THE JOURNEY TO COMPETITIVENESS: EU SPEEDING UP ON THE ROAD PAVED WITH KNOWLEDGE AND INNOVATION

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In the attempt to boost its international competitiveness, the European Union realized that it should enrich the ways to achieve it by using the intangible assets that it holds. Knowledge and intellectual capital, innovation, science and entrepreneurship are key drivers of economic development and renewal. The traditional resources on which economies rely on are scarce, while these ones are abundant and steady. Moreover, this type of assets can easily increase their value through sharing and they trigger multiplicative effects in the economy. The paper tackles these issues and makes an assessment of the degree of innovation in the EU. The study aims to provide an answer to the question of whether EU's overall performance proves that it is truly driven by knowledge and innovation or not. Using a qualitative method of research, this paper identifies innovation patterns of the member states from a geographical perspective. In order to provide a compelling analysis, the data ranges from indicators capturing science and technology activities, firm innovation to the internationalization of research activities and the tertiary-level graduates. The results show substantial discrepancies between the European countries and reveal that knowledge flows scaled by the level of innovation are a localized phenomenon, therefore some countries are more innovation-oriented and they reap the benefits better.

***Keywords**: knowledge-based economy, competitiveness, innovation, R&D, technology.*

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I. Introduction

The European Union is continuously trying to enhance its international competitiveness and to find new sources of growth by using intangible assets such as innovation, science and entrepreneurship. The development of the knowledge-based economy highlights the need to generate knowledge, to exploit, to transfer and to apply it. Since nowadays information is widely accessible, the knowledge and skills are assets that can provide a real edge. Knowledge and innovation are hot topics because they are key drivers of economic development and along with other components they can turn into a strong competitive advantage of any nation. So far, regions were identified as important players in the knowledge-based economy. Because they fail to enhance their potential on their own, the triple helix model involving the public sector, the business community and the higher education institutions was developed. Its purpose is to create links and interactions between those three and in this manner to create a synergy. UE regions and countries differ from each other in terms of intangible assets and factors of competitiveness.
Knowledge is a special type of resource for an economy and it's a non-rival input in generation of new knowledge. This particular subject is important because unlike most resources that become depleted when used, knowledge can be shared and grow through application which further leads to innovation. Knowledge is not based on the scarcity principle but rather on abundance, hence knowledge and technology became the heart of the global economy. This points out that intangible assets are increasingly turning into competitiveness determinants. Moreover, evidence from a number of countries suggests a faster growth of investment in intangible assets than in tangibles hence the interest for them. The Knowledge Economy Index developed by the World Bank shows that in 2009, the top five countries are European. Denmark is ranked first, followed by Sweden, Finland and the Netherlands, this fact suggesting that the

Nordic countries of EU are economies driven and based on knowledge. Among the economies least based on knowledge are Greece, Bulgaria and Romania. EU's competitors in the global arena are Canada (ranked 6th), the United States (ranked 9th) and Australia (ranked 11th).
Through the multi-level policy governance, the European institutions support the investment in research, infrastructure and transfer of knowledge and technology. The most important pillars are the 7th Framework Programme for Research and Technological Development, the Competitiveness and Innovation Programme and the Structural Funds as tools. Innovation is a growth driver for businesses, industries and countries as it reinforces their competitive position on the markets, boots their productivity and develops key competences. At the European level there are large discrepancies concerning the innovation rates. While different forms of innovation activities do occur in most of the EU regions, those based on R&D are spatially concentrated. Industrial structure, capabilities and other territorial characteristics affect the capacity of various economic actors to generate and absorb knowledge, as well as fostering the innovation processes. EU spends annually an average of 1,81% of the total GDP on research and development activities. Regional knowledge networks and joint research initiatives of the business community and the European universities are becoming increasingly prevalent. The creation of science parks is one of the strategies used by the European universities in order to enhance the knowledge spillovers. Science parks enable rapid technology transfer, offer improved funding for academic programs, sponsored research agreements and they create opportunities to trade the intellectual property. Research partnerships between companies and universities often lead to a high impact on the knowledge flows and innovation.
The paper aims to investigate the degree of innovation throughout the member states of EU as well as to launch hypotheses regarding the causes of the discrepancies between countries. The study attempts to answer the following question: "To what extent is the European Union driven by knowledge and innovation?". The main goal of the research is to identify the innovation patterns of countries from a geographical perspective and to assess the overall status of the EU as a knowledge-based economy.

I. Literature review

The literature referring to the intellectual capital or knowledge, human capital and innovation is not as broad as other topics in economics because it is relatively new and many areas are still to be explored. The theories of knowledge creation have social foundations as Fleck (1935) defined "thought communities", Schon (1983) investigated the "communities of reflective practitioners", Egestrom (1987) "activity systems". Others researched the "communities of practice" or "networks of practice" (Brown and Duguid, 2000). A substantial addition to the literature was brought by Nonaka (1995, 2008) though the concepts of "socialization and Ba". The innovation theories are rooted in a microeconomic approach as they started to arise based on the firm level and later they extended to markets, which further led to a regional approach. A large part of them related to the organizational theories, investigated the conditions in which innovation arises, the intensity of it, the impact of external knowledge while others attempted to create models of innovation (Von Hippel, 1977; Chesbrough, 2003; Nonaka, Toyama and Hirta, 2008). Gary Backer was the pioneer of the human capital theory. The emphasis on human capabilities has been followed and expanded in modern research on innovation. Studies regarding innovation reveal that the development of new technologies and innovation itself occurs through the activities of skilled personnel such as researchers, engineers and managers. Innovation is a social process, involving not only new techniques but also new forms of knowledge and competences. Competence is embodied in the collective experience and activities of the people who implement new technologies (OECD, 2010: 8). Competitiveness depends, to a large extent, on the ability to generate a good momentum of employment, which is the result of issues related to demographics, limitations of the labor market, qualifications of human resources and achievement of high levels of productivity (Couto, Vieira and Tiago & Natario, 2006). Econometric studies confirm the

positive relationship between labor productivity and innovation (Vieira and Vazquez, 2008: 60). In the knowledge-based type of economy, wealth is increasingly created through effective management of knowledge workers instead of using the efficient control of physical and financial assets. The growing importance of knowledge and innovation leads to more investments in the companies' intangibles such as experience, talents, skills, capabilities and intellectual capital (Stewart, 1999: 67).

European cross-country studies using equilibrium models were conducted to define the dynamics of innovation and productivity growth. One particular paper finds that technology diffusion between countries falls as the distance between them grows (Eaton and Kortum, 1996: 251-278). The same authors conclude that human capital raises the ability of a country to absorb technology. The technology diffusion is significant and proportional to the countries' ability to absorb innovation, thus spillover effects arise in different regions (Bottazzi and Peri, 1999: 8). The fact that innovation production is more sensitive to demand pull pressures and less sensitive to supply pressure is underlined by other studies (Gerowski and Van Reenen, 1996). Parts of the literature also tackle the personnel mobility issue and the national innovation systems. The movement of labor force and the tacit knowledge they care with them is a key flow in any national innovation system. The movement of workers through sectors and firms is a way of spreading innovation. Knowledge transfer, human capital enrichment in the form of the production of graduates along with the development of the regional labor force by training activities outlines the potential to promote economic development (Riddel and Schwer, 2003: 80). Despite restrictions and limitations, universities serve as sources of knowledge for businesses. Policies designed to build new niches of knowledge and develop more effective mechanisms for transferring university-based knowledge to regional partners can bolster technology communities and shape innovation cultures (Benneworth and Charles, 2005). Another important idea provided by the literature is that just as agglomerations of traditional resources appear, knowledge spillovers can generate an agglomeration of innovative activity.

III. Methodology

The paper uses an exploratory data analysis in order to examine the spread of knowledge and innovation within the EU, through the research and development activities. The qualitative method of direct observation was considered appropriate in this particular case because it allows making suitable connections between the indicators and it is proper for comparisons. Following it, meaningful conclusions will arise and the main goal of the study can be achieved. A pool of six countries was chosen as a base for the comparison along with the European level comprising the 27 member states. The selection was carried out by geographical criteria and each of the countries aims to represent a group (the core of EU or the West countries, the Central countries, the Nordic countries and the countries located to the periphery). The data collection entailed identifying appropriate indicators that can describe the extensiveness of the R&D activities and their effects (the level of firm innovation, the type of innovation). The "Science, Technology and Industry Scoreboard 2009" by OECD was the primary source for data collection and the information refers up to the year 2008. The first group comprising of four indicators captures a synoptic view over the expenditures in R&D, the main sources and the performers of these activities (Table 1). The second group including three indicators aim to emphasize how does EU and its countries compete in the world economy as far as innovation is concerned, and the next two provide an insight of how Europe connects to the global research. Finally, the last indicator shows to what extent the European Union invests in the knowledge economy through education.

Table 1 The status of research and innovation in the EU

Indicator	EU27	Finland	Germany	Sweden	Czech Republic	Luxemburg	Portugal
GERD (Million current PPP, $)	299 635	7 555	83 974,8	12 521	4 094,8	708,5	4 410
R&D financed by : - Industry - Government (%)	 54,3 34,2	 68,1 24	 67,3 28,4	 58,9 27,3	 45,8 43,9	 76,0 18,2	 48,1 43,7
R&D performers: - Higher education - Industry - Government (%)	 24 61,2 13,6%	 19,7 71 9,3	 17,3 68,2 14,5	 24,9 70,5 4,4	 18,1 60 21,4	 9 73,3 17,3	 35,4 46,7 7,4
Researchers	1 531 000	40 849	311 500	46 719	28 759	2 041	45 909
Share of large firms with new-to-market product innovation (%)	32	49	41	42	35	34	39
In-house product innovators (%)	39	43	59	47	40	70	43
Non-technological innovation (%)	69	75	90	86	70	90	80
The ownership of tinventions made abroad but within the EU (%)	11	16	7	20	10	50	3
Firms with foreign collaboration on innovation as a percentage of all firms, within EU	7,9	17	12	10,5	8,2	14	4
Tertiary-level graduates in total employment * (%)	28	41	28	34	16	32	16

* Tertiary-level graduates are defined as holders of degrees at the ISCED levels 5B, 5A and 6.
Source: compiled by the author based on OECD statistics ("Science, Technology and Industry Scoreboard 2009")

In the coming part I will point out the reasons for choosing these indicators and their relevancy for the analysis. The Gross Domestic Expenditure on Research and Development (GERD) is an indicator of the science and technology (S&T) activities and it is used as a summary of R&D activities. The purpose of including is to assess the amplitude of these expenses in each of the countries included in the study and to underline the large differences in the absolute value. If linked to growth and national income indicators it can contribute to measuring the sustainable development of a country. Further, identifying the finance sources for the R&D activities can uncover the proportion in which a country relies on the private business sector and on the government in this matter. Depending on which sector prevails, conclusions can be drawn regarding the interest and the financial power of each in supporting such activities. As the next step, it is important to also identify which are the performers of the R&D activities and evaluate to what extent the sponsors are also performing them. However, because expenditure does not reflect the potential of R&D in a given country but only the effort conducted in a certain period of time it is appropriate to add other relevant indicators to the analysis.
To have a deeper understanding it is necessary to take a microeconomic approach of this issue and assess the innovation and firm performance. Innovations have different degrees of novelty and the impact of those is significant on the performance and on the competitiveness. Nevertheless, it is a clear distinction between being an adopter and being an innovator. The share

of large firms with a new-to-market product innovation indicator aims to show the scale or the spread of the innovation phenomenon. Large companies were preferred as a measurement unit because usually small and medium enterprises are less likely to introduce novel innovations and they are rather known as adopters. In order to appraise the diffusion of new technologies in EU, the indicator related to in-house product innovators captures whether an innovation was developed within or outside the firm. This shows to what extent the firm interacted with other parties during the process. Innovation has both technological and non-technological aspects. The non-technological innovation arises especially in the case of services and it deals with the development of new marketing methods. EU's economies are mostly tertiary hence it is appropriate to analyze the cases in which innovation is not dependent on technology.
Cross-border inventions occur when the country of residence of the owner and the inventor are different and in most cases it is a result of the activities of multinational corporations (the applicant is a corporation and the inventors are located in a foreign subsidiary). The internationalization of research activities is a driver of innovative firms and country competitiveness. This is often measured through the share of patents filled by one country for an invention made in another country. This ratio shows the extent to which domestic firms control inventions made by residents of other countries. Employment of tertiary-level graduates is an indicator of the innovative potential of an economy and of the capacity of its labor market to allocate human capital to the production processes. Additional data concerning the investments in knowledge economy measured by the new university graduates unwraps pinpoints that EU has a 35% university graduation with almost 2,2 millions of degrees annually. This indicator reflects a country's capacity to absorb, develop and diffuse knowledge and to supply the labor market with highly skilled workers. The scientific studies are more popular in the Nordic Countries where science and engineering degrees account for more than 37% and 29% of total awards [1]. However, most university degree recipients graduate in the social sciences, which in Poland and Hungary exceed 40% of total graduates.

IV. Results

The research and development activities in most of the EU member states are financed by the private sector, through the industry but in the Central and periphery countries a large share is still supported by the national governments. The main performers of these activities are those who fund them, therefore the business sector. However, higher education institutions (universities, institutes or research organizations) conduct a significant part of the European R&D activities (24%). Countries like Portugal or Sweden have a significant level of researching within the academic environment, while Luxemburg does not rely on this category of performers. In the Nordic countries, the governments develop research activities in an extremely limited share as they prefer to contract these services either from institutes, either from business performers. The European Union has more than a million and a half of researchers of which almost one fifth comprises of German researchers. Finland and Sweden have a reduced population but a large ratio of researchers while countries in the Central Europe have higher population and a lot lower shares of researchers then the Nordic ones. The statistics show that product innovation within the large companies in EU is not very widely spreaded, only 32% of the firms were able to bring completely new-to-market product innovations. This means that the majority of companies, both MNCs and SMEs are adaptors and not innovators. However, there are substantial discrepancies between countries but the West and Nordic ones seem to develop new products or improve the existing ones at a larger scale than the rest of the member states. On average, just 39% of the European companies prefer to engage in the innovation process within their own organization, which means the environment for technology diffusion is proper as they strongly interact with other entities. Luxemburg is an exception from this case. Due to the fact that almost all EU's countries have tertiary economies, the non-technological innovation has very high levels which indicates to some extent a certain level of creativity of the marketers. The data emphasizes that a

weakness of the European Union is the reduced internationalization of the research activities. This fact is proven both by the low share of ownership of inventions made within the EU states and the reduced percentage of firms involved in collaboration on innovation. That is rather a surprising finding considering that EU is the host of many transnational corporations, which usually trigger the research internationalization phenomenon. However, significant differences among the countries can be observed in this case too. The Nordic countries or small economies of EU (Luxemburg) tend to collaborate more frequently with foreign partners. Cross-country differences in international collaboration could be explained by the propensity of the firms. Some have similar innovation rates but a different international collaboration rate, which suggests that some are more open or inclined to participate in joint activities. The innovation partnership outside EU is much less frequent and it is usually below 5% in most EU countries. At last, the labor markets within the European Union don't seem to benefit of a strong supply of highly skilled graduates. The low share of tertiary-level graduates indicates that valuable human capital is not allocated properly to the production process, which means that the innovative potential is not harnessed.

V. Conclusions

The European Union raised the awareness of the prominence of knowledge, technology, innovation and science in the race for the world competitiveness. The study confirms that knowledge flows measured by the level of innovation are a localized phenomenon. The West and the Nordic European countries are those with intense research and innovation activities. Furthermore, same countries have a high-income per capita, which could lead to the conclusion that innovations arise only in certain conditions. The presence of research hubs belonging to the multinational corporations, the public research labs and leading research universities, all located in these countries, could be an explanation for this phenomenon. However, the rest of the regions are catching up by developing their research capacity. One major problem is that due to the economic turmoil, the R&D budgets of the European companies were severely diminished. Once the economies will overcome the disarray completely, the situation will certainly improve.

One common characteristic of the European countries is that R&D activities are funded by the business sector which is also the main performer. Private enterprises are those that compete on the national, European and international markets, consequently a higher competitiveness can be achieved by extensive innovation at this level. Large companies innovate more frequently than small and medium size companies, but the situation is not exceptionally great because only one third of them were able to compute new-to-market product innovations. However, the majority of the European firms rely on marketing innovations and not on process, procedure or product innovation. Organizational capabilities and the blend between creativity and productivity usually leads to incremental innovations, which are the most widely spread in business. EU has a proper environment for technology diffusion and innovation as companies are linked through innovation and knowledge flows [2]. Unfortunately, the research activities known as a key determinant of the enhancement of innovation has a low internationalization. Collaborating on innovation with foreign partners is an important source of knowledge inflows and the European companies should be aware of that. The linkages between firms are allowing them to access a broader pool of inputs (technology, human resources, funds, information) than what is available in their local environment as well as it lowers the costs and they share the risks. Since the companies prefer to innovate mostly with partners within the European Union, it suggests that geographical and cultural proximity are factors that have an influence on the innovation processes. A few EU countries are conducting a considering part of the research and development activities through education institutions. It is generally acknowledged that EU has low-mobility labor market and the low share of tertiary level graduates overcasts the innovative potential. It is extensively consented that research and development and a highly trained labor force are among the conditions for innovation and economic development of a country, region or group of countries.

This study contributes to the existing literature by focusing on basic aspects of the R&D activities in the EU countries, making connections between knowledge flows and innovation from a territorial perspective and revealing both strengths and weaknesses of the European innovation networks. Just like a racing car on the move, the European Union despite of having good aerodynamics it cannot reach the finish line (achieving the world competitiveness) if the road is not safe and paved with a durable material (knowledge and innovation).

VI. Notes

1.Science degrees include: life sciences, physical sciences, mathematics and statistics and computing, Engineering degrees comprise: engineering and engineering trades, manufacturing and processing; architecture and building.

2.and services) or process innovations (mainly production processes).

VII. References

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