TRIPLE HELIX INNOVATION MODEL: LINKING THE ACADEMIA, THE BUSINESS SECTOR AND THE GOVERNMENT, CASE STUDY OF MACEDONIA

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1. INTRODUCTION

Innovation has become a key factor to sustainable growth and knowledge economy creation, having impact on the national competitiveness in the regional and global economy.[1]

Innovation systems in small, landlocked developing countries are, inherently problematic, characterized by poor business and governance conditions, low educational levels and meritocratic infrastructure.[2] This raises particular challenges for introducing structured innovative models in small developing countries such as Macedonia.

Even though there is a considerable theoretical and practical experience accumulated in the area of innovation policy and management in developed (OECD) countries, much of this is not directly applicable to developing countries due to the character of the challenges the latter are facing.[3] These challenges stem from inappropriate business and governance infrastructure and insufficient education. Thus developing countries fall into a vicious cycle of systemic impediments to creating sustainable innovation systems.[4]

The Macedonian public and private sector entities are operating in an increasingly complex and uncertain environment associated with the transition from centralized, state governed to a market economy. Moreover, the European Union and the worldwide situation, in general, has forced on the country the need to adopt policy initiatives in

[1] Fagerberg,, "*Innovation, technology and the global knowledge economy: Challenges for future growth*". Paper presented at the "Green roads to growth" conference, Environmental Assessment Institute, Copenhagen (March 1-2, 2006): 90-119.
[2] Aubert, *"Promoting innovation in developing countries: a conceptual framework*", World Bank Institute, (July 2004).
[3] Ibid.
[4] Id.

order to restructure all sectors of the economy and make them more competitive. It has brought the need for reassessing all administrative, political and managerial rules and procedures in order to create the appropriate ambiance for societal growth and sustainable development. Accordingly, the country's policy agenda has been focused on addressing issues considered to be the crux of the development problem. These include factors like: weak economic structure, low level of production, low performance of the educational system, high level of debts, high level of unemployment, low recognition of the private sector and SMEs' contribution to innovation and lack of motivation, commitment and trust.[5]

The main research assumption of this paper is that the implementation of a triple helix innovation model is oftentimes associated with not only constant learning and innovation but also with knowledge sharing and networking with individuals and organizations in order to achieve mutual advantage. The triple helix model, perceived as a positive synergy between the three actors, university, industry and government is increasingly used as a policy framework in both developed and developing countries for the purpose of strengthening their national and regional economies through learning and innovation. The model is characterized by the strong interactions between the university as the centre of activity or influence with its academic based research and development activities, the industry as the provider of the customer demand based on its commercial activities as well as research and development, and the government as a policy maker. The integration of these three actors ideally will increase knowledge spillovers in Macedonia and in the region on a bigger scale; and hence increase the competitive advantage of economic development, regional or national.

The focal research objective of this paper is to give an overview of the main attributes of the current Macedonian innovation system and to initiate the much needed debate on sustainable public policy solutions aimed at creating sustainable triple helix innovation ventures (industry – academia – government).

[5] OECD, "*Science, Technology and Innovation Indicators in a Changing World: Responding to Policy Needs",* (2007). OECD, "*Science, Technology and Industry Scoreboard*" (2009).

The extent, to which the institutional spheres of government, academia and industry are indeed overlapping, and new hybrid organizational forms are emerging in Macedonia to shape the development of a national policy framework for innovation, is a question that requires extensive empirical and analytical investigation. This paper modestly contributes to that end, by featuring the results of an online survey conducted over 50 Macedonian technology firms. The empirical data complement the theoretical observations of the authors of this paper.

One might ask what the main indicators are of the emergence of new 'hybrid' organizational forms across Macedonian universities. Is there evidence of ongoing 'institutional innovations to promote closer relations between faculties and firms'?[6]

In a complex, small developing country's context like Macedonia, it can be expected that the transition to new economic and social forms will be partial, uneven and incomplete. Past social and organizational forms remain active, co-existing with new forms, and there are different possible pathways to common goals. Having said this, the focus of this paper is to shed light on the possible patterns of old and new organizational forms of university–industry partnership in order to entice a sustainable innovation model in Macedonia.

At the beginning this paper will give a brief overview of the triple helix model. It will also give an overview and critical analysis of the Macedonian reality in terms of innovation. Specifically the paper will analyze data on R&D in the private and public sector and the number of innovative activities measured by patents field and granted in Macedonia. It will also examine the relations between the academia and the business sector, and the role of the public sector and government in initiating the whole process of innovation. One should not forget that in order to understand the triple helix model from the viewpoint of a small developing country, it is necessary to analyze and grasp its' implementation risks and pitfalls in the developed countries. Developing countries, such as Macedonia, should take these lessons as public policy benchmarks in order to improve the existing triple helix innovation system embryos.

[6] Etzkowitz and Leydesdorff, "*The Triple Helix as a Model for Innovation Studies, The Triple Helix as a Model for Innovation Studies*", (1996).

2. THE TRIPLE HELIX MODEL OF INNOVATION

Innovation is defined as a complex process involving many different functions, actors and variables in order of creating new products and processes to the market. Rickards explains innovation in terms of two subsystems. The first is related to the firm and its capacity to deal with innovation. The second encompasses the technological, economic, social and institutional factors from the external environment. The basic characteristic of the triple helix innovation model is to bring together different perspectives and actors and to benefit from their interactions in order to provide understanding of the innovative process and its key determinants.[7]

The triple helix model is seen as a holistic approach to innovation based on the networking of diverse organizations and disciplines. As a networking system, it seeks to promote rapid learning through closeness and collaboration between the main actors. Each actor in the system would study the innovation process according to its own interests.[8]

There is handful of theoretic predecessors to the triple helix innovation system, which eventually led to its formation as one of the most successful innovation models. Even though research and development (R&D) policies during the Cold War period were mainly focused on linear model of innovation and favored specific disciplinary research agenda ["Mode 1" of knowledge production, which is investigator-initiated and discipline based. The Mode 1 problems are raised and solved within the academic research community contexts, they are sharply disciplinary, homogenous and the practical considerations or uses are absent [9]], few factors provided the necessary impetus for a shift in the way private and public organizations regarded their research efforts. The end of the transatlantic tension led to the rise of a new techno economic model and to the need to speed up business transactions and force institutional adaptation. Under these circumstances, knowledge creation modes turned to more open approaches responding to socioeconomic and institutional needs. Another innovation model which was developed

[7] Rickards, *Stimulating innovation: A systems approach*, (St. Martin's Press, New York, 1985).
[8] Burns and Stalker, *The Management of Innovation*, (2nd edition London Tavistock Publications, 1966).
[9] Michael Gibbons et al.,*The New Production of Knowledge*, (SAGE, London, 1994).

as a response to the above mentioned conditions is the so called "Mode 2". The latter is defined and shaped by the dynamic links between academia and industry, according to "solution –focused" and design-oriented" models characterized by a "constant" flow back and forth between fundamental and applied, between the theoretical and practical."[10] In this new "mode", the main change regarding the universities is that "knowledge production and dissemination (teaching and research) are no longer self contained activities, carried out in relative isolation. They now involve interaction with variety of other knowledge producers."[11]

This directly links to the Triple Helix model of innovation proposed by Etzkowitz and Leydesdorff where university, industry and government relations are analyzed "in terms of three interlocking dynamics: institutional transformations, evolutionary mechanisms and the new position of the university."[12] This underlying model of innovation is analytically different from the national system of innovation (NIS) approach, which perceives the firm as having the leading role in the innovation process. The Triple Helix considers the three spheres having equal importance in the country's innovation network.[13]

Eztkowitz and Leydersdorff propose three variants of university –government – industry collaboration which can shape the evolution of innovation systems. The first (triple helix I) is a static model in which the government directs the university and industry, and the relation between them.[14] This can be seen in Macedonia before the independence 1991, where the state directed the research relations between the university and industry, typically state owned; also static model was seen and deployed in the former Soviet Union as well in some of the European countries such as the countries from Eastern Block, as well Latin American countries. The second (triple helix II) is a laissez faire model in which there are separate institutional borders and highly subscribed

[10] Ibid, page 19.
[11] Gibbons, "*Higher Education Relevance in the 21st Century*", (1998).
[12] Etzkowitz and Leydesdorff, "*The Triple Helix as a Model for Innovation Studies, The Triple Helix as a Model for Innovation Studies*", (1996).
[13] Lundvall, B. Å., "*National Business Systems and National Systems of Innovation*", Special Issue on Business Systems, International Studies of Management and Organization, (Summer 1999).
[14] Etzkowitz and Leydesdorff, "*The Triple Helix as a Model for Innovation Studies, The Triple Helix as a Model for Innovation Studies*", (1996).

relations between government, industry and universities.[15] Last, but not least, the third (triple helix III) is the interaction model that generates a new knowledge infrastructure through overlapping institutional spheres, and hybrid organizations (such as public private partnerships) appearing at the interfaces.[16] Such inter relations generate an overlay of new organizational forms. These newly created organizations take on the functions and features of the other. Etzkowitz and Leydersdorff claim that "most countries and regions are trying to attain some form of Triple Helix III, as normative model or ideal for development.[17] The very idea of this research paper is to argue that Macedonia should implement as a matter of public policy the Triple Helix III model developed by Etzkowitz and Leydersdorff.

The triple helix model argues that competitiveness is derived from the ability to continuously learn and innovate in order to reproduce distinctive organizational competences over time. It emphasizes the changing nature of institutional and organizational contexts of innovation and the strategic role of management in determining as to how appropriately individual actors adapt, integrate and reconfigure internal and external organizational skills, resources and functional competences in response to these changes.[18]

The triple helix develops according to four dimensions.[19] One of the objectives of this paper is to develop and pinpoint the main public policy strategies which will entice the transposition of these dimensions into Macedonian context. The first dimension is the internal transformations in each of the helices. Universities should not only be teaching and doing research but also trying to capitalize the knowledge they produce, which implies a new mode of knowledge production[20]; lateral ties among firms based on the strategic alliances should be developing within industry. The government should be taking the role of a venture capitalist as well. The second dimension concerns the influence of one helix upon another. A very successful example in this regard would be

[15] Ibid.
[16] Id.
[17] Id.
[18] Michael E. Porter, "*What is Strategy*?", Harvard Business Review, (November-December 1996).
[19] Etzkowitz, "*The evolution of the entrepreneurial university*", International Journal of Technology and Globalisation, Volume 1, Number 1 (2004).
[20] Michael Gibbons et al.,*The New Production of Knowledge*, (SAGE, London, 1994).

the famous US Bayh-Dole Act 1980 that instituted industrial policy through which the federal government encouraged academia to assist industrial innovation. This was done through granting the academia the rights to the inventions created by federal grants.[21] The third dimension is the generation of a new overlay of institutional structures stemming from the interaction among the three helices; small and large firms, universities and other research organizations, local, regional and national governments get together to brainstorm new ideas and attempt to fill in gaps in the innovation systems.[22] One of the most representative examples of this third dimension of the Triple Helix is the Research Triangle Park (RTP) in North Carolina. RTP was founded by the government, university and business leaders as a model for research, innovation and economic development. It was established as a place where educators, researchers and business will collaborate as partners with the objective to change the economic conditions of the region and the state. It was named according to the geographic location of the region's three most regarded educational and research universities – the University of North Carolina at Chapel Hill, Duke University and North Carolina State University. In addition to the research capacity, the region possesses a network of organizations, institutions and companies that work together reflecting the spirit of cooperation and learning. Just to name few companies represented in the RTP: IBM, Cisco Systems, Ericsson, BASF, etc. Due to the positive impact to society, RTP is a model for innovation, education and economic development that has been applied around the world.[23] The fourth dimension consists of a recursive effect of the trilateral networks on the spirals from which they emerge and on the wider society; interaction of universities with industry and government is transformed when the capitalization of academic knowledge displaces distance and inherent public nature of knowledge; this, in turn, is seen as the result of the practices of industrial

[21] Etzkowitz, "*The evolution of the entrepreneurial university*", International Journal of Technology and Globalisation, Volume 1, Number 1 (2004).
[22] Ibid.
[23] Weddle, Rooks, and Valdecanas, "Research Triangle Park: evolution and renaissance", prepared for and presented at the International Association of Science Parks World Conference, Helsinki, Finland (June 6-9, 2006).

science, internal entrepreneurial dynamics within academia, and from government policies.[24]

The main credo of this research paper would be that we should try to follow the above illustrated dimensions of the Triple Helix innovation model. However in doing so we should not blindly strive to excel them, but try to incorporate them into the Macedonian society with certain bigger or lesser aberrations.

3. THE MACEDONIAN INNOVATION SYSTEM: CURRENT SITUATION AND THE WAY AHEAD

In terms of development economics, acquiring and transferring technology, as a core component of the triple helix innovation system, can be difficult for a small developing country such as the Republic of Macedonia. As a general rule, unsuccessful technology transfer policies in developing countries might come as a result of: (i) Lack of supply of and demand for qualified human resources (social and human capital); (ii) Problems associated with the knowledge base (research capacity); (iii) Problems associated with the ability to innovate (technology and innovation performance); and (iv) Problems associated with the capacity of markets to absorb and diffuse innovations (absorptive capacity).[25]

Macedonia is experiencing constrains in relation to science, technology and innovation policies, similar to those of other South Eastern European countries since gaining independence. The country needs a holistic approach to research and development (R&D) issues and human capital creation, in order to align its' scientific and research target policies with the ones stipulated in the EU's Lisbon strategy 2020 (augmenting the R&D part in the nation's GDP up to 3%).

A study conducted by the Ss. Cyril and Methodius University Business Start-up Centre, Skopje, Macedonia shows that the R&D share in the Macedonian GDP in 2003

[24] Etzkowitz, "*The evolution of the entrepreneurial university*", International Journal of Technology and Globalisation, Volume 1, Number 1 (2004).
[25] John H. Barton, "*New Trends in Technology Transfer*", International Centre for Trade and Sustainable Development Intellectual Property and Sustainable Development Series, Issue Paper, No. 18 (2007).

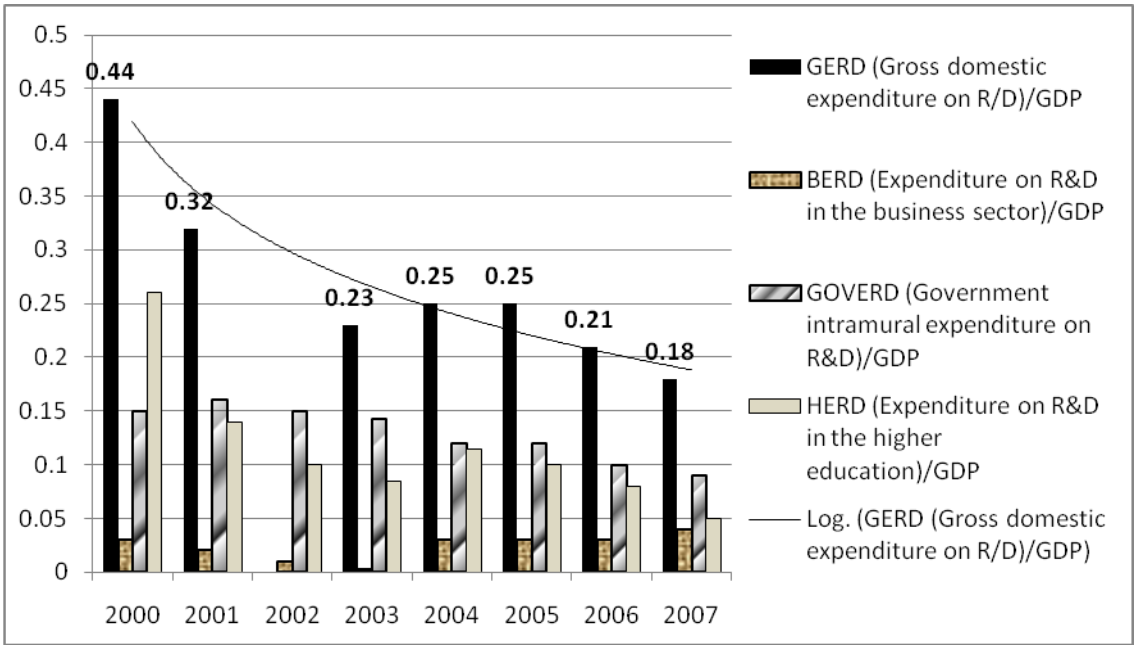
was 0.22 %, compared to Serbia's 0.32 %, Bulgaria's 0.5 % and Croatia's 1.10 %. [26] Although in the above mentioned countries this percentage has been constantly increasing, Macedonia has experienced a downward trend. This can be attested if one looks no further than Graph 1 below. As shown in Table 1 and Graph 2, the Macedonian R&D expenditures in 2003 primarily came from either the higher education (37%) or the governmental sector (67%), with only pitiful 1% coming from the business sector compared to the EU practice where the business sector participates with c.ca 65.3%. In order to further strengthen the argument, we take the Macedonian biotech sector, a high tech segment of the innovation system, as an example. In the year of 2007 there were only 17 biotechnology research projects (12 in the applied research sector and 5 in the basic research sector) out of 185 in total in the Republic of Macedonia. All of them were funded by state ministries and agencies (15 by the Ministry of Education and Science and 2 by other state agencies). [27]

Type of R&D expenditure	2000	2001	2002	2003	2004	2005	2006	2007
GERD (Gross domestic expenditure on R/D)/GDP	0.44	0.32	0.26	0.23	0.25	0.25	0.21	0.18
BERD (Expenditure on R&D in the business sector)/GDP	0.03	0.02	0.01	0.003	0.03	0.03	0.03	0.04
GOVERD (Government intramural expenditure on R&D)/GDP	0.15	0.16	0.15	0.143	0.12	0.12	0.10	0.09
HERD (Expenditure on R&D in the higher education)/GDP	0.26	0.14	0.10	0.084	0.115	0.10	0.08	0.05

[26] Pinto and Polenakovic, "*The National Innovation System and its Relation to Small Enterprises – the Case of the Macedonia*", World Review Science, Technology and Sustainable Development, Vol. x, No. x, (xxxx).

[27] State Statistical Office of the Republic of Macedonia, "*Statistical Review: Population and social statistics, Research and Development Activity*", (2007). Note: In interpreting the statistical results one has to keep in mind that the Statistical Office of the Republic of Macedonia uses interchangeably the terms: biotechnology and agriculture. Thus, the statistical report encompasses projects carried out in agricultural biotechnology only. Also, the statistical data refers to year 2007 only. More data is needed in order to carry out an in depth analysis for the biotechnology R&D trends in Macedonia. For the purposes of a simple analysis the year 2007 is held as a statistical representative sample. Nonetheless, this assumption might be refuted by further research in this field.

Table 1. R&D expenditures by type. Source: ERAWATCH Research Report for the FYROM, European Commission, 2010.



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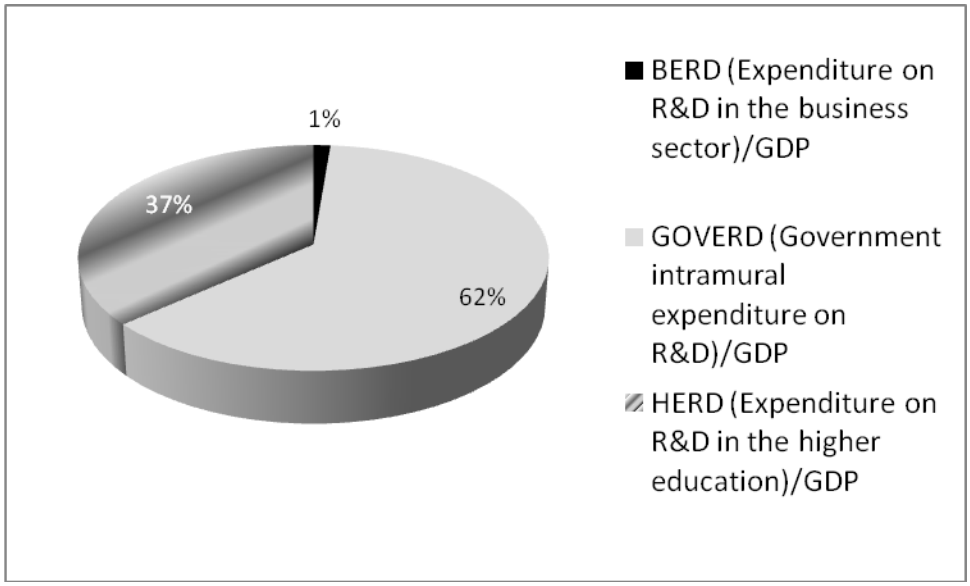
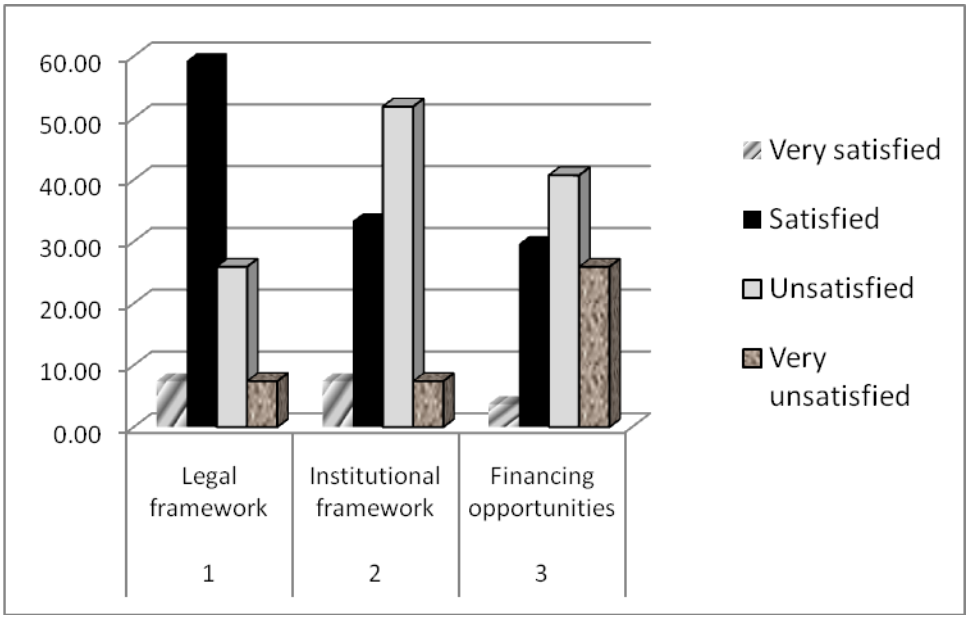


Graph 2. R&D expenditures by type, year 2003. Source: ERAWATCH Research Report for the FYROM, European Commission, 2010.

These observations are supported furthermore by our survey results. The survey "Technology Transfer in the Republic of Macedonia" was conducted online, via a software platform Qualtrix. It covered 50 high tech, domestic and foreign owned firms in Macedonia. It researched the perception of the firms' managers of the technology transfer climate in Macedonia.

Interestingly, the survey results show that 31% of the surveyed managers answered that their firm has never been involved in technology transfer. What is more, almost 52% of the survey respondents, who claimed that their firm participated in technology transfer, answered that the technology was transferred by another entity. Out of those, 100% answered that the transferring entity was a foreign firm. Thus, there is no mention of universities, governmental institutes or other domestic firms. This situation is indicative of the low research culture within the Macedonian business community. It seems that the Macedonian firms' managers perceive the option of technology transfer from a foreign firm as the sole option available. Hence, it will be very difficult for the public policy stakeholders in the research and scientific area to put the triple helix innovation model on the agenda and entice the private sector to stimulate its own R&D involvements.

Another interesting issue to analyze is the fact that the survey respondents give relatively high credibility to the legal framework pertaining to technology transfer (59.26%) when compared to the institutional framework (33.33%) and the financing opportunities (29.36%). The public policy stakeholders should bear this in mind when crafting adequate mechanisms for the triple helix innovation model implementation in Macedonia.

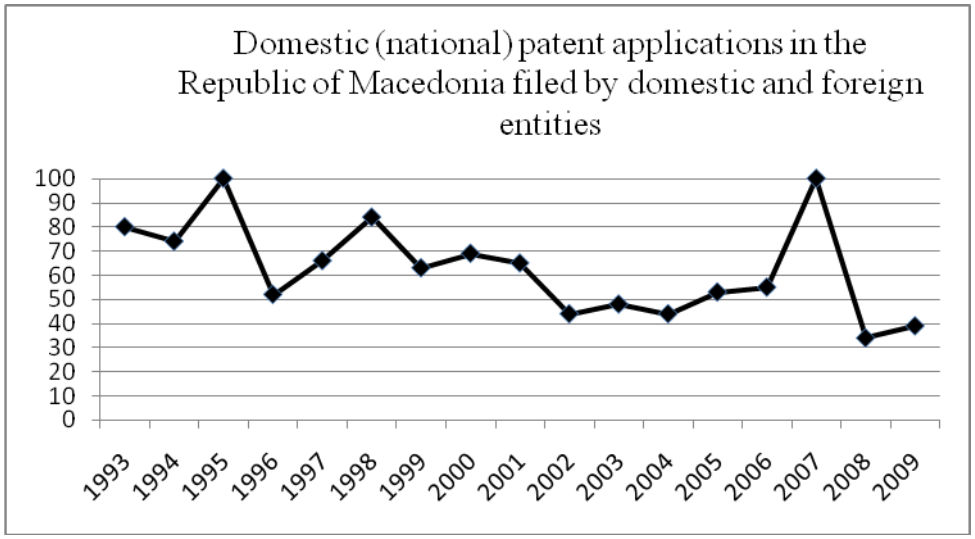


Graph 3. Question: Please evaluate your experience in technology transfer in Macedonia according to the following indicators. Source: Survey "Technology Transfer in the Republic of Macedonia"

High number of survey respondents (92.59%) thinks that the state should make bigger budgetary allotments to the R&D endeavors undertaken by the business sector. Moreover, high is the number of respondents (81.48%) who claim that the state does not support public private partnerships. Thus, the business sector representatives clearly observe and acknowledge the nonexistence of the link between the state and the business sector in the innovation model of Macedonia. This is also the case when asked about their perception of the role of the Macedonian academia in generating and sustaining the innovation process wheel. Most of the respondents agreed that there is a need for establishing so called technology transfer offices under the auspices of the Macedonian universities, which will serve as an initial block of the Macedonian triple helix innovation platform. Yet, much remains to be done in the area of raising the general awareness, and more specifically the awareness of certain groups of stakeholders, in order to reach the stage of triple helix innovation model III, as described by Etzkowitz and Leydersdorff.

According to the World Economic Forum Global Competitiveness Report 2010-2011, Macedonia is considered to be in the efficiency driven stage of its economic development. Hence Macedonia has not reached yet the innovation driven stage of the

economic development, imminent for the highly developed, knowledge based societies. According to this Report, innovation is considered to be one of the main pillars of economic development. One way of measuring innovation would be through measuring the nation's ability to innovate. The best method of doing this is through measuring nation's patent activity. Of special importance is the number of filed patent applications by domestic and foreign entities in Macedonia, because this is an indicator of the vitality of the country's innovation system. Even of greater analytical importance is the number of successful patent applications by domestic entities submitted in front of the EPO (European Patent Office), the USPTO (United States Patent and Trademark Office) and the WIPO (PCT applications). As figures show, again, Macedonia does poorly in the area of domestic patenting. There is a declining trend in domestically filed patent applications which is taken as one of the main indicators of the decayed innovation system in Macedonia. Even more disappointing is the fact that in twenty years time span there are only two successful patent applications submitted by domestic entities in front of the USPTO. This serves as yet another evidence of the current atrocities of the Macedonian innovation system.



Graph 4. Domestic (national) patent applications in the Republic of Macedonia filed by domestic and foreign entities. Source: Own calculations based on figures obtained from the Macedonian Industrial Property Bureau.

Thus the main question resonates: How to proceed from a point, that many believe, is the point of no return? How to establish an effective mechanism of collaboration between the academia, the business sector and the government? How to entice the formation of new innovative institutional hybrid forms that will represent a quantum leap in the innovation matrix of Macedonia?

The aim of this paper is not to give definite answers, but to touch upon certain anomalies of the Macedonian innovation system and, at the same time, to entice the much needed debate on the triple helix innovation system formation in Macedonia.

We do believe that Macedonia has a lot to learn with respect to building sustainable triple helix innovation system from the developed countries. However, imitating other countries' "triumphant" systems in this respect would be a short sighted solution from a public policy perspective. The Macedonian innovation system has specificities on its own and these should be taken into account when crafting the triple helix innovation platform. Hence we have to devise a system on our own. In doing so we should rely upon the successful models developed by others, but not blindly.

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17. World Economic Forum, *Global Competitiveness Report* 2010-2011.