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The relationship between R&D and higher education – What lies ahead for Europe?

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The aim of this study is to present the measures to be taken in the field of higher education from the Europe 2020 Strategy programme's most important elements, considering them from the competitiveness point of view. We highlighted both the EU and the national objectives in terms of R&D expenditures and the number of 30-34 years old age group with higher education qualifications, and we have surveyed the results achieved so far and the trends experienced regarding performance, based on the most recent data. According to the statistical data, it can be stated that the GDP-proportional expenditures relating to research and development have increased modestly over recent years, but they lag behind the 3% defined in the Strategy, with only Finland, Denmark and Sweden having fulfilled the EU expectations. In most countries, significant progress has been made towards reaching the declared target of 40% of the population obtaining a higher education qualification. In 2013, the performance of the 28 union countries lagged behind the Europe 2020 Strategy's objective of 40% by 2.9 percentage points; this reinforces the assumption that an ever-increasing proportion of the European population are graduates and this fact lays the foundation for economic growth based on knowledge and innovation.

Keywords: Europe 2020 Strategy, GDP, higher education, research and development, number of students.

JEL codes: N33, O3, O57.

Introduction

The study deals with changes concerning the numbers of students in higher education; it presents data on a regional level as well as an international comparison. It examines how research and development expenditures have changed in individual countries, and to what extent

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this has contributed to the growth of the economy. The research is based on statistical data from the years 2009-2013 which marks, on one hand, the elaboration and assessment of the Lisbon Strategy and, on the other hand, the launching of the Europe 2020 Strategy. At the same time, irrespectively of the stated objectives, the international financial crisis had a significant effect on the creation of both programs, although these effects cannot be separated numerically. In Hungary, in the 2000s, the accession to the EU meant that the tasks relating to the introduction of the Bologna Process had to be carried out in line and accordance with the programs mentioned above.

The first Lisbon Strategy was accepted in 2000 with the main objective that the EU should become the most competitive region in the world by 2010. To this end, a program of concrete goals was drafted[3]. However, it had already become apparent in the first half of the decade that, due to the different states of development of the member states, the results regarding growth and employment are quite mixed (Losoncz 2007) and the main goals of competitiveness, as well as the research and development target, cannot be fulfilled (Kőrösi 2012). Consequently, the program has been modified several times and in 2002 an agreement was reached that member states should spend 3% of the GDP on R&D by 2010 (Sapir et al. 2004; Mosconi 2015).

In 2003, the Council of Ministers of Education established indicators[4], with the goal that the community could get explicit

[3] (1) Establishing a knowledge-based society and economy, (2) dynamic economic growth, (3) ensuring economic competitiveness in the global market (4) sustainability, protection of the natural environment, and (5) social cohesion, establishing total employment as far as possible.

[4] (1) Decreasing the EU average rate of early school leavers from 18.8% to 10%; (2) in addition to improving the proportion of women, increasing the number of individuals with mathematical, natural science and technical qualifications by an average of 15%; (3) increasing the rate of individuals with higher and secondary education qualifications from 75% to 85% on average; (4) improving reading-comprehension of 15-years-olds according to the PISA-measurement; (5) increasing the proportion of those participating in life-long learning from 8.5% to 12.5%.

feedback about how much a member state contributed to the achievement of common goals. At the same time, the indicators also give an opportunity to substitute the measurement of the interaction between education and the economy with the efficiency achieved in the indicator in question (Kovács 2004). Essentially, Máté (2015) also claimed that an increase in the level of human capital (the number of completed school years) is positively correlated with the output per capita growth in high-skilled sectors in OECD countries.

Higher education efficiency indicators (e.g. the number of graduates, the proportion of graduates in certain age groups of the population, the proportion of engineering and science graduates, the number of PhD graduates) appear in the sustainable development strategies' indicator sets of the European Union, and also of its member states (Karcagi-Kováts 2011).

The focus of the Europe 2020 Strategy is to preserve the competitive economic power of the community, something which affects the lives of 500 million people. The primary reason for this is to avoid the 28-member, much more heterogeneous, EU lagging behind its main economic and political competitors. The new strategy, preserving the general goals of the Lisbon Strategy, drafted five main objectives[5] for the member states (Eurostat 2015a), objectives which they have only partially built into their action plans (Kőrösi 2012). The fulfilment of these objectives is not binding, but a proposal based on the advanced economic state and structural arrangement of the member states and their national objectives was determined according to their starting position (EC 2010).

[5] (1) Reaching an employment rate of 75% in the age-group between 20 and 64; (2) increasing R+D investments from 1.9% to 3%; (3) increasing the rate of energy efficiency, decreasing energy consumption, decreasing carbon dioxide emissions; (4) decreasing the rate of those not finishing primary school to below 10% and 40% of those in the 30-34 age group should be participating in higher education or have a degree; (5) reducing the number of people living below the poverty line by 25% (this line is different in different countries).

Among the objectives of the programs, we will examine only the development of R&D expenditures and the proportion of the population with a higher education qualification, as well as their relationship with economic growth.

Methodology

The first step during the research was to review the relevant literature related to the subject.

During the analysis we have used data from the Hungarian Central Statistical Office and Eurostat for the years 2009-2013. The reason for choosing this period is partly because by that time the economic effects of the financial-economic crisis could be felt in most countries, and partly because in 2010 the Europe 2020 strategy was launched, which places a special emphasis on resources devoted to R&D and on the proportion of graduates among the 30-34 age group. In our analysis we focused on the GDP data from countries with the greatest number, an increasing number, or a decreasing number of students, with the aim of proving that the number of students in higher education is rising in those countries where the economic performance is also high. At the same time, we show that there are countries where the economic performance in the period under examination is low, but the growth of student numbers is significant. Following this we compare the development of the number of full time students in higher education in the statistical regions in Hungary, and indicate the differences between the regions.

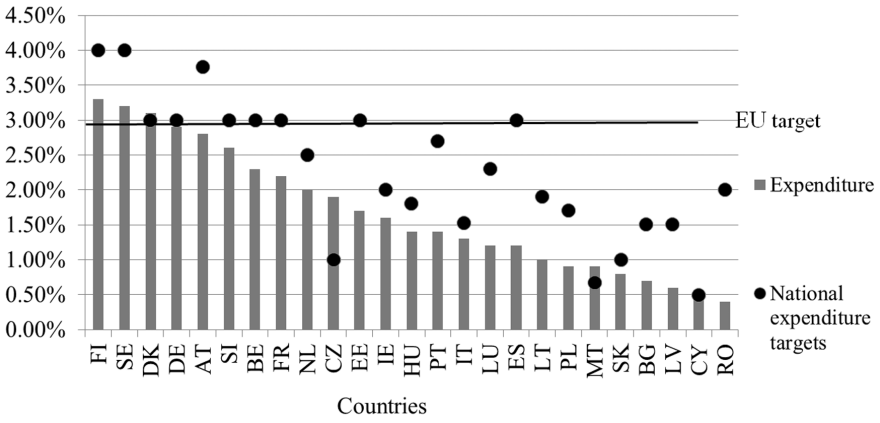
To process the statistical data, we used the Microsoft Excel spreadsheet and graphics program.

Data and results

Progress towards the Europe 2020 Strategy's objective related to research and development

The EU spending on research and development has grown somewhat recently but remains below the objective of 3% determined in the Europe 2020 Strategy (Figure 1). The objective for R&D measures the gross domestic expenditures of the public and private sectors spent on research

and development as a percentage of the GDP. The extent of public funding directly reflects attempts to support R&D. The follow-up of private funding allows an assessment of the efficiency of policies which are aimed at involving and furthering research and development investments performed in the area of business, as well as establishing and enlarging knowledge-intensive undertakings (EC 2014). According to the Eurostat data, the EU-level GDP-proportional permanent expenditure on R&D fluctuated around 1.8% in the period between 2000 and 2007. It was a little over 2% in 2009, then it moderately increased, but even so, it is clearly lower than the performance of the USA (Figures 1 and 4). Based on the developmental trend so far, it is not likely that the Strategy's objectives related to research and development will be fulfilled successfully by 2020. To reach this target, in the next few years the developmental tempo of the union's R&D expenditures should almost double in comparison with the period between 2007 and 2012. There are already forecasts that R&D investment will only increase to 2.2% by 2020. If member states succeed in reaching their objectives, this proportion could reach 2.6% (EC 2010; EC 2014).



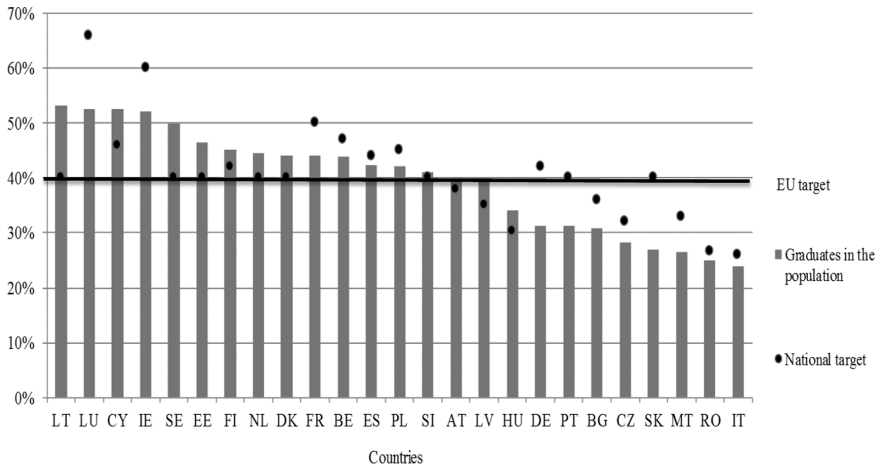
Source: Eurostat 2015b

Figure 1. Expenditures and national targets for R&D as a % of GDP (2013)

The intended goals for R&D indicate endeavours at different levels by member states. Sweden and Finland have set the highest (4%) R&D intensity target for 2020, but Finland (3.3%), Denmark (3.1%) and Sweden (3.2%) had already met the EU expectations in 2013. Cyprus declared an extremely cautious target of 0.5%, which has already been reached. Furthermore, the data for Austria (2.8%), Germany (2.9%) and Slovenia (2.6%) for 2013 are hardly behind both the national and EU objectives. The commitments of Romania and Portugal are the most difficult to achieve: by 2020, Romania wishes to increase its GDP-proportional R&D expenditure from 0.4% to 2% and Portugal would like to increase it from 2.7% to 3.3%. Hungary undertook to reach 1.8% and had already fulfilled 1.4% by 2013. Optimistic and pessimistic scenarios were also set when deciding the target (Borbás 2012), but it seems that the country can certainly fulfil its national objective by the end of this decade.

Progress towards the Europe 2020 Strategy's objectives related to education

In most member states significant progress was made towards achieving the 40% target established by the Europe 2020 Strategy, for obtaining a higher educational qualification (or its equivalent). The aim is to increase the proportion of graduates to 40% in the 30-34 age group. At the EU level, the 22.4% measured in 2000 was followed by 27.9% in 2005 and 35.7% in 2012; this represents a 13.3 percentage point growth over 12 years. The EU had already made significant progress towards achieving its stated objective by the beginning of the period, and the number of those with higher education has also increased. The performance of the 28 EU countries in 2013 was only 2.9 percentage points away from the Europe 2020 Strategy objective of 40%. These figures reinforce the assumption that the proportion of the EU population studying for a higher education qualification is increasing continuously. The number of students participating in higher education was 20.0 million in the EU-28 countries in 2012 (EC 2014; EC 2010, Eurostat 2015c).



Source: Eurostat 2015c

Figure 2. Proportion of graduates in the 30–34 age group (2013)[6]

According to the statistical data (Eurostat 2015c), the proportion of graduates is the highest in Lithuania, where 53.3% of the age-group in question have a higher education qualification. Luxembourg is second with 52.7%, and Cyprus is the third with graduates making up 52.2% of those aged between 30 and 34. The EU expectation of 40% was reached in 2013 by six countries. Bringing up the rear is Turkey[7] (Eurostat 2015b), where 21% are graduates, and which is overtaken by Italy with 23.9%. In Romania, 22.4% of those between 30 and 34 have graduated higher education (Figure 2).

The different levels of the member states' efforts are reflected in the fact that national objectives range between 26% in Italy and 66% in

[6] Figures 1 and 2 show data of 25 EU countries only, as the UK has not subscribed to the targets, Greece was subject to procedure in 2013 and Croatia joined the European Union in 2013.

[7] Turkey is not a member of the EU, however, the number of students has significantly grown during the period examined and the pace of the increase exceeds that of developed countries.

Luxembourg. In 2013, ten member states – Lithuania, Luxembourg, Cyprus, Sweden, Estonia, Finland, Denmark, the Netherlands, Slovenia and Austria – had already reached their objectives. Portugal, Croatia, Slovakia and Malta are the furthest away from reaching their targets. Unlike Italy, with its plan for 26% participation, some countries have set quite high goals: for example, 40% in the case of Slovakia and Portugal, 60% in the case of Ireland and 66% for Luxembourg. According to the forecasts for 2020, most countries will probably reach their objectives – supposedly excluding Malta, Portugal and Slovakia.

The evolution of the number of students based on international data

Firstly, we examine the evolution of student numbers at an international level and then in the Hungarian regional units. The data in Table 1 show the extent of the increase/decrease in the number of students in higher education in different countries. We have presented the data of those countries where the number of students is the highest/lowest, as well as those where the change is significant. In addition to the chosen EU countries, data for Switzerland, Turkey and the USA are also shown.

Table 1. Number of students in the higher education (2009–2012)

Countries/Year	Number of students (thousand persons)				Change 2009–2012 (thousand persons)	Change rate previous year=100%		
	2009	2010	2011	2012		2010	2011	2012
Austria	308.2	350.2	361.8	376.5	68.3	1.14	1.03	1.04
Belgium	425.2	445.3	462.4	477.7	52.5	1.05	1.04	1.03
United Kingdom	2415.2	2497.2	2492.3	2495.8	80.6	1.03	1.01	1.00
France	2172.9	2245.1	2259.4	2296.3	123.4	1.03	1.01	1.02
Netherlands	618.5	650.9	780.0	793.7	175.2	1.05	1.20	1.02
Croatia	139.1	140.9	154.0	157.3	18.2	1.01	1.10	1.02
Poland	2150.0	2148.7	2080.3	2007.2	-142.8	1.00	0.97	0.96
Latvia	125.4	112.6	103.9	97.0	-28.4	0.90	0.92	0.93
Hungary	397.7	389.0	381.9	380.8	-16.9	0.98	0.98	1.00
Germany	2438.6	2555.6	2763.1	2939.5	500.9	1.05	1.08	1.06
Italy	2011.7	1980.4	1967.6	1925.9	-85.8	0.98	0.99	0.98
Romania	1098.2	999.5	871.8	705.3	-392.9	0.91	0.87	0.81
Spain	1800.8	1879.0	1950.5	1965.8	165.0	1.04	1.04	1.01
Norway	219.3	224.7	229.7	238.2	18.9	1.02	1.02	1.04
Switzerland	233.5	248.6	257.7	269.6	36.1	1.06	1.04	1.05
Turkey	2924.3	3529.3	3817.1	4353.5	1429.2	1.21	1.08	1.14
USA	19102.8	20427.7	21016.1	20994.1	1891.3	1.07	1.03	1.00

Source: author's own calculations based on KSH 2014a data.

A growth in the number of students can be seen in several countries; the increase ranges from a few thousands to an extra 1.9 million students (in the USA). Among the small countries only Austria is outstanding, where the number of students grew with 13.6% from 2009 to 2010 and the growth continued at a yearly rate of about 3-4%, summing up a total increase of 68 000 students over four years. The reason for this is that education is free[8] in Austria and participants can "easily" get onto a course, there being no entrance exam, except for 8-10 majors (e.g. medical and journalism majors) (Eduline 2012).

An unambiguous and significant decrease in student numbers has occurred in some Eastern European countries (Poland, Latvia, Lithuania, Hungary, Romania, Slovakia, and Slovenia) and in Italy.

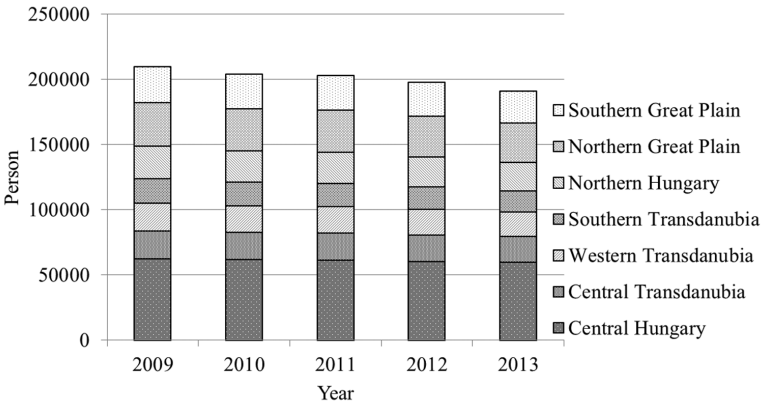
Evolution of the number of students in Hungary

Hungarian higher education has gone through a significant change; as a consequence, the number of university students continuously increased in the 1990s and in the beginning of the 2000s. The subsequent decrease in student numbers was initially caused by the decline in the number of participants in evening, correspondence and distance education courses. From 2010, this decline extended into full-time education, also as a result of education policy measures meaning that higher education has been put at a disadvantage (Ladányi–Szemerszki 2014).

In 2012, the higher education policy introduced two important changes, whose aim was to modify the internal composition of higher education rather than directly affect the total number of students. One of these changes was aimed at changing the proportions of students studying within different training areas. Two elements were employed to achieve this: defining the quotas and modifying the support system.

[8] Students have to pay only 20 EUR for a semester as a so-called tuition fee. If a student does not complete a first degree course within 8 half-years, the student will have to pay a tuition fee of 360 EUR. The period of "toleration" lasts for seven semesters in the master's degree program.

There were increases in the numbers of funded students in the natural sciences, technical subjects, IT and life sciences, but this involved a fall and almost complete reduction in the number of state-funded places in Law, Business, Economics, and Arts majors. In addition to the government's declared preference for certain training areas, there were no alluring jobs, salaries or enticing labour market forecasts in certain subjects (Temesi et al. 2013). However, according to the statistical data, the number of students has not increased in these majors, even though the state finances them. In those majors where state aid has ceased, potential students can choose another course financed by the state, but practice shows that students prefer to pay rather than change career path – they want to graduate in Law, Economics etc. Students who pay can decide to choose among state, private or foreign higher education institutions. Whatever they choose, the composition effect desired by the government will not occur, or will only occur to a limited extent. For students studying in Hungary, a tuition fee has to be paid, which is limited by the parents' income. If a student goes abroad, then there is an absolute decrease in the number of students in Hungary. The government tried to keep students, mainly doctors, in the country by means of a



Source: author's own edition based on KSH 2014b data

Figure 3. Number of students in full-time training in Hungarian higher education by regions, 2009–2013

student contract, but this tool is rather a "threat" than a reasoned solution. The student can borrow a student loan to finance the course. However, this did not prove to be an acceptable solution in previous years, because graduates' starting salaries are low, and so the repayment instalments represent a huge burden during the first years of a career.

The continuing migration of people with higher education qualifications puts Hungary at a competition disadvantage. The experience of previous years shows that Hungary's present higher education system produces a well-educated labour force which is "sucked up" by the labour markets of other countries, and so strengthens the economy there.

Figure 3 shows the number of full-time students participating in basic and master programs[9] from Hungary in the period 2009–2013, grouped by residency. In Hungary, a process contrary to the European trend has started. In 2006, 380 000 students were studying on basic- and master courses; this number decreased to 328 000 in 2009 (despite education being free) and to 282 000 by 2013. At first, it was just the number of participants in correspondence and distance courses which decreased, but from 2009 the number of students on full-time courses also declined, from 222 000 to 209 000, representing a 6.4% reduction nationwide. (KSH 2014c)

By examining the NUTS2 statistical regions of the country (Figure 3), it can be stated that a sharp contrast appears in the number of students in Central Hungary and in the other six regions of the country. The smallest fall has occurred in Central Hungary (only 4%), but it has been much greater in the provincial universities: 17.7% in Southern Transdanubia, 14.3% in Northern Hungary, 10.8% in the Northern Great Plain and 12.1% in the Southern Great Plain. The decisive role of

[9] The Hungarian higher education system changed to the so-called multi-cycle course in 2006; the three cycles are the following: basic-, master- and doctoral courses. The primary aim of the system was to ensure much more flexible frameworks for continuing education and to comply with the principle of life-long learning.

Budapest is indisputable. Its cause is to be found in the popularity of its famous universities and colleges, in the high level of education and in the more or less appropriate relationship between supply and demand. This region also features as the main centre of Hungary from the point of view of trade, economy, education etc. Accordingly, there are many more opportunities for employment here than in any other region.

R&D expenditures and GDP

A state should spend on higher education because a considerable public benefit results through education (Friedman 1996). However, from a state's point of view, there is an important question to answer: whether this investment will be refunded over time? Investment in human capital can be defined as a very costly and time-consuming process which is refunded in the longer term.

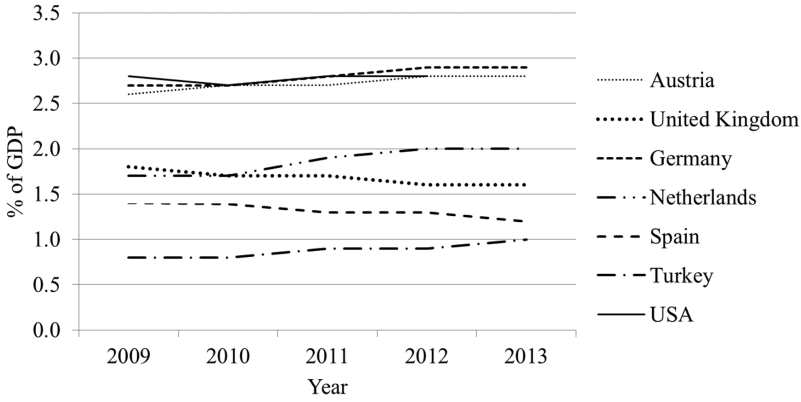
In the beginning of this study, we claimed that a close relationship applies between qualifications and GDP and the more of its GDP a country "devotes" to education, the more educated the intellectual labour force will be.

In the following, we present the total GDP (Table 2) and the share of the gross domestic product created used to finance research and development (Figure 4) of countries where the criterion of an increasing number of students has been met, according to the available data.

Table 2. GDP of countries with an increasing number of students, 2009–2013 (billion EUR)

Country	2009	2010	2011	2012	2013
Austria	286.2	294.2	308.7	317.2	322.6
United Kingdom	1663.6	1816.6	1836.9	2041.5	2017.4
Germany	2456.7	2576.2	2699.1	2749.9	2809.5
Netherlands	617.7	631.5	642.9	640.6	642.9
Spain	1079	1080.9	1075.1	1055.2	1049.2
Turkey	440.4	550.4	555.1	612.4	617.8
USA	10337.5	11287.9	11147.9	12580.3	12625.6

Source: KSH 2014d



Source: author's own design based on KSH 2014e data.

Figure 4. R&D expenditures as a % of GDP of countries with an increasing number of students, 2009–2013

Based on the data from Figure 4, it can be seen that Germany spends the highest proportion of its GDP (2.9%) on R&D, closely followed by Austria (2.8%) and the USA (2.8%). However, the amounts differ significantly: the Germans spend 81.5 billion EUR, the Austrians spend 9.0 billion EUR, while the Americans spend 353.5 billion EUR on research and development.

In Turkey, only 0.9% of the GDP is spent on research and development, but the GDP created has increased by 177.4 billion EUR over four years and the number of students has also increased significantly, by more than 1.4 million. In 2012-2013, the Netherlands and United Kingdom decreased their R&D expenditures to a modest extent.

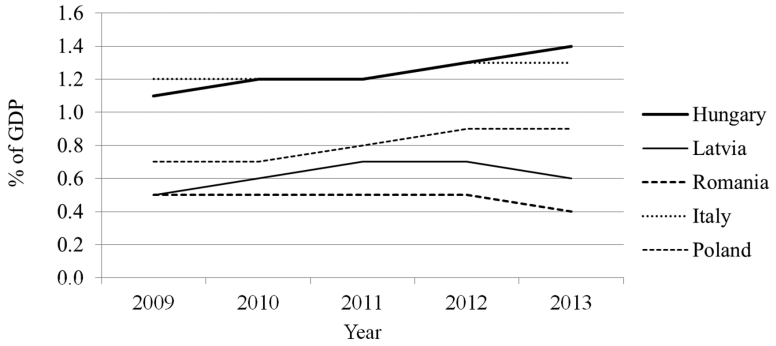
In Table 3, the GDP of those countries are shown where the decrease in the number of higher educational students was the greatest and Figure 5 presents the share of GDP spent on research and development by the same countries. Hungary spends almost as much of its GDP on research and development as Italy (1.3% on average), but there is a significant difference in the amounts expressed in EUR:

almost 1.3 billion EUR in Hungary, but 21.0 billion EUR in Italy. Latvia and Romania spend only a very small proportion of their GDP on supporting R&D activities.

Table 3. GDP of countries with a decreasing numbers of students, 2009–2013 (billion EUR)

Country	2009	2010	2011	2012	2013
Hungary	93.4	97.8	100.4	98.7	100.5
Poland	314.7	359.8	377.0	386.1	396.1
Latvia	18.8	18.0	20.2	22.2	23.3
Romania	120.4	126.7	133.3	133.8	144.3
Italy	1573.7	1605.7	1638.9	1615.1	1609.5

Source: KSH 2014d.



Source: author's own design based on KSH 2014e data.

Figure 5. R&D expenditures as a % of GDP of countries with a decreasing numbers of students, 2009–2013

Research and development activity has been increasingly seen as a key tool which creates revenue from economic activity over several years (Dienes 2014). This change of attitude developed gradually as a result of a long process and its role in economic policy is now very important; knowledge and skill accumulated in this area has been recognized as a means of production tool. Nowadays, one of the important indices of a

country's economic development is the evolution of its R&D expenditures. Further important information for economic operators and investors is the share business enterprises, research institutions and higher educational units receive from R&D expenditures.

Table 4. Proportion of R&D expenditures received by business enterprises, research institutions and higher educational units in 2013 (%)

Countries	Business enterprises	Research institutes	Higher education units
Austria	68.6	5.1	25.6
United Kingdom	64.5	7.3	26.3
Germany	67.8	14.7	17.5
Netherlands	57.5	10.7	31.8
Spain	53.2	18.7	27.9
Turkey	45.1	11.0	43.9
USA	69.8	12.3	13.8
Hungary	69.4	14.9	14.4
Latvia	28.3	29.0	42.7
Poland	43.6	26.8	29.3
Romania	30.7	49.2	19.7
Italy	54.0	14.9	28.2

Source: KSH 2015.

In countries with an increasing number of students about 53-70% of the R&D expenditures flow into the business sector and 14-32% into higher education (Table 4), except from Turkey, where the proportion of R&D expenditures received by higher education units is 43.9%.

The picture is more varied in the countries with a decreasing number of students. In Hungary, business enterprises' share of research and development expenditures is more than two-thirds, while that of higher education units is barely 14.4%. Higher education units received in 2013 a more important share (42.7%) of R&D activities in Latvia, research institutes (49.2%) in Romania and the business sector in Italy (54.0%) and in Poland (43.6%).

Conclusions

With the requirements of sustainable development and the improvement in competitiveness in mind, the Europe 2020 Strategy worded specific numerical proposals for member states, which went beyond general objectives. The EU expenditures related to research and development have recently grown slightly, but they lag behind the 3% objective defined by the Strategy. Significant progress has been made in increasing the number of people with a higher education qualification, and some countries, such as Lithuania, Cyprus, Ireland, Sweden, and Finland, have already reached the union objective (40 %) by the middle of the period. With regard to the commitment for 2020, most countries will probably fulfil their national targets.

Our analysis supports the statement according to which countries with better economic performance spend more (2-3%) on R&D and have an increasing number of students in higher education, however Turkey spends only 0.9% of GDP on R&D, but its number of students increased from 2.9 to 4.3 million in the reference period (2009-2013). The biggest reduction in the number of students occurred in Latvia, Romania and Italy.

Statistical data show that Hungary has not been among the leading countries in terms of R&D expenditures, the number of students in higher education, or graduates; indeed, as Harsányi and Vincze (2012) noticed earlier, Hungary can be found rather at the rear of the EU countries' list. Therefore, the education policy should pay much more attention to adult education, since this is an important element in the economic and social development of a country (Polónyi 2014).

The national target set for Hungary by the EU 2020 Strategy regarding the share of the 30-34 age group with a higher education qualification, is of 34% (below the EU target of 40%); this target was already achieved in 2014. Due to demographic reasons, a large-scale reduction can be predicted in the number of young people in the higher education age bracket over the next few years (Berde 2013), which conceals a so-called historic opportunity: the share of graduates can be increased without enlarging the existing capacity of higher education,

only the present number of students needs to be retained. Of course, the benefit from the demographic headcount reduction cannot be counted as a long-term economic goal in this sense.

With the continuous development of social and economic life, it is to be hoped that higher educational activity will be increasingly appreciated in Hungary, as well as in other EU countries.

To stop the further reduction in the number of students in the countries with negative trends, the opportunities for learning in higher education should be popularized, and there should be greater recognition of the moral and material value of higher education.

Altogether more than half of R&D expenditures flow into the corporate sector. Enterprises can give a mandate to the other two sectors, can get ideas based on the results produced by higher education and research institutions, and can cooperate with them in order to solve innovation tasks. One economic policy dilemma brought to the surface by today's financial crisis is precisely the question of which area needs a deeper integration. It had already been previously recognized in the EU member states that the utilization of R&D resources should be harmonized at national, sectoral, as well as regional levels.

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