TRANSECTIONAL ANALYSIS BETWEEN INNOVATION AND ICT READINESS FOR THE EUROPEAN UNION COUNTRIES

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ABSTRACT

Previous researches have shown that the Innovation performance is in a strong link with the Information and Communication Technologies (ICT) readiness, at European Union level. In this article, we have investigated if these results still maintain in 2015, according to data published in 2016 reports, and whether they are dependent on the indicator used for measuring innovation.

Using unifactorial linear regressions, a comparative analysis has been developed: we modeled the relationship between the Networked Readiness Index (NRI) – created by the World Economic Forum, in collaboration with INSEAD, and published yearly since 2002- and: (1) the Global Innovation Index (GII) – published yearly since 2007, by INSEAD in collaboration with WIPO, Cornell University and their Knowledge Partners, on one hand, and (2) the Summary Innovation Index (SII) – created on the initiative of the European Commission and computed yearly since 2001- on the other hand.

The transversal linkage between the two pairs of indicators for the 28 Member States were tested. The results show a strong relationship between ICT and innovation in 2015. This relationship is not accidental - it has been verified using historical data for the last 8 years.

KEYWORDS: *ICT, Networked Readiness Index (NRI), innovation performance, Global Innovation Index (GII), Summary Innovation Index (SII)*

1. INTRODUCTION

As European Innovation Scoreboard 2016 states, "Innovation grows the EU's knowledge economy, it enhances our competitiveness and it creates a prosperous future for all Member States. This is why innovation features prominently in the ten priorities of the Juncker Commission".

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Many researches have studied the progress of innovation and how to foster innovation. In the last years, we conducted a research focused on identifying the ICT factors that can influence innovation. The studies have been concentrated on the Member States and have used the Summary Innovation Index (SII) for measuring the innovation level, created on the initiative of the European Commission. For measuring the ICT we have used the Networked Readiness Index (NRI), published yearly in the Global Information Technology Report. We have shown that the two indicators, SII and NRI are strongly linked, hypothesis that has been verified in two ways: longitudinally, using historical data at national level, over a period longer than 6 years [4][12], and cross-sectionally, for a specific year, considering the most of European countries [4][10][12]. We have deepened our research testing the linkage between innovation and ICT at structural level, considering the four subindexes of NRI: Environment, Readiness, Usage, and Impact [10][12].

As ICT indicators, we have tested some other indexes, such as the e-Readiness index [11], published yearly in the Economist Intelligence Unit, and the 'e-Government' indicator [13] or the 'Frequency of computer use by individuals' indicator [3], both indexes are available in the Eurostat database.

In this paper, we'll continue our work, the research on the relationship between innovation and ICT with recent data, this time using, in a parallel approach, two different indicators for innovation: the Summary Innovation Index (SII) and the Global Innovation Index (GII), published yearly by INSEAD and its collaborators. The analyzis show that previous results still maintain when using different indicators for innovation.

2. NATIONAL INDICATORS FOR ICT READINESS AND INNOVATION PERFORMANCE

2.1. The Networked Readiness Index (NRI)

The Networked Readiness Index is a measure of drivers of the ICT revolution. It has been computed since 2001 and published in the Global Information Technology Report by the World Economic Forum in partnership with Cornell University and INSEAD. The 2016 GITR covers 143 economies.

The NRI is a composite indicator. Its structure has changed in time. In GITR 2015, the Networked Readiness Index has four equal weighted sub-indexes, every of them being evaluated through a set of pillars, ten in total:
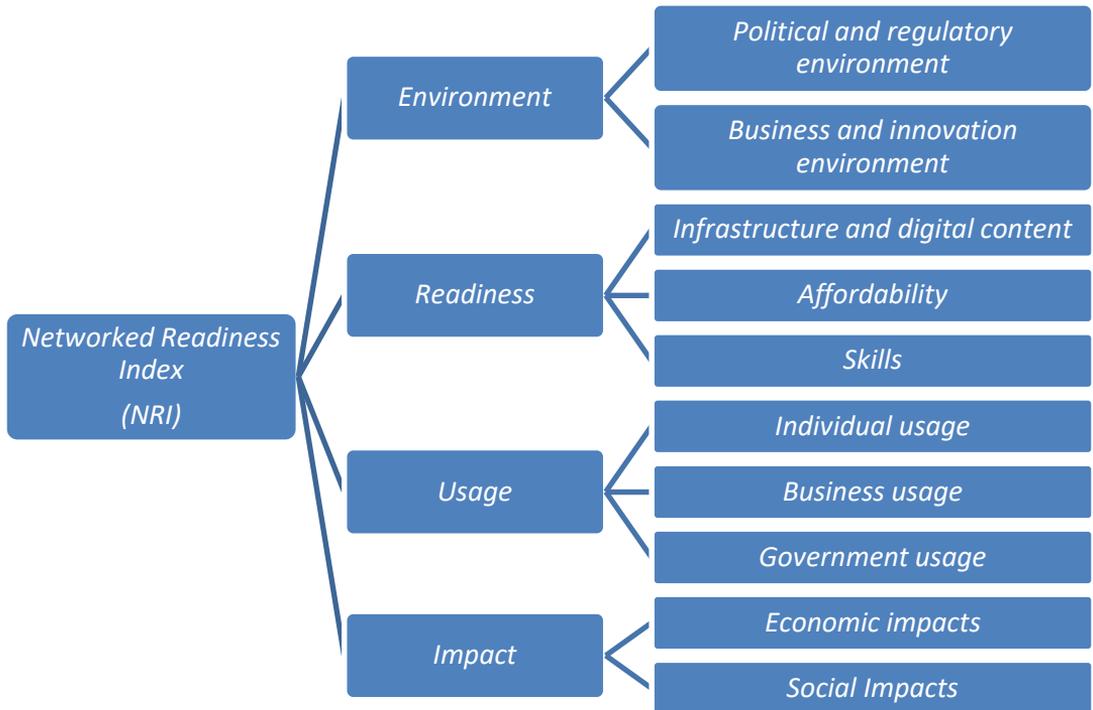
Figure 1. The structure of the Networked Readiness Index in GITR 2016
Source: Made by authors using data from information from GITR 2016

According to the Global Information Technology Report 2016, the theme for the last year was focused on 'Innovating in the Digital Economy'.

2.2. The Summary Innovation Index (SII)

The Summary Innovation Index was created at the request of the European Council in Lisbon in 2000, and has been published annually in the European Innovation Scoreboard (EIS)[1] starting from 2001. SII measures the overall innovation performance of an economy.

The European Innovation Scoreboard 2016 is developed under the motto *Innovation = Creativity-Knowledge-Technology-Europe-Investment-Research-Competitiveness-Skills-Collaboration-Growth and Jobs*. It publishes the Summary Innovation Index 2016 as a composite index that uses 25 indicators across a range of themes, which are grouped into 8 pillars (Figure 2) that form 3 categories: Enablers, Firm activities and Outputs.

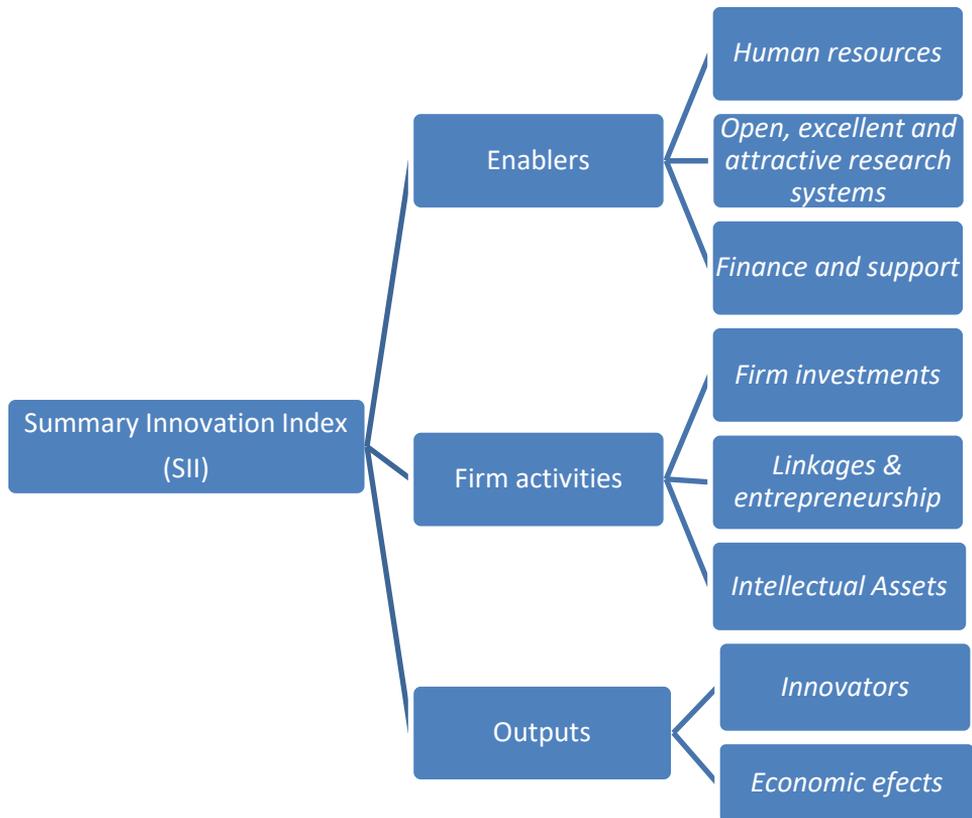[1] called Innovation Union Scoreboard (IUS) in the period 2010 - 2015

Figure 2. The structure of the Summary Innovation Index in EIS 2016
Source: Made by authors using information published in EIS 2016

Using the SII indicator, Member States are classified, every year, into four groups (Fig. 3):

- *Innovation leaders* (Denmark, Finland, Germany, the Netherlands, and Sweden) – perform in innovation well above the EU-28 average;

- *Innovation followers* (Austria, Belgium, France, Ireland, Luxembourg, Slovenia, and the UK) – innovate below the leaders, but close to or above that of the EU-28;

- *Moderate innovators* (Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia, and Spain) – perform in innovation below the EU-28 average;

- *Modest innovators* (Bulgaria and Romania) – innovate well below the EU-28 average, their innovation performance is well below that of the EU-28 average.
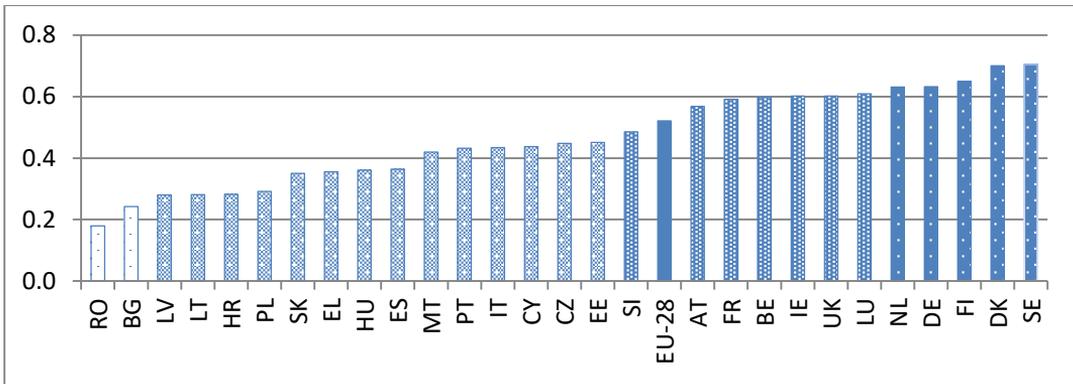
Figure 3. The four groups of EU-28 countries by their innovation performance (SII)
Source: Made by authors using data from EIS 2016

2.3. The Global Innovation Index (GII)

Along with SII, the Global Innovation Index (GII) identifies and analyses global innovation trends. While SII is computed mostly for the EU countries, GII is a worldwide indicator, the 2016 edition covering 141 economies around the globe. It is published annually in the Global Innovation Index Report as a collaborative work of Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO) as co-publishers, and their Knowledge Partners.

The Global Innovation Index 2016 uses 79 indicators across a range of themes, which are grouped into 7 pillars:
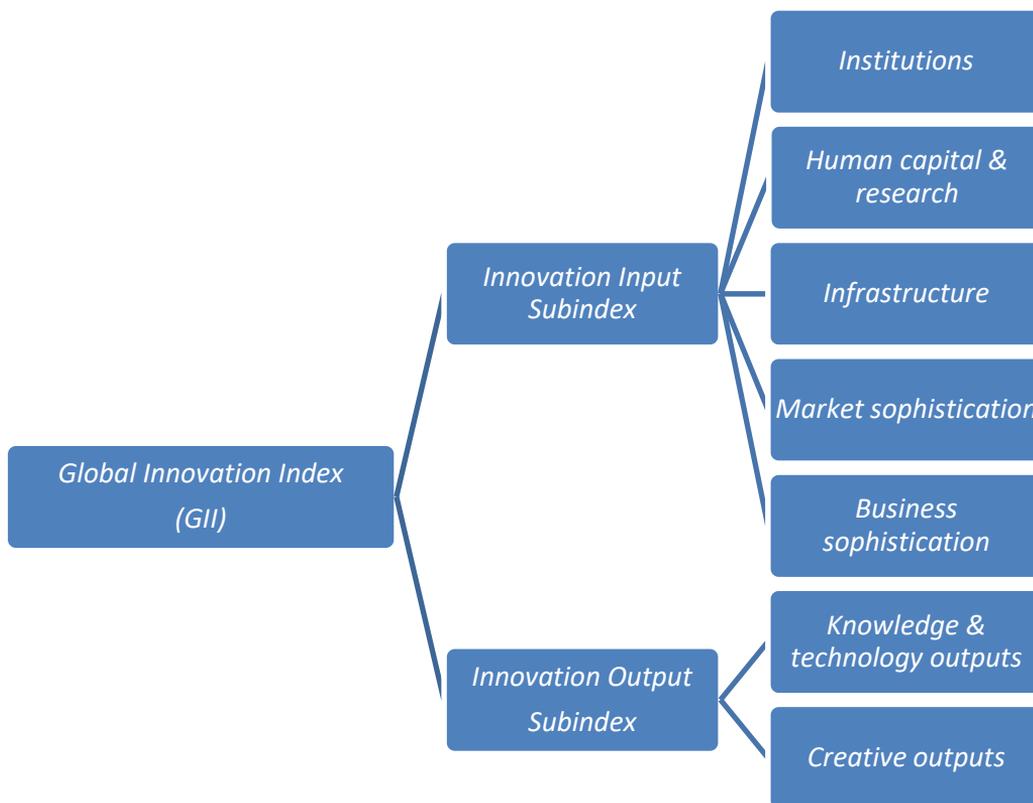
Figure 4. The structure of the Global Innovation Index in GII 2016
Source: Made by authors using the information published in GII 2016

The Innovation Input Subindex is the simple average of five pillar scores, while the Innovation Output Subindex is the simple average of the next two pillar scores. The Global Innovation Index is the simple average of the Input and Output Subindex scores.

According to the Global Innovation Index Report 2016, the theme for the last year was focused on 'Effective Innovation Policies for Development'.

3. TRANSECTIONAL ANALYSIS BETWEEN INNOVATION AND ICT READINESS FOR THE EU-28 MEMBER STATES ACCORDING TO THE 2016 REPORTS

Previous researches have shown that the Innovation performance is in a strong link with the ICT readiness, at European Union level. In those researches the innovation state was measured by the SII indicator, proposed by European Commission for the 28 Member States and some more countries. In this section we have investigated if these results still maintain using data published in 2016 and whether they are dependent on the indicator used for measuring innovation. A comparative analysis has been developed: the relationship between NRI and GII, on the one hand, and between NRI and SII on the other hand. In both cases, the EU-28 Member States were considered.

a. The link between NRI and GII

The first hypothesis we have investigated is the link between the Networked Readiness and the Global Innovation indexes. Using a unifactorial regression model (trendline is shown in Figure 5), we have described this link:

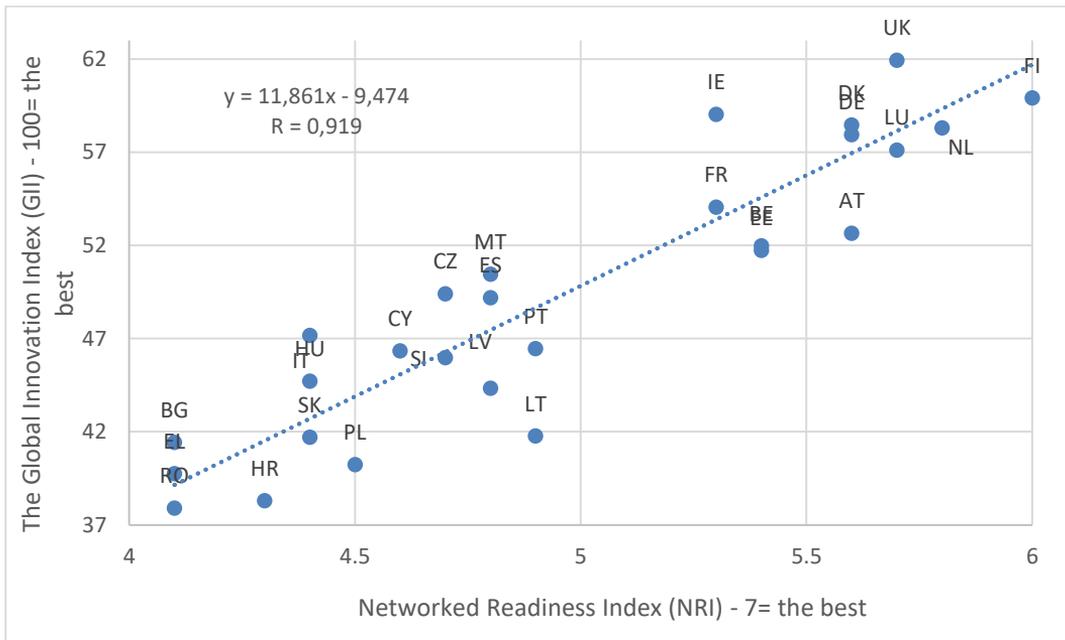$$GII = 11,861*NRI - 9,474, \ R=0,919$$

Figure 5. Correlation between NRI and GII indicators for the EU-28 Member States in 2015
Source: Made by authors using data from GII 2016 Report and GITR 2016

The correlation factor R=0,918 proves that there is a strong link between the two indicators in the year 2015. This linkage is not accidental – it has been verified in the last nine years. As Table 1 illustrates, the regression parameters have changed in time, but insignificantly, excepting the 2012 year which is an isolated case. Moreover, the correlation coefficients exceed the 0,9 threshold, indicating a constant strong relationship between GII and NRI.

Table 1. Transversal analysis of the correlation between GII and NRI at national level, for the EU-28 countries, in the period 2008-2015

Year	2008	2009	2010	2011	2012	2013	2014	2015
Slope	9,746	8,174	12,455	12,257	0,220	10,655	11,811	11,861
Intercept	-7,456	1,592	-9,546	-8,182	-0,523	-2,077	-8,026	- 9,474
Correlation Coefficient	0,909	0,965	0,936	0,942	0,782	0,907	0,912	0,919

Source: Authors' calculations using data from GITR 2009 – GITR 2016
and GII 2009 - GII 2016 Reports

b. The link between NRI and SII

As shown above, in the European Innovation Scoreboard 2016, the 28 Member States were grouped into four groups, in accordance with their innovation level. In Figure 6, the position of these four groups vs. their ICT readiness is represented. The unifactorial regression model provides the equation:

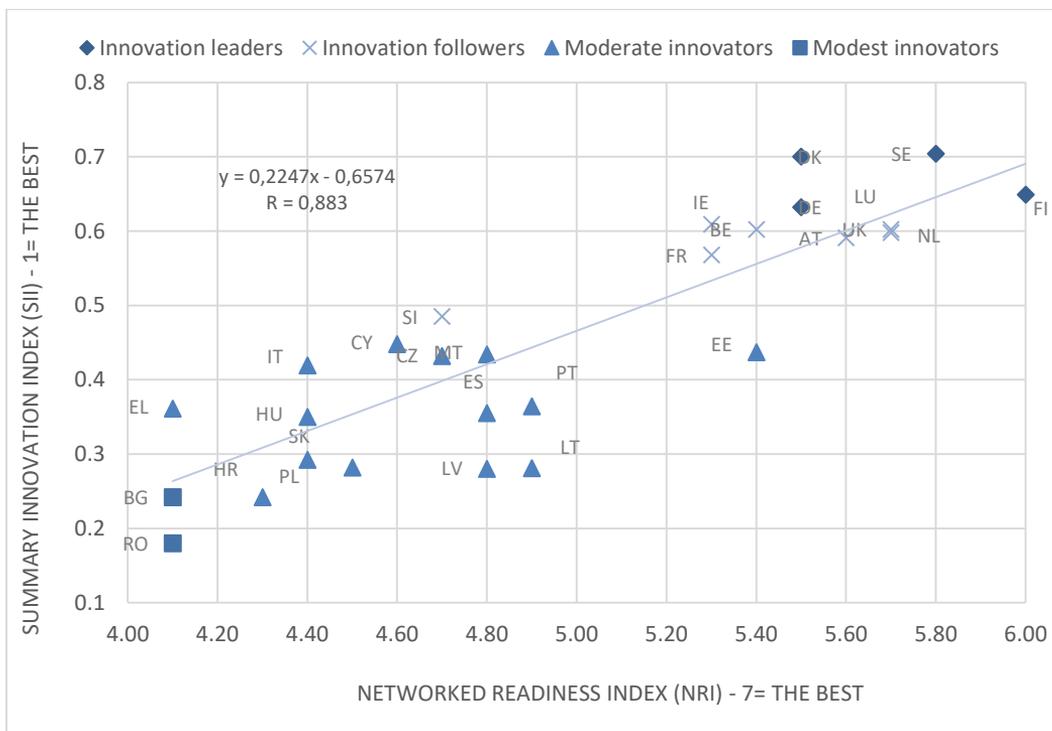$$SII = 0,225*NRI – 0,657, \quad R=0,883$$

Figure 6. Correlation between NRI and SII indicators for the EU-28 countries in 2015
Source: Made by authors using data from GITR 2016 and EIS 2016

Considering the historical data published in the last eight years reports, we investigated the linear regression with the same indicators. The results are tabled below.

Table 2. Transversal analysis of the correlation between SII and NRI at national level, for the EU-28 countries, in the period 2008-2015

Year	2008	2009	2010	2011	2012	2013	2014	2015
Slope	0,225	0,230	0,248	0,217	0,074	0,211	0,227	0,225
Intercept	-0,607	-0,585	-0,655	-0,562	0,138	-0,537	-0,636	-0,657
Correlation Coefficient	0,885	0,913	0,900	0,871	0,490	0,813	0,856	0,883

Source: Authors' calculations using data from GITR 2009- GITR 2016 and EIS 2016

We can notice that the historical data in this case yield to the same results: the 2012 year is an exception, while in all the other years, the connection is very strong.

Note. The values in the table are slightly changed from the ones published by the authors in [10], due the fact that the global indicators have changed (EU countries being in a continuous process of evaluating and publishing indicators from the past). In this analysis we used SII indicators for 2008-2015 published in the European Innovation Scoreboard 2016.

4. CONCLUSIONS

In the last years, the European Union has continuously improved its innovation performance, but significant gaps still exist between countries within EU on one hand, and, one the other hand, between European Member States and international leaders in innovation such as Switzerland at a wider European level and South Korea and US at global level. As European Innovation Scoreboard 2016 states, "the process of convergence in performance differences between Member States – as observed in previous reports since 2012 – appears to have come to a halt" (EIS 2016, pp 6).

Researches have shown that ICT and innovation are in a strong linkage; we consider that this relationship proves that ICT is one of the driving factors that can stimulate innovation, and investing in ICT could accelerate the progress of innovation, especially for the Member States with low performances in this domain.

5. REFERENCES

[1]   COM (2010) 546 final, "Europe 2020 Flagship Initiative Innovation Union". Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0546:FIN:EN:PDF

[2]   COM(2010) 2020 final, "EUROPE 2020 - A strategy for smart, sustainable and inclusive growth". Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF

[3]   Crișan D.A., Potecea O., Preda A.M., Stănică J.L., "ICT determining factors in increasing the innovation in Romania", Journal of Information Systems and Operations Management (JISOM), Vol. 5 No. 1 / May 2011, 2011, pp. 94-99, 2011;

[4]   Crișan D.A., Preda A.M., Coculescu C., Altăr-Samuel A.N., "Some aspects concerning the correlation between ICT and innovation in Europe", The 6th International Conference "European Integration – New Challenges", 28 - 29 May 2010, Univ. Oradea, Romania, pp. 2436-2442, ISBN 978-606-10-0149-1, 2010, published in „Analele Universităţii din Oradea, Seria Ştiinţe Economice"(Journal: Annals of the University of Oradea : Economic Science Year: 2010 Vol: 1 Issue: 2 Pages/record No.: 1183-1189), ISSN-122569, vol I, issue 2, pp. 1183-1189, 2010;

[5]   European Commission (2013), "HORIZON 2020 in brief. The EU Framework Programme for Research & Innovation". Available at: http://bookshop.europa.eu/en/horizon-2020-in-brief-pbKI0213413/?CatalogCategoryID=Gj0KABst5F4AAAEjsZAY4e5L

[6]   European Commission (2013),"Factsheet: HORIZON 2020 Budget". Available at: http://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/281113_Horizon%202020%20standard%20presentation.pdf

[7]   European Commission (2014), "Innovation Union Competitiveness Report 2013". Available at http://ec.europa.eu/research/innovation-union/pdf//competitiveness_report_2013.pdf#view=fit&pagemode=none

[8]   European Commission (2016), "European Innovation Scoreboard 2016". Available at http://ec.europa.eu/DocsRoom/documents/17822

[9]   European Union (2013), "Regulation (EU) no 1291/2013 of the European Parliament and of the Council of 11 december 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC", Official Journal of European Union, series L 134, 20.12.2013, pp. 104-173. Available at: http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/fp/h2020-eu-establact_en.pdf

        https://www.globalinnovationindex.org/

[10]   Preda A.M., Crișan D. A., Stănică J.L., "The Impact of ICT on Innovation Performance in Europe. Case of Romania", Journal of Information Systems and Operations Management (JISOM), Vol 8 No 1, 2014, pp. 1-12, Ed. Universitara, 2014;

[11]   Preda A.M., Crișan D.A., Potecea O.," A study on the relationship between ICT and innovation in Europe", The 17th International Economic Conference – IECS 2010 "Economic world' destiny: Crisis and Globalization", May 13-14, 2010, Univ. Lucian Blaga, Sibiu, Romania, proceedings: pp.178-183 (CD Version), 2010;

[12]   Preda A.M., Crișan D.A., Stănică J.L.,,"Modeling the impact of ICT on innovation performance", presented at the 19th International Economic Conference – IECS 2012, "The persistence of the global economic crisis: causes, implications, solutions", June 12 2012, Univ. Lucian Blaga, Sibiu, Romania, published in proceedings: (CD Version), 2012;

[13]   Preda A.M., Stănică J.L., Crișan D.A., Coculescu C., "E-Government: A Driving Factor For Stimulating Innovation Performance In Romania?", Proceedings of the 7th International Conference European Integration – New Challenges, 7th Edition, May 2011, Univ. Oradea, Romania, 2011, pp. 125-130, ISBN 978-606-10-0521-5; Journal: Annals of the University of Oradea : Economic Science Year: 2011 Vol: 1 Issue: 1 Pages/record No.: 125-130, ISSN (print): 1222-569X, 2011;

[14]   PRO INNO Europe® (2013), "Innovation Union Scoreboard (IUS) 2013: Research and Innovation Union Scoreboard".

[15]   PRO INNO Europe® (2014), "Innovation Union Scoreboard (IUS) 2014: Research and Innovation Union Scoreboard".

[16]   PRO INNO Europe® (2015), "Innovation Union Scoreboard 2015". Available at http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards/files/ius-2015_en.pdf

[17]   World Economic Forum (2007), "Global Information Technology Report 2006-2007: Connecting to the Networked Economy". Soumitra Dutta, Irene Mia, Ed. Palgrave Macmillan

[18]   World Economic Forum (2008), "The Global Information Technology Report 2007-2008: Fostering Innovation through Networked Readiness". Soumitra Dutta, Irene Mia, Ed. Palgrave Macmillan

[19]   World Economic Forum (2009), "The Global Information Technology Report 2008-2009: Mobility in a Networked World". Soumitra Dutta, Irene Mia, Ed. SRO-Kundig, Geneva

[20] World Economic Forum (2010), "The Global Information Technology Report 2009-2010: ICT for Sustainability". Soumitra Dutta, Irene Mia, Ed. SRO-Kundig, Geneva

[21] World Economic Forum (2011), "The Global Information Technology Report 2010-2011: Transformations 2.0". Soumitra Dutta, Irene Mia, Ed. SRO-Kundig, Geneva

[22] World Economic Forum (2012), "The Global Information Technology Report (GITR) 2012 - Living in a Hyperconnected World", Soumitra Dutta, Beñat Bilbao-Osorio, Ed. SRO-Kundig, Geneva

[23] World Economic Forum (2013), "The Global Information Technology Report 2013 - Growth and Jobs in a Hyperconnected World", Beñat Bilbao-Osorio, Soumitra Dutta, Bruno Lanvin, Ed. SRO-Kundig, Geneva

[24] World Economic Forum (2014), "The Global Information Technology Report 2014 - Rewards and Risks of Big Data", Beñat Bilbao-Osorio, Soumitra Dutta, Bruno Lanvin, Ed. SRO-Kundig, Geneva

[25] World Economic Forum (2015), "The Global Information Technology Report 2015 - ICTs for Inclusive Growth", Soumitra Dutta, Thierry Geiger, Bruno Lanvin, Ed. SRO-Kundig, Geneva, available at: http://reports.weforum.org/global-information-technology-report-2015/network-readiness-index/

[26] World Economic Forum (2016), "The Global Information Technology Report 2016: Innovating in the Digital Economy", Ed. Silja Baller, Soumitra Dutta, and Bruno Lanvin, available at: http://www3.weforum.org/docs/GITR2016/WEF_GITR_Full_Report.pdf

[27] World Economic Forum (2016), "The Global Innovation Index 2016. Winning with Global Innovation", Ed. Soumitra Dutta, Bruno Lanvin, and Sacha Wunsch-Vincent, available at: https://www.globalinnovationindex.org/

[28] World Intellectual Property Organization (2015), "The Global Innovation Index 2015 - Efective Innovation Policies for Development", Soumitra Dutta, Bruno Lanvin, and Sacha Wunsch-Vincent, Geneva, Switzerland, available at: https://www.globalinnovationindex.org/userfiles/file/reportpdf/GII-2015-v5.pdf