

Innovative Higher Education: Balance between the Cooperation and Competition

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Abstract

Nothing is fostering innovations in higher education faster than 'demand for required solution' and 'demand for stronger position or leadership.' The first demand is for friendly cooperation among institutions; the second is for competition. Noticeably, that second demand, highlighting a few important aspects, is closely related to the first one – gaining a stronger position sometimes means a sort of contribution in order to solve related problems. The Vice versa effect, when the successful solution strengthens the position in the market, is also frequent. In order to cover the wide spectrum of demand, both 'solution' and 'leadership' should be understood in an extensive context. Analysis of related preconditions proves that both cooperation and competition are essential elements of the behavioral policy of higher education institutions.

Keywords: innovations, higher education, demand, cooperation, competition

1. Introduction

Every activity directed at improving a current situation or proposing a new solution takes its roots from the demand coming from both inner and external sources. The market in general, its players and possible consumers dictate demand, which is a clear signal to pay attention to those who are dealing with innovations. In most general terms, an innovation is a totally new, or significantly improved, solution for existing or expected problems, inconveniences, and difficulties. In other words, innovation is equal to a solution with some mandatory elements (for instance, the novelty of a solution or the improvement of an already existing solution).

Higher education institutions are among the entities dealing with innovations. Noticeably, dealing with innovations is a very specific level. It ensures contact with knowledge, know-how or at least inspiration for know-how. It is highly expected that higher education institutions have qualified researchers who are able to analyze the demand of the market and propose the proper solutions. Also, it is expected that such institutions have qualified managers who are able to support inner scientific potential. In other words, it is expected that higher education institutions are able to provide ideas, solutions and human resources.

Despite the fact that in some international rankings, which are tightly related to innovations in separate geopolitical regions, higher education institutions are not

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mentioned, a closer analysis finds a clear link between the innovativeness of such institutions and the innovation level of the states represented by such institutions. The success of a country in the ranking of innovativeness is strongly related with the innovativeness of its higher education institutions.

As in other legal entities, the development of innovation in higher education institutions depends on two processes – cooperation and competition. These processes are valid in all institutions and are determined by the market and by the policies of related institutions. Together, those processes have a significant impact on the innovativeness of institutions and the states those institutions act in. A proper balance between cooperation and competition has a decisive impact on the future of institutions and other related subjects. 'Collaboration between higher education institutions is expected to increase, but even more so, the fierce competition between them, which may sometimes lead to the disappearance of some institutions' (Brennan, 2014). Cooperation or collaboration undoubtedly could lead to the situation in which collaborating parties, through their stronger position in the market, are able to push out cooperating entities from this market.

Both cooperation and competition are challenges for higher education institutions, especially for those, who have been supported by the state and grew under greenhouse conditions. The time of self-sufficient institutions has passed away. Now, they are forced to choose with whom to work and who should be observed as a possible competitor. Despite a chosen direction, it is expected that activity of every single higher education institution will bring an added value and will be competitive in the market. Otherwise, it will fade naturally. This makes no sense in providing state funding. Institutions, oriented to innovative higher education, potentially are programmed for success.

How should an innovative higher education be understood? In general terms it is a higher education flexible for innovations on the level of their creation, development and usage. Innovations should be understood in the wider context than they are usually defined. This concept should cover social and technological innovations. The first one is aimed at improving the teaching process and providing support (for instance, an improved working model inside a group of researchers) for working on technological innovations, as well as dealing with emerging social challenges. Previously, society believed that social innovations do not exist.

Further, the cooperation and competition processes in higher education institutions are analyzed with a special focus on Eastern European countries with a comparison to the Baltics, who had the same starting position, and through some political decisions, currently are holding higher positions in the rankings related to innovativeness.

2. Importance of innovations in higher education

It is hard not to underestimate the importance of creating, developing and using innovations in higher education. This comes from the very nature of these institutions. They are expected not only to transfer the knowledge, but also to make significant contributions to the processes related to the appearance of innovation. If an institution cannot propose something new or something that meets the demand, it cannot be

competitive in the market. Only few higher education institutions can expect to avoid the 'natural obligation' to be innovative, and this right for them is granted only because of historical circumstances and reasons – they must be preserved because of their 'glorious past' or because they are simply unique. However, these institutions are taking the appropriate steps to remain visible and prestigious in the market.

The importance of innovations in higher education is determined by the natural necessity of institutions to survive and move forward and by requirements from policy makers. Usually, the basic requirement to be competitive in the national market comes from the national authorities. Becoming a competitive player in the smaller market raises the need to improve the institutions' position in the wider market. The EU requires that the players of the inner market be competitive worldwide. Additionally, a strategic aim of the 'Innovation Union' vision is the investment (not only financial resources) required to achieve this goal. The vision of the 'Innovation Union' is embodied in the main EU strategic documents. Europe 2020, a strategy for smart, sustainable and inclusive growth, presents 'Innovation Union' as one of seven flagship initiatives which are aimed 'to improve framework conditions and access to finance for research and innovation so as to ensure that innovative ideas can be turned into products and services that create growth and jobs' (hereinafter – Europe 2020 strategy).

The EU stresses that innovations are vital for increasing and maintaining European competitiveness in the global economy. Through education and innovation, the EU seeks to strengthen its position globally. The gap between separate member states is not only obvious but sometimes dramatic. Unsurprisingly, the representatives of Eastern Europe are expected to improve their positions. According to the European Commission, 'Innovation Union is the European Union strategy to create an innovation-friendly environment that makes it easier for great ideas to be turned into products and services that will bring our economy growth and jobs.'

The importance of innovations in the EU is clearly expressed in the Europe 2020 strategy, which distinguishes three priorities widely known as 'smart growth,' 'sustainable growth' and 'inclusive growth.' The first one is defined as the development of 'economy based on knowledge and innovation.' The other two also deal directly with innovations. All priorities are aimed at strengthening the competitiveness of the EU. And this could be done only if the contributions from different EU regions are sufficient.

According to Communication from the Commission on European higher education in the world, 'The EU contribution will focus on two policy objectives described hereafter: increasing the attractiveness of European higher education by improving quality and transparency; and increasing worldwide cooperation for innovation and development through partnerships, dialogue and capacity building.' One of the prospective goals of this document marks increasing worldwide cooperation for innovation and development. On one hand, this obliges higher education institutions to pay additional attention to common goals. On the other hand, the results are dependent on the rankings, despite the officially declared goals of every single higher education institution. Those criteria determine the future of such institutions – to continue the activity or to disappear. Further provided data will disclose a dramatic difference between the EU member states. Obviously, institutions from Eastern Europe are not among the leaders of the rankings related to the innovations in higher education.

The strategies of separate countries are similar to Europe 2020 goals. Undoubtedly, a special role is for innovation and education. For instance, the Romanian 2020 strategy focuses on 'improving the quality of investment in research, innovation and education.' The Polish 2020 strategy states that 'in order to increase innovativeness of enterprises, the measures in numerous fields are necessary – removing barriers for conducting business activity, improving the quality of education to provide competent personnel, expanding access to finance, promoting knowledge transfer, developing business environment institutions, stimulating cooperation between science and business.' In the last strategy, policy makers clearly indicate the link between the improvement of education quality and increasing the innovativeness of undertakings. Despite the positions held in different rankings, the improvement of the education system should be among the priorities of each single state.

Among the strategic goals for the EU in higher education is 'enhancing creativity and innovation, including entrepreneurship, at all levels of education and training.' This goal covers all levels of higher education. Principles for Innovative Doctoral Training, a document adopted by the European Commission Directorate General for Research & Innovations, guides innovations for higher education, especially at the PhD level, which is the most promising. Those principles are 'research excellence', 'attractive institutional environment', 'interdisciplinary research options', 'exposure to industry and other relevant employment sectors', 'international networking', 'transferable skills training' and 'quality assurance.'

Every higher education system is sensitive to negative changes whilst any positive effect is achievable only through time. This means that wrong political decisions have a long impact with dire consequences. Any positive changes, including the growth innovativeness requires, should be understood as an investment into the future. Current differences among countries on innovativeness of higher education are determined by wrong political decisions in the past.

The higher education institutions from Eastern European are improving their positions among the innovative institutions in Europe, but the growth rate has been insufficient. Based on data from Reuters, 'The 100 most innovative universities in Europe 2016' was published in June 2016. The results of Eastern European universities are still upsetting: 'Universities in Western Europe claim 60 universities of the top 100, with Northern Europe second with 24, Southern Europe boasting 15 and Eastern Europe just one – Poland's Jagiellonian University, ranked 92.'

The clear view of any ranking is possible only after the disclosure of methodology. It is important to analyze the components taken into account preparing this rating. Reuters made their final evaluation after assessing received data on 'patent volume,' 'patent success,' 'global patents,' 'patent citations,' 'patent citation impact,' 'percent of patents cited,' 'patent to article citation impact,' 'industry article citation impact,' 'percent of industry collaborative articles' and 'total web of science core collection papers.'

It is worth noting that scientists from Eastern Europe traditionally are passive and pessimistic on patenting and protecting their findings. This does not mean automatically that the count of innovations coming from there is too low. Usually, innovations in this region are implemented without claiming a legal protection. In Eastern Europe scientists prefer to protect only technological innovations with

undoubtedly high commercial potential. There are no traditions and trends to protect potentially risky ideas or products. It differs from the attitude to the value of the same results of scientific activity in the USA, Japan and in countries from Western Europe.

On the other hand, the criteria related to patentability and patenting allows for the avoidance of the situation when some institutions call their implemented results innovative without paying attention to the fact that 'such innovations' for some period are not innovative for other institutions anymore. This could happen because of the foreclosure of institutions (nobody conducts research on innovations elsewhere) or the different level of development (something is new only for the concrete institution). In such cases it is possible to talk only about the 'local institutional innovations.'

It is important not to forget that the ranking does not reflect the social innovations. Historically, only a small number of successful social innovations, models, and other intellectual results had been legally protected. This happened because the social innovations:

- a. Are constantly and rapidly changing (one solution comes after another and there is no time to think about the cost formalities).
- b. Usually are understood as a usual solution that does not require additional protection (solution is useful, timely but 'too natural').
- c. Despite the fact that the solution makes concrete processes easier and usually cheaper are not so profitable (affords to protect innovation and the financial return are scaled).
- d. At the same time at least a few similar solutions appear (it is harder to prove the originality of social innovation).
- e. Nor researchers nor higher education institutions are not enthusiastic to have additional expenses (this is common for Eastern European countries).

The importance of innovations in every higher education institution, despite the position in any related rankings, is unquestionable. If the entity involved in higher education cannot propose the innovative training and cannot prepare students to be innovative and creative, the future of this type of institution is questionable. It will be hardly competitive in the market where the same services are provided, taking into account the newest methods and solutions. The opinions that some specialties and educational preparations related to them do not necessarily require an innovative approach are acceptable only on a partial basis. Furthermore two processes, which have a significant impact on the development of innovations in academia, are analyzed.

3. Factors promoting cooperation

Every higher education institution is familiar with its strengths and weaknesses. In case the strengths and weaknesses are unknown or unclear, they at least are predictable from previous practice or the current situation. This entitles the search for a way to: a. use and increase strengths; b. abolish or at least minimize the weaknesses. In order to achieve the highest results, institutions are encouraged to cooperate. This comes from the fact that institutions are not self-sufficient.

What are the main factors and reasons promoting cooperation among the higher education institutions? They should be distinguished by the following:

- a. A wish to fulfill needs and demand in the market.
- b. A wish to be competitive in the market and to keep the current position without

- allowing a competitor to retake it.
- c. A wish to receive funding (some financial support requires proper results, some require cooperation).
- d. A wish to expand current activity and enter into new markets.
- e. Other reasons.

Higher education institutions cannot conduct 'activity for activity' because a process cannot be only for a process. Activity should provide results. The source and the demand for such activity come from the market, which is dependent on: a. society; b. state and other related authorities; c. businesses. In the market where the main criteria for provided services are quality, higher education institutions usually choose cooperation or joint solutions.

In order to survive, higher education institutions are encouraged to cooperate. This comes from the fact that basic funding is not sufficient to stay competitive in the market for a long period. Losing competitiveness leads to disappearance or trials to resurrect cooperation with other institutions.

Competition also fosters cooperation, especially in the markets with a long list of players. The amount of cooperation with foreign partners in order to be competitive in the inner market is constantly increasing.

It is expected that cooperation among the institutions will bring a quality into the study process. Higher education policy makers are encouraging international cooperation: 'Bologna process promotes the development of international cooperation and interculturalism' (Bulajeva, 2013).

Taking into account the interest of the EU to promote cooperation between the member states and to provide funding not only to single institutions, calls for the projects are based on the cooperation among institutions from different states. It is obvious from the analysis of EU policy and already opened calls or planned calls for the projects (for instance Horizon 2020 and others).

Some calls for projects (for instance, 'Twinning' projects) allow higher education institutions to cooperate in order to increase the competitiveness and the innovativeness of lower developed institutions through receiving and providing support, sharing know-how and cooperating on other activities. Practically, it is a tool, which allows the minimization of the qualitative differences between the regions and institutions. The main goal is to make different regions of the EU more equal in the sense of higher education.

Successful cooperation among the institutions from different countries could be named EMP-AIM, which 'is a Partnership of 17 Universities from European countries, Belarus, Ukraine and Moldova, which aims to build a structured and sustainable cooperation between the involved universities and thus to strengthen academic, cultural, economic collaboration between the European and Eastern Europe region countries.' Joint Bachelors, Masters, and PhD programmes are also proper and attractive and an encouraged way of cooperation among the institutions. As previously mentioned Principles for Innovative Doctoral Training provided principles that could be implemented only through cooperation (this could be said not only about 'international networking'). Students are expected to gain transferable skills. Usually, this is possible only through their participation in the activities of at least a few institutions.

In order to strengthen the cooperation among the scientists from different countries and increase the quality of research entire networks were created, for instance, COST or European Cooperation in Science and Technology. Despite the fact that membership in COST is limited to a precise list of countries, initiatives including researchers from Near Neighbourhood countries, is highly encouraged. Taking into account the universality of the science, representatives of other jurisdictions are also welcome to contribute to the network. Such an approach supports the general idea of 'science without borders.' Promoting networking and cooperation allows institutions to increase the quality of services they provide. It also abolishes a foreclosure.

Cooperation between academia and businesses is promoted at the EU and national levels. Businesses are willing to cooperate with academia and receive results that the market is interested in. This is the reason why more than one academic partner is usually involved in such cooperation. Usually, the competition in the inner market determines that higher education institutions are avoiding adding other institutions from their countries and prefer to have a foreign academic partner.

3. Factors promoting competition

Competition is natural and expected not only in the relevant market where the businesses operate, but also in the not so commercialized higher education sector. The reason to ensure competition among higher education institutions is the same for competition maintenance in commercial markets. Higher education institutions propose their services to the beneficiaries, and their possibility to survive depends on their position in comparison with the position of their competitors.

Competition among higher education institutions is directed:

- a. To attract related parties. Usually, higher education institutions are competing to attract students.
- b. To attract investments and funding. Usually, financial support is dependent on the results achieved by each institution.
- c. To maintain the position in the market. Institutions with deeper traditions are interested in showing that they are still strong.
- d. Other reasons.

Competition is usually expected in the market with more than one player. The benefits from competition are obvious – institutions are competing by strengthening the quality of their services, by providing innovative models of teaching, and by launching innovative programmes.

The additional motivation to compete comes from the policy and decision makers. In the case of institutions supported by the state, it is highly important to provide better results than the competitor does. It ensures financial support for a longer period. By providing financial support based on the individual results of every single institution, authorities encourage competition among institutions. Here, institutions prefer to cooperate with foreign partners by that strengthening their positions over the local competitors.

Despite the fact that in Eastern Europe the majority of higher education institutions are receiving financial support from their state, it is highly expected that such institutions will gain more financial independence. The governments encourage

institutions to be active in the market (providing innovative services and launching prospective international programmes) as well as actively participate in international project activities. The same situation also occurs in the Baltics. For instance, in Lithuania, 'while previously universities have received all funding from the national budget on the basis of the results of the previous years, recently the funding system has changed from basic funding to quasi-basic funding and introduction of competitive funding. It means that a part of national funds are allocated to universities on the grounds of basic funding and a part of it universities have to fund-raise from external sources' (Gudeliene, 2016).

This type of practice is common for the majority of states – institutions are expected to form their budget from external sources (for instance, international projects). The rivalry for relevant sources also fosters competition among the academic institutions. Usually, such competition is visible in the frames of one special country. International competition is expected as well. However, institutions from some countries are practically invisible on the international map.

Competitiveness provides information about the flexibility of each assessed unit to conduct activity in the market, react to changes, to adopt the newest solutions in their daily activities and to compete successfully with other units in the same or related markets. The competitiveness index and flexibility of each country provides information for businesses searching for a proper partner. Furthermore, in Table 1 the data on the competitiveness of selected countries is provided. Chosen countries from Eastern Europe were compared to the Baltics in order to reveal the differences among the countries that a few decades before had similar starting positions but from a political point of view paid different attention to competitiveness.

Table 1. All pillars. Selected countries from Eastern and Northern (Baltics) Europe

Country	Score	Rank	Separately rank in innovation and sophistication factors
Estonia	4.74	30 th	31 st (score – 4.15)
Latvia	4.45	44 th	58 th (score – 3.69)
Lithuania	4.55	36 th	37 th (score – 4.02)
Moldova	4.00	84 th	128 th (score – 2.93)
Poland	4.49	41 st	57 th (score – 3.70)
Romania	4.32	53 rd	84 th (score – 3.48)
Ukraine	4.03	79 th	72 nd (score – 3.55)

Source: The Global Competitiveness Index 2015-2016.

The northern region is near the leaders while Eastern European countries are improving their positions by slowly moving up. What is hidden under the provided data? The answer is in the elements assessed. The ranking is based on 12 pillars, which are 'institutions,' 'infrastructure,' 'macroeconomic environment,' 'health and primary education,' 'higher education and training,' 'goods market efficiency,' 'labor market efficiency,' 'financial market development,' 'technological readiness,' 'market size,' 'business sophistication' and 'innovation.' The pillars from 1 to 4 are known as 'basic

requirements,' from 5 to 10 are 'efficiency enhancers,' from 11 to 12 are 'innovation and sophistication factors' (The Global Competitiveness Index 2015-2016. Methodology).

Table 2 shows how the states from Table 1 are ranked in accordance with two pillars related to higher education and innovations. Those two pillars more precisely reflect the impact of academia on the competitiveness of the represented state.

Table 2. Fifth pillar 'Higher education and training' and twelfth pillar 'Innovation.' Selected countries from Eastern and Northern (Baltics) Europe

Country	5 th pillar score	5 th pillar rank	12 th pillar score	12 th pillar rank
Estonia	5.5	20 th	4.0	29 th
Latvia	5.1	32 nd	3.3	62 nd
Lithuania	5.3	24 th	3.7	36 th
Moldova	4.1	79 th	2.6	130 th
Poland	5.1	31 st	3.3	64 th
Romania	4.5	59 th	3.2	75 th
Ukraine	5.0	34 th	3.4	54 th

Source: The Global Competitiveness Index 2015-2016).

Despite the fact that Table 2 represents only two pillars, their impact on the standings of countries is obvious and reveals that countries are holding almost the same positions as in the general standings. This could be explained as well by the fact that other pillars also are interrelated. Measuring innovations in education is also important to pay additional attention to the measurement methods and techniques (OCDE, 2014).

The competitiveness index is one side of the coin. Another side is the innovation index of already analyzed countries. The following is provided in Table 3 with special focus on 'human capital and research.'

Table 3. The Global Innovation Index 2015.

Country	Percentage rank	Rank on 'Human capital and research'
Estonia	0.84	0.79
Latvia	0.77	0.62
Lithuania	0.74	0.71
Moldova	0.69	0.48
Poland	0.68	0.69
Romania	0.62	0.49
Ukraine	0.55	0.75

Source: Selected countries from Eastern and Northern (Baltics) Europe.

Despite the fact that every ranking has its minuses and the objective situation in the market cannot be reflected, the following data reveals some general trends. The situation on 'human capital and research' plays an important role in being innovative in the market. In most cases it is crucial. In other cases it allows the countries to stay at least in the middle of the ranking and not to be among the outsiders (for instance, in the case of Ukraine in Global Innovation Index 2015).

4. Balance between cooperation and competition

Higher education institutions are known as competitive market players and are dependent on the demand coming from different sources. It is hard to deny that 'innovation often requires new forms of collaboration which may sometimes be blocked by the competitiveness inherent to market-led forces; therefore, a good balance between collaboration and competitiveness is essential for good relationships between institutions and the individuals' (Hazelkorn, 2011 and Brennan, 2014). The balance between those two actions comes from the market. Also, it is important to pay attention to the fact that 'increasing cooperation does not contradict the increasing competition that we also noticed among higher education institutions, but the two aspects coexist and manifest themselves as distinct individual and institutional responses at different levels and in different geographic or socio-economic contexts' (Brennan, 2014).

Both cooperation and competition cause a risk to institutions. Competing institutions fight for their place in the market. Cooperating institutions should be assured that their partners would be fair and flexible. Most likely institutions will choose to cooperate on innovations that are easy to implement. The reason for is simple – the more steps required, the more risk that partner would have for a different interest or position. Even in the implementation process, higher education institutions prefer an easier way in order to avoid any additional risk: 'The institutions themselves are most likely to incorporate innovations that sustain the current model, and reject innovations that would require significant change' (Armstrong, 2014).

The proper balance between cooperation and competition is what every institution should find for itself in order to achieve its legally grounded goals.

Cooperation cannot lead to restrictions of competition. If the main aim for starting or continuing cooperation is to increase someone's positions' by 'kicking off' competitors from the market, we cannot talk about the legally grounded policy.

5. Conclusions

As is the nature of institutions, national and supranational systems encourage higher education institution to cooperate and to compete. Both processes should be fair and legally grounded. Only the proper balance between cooperation and competition among the representatives of academia can bring innovativeness into higher education.

The analysis of different ranking systems reveals the importance of innovative higher education for the innovativeness and competitiveness of the countries represented by innovative institutions. The rankings also reveal that the gap among not only different countries but also regions in Europe is huge (the positions of states from Eastern Europe are weak).

Bibliography:

- Armstrong, L. (2014). Barriers to Innovation and Change in Higher Education. TIAA-CREF Institute. Retrieved June 10, 2016, from <https://www.tiaainstitute.org/public/pdf/barriers-to-innovation-and-change-in-higher-education.pdf>
- Brennan, J., Broek, S., Durazzi, N., Kamphuis, B., Ranga, M., Ryan, S. (2014) Study on innovation in higher education: final report. European Commission Directorate for Education and Training Study on Innovation in Higher Education, Publications Office of the European Union, Luxembourg.
- Bulajeva, T. (2013). Tarptautiškumo politikos iššūkiai Lietuvos aukštajam mokslui: konkurencija vs bendradarbiavimas. ActPaed Acta Paedagogica Vilnensia, 30(30). doi:10.15388/actpaed.2013.30.1548
- Communication from the Commission 'Europe 2020. A strategy for smart, sustainable and inclusive growth'. COM (2010) 2020 final.
- Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'European higher education in the world'. COM / 2013 / 0499 final.
- COST. European Cooperation in Science and Technology. Retrieved June 10, 2016, from <http://www.cost.eu>
- EMP-AIM Project. Retrieved June 07, 2016, from <http://emp-aim.mruni.eu/project/>
- Europe's Most Innovative Universities. Retrieved June 10, 2016, from <http://www.reuters.com/article/us-innovative-stories-europe-idUSKCN0Z00CT>
- European Commission. Innovation Union. Retrieved June 06, 2016, from http://ec.europa.eu/research/innovation-union/index_en.cfm
- Gudeliene, N. (2016). University and business cooperation governance in Lithuania. Doctoral Dissertation: Social Sciences, Management (03 S).
- Hazelkorn, E. (2011). Rankings and the reshaping of higher education. Houndmills, Basingstoke, Hampshire: Palgrave Macmillan.
- Methodology: Europe's Top Universities. Reuters. Retrieved June 10, 2016, from <http://www.reuters.com/most-innovative-universities-europe/methodology>
- OCDE (2014). Measuring Innovation in Education a New Perspective. Centre for Educational Research and Innovation.
- Poland. National Reform Programme. Retrieved June 10, 2016, from http://ec.europa.eu/europe2020/pdf/csr2015/nrp2015_poland_en.pdf
- Principles for Innovative Doctoral Training. European Commission Directorate General for
- Research & Innovations. 27/06/2011. Retrieved June 10, 2016, from http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf
- Romania. National Reform Programme. Retrieved June 10, 2016, from http://ec.europa.eu/europe2020/pdf/csr2015/nrp2015_romania_en.pdf
- The 100 most innovative universities in Europe 2016. Retrieved June 10, 2016, from <https://www.timeshighereducation.com/features/100-most-innovative-universities-europe-2016>

The Global Competitiveness Index 2015-2016. Retrieved June 10, 2016, from <https://widgets.weforum.org/global-competitiveness-report-2015/>

The Global Competitiveness Index 2015-2016. Methodology. Retrieved June 10, 2016, from <http://reports.weforum.org/global-competitiveness-report-2015-2016/methodology/>

The Global Innovation Index 2015. Retrieved June 10, 2016, from <https://www.globalinnovationindex.org/>