicators. It gives possibility to compare the EU countries' achievements in the effectiveness of higher education with a weighted index and an unweight measure.

Table 5. European Union countries' positions according to the effectiveness of higher education in the context of technology adoption and knowledge development

	Aggregate index of higher education effectiveness (1)		**Average position according to 7 indicators of higher education effectiveness (2)**		**A shift in ranking position in five years**	
	2007-08	**2011-12**	**2007-08**	**2011-12**	**1**	**2**
Austria	7	7	8	9	0	-1
Belgium	4	4	5	4	0	1
Bulgaria	26	25	25	25	1	0
Cyprus	14	17	15	16	-3	-1
Czech Republic	11	15	12	17	-4	-5
Denmark	2	9	4	9	-7	-5

Table 5 continued

	Aggregate index of higher education effectiveness (1)		Average position according to 7 indicators of higher education effectiveness (2)		A shift in ranking position in five years	
	2007-08	**2011-12**	**2007-08**	**2011-12**	**1**	**2**
Estonia	12	14	12	14	-2	-2
Finland	1	1	3	3	0	0
France	9	11	7	10	-2	-3
Germany	5	5	7	7	0	0
Greece	25	24	23	24	1	-1
Hungary	21	19	20	19	2	1
Ireland	10	8	10	9	2	1
Italy	22	20	21	19	2	2
Latvia	24	22	23	21	2	2
Lithuania	20	16	19	16	4	3
Luxemburg	13	10	16	11	3	5
Malta	17	13	17	14	4	3
Netherlands	6	3	6	4	3	2
Poland	23	21	21	21	2	0
Portugal	16	12	17	14	4	3
Romania	26	26	22	25	0	-3
Slovakia	19	23	19	22	-4	-3
Slovenia	15	18	15	17	-3	-2
Spain	18	16	16	16	2	0
Sweden	3	2	5	5	1	0
United Kingdom	8	6	9	6	2	3

Source: own calculation.

The result of our study show, for example, that Nordic European countries like Finland, Sweden, and Belgium, but not Denmark, maintain their great effectiveness of higher education. Finland retains its place at the 1st position in the aggregate index of higher education effectiveness in 2012, as well as Belgium ranks 5th, and Germany occupies the 4th position. Denmark, overtaken by Sweden placing 2nd in 2012, falls seven places to the 9th position. The Netherlands moves up by three positions to the 3rd place this year, and the United Kingdom rises by two places to the 6th rank. Country leaders in the case of average position, according to all indicators of higher education effectiveness are Finland, Belgium, the Netherlands, the United Kingdom, Sweden, Germany. There are thus the same six countries as in the case of the aggregate index of higher education effectiveness in 2012. These six

EU countries are also in the *Innovation Union Scoreboard 2011* or the'Innovation leaders' (Finland, Germany and Sweden) or the 'Innovation followers' (Belgium, the Netherlands and the United Kingdom), which are the most advanced economies in the innovativeness level in the opinion of the European Commission.

In 2012, the bottom 6 European Union countries according to the value of aggregate index of higher education effectiveness were Latvia, Slovakia, Greece, Bulgaria, Romania, Poland. The same situation occurred for the average position reached by an EU country. Between 2008 and 2012 the largest falls in the rank obtained by an EU country according to the value of aggregate index of higher education effectiveness took place in Denmark (down 7 places), the Czech Republic (down 4 places), Slovakia (down 4 places), and for the average position in the Czech Republic and Denmark (down 5 places). In the researched period, the largest progress, by 4 places, in the obtained ranks for the aggregate index was achieved by Lithuania, Malta, Portugal, and in the case of average position Luxemburg that moved up by 5 places.

For Poland, the average position according to all indicators of higher education effectiveness is 21^{st}, like Lithuania, and Poland rises by two places to reach also the 21st rank for the aggregate index in 2012. If Poland's transition to the innovation-driven stage of development was to be possible, it should invest more in the innovation system, which also includes the higher educational system. As our research results indicate, Poland should invest especially in all kinds of institutions and facilities that foster cooperation between universities and business in R&D, and increase the availability of the latest technologies, as well as the firm-level technology absorption. Unfortunately, as the authors of *Innovation Scorecard. Country Innovation Profiles* describe, Poland has seen uneven investment in its innovation system over the last decade, and has experienced problems with both the coordination and delivery of its programs in this area. For example, the program entitled *Innovative Economy 2007-2013* consists of multiple strategies managed by different government ministries, which complicates the overall approach and reduces the effectiveness of the program as a whole (see: *Innovation Scorecard. Country Innovation Profiles* 2012).

Conclusions

Despite the fact that the effectiveness of higher education has always been a fundamental component of national competitiveness, its importance to boost productivity levels has grown significantly in the current challenging global economy characterized by higher technological progress. Therefore, in this paper we have presented a new index of higher education effectiveness including the components that are specific to both the knowledge economy development and new growth theories.

It is connected with the assumption that improving the effectiveness of higher education gives a chance to reach the innovation stage of development, also by adopting technologies from the rest of the world. To achieve this stage of development, higher education should enhance such kind of human capital skills, which cause that enterprises can design and develop cutting-edge products and processes to maintain a competitive edge and move toward higher value-added activities. While governments must encourage partnerships between businesses and academic institutions that increasing the technical knowledge resources and reduce the gap between what students learn and what they need to know to become productive employees. In other worlds, the good higher education would help the country to move toward a more future-oriented development path and rise prosperity of its population.

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