

Sub-theme: Entrepreneurial University and Triple Helix's Development

Title: Triple Helix Model Development in Serbia: The Case of Educons University as an Entrepreneurial University

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Abstract:

The basic aim of this paper is to underline the importance of various processes and forms of interaction between two vital spheres of the contemporary economic development – university and business sector. These two spheres, at the same time, represents one side of relations in triple-helix model. Today, in rapidly changed economic conditions, on scene is, so called, third mission of university: creation of new knowledge and technology and its exploitation out of academic environment. The academic entrepreneurship phenomena lies in a more prominent role of university and an interaction between university, business sector and government institutions (Triple-Helix Model). The paper focuses on the conditions of triple helix model development in The Republic of Serbia, with emphasizing university-industry interactions through incitement of development and spreading entrepreneurial university values. The research interest of this paper also include the entrepreneurial university, as an organization with entrepreneurial culture and a specific form of knowledge implementation related to potential market needs and contribution to regional/national economic development. Based on findings discovered and presented in the first part of the paper, the second part is dedicated to case study and representation of the First Entrepreneurial University in the Vojvodina Region – the Educons University.

Keywords:

Triple Helix Model, Triple Helix Indicators, Entrepreneurial University, National Innovation System, Academic Entrepreneurship.

Introduction

The European Union, at the European Council meeting in Lisbon, in March 2000, proclaimed the strategic goal, by which, over the next decade, it has to become the most competitive and dynamic knowledge-based economy in the world, capable of sustained economic growth with more and better jobs and greater social cohesion. Comprehensive development agenda entitled "*Employment, economic reform and social cohesion - the road to Europe based on information and knowledge*" or simply *the Lisbon strategy* was based on the integration of education, research and innovation, as key drivers of the knowledge economy.

Faced with the great changes brought by globalization, economic and political domination of the United States (the development of new technologies, dynamic entrepreneurial sector, high productivity in the industrial sector), followed by a pronounced competitiveness of the Japanese economy, with the growth of China's new economic power, as well as the expected accession of New Member States, the EU has defined objectives and instruments which should ensure competitiveness in the changed conditions and improve the standard of its citizens. A key component of the Lisbon strategy was the development and advancement of knowledge which included greater investment in education and professional training, scientific and technological research and innovation (3% of GDP), but also the intensification in connections between private sector and education/R&D institutions. In actual practice, it shall mean the establishment and strengthening the infrastructure for advancement of knowledge by incentive capital and stimulating more creative individuals - growth in the employment rate to 70% by 2010, average economic growth rate of 3% as well as coverage of 30% of the European population with speed internet network.

Under the leadership of former Dutch Prime Minister Wim Kok, at the halfway to the determined date, in 2004, the European Commission received and presented a report (the so-called *Kok report*) in which it is stressed out the weak, uneven, even disappointing progress in the implementation of the Lisbon criteria.¹ Two main objectives have not been achieved - the employment rate - 70% and investment in scientific and technological research of 3% of GDP.² The reasons for this are the result of too broadly defined goals, extensive programs, lack of coordination, conflicting priorities and the unfavorable development of the global economy in the first five-year period of the 21st century.

In the middle of 2005, the European Council, not abandoning its primary objective, adopted the *Revised Lisbon Strategy* - knowledge, innovation and optimization of human capital remained a key for sustainable economic development. Respecting the global challenges facing the EU - economic empowerment of emerging countries, the reorganization of global finance, aging population, climate change and limited resources, these revised targets were only a prelude to the adoption of the Europe 2020 strategy, which was adopted in 2010.

According to the vision of *Europe's social market economy of the 21st century*, as the key priorities of the new strategy have been defined: *smart growth* (knowledge-based economy), *sustainable growth*

¹ Facing the Challenge - The Lisbon Strategy for growth and employment, Report from the High Level Group chaired by Wim Kok (2004), European Commission, Luxembourg: Office for Official Publications of the European Communities, Brussels, Belgium

² European Commission, Lisbon Strategy Evaluation Document SEC (2010) 114 final, Brussels, Belgium

(economy that consumes resources efficiently, ecologically oriented and competitive) and *integrative growth* (economy, which has a high rate of employment and social and territorial integrity). The characteristics of the current, *global knowledge revolution*, as well as a specific EU-28 context of the knowledge society, particularly emphasize the importance of the so-called *helix logic* in understanding the mechanisms of progress of modern science and its application based on two fundamental processes: *learning and innovation*. The process of developing new knowledge to revive economic flows is vital for the economic structure of the Republic of Serbia,³ which is still in the process of transition. In such conditions, many regions, local communities and even cities, are shown the need of modeling a new innovation environment, composed of state, universities and business sector institutions (mainly spin-off companies), or tri-lateral initiatives for economic development based on knowledge - *Triple helix* model III.⁴

2. State-of-the-art

2.1. Synteraction of university, bussines and state sector

Competitiveness of middle-income economies is increasingly conditioned by their innovation capacity. Triple helix, as a model of dynamic partnerships that optimize collaboration and encourage innovation, presupposes that its key actors (*university - industry - government*) affects on the principles of open circulation of ideas and knowledge, based on a continuous process of learning, communication and cooperation. These helical connections resulting in multiple relationships in the capitalization of knowledge (knowledge hybridization), creating new forms (institutions, projects) that occur in interaction sections of key actors and do not belong exclusively to any of them.

Hence, this model includes the development and implementation of interactive approaches that are much more complex than the concepts of one-way technology transfer. In particularly, this refers to cooperation in determining the scale of development priorities, but also to respect differences and specificities of all the organizations involved. Certainly, interactive models of cooperation between science and business, encourage creativity, internal entrepreneurship, contributing to the emergence of new ideas and contribute to increase national competitiveness. New forms of spiral connections (hybrid organizations) may be different institutions or projects (business incubators, centers of excellence, technology parks, technology networks and platforms) that arise through cooperation and require a permanent communication in the changing outdoor environment (Penezić, Đuran, 2010).

According to the *Global Competitiveness Index* (GCI) of the World Economic Forum for 2014-2015, Serbia is positioned at 94th position out of 144 countries (the four countries less than in the previous year and 101. place positions), with a recorded index value of 3.9.⁵ Thereby, it should be noted that the theoretical value of GCI is in the range from 1 to 7. The highest value of GCI (5.70) and first place in the list of the World Economic Forum in 2014-2015. is registered by Switzerland, while the lowest value (2.79) recorded by Guinea which is at the last, 144th place.

³ Since March 2012, Serbia was granted candidate status for EU membership, and in early 2014 marked the start of accession negotiations at the political level.

⁴ Etzkowitz, H., Leydesdorff, L. (2000), *The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations*, Research Policy 29 (2): 109-123.

⁵ The Global Competitiveness Report 2014-2015, (2014), World Economic Forum, Geneva, Switzerland, p.69.

Table 1. The value of the GCI pillars of competitiveness, SRB: 2012-2014⁶

Pillars of competitiveness	2012.	2013.	2014.	Changes 2014/2013.
Institutions	3,16	3,20	3,21	→
Infrastructure	3,78	3,51	3,93	↗
Macroeconomic environment	3,91	3,36	3,51	↗
Health and primary education	5,73	5,75	5,76	↗
Higher education and training	3,97	4,05	4,25	↗
Goods market efficiency	3,57	3,64	3,78	↗
Labour market efficiency	4,04	3,90	3,73	↘
Financial market development	3,68	3,48	3,50	↗
Technological readiness	4,10	3,94	4,45	↗
Market size	3,64	3,68	3,68	→
Business sophistication	3,11	3,18	3,21	↗
Innovation	2,81	2,85	2,89	↗

These data indicate that the significant growth was achieved even in five segments: infrastructure, macroeconomic environment, higher education and training, goods market efficiency and technological competence. On the other pillars, the changes can be considered to be minor, excepting the labour market efficiency, where it was recorded a slight decline compared to the previous year.

However, according to estimates of entrepreneurs, the most significant obstacles to business remain: inefficient bureaucracy, access to finance, corruption, foreign exchange and tax regulations, underdeveloped infrastructure, and insufficient capacity to innovate. The competitiveness of Serbian companies (SME sector as the dominant segment of the economic structure) largely depends on their ability to produce safe and quality products compliant with the relevant technical standards. However, low competitiveness, according to recent research,⁷ lies in the lack of technical knowledge in enterprises, insufficient application of standards, lack of awareness about the importance of compliance with international standards of products and management systems, lack of facilities for testing.

In 2013, the entrepreneurial sector of Serbia included 315.412 companies, representing 99.8% of the total number of companies (315.906). SME sector generated 64.9% of employment by engaging the non-financial sector by 768.550 workers and 64.3% of turnover (5.714 bln. RSD; 18.1 mil. RSD per company)

⁶ Ristic, B., Tanaskovic, S.(2013), Competitive position of Serbia in 2013-2014. according to the World Economic Forum, the Foundation for the Advancement of Economics, Belgrade, (www.fren.org.rs-visited 31.03.2015.)

⁷ Assistance to competitiveness and compatibility with the EU of Serbian SMEs, GIZ ACCESS project, <http://www.giz.de/themen/en/34334.htm>

and 54.1% of GVA (964,0 bln. RSD, 3.1 mil. RSD per enterprise). It is estimated that, in 2013, SME participates for about 34% of the GDP in the Republic of Serbia.⁸

After crisis conditions in years 2009-2013. have influenced the deterioration of basic indicators of cost competitiveness in the Serbian economy, resulting with the unfavorable trends of underlying business performance which were more pronounced in the SME sector with regard to large companies. High wage costs in realized GVA SMEs (65.5% in 2013) and their growth compared to 2008 (5.8%) indicate the limited investment opportunities in the modernization process of labor. The decline in productivity in the SME sector by 5.5% compared to 2008 also conditioned the real decline of this indicator in the non-financial sector by 0.4% (+4.2% in large companies).

Significant economic growth and increase of employment in the long term can only strengthen the overall competitiveness of the economy allowing for a more dynamic export growth by reducing the foreign trade deficit. For this reason business organization of SMEs need to be oriented in the direction of investment in knowledge and to increase labor productivity on knowledge and innovation basis. In order to achieve the desired level of sustainable development at the national level, it is necessary to develop and implement strategies of high productivity based on innovation.

Hence, one of the key developmental, strategic objectives exactly is encouraging *cooperation between universities, industry and the state*, primarily through:

- increasing the level of demand for R&D by the industry sector,
- modeling the appropriate financing scheme for research at universities and public-private partnerships,
- encouraging research on demand, joint research and consulting,
- support all forms of innovation, or "shift of power" from an exclusive reliance on technology to innovation,
- improvement and development of legislation relating to the innovation activity,
- communication support in the process of knowledge transfer,
- greater flexibility in the transfer of intellectual property rights between universities and industry,
- establishment of technology transfer centers with trained and motivated intellectual capital,
- strengthening the role of universities in sustainable local economic development ("smart specialization")
- practical determination of curriculums (syllabus) and the development of life-long learning programs⁹

The intensity of research in the Serbian economy, compared with developed countries, is low, to some extent even worsened in the last few decades. However, one of the key challenges for the development agenda of the Serbian economy is not in a modest number of business ideas generated at universities and directed (placed) to the industry sector, but in the necessity to raise the level of demand for research by the industry sector. The interactive nature of the relationship of entrepreneurs and representatives of the academic community calls for different models of contracts regulating the ownership and intellectual

⁸ Report on small and medium enterprises and entrepreneurship for 2013 (2014), Ministry of Economy and the National Agency for Regional Development, Belgrade, December, p.13.

⁹ National platform for knowledge triangle in Serbia - the synergy of innovation, research and education (2013), 158881 - TEMPUS - RS - JPHEs, Belgrade, 2013.; The participation of the Educons University expert team in the research projects No. 47009 (*European integrations and social and economic changes in Serbian economy on the way to the EU*) and No. 179015 (*Challenges and prospects of structural changes in Serbia: Strategic directions for economic development and harmonization with EU requirements*) financed by Ministry of Education, Science and Technological Development.

property rights. In other words, a flexible distribution of intellectual property rights between universities and industry in joint research is a necessity.

Universities in Serbia have a substantial scientific research base, as well as the potential for conversion of knowledge into intellectual capital and its transit to the industry. Most universities conduct technology transfer, but the emphasis was usually given to the development of spin-off companies, and less to the development of efficient and effective technology transfer centers (as a form of the before mentioned hybridization of knowledge in the framework of a triple helix model). Public funding of basic research and development of technology transfer centers is becoming a priority in the development of knowledge-based economies.

Public funding in 25 countries of the European Union represents approximately 1% of gross domestic product as well as the case of the United States. However, private funding in the United States reached 1.4% of GDP compared with 0.1% for Europe. When universities are increasingly privately funded (by the industry, endowments or from own sources) it is important that the hard-won autonomy from the state not to be replaced by restrictions imposed by private funders.¹⁰

Contract research, joint research and consulting are vital forms of cooperation between universities and industry. In contract research, researchers at the university are funded by business sector to conduct some research for their needs, whereby the purchaser is not actively involved in the research. In joint research, researchers from academia and industry working together and in contrast to the ordered (typically commercial), these studies are usually in the category of fundamental research. Realization of such researches are mostly financially supported by companies and universities or the public sector (Ministry of Education, Science and technological research). Although the practice may have some doubts, consulting scientist at giving advice to the industry, rather than to conduct some research.

The European innovation policy has identified the different concepts, strategies and paradigms of innovation activities with a positive impact on economic growth – we will mention the most important: innovative union, innovation by needs, innovations on the user side, innovative community, personal production, innovation in design, eco - innovation systems, innovation in services, regional innovation, etc. A special place here takes so-called open innovation as a practical use of input and output flows of knowledge to accelerate internal innovation and expansion of the market for external application and innovation.

The complex *anatomy* and *physiology* of the triple helix model, or in the other words *synteraction* (anatomy-physiology-synergy/interaction) of the stakeholders, has been investigated within the framework of projects: 47009 (*European integrations and social and economic changes in Serbian economy on the way to the EU*) and No. 179015 (*Challenges and prospects of structural changes in Serbia: Strategic directions for economic development and harmonization with EU requirements*) financed by Ministry of Education, Science and Technological Development, which was attended by the research teams of the Educons University.

Although in the last two decades Triple Helix has developed into a widely accepted conceptual framework that brings together the knowledge, consensus and innovation of the three main social actors: university - industry – government, it remains a major challenge for the identification and measurement of the

¹⁰ National platform for knowledge triangle in Serbia - the synergy of innovation, research and education (2013), 158881 - TEMPUS -RS - JPHES, Belgrade; p.77.

relationship between the main actors in the efficient and effective conversion of this model from intuitive guide for policy makers and researchers into the model of social organization.¹¹

A special issue is how existing and (statistically) available indicators correspond Triple Helix conceptual framework, or respectively, how are them suitable for testing attitudes, activities and aspirations of all three main actors? It is very important to identify the best descriptors of main actors vital characteristics and define a way of measuring and evaluating the expected results. In this sense, in the following text we give some of the research results of the selected projects in which, on the basis of selected statistical data and applying adequate quantitative methods, examines the nature of the triple helix partnerships and provide developmental recommendations.

On the whole, the Serbian economy is in a phase when achieving sustainable growth and regional competitiveness is not possible without adopting a new dynamic, an export-oriented paradigm based on the use of knowledge, innovation and technology, with higher productivity, more jobs, that require higher expertise as well as a vital sector of small and medium-sized enterprises. Hence, companies will have to invest more in research and development, in partnership with academic and other non-profit research institutions.

2.2. The meaning of Entrepreneurial university in the Republic of Serbia

Universities should see themselves as entrepreneurial organisations and environments held together by common values/missions and not detailed control systems. To score highly a university should have a working mission statement with an entrepreneurial vision for the future of the institution. In addition, the strategy could have specific objectives for entrepreneurship with associated performance indicators (e.g. generating entrepreneurial motivation, cognition, and attitudes; generating entrepreneurial competences and skills; support business start-ups; commercialise research results through technology transfers and business start-ups; generate revenues for the institution from spin-off activities; strengthen co-operation between the institution and local firms).¹² In order to develop an entrepreneurial culture in an institution, strong leadership and good governance are crucial. This section highlights some of the important factors, according to the Guiding Framework for Entrepreneurial Universities, a university may consider in order to strengthen their entrepreneurial agenda.

The Guiding Framework for Entrepreneurial universities is aimed at those European universities looking for advice, ideas and inspiration for the effective management of institutional and cultural change. It is designed to help interested universities assess themselves against statements which are organised under the following seven areas:¹³

1. Leadership and Governance
2. Organisational Capacity, People and Incentives
3. Entrepreneurship development in teaching and learning
4. Pathways for entrepreneurs
5. University – business/external relationships for knowledge exchange
6. The Entrepreneurial University as an internationalised institution
7. Measuring the impact of the Entrepreneurial University

¹¹ More: Singer, S., Oberman Peterka, S.: Triple Helix Evaluation: How To Test A New Concept With Old Indicators?, (2012), Ekonomski pregled, Vol. 63, No.11, Zagreb, str.609.

¹² A Guiding Framework for Entrepreneurial Universities, OECD, 2012.

¹³ Ibidem

Central to the debate on the idea of the 'entrepreneurial university' is the question of how the 'entrepreneurship concept', and the often associated meaning and use of the word 'enterprise', are interpreted. Entrepreneurship is perceived by many academics to be associated solely with business and the commercialisation of university intellectual property (particularly in the science and engineering fields) and is therefore tied in with innovation in the context of the work of technology transfer offices, incubators and science parks. This view is strengthened substantially by government and even international (OECD) perspectives that perceive universities as sources of technological innovation and 'engines of growth'.¹⁴

The entrepreneurial universities are contributing to solving the real problems and developing practical models for the creation and implementation of new contemporary knowledge. The success in that activities is also measured by the ability of firms to gain appropriate new economic value from the knowledge creation and transfer. However, within the university, academic entrepreneurs and scientists are the main originators of transferable knowledge, who serves as the agents of knowledge creation.

Methodology

The first part of the paper, underlying this research, was performed in the form of explorative literature review with elements of critical appraisal of methodology, theoretical framework and data used by different authors as well as applicability and generalizability of different studies about triple helix development and entrepreneurial university phenomenon in Western Balkan countries. Choosing literature review as the method for the research imposes specific liabilities to find and include as much relevant studies about entrepreneurial universities cases, as it is possible. Therefore, it was important to correctly define (1) search criteria (keywords and sources of data); and, (2) conclusion criteria.

Based on findings discovered and presented in the first part of the paper, the second part is dedicated to case study and representation of the First Entrepreneurial University in the Vojvodina Region – the Educons University. The data base for this research is conducted from Statistical Office of The Republic of Serbia, which is related to science, technology and innovation, information and communication technologies, as well as structural business statistics.

In fundamental terms of methodological approach to the research, besides the basic analytical methods and basic synthetic methods, the following research methods are used: method of data collection and analysis of content, at the level of the original material and the level of scientific literature and comparative methods. From basic analytical methods were used: analysis method, the method of abstraction, methods of specialization and the method of deduction. From basic synthetic methods were used: synthesis, concretization, generalization and induction.

The research focus is to highlight and promote the basic tendency of university environment that nurtures academic entrepreneurship, with the mission to: (1) facilitate cooperation between universities and industry to improve the satisfaction of needs in the sector of information and communication technologies, as well as to give greater contribution to the state change towards stronger knowledge economy; (2) develop a working environment for teachers, academics and students to improve understanding of the relationship between work, teamwork and technical skills in order to enlarge the knowledge and familiarity with the latest developments in their fields of science, research and application

¹⁴ The National Centre for Entrepreneurship in Education, The Entrepreneurial University: From Concept To Action, 2013.

of knowledge; (3) promote, encourage and implement good practice in this form compatible entrepreneurial university cooperation and economic structures. The subject of this paper is, also, to describe the basic determinants of entrepreneurial university, to facilitate easier understanding of the institutional environment of the university that tends to be entrepreneurial, as well as to shed light on some theoretical models that integrate individual, organizational and institutional determinants of entrepreneurial intentions in the university environment.

Findings and interpretation

Quadruple helix model as an complementary use of knowledge and innovation and a factor of economic growth potential.

The role of the Quadruple Helix Model in helping universities, businesses, government and institutions of civil society to meet new economic challenges is, in the first place, represented in: enhancing the role of entrepreneurial universities as innovation initiator, and at the same time - increasing the absorptive capacity of academic knowledge and innovations within business firms and civil society. Secondly, but not less important, challenges are contained in stimulating the creation and improvement of intellectual property policies, increasing international collaboration and stimulating the entrepreneurial role, thinking and acting of government institutions.

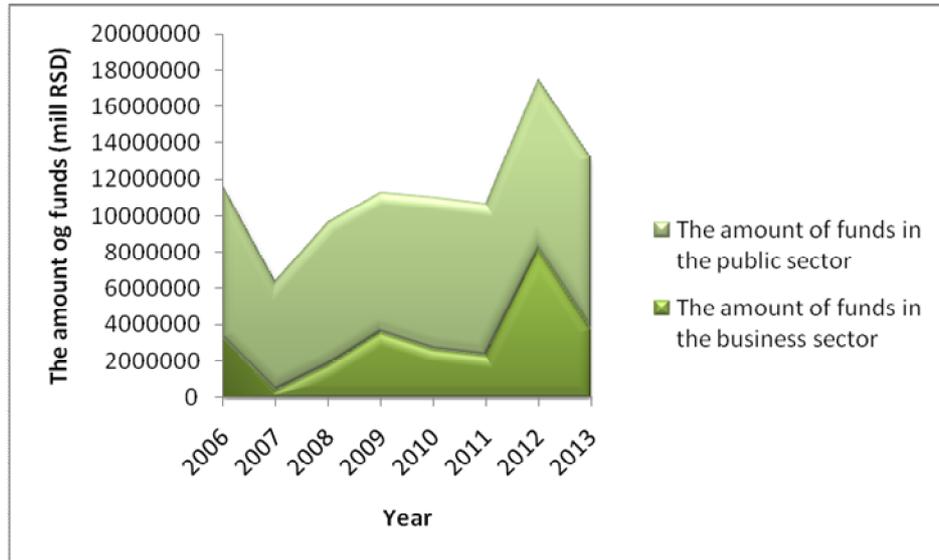
The first and basic hypothesis – H1, examines the following influence: respecting the major determinants of academic entrepreneurship, creating positive links between universities and business firms, we can form significant potential for economic growth. In addition to the basic hypothesis - H1 and for the purpose of its ratification, auxiliary hypotheses were established:

Hypothesis H2: government efforts to create an encouraging and favorable environment for the development of the interaction level between R&D sector, business firms and institutions of civil society, is proportional to increasing the positive impact of a quadruple helix model on the economic growth.

Influence of business funds in R&D sector on scientific production

The first and second hypothesis are dedicated the relationship between investment funds in R&D in business sector and public sector. In the figure 2, we can see the difference in the amount of investment in research and development between business and the public sector in the Republic of Serbia for the period from 2006 to 2013.

Figure 2. Comparative review of the funding amount in research and development for the public and the business sector in the Republic of Serbia, from 2006 to 2013.

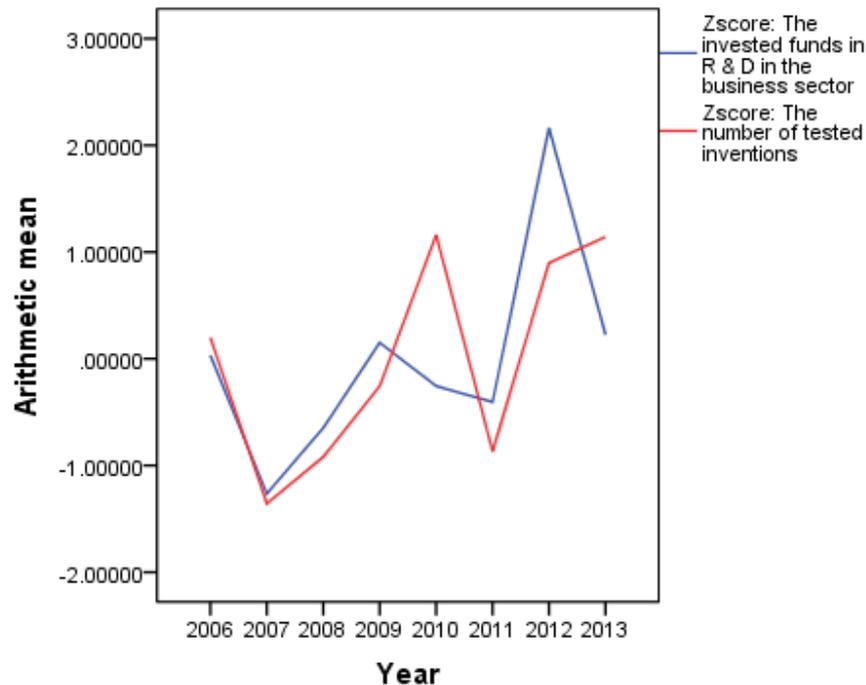


Source: Authors, according to the data from Statistical Office of The Republic of Serbia, Bulletin for scientific research activity in the Republic of Serbia, (2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013)

The first hypothesis refers to ‘one side’ of Quadruple Helix Model which covers the links between the business sector and the R&D institutions in the Republic of Serbia.

For testing the first hypothesis we used Spearman’s rank correlation, since the data deviate from a normal distribution. We wanted to check the connections between **investments in science from business sector**, on the one hand, and the **scientific and patent production** on the other. After the performed analysis we identified one statistically significant relationship. It turned out that the sources of **funding for research and development in the business sector significantly positively correlated with the number tested inventions**, $R(8)=0.714$, $p<0.047$. In other words, with increasing investment by the business sector in research and development, increases the number of tested inventions. Given that this is a rank correlation, regression is not possible to make the scores, but in the figure 3 we can see an advanced display of the distribution of investment funds and the number of tested inventions. The values of these variables were first standardized (converted into Z scores) to have the same scales and to be comparable to the chart.

Figure 3. Comparative review of the distribution for arithmetic means (Z values) - for the invested funds in R & D in the business sector and the number of tested inventions, in the Republic of Serbia, from 2006 to 2013



Source: Authors, according to the data from Statistical Office of The Republic of Serbia, Bulletin for scientific research activity in the Republic of Serbia, (2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013)

Impact of government funds in R&D on the selected business activities (research, development and innovation sector - RDI)

For testing the second hypothesis, in regression analysis we used gross value added by RDI sector as the criterion, and number of commissioned scientific research papers by the Ministries as a predictor. The aim of the regression analysis is to determine whether and up to what extent there is a dependency between the considered variables - Number of scientific research papers commissioned by the Ministries in relation with Gross value added by sector (RDI) and GDP (current prices, mill RSD). The value of correlation coefficient $R=0.96$ indicates that there is a strong correlation between the observed variables. Coefficient of determination R^2 is 0.924. This means that the model explains a 92,4% variance of the dependent variable i.e. Gross value added by sector (RDI) and gross domestic product (current prices, mill RSD), that is 92,4% of the sum of squares of deviation of the dependent variable from the arithmetic mean is explained by the regression model.

Table 2. The correlation coefficient, coefficient of determination and standard error of the regression model

Model	R	R ²	Adjusted R ²	Standard Error of Estimate
1	.961 ^a	.924	.911	5842.43656

The obtained value of correlation coefficient is significant and amounts $R = 0.96$, $p < 0.01$, while the coefficient of determination was $R^2 = 0.924$ (table 2 and table 3), in other words, a predictor explains 92,4 % of variance criteria. In Table 4, we can see the values of the regression coefficients, as well as assessment of their significance.

Table 3. Evaluation of statistical significance of the regression model

Model	Sum of Squares	Degrees of freedom	Mean Square	F	Significance
1 Regression	2.494E9	1	2.494E9	73.069	.000 ^a
Residual	2.048E8	6	34134064.935		
Total	2.699E9	7			

Table 4. Values of regression coefficients

Model	Unstandardized coefficients		Standardized coefficients	t test	Significance
	B	St. Error	β		
1 Constant	45937.395	5813.355		7.902	.000
Number of scientific research papers commissioned by the Ministries	8.006	.937	.961	8.548	.000

The regression equation has the following form:

$$\hat{Y} = \beta_0 + \beta_1 * X, \text{ respectively}$$

$$\hat{Y} = 45937.395 + 8.006 * X,$$

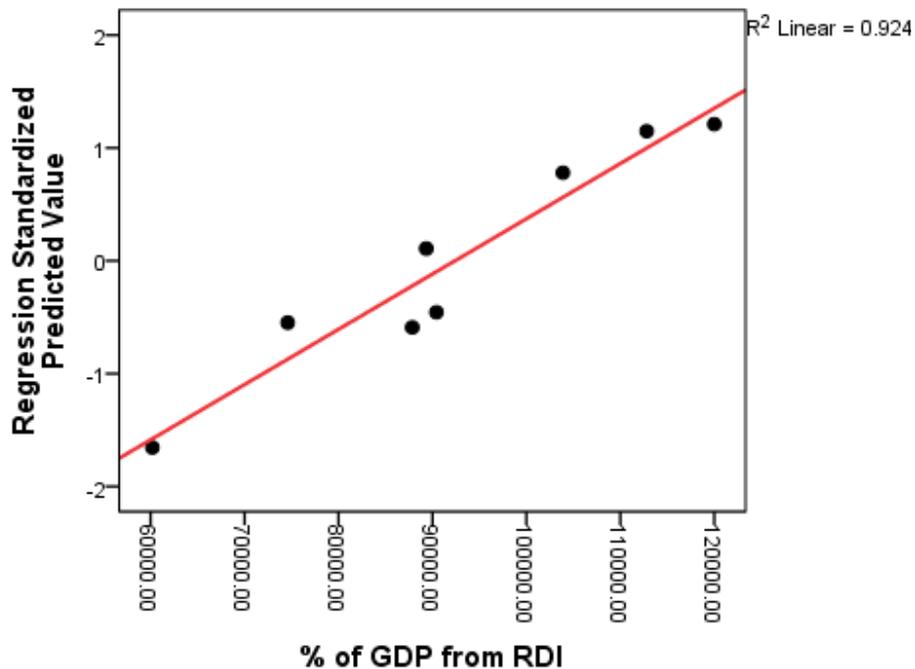
\hat{Y} – Regression standardized predicted value

X – Number of scientific research papers commissioned by the Ministries

Therefore, **if the number of scientific research papers commissioned by the Ministries is larger, the gross value added by RDI sector is higher.** In the other words, with the increasing the number of

scientific research papers commissioned by the Ministries, the gross value added by RDI sector exceeds. In the figure 4 we can see a graphical representation of the regression analysis.

Figure 4. Regression of standardized predicted values of the criteria - gross value added by RDI sector



Impact of applied and developmental scientific works on the fundamental scientific works

The Case of the First Private Entrepreneurial University in the Region of Vojvodina

Educons University was founded in 2008, and it is the first private university in the Region of Vojvodina, which is located in the northern part of the country, in the [Pannonian Plain](#). [Novi Sad](#) is the largest city and administrative center of Vojvodina and the second-largest city in Serbia. Vojvodina has a population of approximately 2 million (26.88% of the Serbian population) with a strong multi-ethnic and multi-cultural identity (26 [ethnic groups](#)) and six [official languages](#).

The idea of an integrated university - strong center with following faculties and departments, legal entity status and a "new bureaucracy" as a key component of its entrepreneurial character, was successfully promoted and recognized in practice by establishing Educons University. Based on the principles of the Bologna process and organized as a modern academic community of teachers, researchers, artists and students, Educons University, with its 9 faculties and 36 study programs, today is the leading private, accredited university in Vojvodina, completely integrated in the Serbian academic community, economic structure and civil society.

The University was founded as a unique entrepreneurial response to the current economic and social transitional situation in Serbia, as well as the need for young, educated, innovative and creative individuals, a kind of *agents of economic change*. The University EDUCONS is comprised of the following faculties: Faculty of Business Economics, Faculty of Environmental Protection, Faculty of Organic Agriculture, Faculty of digital production, Faculty of Applied Security, Faculty of information

technologies, Academy of classical painting, Faculty of Sport and Tourism and Faculty of European Business and Law Studies.

Most teachers and researchers have acquired their education and academic levels at prestigious universities in the country and abroad and have been recognized in the business community as successful managers and leaders. The University has modern newly constructed space, modern equipment and a rich library necessary to run the education and scientific research at the *undergraduate level, graduate academic studies - master, specialist studies and doctoral studies*, and other facilities necessary for the conduct of teaching and other student activities (computer labs, student café, bookstore, etc.).

The main competitive advantage of the University and its leading position in the region is primarily based on the *knowing, understanding and practical realization* of widespread spectrum of a very modern (entrepreneurial) university opportunities, supported by various activities and services, that are based on its *three key missions*:

Higher education and training as the basic and dominant form of relationship between academia and industry and the main source of recruitment of educated individuals, managers and would-be entrepreneurs. All study programs are predominantly practically determined, continuously improving and adapting to the demands of employers and the labor market conjuncture. As a result of this approach, the existing portfolio of accredited study program has recently been supplemented with a new programmes: *global and regional energy policies, logistics, green economy and information engineering*.

Considering current needs of the society, and all specific economies on global level, the study programs at EDUCONS University are designed to tackle those areas of expertise that are modern, attractive and provide the basis for students' promotion. At the moment, there is a particular interest in master course within *Public Administration Management* representing an ideal possibility for vocational improvement of existing management of local government and administration. Raising issues of environmental protection and needs of the state to solve pressing problems by harmonization of our laws with the standards of European Union are followed by appropriate study program at the Faculty of Environmental Protection. This study program enables education of Environmental Protection Analysts introducing core analyses of current problems in this field.

Getting closer to customers, cooperation with industry and service to the society - a very wide range of activities of the *third mission of universities*:

(i) *communication and public awareness about university activities* - Important function in this process takes Alumni club, made of former students of the University EDUCONS, who are today on important position in different areas of social life. The members of the Alumni club, affirm the product of EDUCONS University- quality of education based on high level of identification with EDUCONS University and its successful operations. On the other hand EDUCONS University manages to use the potential of its former students by forming network of contacts, useful not only to EDUCONS University and its students but for the society as a whole.

(ii) *Public-private partnerships: linking social and economic spheres* - the University EDUCONS intensively cooperates with business entities, local governments and municipal bodies. Through the initiative for forming the *local development coalition*, the expert team of the University was able to bring all local key actors together and participate in the preparation of local strategic development documents, such as:

- the Masterplan for the tourist destination of Sremski Karlovci with Fruska Gora Region
- Strategy of sustainable local economic development with action plans for the municipality of Srbobran

- Strategy of local economic development in the municipality of Beočin
- Marketing strategy of tourism development in Vojvodina Region,

Recognizing the necessity for the full implementation of the Bologna process, the EDUCONS University has initiated the organization of higher education institutions under the name “The Alliance of Central-Eastern European Universities” (ACEU). The Alliance of Central-Eastern European Universities includes the private and state universities from Romania, Hungary, Slovakia, Bulgaria, Slovenia, Macedonia, Montenegro, Ukraine, Croatia, Serbia and other countries of Central-eastern Europe.

The aim of the Alliance is the promotion of knowledge as the key segment of the development of the higher education institutions through: Exchange of information on research work and curricula, Exchange of information on lectures, teaching aids, publications and literature significant for education and research, Common curricula of mutual interest, Common organization of seminars, conferences, conventions and other events, Exchange of the students at all levels of studies, Exchange of the teaching staff, Common publishing business, Common application for projects to the European institution funds, regional organizations and to the funds of the governments of Central-eastern European countries.

(iii) participation of experts from business practices in university boards, committees and cooperation in defining syllabus,

(iv) referencing students to business practices,

(v) continuing education to the creation of opportunities for lifelong learning,

(vi) the improvement and development of entrepreneurship, supporting the establishment of spin-off companies

(vii) advisory services (testing), offering research equipment and facilities to external users - As part of the organizational structure of the University (Faculty of Environmental Protection) , *A Bio Tech Lab* - chemical and biological laboratory enables introduction of students with main work procedures in laboratory related to making of the solutions, mass and volume measurements, titration, pH metrics, gravimetry and the latest methods applied in the world today. Practically, the students in the laboratory may observe analysis procedures such as:

- metals in soil, water and plant material by applying micro wave digestion followed by ICP analysis technique
- quantitative analysis of presence of genetic modification in food by applying PCR technique
- determining of residues of organic compounds (pesticides, hydrocarbon, polychlorinated bifenils, polycyclic aromatic hydrocarbons etc.) in soil, water and foods of plant origin, by applying extraction and filtering on solid phase of adsorbents and GC-MS techniques and/or HPLC/FD/DAD with post column derivatization.

Thus organized laboratory is the main lever of research at the university,

(vii) contract and cooperative/joint research (based on co-financing from public, national and international sources) and a key mechanism for knowledge and technology transfer to the economy and society

Researching - in addition to the fundamental, *commissioned and joint research*, funded from the public, national, provincial and foreign sources, represent a very important area of research activities at the University, focused on the later application in business practice. Proactive and also synergistic role of the University particularly came to the fore in following projects:

- Mobility of herbicides in Vojvodina soils;
- The study on the state of the environment in Vojvodina - issues and challenges - an element of the environment: waste;
- Analytical research of the impact of pollution on the population in selected urban locations (Municipality of Pancevo, Vrsac, Bor);
- Digital media technology and socio-educational change (project commissioned and funded by the Ministry of Education and Science of the Republic of Serbia);
- Characterization of the kinetics and the influence of highly hazardous (emerging) pollutant waste streams printing industry (project commissioned and funded by the Ministry of Education and Science of the Republic of Serbia);
- Simultaneous bioremediation and soilification degraded areas for the conservation of the natural resources of biologically active substances and the development and manufacture of biomaterials and dietary products (project commissioned and funded by the Ministry of Education and Science of the Republic of Serbia);
- Biodiversity as potential in ecoremediation technologies damaged ecosystems (project commissioned and funded by the Ministry of Education and Science of the Republic of Serbia);
- Determination of the biodiversity of microorganisms in different soil types using molecular methods (project commissioned and funded by the Provincial Secretariat for Science and Technological Development);
- Competitiveness and knowledge as development sources of AP Vojvodina (project commissioned and funded by the Provincial Secretariat for Science and Technological Development);
- Development of an infield, ecologically safe, continuously detoxifying technology for producing bio vegetable (IPA-EU project),
- Cross-border learning region: examination of universities' possible role in the economic development of the Hungarian-Serbian cross-border region (IPA-EU project).

Within seven national and two international projects in the field of environmental protection and organic farming are carried out scientific research aimed at *developing new methods* for environmental monitoring, remediation of damaged and polluted ecosystems, to *develop new environmental technologies in food production*, as well as raising educational capacity for the development of organic farming.

Conclusions

With the aim to examine recent innovation capacities and development in the Republic of Serbia from a Triple Helix perspective, we also emphasised the need of comprehension the fourth factor – the civil society, in the context of transitional countries. Transitions and transformations induced by the integration in EU and the preparations in view of this process have the main objective to assess the impact of EU integration on the reform and implementation of more superior national RDI policies, programmes, actors, infrastructures, institutional framework, strengthening of science-industry links and research commercialisation, internationalisation, etc. Investing in the use of knowledge and innovation will restore confidence in state institutions of society and strengthen the influence of civil society organizations (including universities, industry and state) as the fourth pillar in the long process of building innovative knowledge-based society and the creation of a stable national innovation system.

The answers given in testing the first and second hypothesis, shows the different levels in developing relations in business sector supported R&D, and at the other hand, governmental efforts in encouraging R&D at scientific and research institutions.

From the analysis of the data collected from the National Statistical Office and conducted research, we discovered that in the Republic of Serbia, the government institutions are predominant initiators of

scientific activities, unlike the business sector, in which is detected the lowest rate of cooperation between business and scientific institutions. Those results indicates that the Republic of Serbia falls into the group of less developed countries, in which the innovation process is not enough institutionalized and mainly driven by government funding, not by the business sector. The lack of interconnections between university and industry is mitigated by endeavor of universities to be more entrepreneurial and to have closer connections with business firms. One of good examples in creating an entrepreneurial climate in university surrounding is Educons University, the first private university in the Vojvodina region.

The important conclusion, also, is that results corroborate with the assertion of the third hypothesis-increasing the emphasis on the commercialization of university research and knowledge will not adversely affect on preservation of traditional knowledge and further development of basic scientific research, that the set of increased growth of applied and developmental scientific papers will not adversely affect the production of fundamental scientific papers. Those findings are in favor of not disturbing the fundamental scientific papers by increasing the funding of developmental and applied scientific papers.

Common complementary action – '*syntegration*' of universities, industry, government and society leads to the development of a stronger institutional environment for stimulating the use of knowledge and innovation.

Policy implications

Policy makers in transitional countries should consider the rising significance in RDI legislation for fostering quadruple helix '*synteractions*' on regional and national levels. Emergence of the entrepreneurial university and development of infrastructure for technology transfer and commercialization structures are very important for nurturing patenting and licensing from universities and R&D institutions, academic entrepreneurship education and practice for students and faculty, creation of university start-ups, increasing role of university as partner in regional systems of innovation. The role of quadruple helix is crucial, also, in enhancing human resources for innovation and cooperation (recruitment of staff from industry and the public sector by universities and recruitment of staff and students from universities by industry and by the public sector), providing more spaces for innovation processes.

Primarily, creation of regional innovation strategies should help all actors in innovation process to construct comparative advantages, based on technological specialization – strengthening the relatively weak categories and sectors, but not neglecting the stronger branches. Tendency to encourage the different levels of regional development to decrease variation in regional growth, can help in increasing the regional and national competitiveness.

Furthermore, by developing, implementing and monitoring the Quadruple Helix indicators, analyzing and synthesizing the relations and mobility in Quadruple Helix institutional spheres (local, national, international), we can have more clearer view of reality in measurement of the knowledge and innovation process efficiency. Formation of specific anatomy (represented in institutions of QH model), physiology (represented in functions of all institutions in QH model) and '*synteraction*' (represented in relations between the all institutions of QH model) of Quadruple helix model is imperative of knowledge society. Steady and flexible, at the same time, national and regional innovation system, supported by discerning and piercing innovation strategy, could avoid and overcome negative impacts of the global economic crises in transitional countries.

Directions for further research

The further research will be opened and directed into the field of the measuring influence of the university, as the initiator and originator of entrepreneurial environment based on the excellence knowledge values. The other perspective of the further research directions is top-down approach – how regional innovative strategies aims to increase the economic competitiveness of that particular region through proper selection of innovative activities that constitute the innovation system, with the entrepreneurial university as a main engine. It is understandable that strategic planning should be achieved through cooperation with neighboring regions and the harmonization and optimal use of resources. Regional development agencies have a duty to be a link between public, private and civil sector in building strategic partnerships through the preparation and implementation of projects that contribute to raising living standards in the area of the region and a more balanced regional development in the region, and the territory of the Autonomous Province of Vojvodina and the Republic of Serbia in whole. Another important mission of regional development agencies is to encourage regional development using local and national resources and the available funds and other funds of the international community, as well as attract foreign investors to the area of the region.

Additional topics, as subjects of interest, in the future projects, are directed to:

- application of law, legislation rules and influence of financial inputs of governing state institutions, as a factor of the realization in the complementary quadruple helix model of relations between university, business sector and government.
- analysis of university attitude about transfer and commercialization of knowledge. Whether, negative attitude and resistance to commercialization of knowledge will significantly slowdown the development and implementation of a quadruple helix model in practice. At the other hand, in which extent, positive attitude of university will effect in technology transfer and production of new values.
- involvement of universities in local economic development raises important pillar of innovation in the region, the question is will that increase the competitiveness index at the national level.
- start-up activities and assisting spin-off ventures by universities are increasing the survival rate of young businesses. How much influence does it have in ensuring economic growth level.

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References

1. Clark, B. (1998), *Creating Entrepreneurial Universities: organizational pathways of transformation*, Pergamon Press, New York, 1998.
2. Duran (Jesic), J. (2010), *Academic entrepreneurship*, Andrejevic Foundation, Belgrade.
3. Duran (Jesic), J., Galetin, M. (2010), *Contemporary trends in the development of scientific research role of universities in transition*, Proceedings from the First scientific conference with international participation - Business Economy in Transition, Sremska Kamenica, vol. 1, p. 101-112.

4. Etzkowitz, H. (1983), *Entrepreneurial Scientists and Entrepreneurial Universities in American Academic Science*, *Minerva* 21, 198-233.
5. Etzkowitz, H., Leydesdorff, L. (2000), *The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations*, *Research Policy* 29 (2): 109-123.
6. Etzkowitz, H., Leydesdorff, L. (1998), *The endless transition: A "triple helix" of university-industry-government relations*. *Minerva* 36: 203-208.
7. Etzkowitz, H. (2002), Working paper 2002-11, *The Triple Helix of University-Industry-Government Implications for Policy and Evaluation*, Science Policy Institute, Stockholm.
8. European Commission, (2014-2015) *Serbia 2014 progress report*, Enlargement Strategy and Main Challenges.
9. European Commission, (2004), *Facing the Challenge - The Lisbon Strategy for growth and employment*, Report from the High Level Group chaired by Wim Kok, Luxembourg: Office for Official Publications of the European Communities, Brussels, Belgium.
10. European Commission, (2010), *Lisbon Strategy Evaluation Document SEC*, 114 final, Brussels, Belgium.
11. European Commission (2010), *Europe 2020 – Background Information for the Informal European Council*, 11.2.2010, http://ec.europa.eu/commission_2010_2014/president/news/statements/pdf/2_01002103en.pdf
12. The Global Competitiveness Report 2014-2015, (2014), World Economic Forum, Geneva, Switzerland, p.69.
13. *A Guiding Framework for Entrepreneurial Universities* (2012), OECD.
14. Jasic, J., Penezic, N., Malenkovic, N. (2014), *The role of triple-helix model in development of the national innovation system*, *Journal of business economy*, Educons University, vol. 8, no. 2, p. 127-142, Sremska Kamenica.
15. Leydesdorff, L., Meyer, M. (2006), *Triple Helix indicators of knowledge-based innovation systems: Introduction to the special issue*, *Research Policy*, Volume 35, Issue 10, Pages 1441-1449.
16. Leydesdorff, L., Fritsch, M. (2006), *Measuring the knowledge base of regional innovation systems in Germany in terms of a Triple Helix dynamics*, *Research Policy*, Volume 35, Issue 10, Pages 1538-1553.
17. Leydesdorff, L. (2000), *The triple helix an evolutionary model of innovations*, *Research Policy*, Volume 29, Issue 2, Pages 243-156.
18. Ministry of Economy and the National Agency for Regional Development, (2014), *Report on small and medium enterprises and entrepreneurship for 2013*, Belgrade, December, p.13.
19. The National Centre for Entrepreneurship in Education (2013), *The Entrepreneurial University: From Concept To Action*.
20. *National platform for knowledge triangle in Serbia - the synergy of innovation, research and education* (2013), 158881 - TEMPUS - RS - JPHES, Belgrade, 2013.
21. Penezic, N. (2008), *Entrepreneurship – the contemporary approach*, Academic book, Novi Sad.
22. Penezic, N. (2012), *Endogenous entrepreneurial perspective of local economic development and growth*, *Proceedings from the Third scientific conference with international participation - Business Economy in Transition*, Sremska Kamenica, vol. 3, p. 417-428.
23. Penezic, D., N., Duran (Jasic), S., J. (2010), *The phenomenon of academic entrepreneurship*, *Journal of business economy*, Educons University, vol. 4, no. 2, p. 173-195, Sremska Kamenica.
24. Penezic, N., Duran (Jasic), J. (2013), *The triple helix model as a basis for building a national innovation system*, *Proceedings from the Fourth scientific conference with international participation - Business Economy in Transition*, Sremska Kamenica, vol. 4, p. 151-165.

25. Ranga, M. (2014), *International Journal of Transitions and Innovation Systems*, Special Issue on European Integration and Triple Helix Systems in the New EU Member States and Candidate Countries, Vol. 3 No. 3, editorial.
26. Ranga, M. and H. Etzkowitz. (2013), *Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society*, Industry and Higher Education 27 (4), Special Issue.
27. Ristic, B., Tanaskovic, S.(2013), Competitive position of Serbia in 2013-2014. according to the World Economic Forum, the Foundation for the Advancement of Economics, Belgrade, <http://www.fren.org.rs> posećeno 31.03.2015.)
28. Singer, S., Oberman Peterka, S.: Triple Helix Evaluation: How To Test A New Concept With Old Indicators?, (2012), Ekonomski pregled, Vol. 63, No.11, Zagreb, str.609.
29. Statistical Office of The Republic of Serbia. (2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013), Bulletin for scientific research activity in the Republic of Serbia.
30. Tilford, S. and Whyte, P. The Lisbon Scorecard X: The Road to 2020. Centre for European Reform. (2010), http://www.cer.org.uk/pdf/rp_967.pdf
31. Educons University Profile, <http://www.educons.edu.rs/en/english/EDUCONS-University-Profile>
32. Assistance to competitiveness and compatibility with the EU of Serbian SMEs, GIZ ACCESS project, <http://www.giz.de/themen/en/34334.htm>