INTERCONNECTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES AS A RIS3 KEY PRIORITY AND INNOVATION

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Abstract
Smart Specialisation Strategy (S3) concept is incorporated in EU policies almost a decade ago with the aim of more effective and stronger support to national and regional strategic priorities and fields in which countries and regions can develop a potential competitive advantage. Information and communication technologies (ICT), although a priority area themselves, interconnect and complement all other priority areas which makes them even more important. In analyzing S3 concept implementation researchers found numerous issues that limit its application in desired scope. This paper aims to analyze the S3 implementation and inclusion of ICT as one of the key priorities of National Research and Innovation Strategies for Smart Specialisation (RIS3). This paper is giving the answers on following research questions: "Are digital technologies in the focus of less developed or lower level innovation countries, as of their existing potential to become future economic growth drivers?" and "What is the impact of *Europe 2020 Strategy,* measured in GDP per capita percentage change, in the period before and after the *Europe 2020 Strategy* presentation?".
It was found that the lower-level innovation countries are more often choosing the ICT as RIS3 priority. These and other findings stated in this paper can be of use for policy-makers on the EU and national level in a future revising of the RIS3.

Keywords
Information & communication technologies, GDP per capita growth, Research and Innovation Strategies for Smart Specialisation

JEL Classification:
O52, O20

Introduction

As of European Union (EU) endeavours to reduce gaps in the development of its Member States and to achieve balanced economic growth, numerous policies have been adopted and activities carried out. „Since 2000, the financial instruments of the European programs have been more focused on making innovation policies more effective and in line with business needs, in particular by encouraging greater cooperation between business and other economic actors." (Pacheco et al., 2020, p.14) "Investment plan for Europe" was adopted in 2014 with the aim "to boost investment, to increase competitiveness and to support long-term economic growth in the EU" (European Council, 2020, p.1). The Smart Specialisation concept on the level of EU was developed in the frame of *Europe 2020: a European strategy for smart, sustainable and inclusive growth* proposed by the European Commission in 2010. The regions and Member States have been developing their own national and regional *Research and Innovation Strategies for Smart Specialisation* (RIS3) for the financial period 2014-2020, intending to identify the key priorities which can be supported from the EU funds, primary European Regional Development Fund (ERDF) (Jurlin et al., 2018) The special value of the Smart specialisation concept was that it was „expected to create more diversity among regions than a regime in which each region tries to create more or less the same by imitation." (Foray et al., n.d.) Smart Specialisation in this context means „countries should identify strategic "domains" of existing and/or potential competitive advantage, where they can specialize and create capabilities in a different way compared to other countries and regions" (Asheim, 2018, pp. 2-3) „Smart Specialisation policy targets industrial restructuring and economic growth, therefore understanding the economic effects of S3 is crucial for policy design and evaluation." (Varga et. al, 2020, p. 17) The concept of sustainable and smart growth was spread over the EU borders. In 2015 UN Member States, adopted 17 Sustainable Development Goals (SDGs) as part of the 2030 Agenda for Sustainable Development. Out of 17 goals, 3 are directly connected to the macroeconomic aspect of growth; *Reduce inequality within and among countries* (10), *Industry innovation and infrastructure* (9) and *Promote sustained, inclusive and sustainable economic growth full of productive employment and decent work for all* (8). By analyzing the achievements of all member countries it was found that EU countries are among the top 20 worldwide in achieving the SDGs. At, the other hand the European Commission (EC) gave an overview of progress towards the SDGs in an EU context where it was emphasized that the macroeconomic directed goals 9 and 10 are the lowest-ranked, while the 8 is placed in the middle of the moderate progress rank (European Union, 2019). Following the previous S3 concept „in the new programming period 2021-2027, according to the European Commission proposal (2018), the governance of the national or regional strategy for smart Specialisation is the only enabling condition (a precondition for effective and efficient implementation) for Cohesion Policy Objective 1: "A smarter Europe, promoting smart and innovative economic transformation". (Pacheco et al., 2020, p. 10) Landesmann and Stöllinger (2020) are seeing S3 supported by the major EU fund (ERDF) as a way of improving the effectiveness of the EU's cohesion. In this process digital transformation, key technologies and ICT are seen as development drivers (Bestvina and Đurđević Babić, 2019). In Slovakia, as a result of technology-oriented national Smart Specialisation strategies almost EUR 400 million was invested in science parks and capacity building incubators specializing in ICT or biotechnology (Balog, 2020:114) to raise the level of digital and technical innovation capacities. Nevertheless, the significant differences in absorption power and the capacity to implement the RIS3 between Member States are arising. The aim of this paper is to contribute to the ongoing discussion and better understanding of an S3 concept and analysis of the level of inclusion of ICT as one of the RIS3 key priorities which will be determining Europe's future global competitiveness and a concept that can contribute to fostering of economic growth of less developed or countries positioned on a lower level of Innovation Scoreboard. The authors are expecting to get the answers on the

following research questions: “Are new technologies in the focus of less developed or less innovative countries as possible future economic growth drivers?” and “What is the impact of *Europe 2020 Strategy,* measured in GDP per capita percentage change, in the period before and after the Strategy presentation?”.
The paper is giving the analyses of data published by Eurostat and EU of the presence of the ICT in the national RIS3 by the level of country innovation performance and analysis of annual GDP per capita percentage change trends (observing the periods before and after the presentation of the *Europe 2020 Strategy*, i.e. 2000-2009 and 2010-2018) for 28 European countries (EU Member States and United Kingdom (UK)).

Smart Specialisation implementation challenges

Although S3 is a progressive concept set on the level of EU policies and strategic documents its implementation faced numerous obstacles. Many factors are influencing the S3 success and furthermore, even its applicability to less-developed countries and regions has been questioned (Hassink and Gong, 2019; Trippl et al., 2020, Murzyn, 2019; Kiel, 2019). It was found that there are open question starting from the efforts of local policy to develop models for its implementation and development of institutional support, the absorptive capacity of regions and companies, R&D organization inclusion into development processes, funding capacities, etc. It seems that after the S3 devising, the development of a supporting environment for its implementation should become a priority. (Trippl et al., 2020) But the differences in absorption are not only coming from the challenges on the national level but on the regional and local levels (Keil, 2019, Hassink and Gong, 2019; Trippl et al., 2020, Murzyn, 2019). Pavone et al. (2019) are searching for regional differences to find complementarities and synergies among the EU regions that could be of use in designing and implementation of innovative programs within the regions, where regions should conduct more focused than generic analyses and learn from other more successful regions (Balland et al., 2018; Varga et al., 2020). The models of improving connectivity between regional stakeholders should be developed, as low connectivity is slowing down the S3 implementation (Mäenpää, 2020). But, at the same time „even when regional capabilities and inter-regional linkages are in place, a weak institutional structure might still prevent a successful diversification process in regions.” (Balland, Boschma, 2019) Papamichail, Rosiello and Wield (2019) have argued that there are three Capacity-building barriers are preventing S3 practices fulfilling its goals which include the lack of collaboration especially between the companies and universities and absence of trusted-based relationships based on Quadruple Helix model that lead towards a different understanding of strategic networking and lack of quality science-business projects (Papamichail et al., 2019) Keil (2019) analyzed how the S3 affected policy-making and how it was adopted in an existing institutional environment in Poland and Lithuania, both moderate innovators. She found that both countries struggled with adopting the innovation concept, especially in the business sector, trying to find a solution with low absorption capacities and possible low cooperation level between business, government and universities with a consequence of a relatively low application success rate in some priority field where business should be involved (Keil, 2019). This is in line with the findings of other authors (Trippl et al., 2020; Papamichail et al., 2019; Asheim, 2018). For those reasons the researchers are questioning the ways of the S3 model implementation and setting models of measurement of the Smart Specialisation effects (Hassink and Gong, 2019; Varga et al. (2020). Hassink and Gong (2019) state that the measurements are important to assess the potential of the regional economy to set and carry out the strategy and to evaluate the results of carried measures according to the strategic plan. This could be of valuable help to policy-makers to set up new or conduct a revision of existing S3 priorities (Varga et al. 2019). Future Smart Specialisation development measures need to impact on „research and

innovation, education (training and skills development), and digital society (using IT and communication technologies)" (Murzyn, 201, p.4)

Research methodology

The study was conducted through the following steps:

1) Review of EU policies, EU strategies and studies on S3 concept implementation which were given by previous chapters for the purpose of research question development;
2) Design of the research questions and identification of data sources;
3) Data processing, analysis and conclusions:
   a) Determination of the relation between the level of innovation and ICT as a key priority in RIS3 on the level of the Member States and the UK;
   b) Statistical analysis: comparison of differences in a GDP per capita percentage change, before and after the *Europe 2020* proposal based on country innovation level and comparison of differences in a GDP per capita percentage change of countries that defined ICT as RIS3 key priority.

Through the literature review, the following research questions were set: "Are the new technologies in the focus of less developed or less innovative countries as possible future growth drivers?" and, "What is the impact of *Europe 2020 Strategy,* measured by GDP per capita percentage change in the period before and after the *Europe 2020 Strategy* presentation?"

This study presents the analysis of data published by Eurostat and EU institutions where quantitative analysis applies on two periods: 2000 to 2009 and 2010 to 2008 (before and after the presentation of the *Europe 2020 Strategy* respectively*)*. As of the small sample (28 countries composed of EU Member States and the UK as a former member that was still having a membership status in 2018) the for the purpose of analysis and confirmation of research claims authors used descriptive statistics and non-parametric (Mann-Whitney test). For the same reason the EU Member States were divided by innovation level on two groups: the Lower level innovators (modest and moderate innovators) and the Upper-level innovators (strong innovators and innovation leaders) by 2019 Innovation Scoreboard (Hollanders et al. 2019). Following this paper presents research limitations as follows: small sample size (all EU countries) and mixed distributions (tested by Shapiro-Wilk test) which were the reasons why a non-parametric test was used in statistical analysis. Additionally, the analysis was conducted on the national level where there could be differences depending on the level of regional development and absorption power. This paper is not indicating the reasons for success or a less satisfying S3 implementation results, but it is only presenting the conclusion regarding the existence of differences for the two observed groups during different periods. As well, this research was not analyzing macroeconomic circumstances that could affect the GDP. Global changes are more or less having an impact on all open economies but there are macroeconomic changes on the national level that are as well, out of reach of this survey.

Results and discussion

Through the first step of this research the identification of the connection of innovation level and ICT as a key priority in RIS3 on the level of the Member States and the UK was carried out. Table 1 provides a comparative analysis of the presence of ICT in the national S3 of the Member States and the United Kingdom, by the level of country innovation performance. It can be seen that the presence of the ICT as a Smart Specialisation priority area is more frequent in the modest and moderate level innovator group (69%) than in the upper level innovator countries (42%) where they could be hoping that new digital technologies and development of the society of knowledge will foster their economic growth and mitigate the difference in development to highly developed countries.

Table no. 1 Comparative analysis of the presence of the ICT as a RIS3 priority of EU Member States and the UK by the level of country innovation performance

Upper-level innovators		Lower-level innovators	
Innovation Leader	**Strong Innovator**	**Moderate Innovator**	**Modest Innovator**
FINLAND*	**IRELAND***	**ESTONIA***	**BULGARIA***
SWEEDEN*	**AUSTRIA***	**HUNGARY***	**ROMANIA***
GERMANY*	FRANCE	**POLAND***	
UK (former EU member)	LUXEMBOURG	**ITALIA***	
NETHERLANDS	SLOVENIA	**LATVIA***	
DENMARK		**SPAIN***	
BELGIUM		**CZECH REPUBLIC***	
		SLOVAKIA*	
		MALTA*	
		CROATIA	
		PORTUGAL	
		LITHUANIA	
		GREECE	
		CYPRUS	
% of countries with ICT as a RIS3 key priority in the innovation group			
43%	**40%**	**60%**	**100%**

**Note: EU Member countries with ICT as a RIS3 key priority.*

Source: author's work according to the Data published by the European Commission (2017), Publications Smart Specialisation - Strengthening Innovation (for all member countries and UK) and European Innovation Scoreboard report (Hollanders et al. 2019).

The quantitative research was based on analysis of differences of annual GDP per capita percentage change of the Member States and the UK, before and after the *Europe 2020* proposal through the following:

a) Comparison of a difference between the average annual GDP per capita percentage change in two periods (2000-2009 / 2010-2018). The countries were divided into two categories based on their innovation performance; therefore, the grouping variable was Innovation level where countries were divided on Upper and Lower level innovation countries (by Innovation Scoreboard 2019).

b) Comparison of a difference between the average annual GDP per capita percentage change in two periods (2000-2009 / 2010-2018) by the existence of ICT as RIS3 key priority (grouping variable).

A non-parametric Mann–Whitney test was used to analyze statistical differences on the sample of 28 countries, EU Member States and the UK. The results are following:

a) Grouping Variable: Innovation level (Upper and Lower level innovators) :

Difference of average annual GDP per capita percentage change of two observed periods for Upper level innovators (Mdn = -1.561) significantly differ the same indicator for Lower level innovators (Mdn = -1.112). (Mann-Whitney U = 45.00, z = -2.368, $p < .05$ (Exact Sig. (2-tailed)), r(Hedges' g) = 0.885. The effect size is large by benchmarks set by Jacob Cohen (1988).

By analysis of an annual GDP per capita percentage change between two observed periods, it was found that after the *Europe 2020 Strategy* proposal as of macroeconomic environment all countries faced decrease (from average annual growth of 2.55% to 1.94% comparing two observed periods) where the Lower level innovators faced a larger decrease of an average annual GDP per capita percentage growth (from 3.41% to 2.24%) than Upper-level innovators (1.54% to 1.40%), although all countries in average continued to achieve a positive annual GDP per capita percentage growth in a period following 2010 this increase was more modest.

b) Grouping Variable: ICT as RIS3 priority : By analysis of the differences between observed countries by criteria of the ICT as a key priority in RIS3 it was found that average annual GDP per capita percentage growth in both observed periods significantly differ between the countries that have not chosen ICT as a key priority in RIS3 ($Mdn0_{2010-2018} = 1.4450$; $Mdn0 = 0.9556$) in comparison to those that have chosen it ($Mdn1_{2000-2009} = 2.2500$; $Mdn1_{2010-2018} = 2.9111$). Following the results for both periods are given:

Results for the average change of average annual GDP per capita percentage growth in the period 2000-2009 (Grouping variable: ICT as RIS3 priority): (Mann-Whitney $U = 66.00$, $z = -1.393$, $p < .05$ (Exact Sig. (2-tailed)), r(Hedges' g) = 0.517619. The effect size is medium (Cohen, 1988).

Results for the average change of GDP per capita in the period 2010-2018 (Grouping Variable: ICT as RIS3 priority): (Mann-Whitney $U = 51.50$, $z = -2.066$, $p < .05$ (Exact Sig. (2-tailed)), r(Hedges' g) = 1.00238. The effect size is large (Cohen, 1988).

Through this analysis, it was found that both innovation groups that have chosen ICT as their RIS3 key priority have had larger growth of the observed indicator than the countries from the same group that has chosen other priorities (a group of countries with ICT as RIS3 key priority: Upper = 2.15%; Lower = 2.77; countries without ICT as RIS3 key priority Upper = 1.10%; Lower = 1.06).

Conclusions

The aim of this paper was to contribute to the ongoing discussion and better understanding of an S3 concept and to give the results of the analysis of the level of inclusion of ICT as one of the RIS3 key priorities as digital technologies are the ones that are considered as drivers of Europe's future global competitiveness and a concept that can contribute to fostering of economic growth of less developed countries. The question of a lack of institutional capacities and differences in the economic development and innovation level between countries and regions is being raised as an obstacle to a more efficient S3 implementation. The positive impact of implementation *Europe 2020 Strategy* was not found as both groups have faced the decline of the annual GDP per capita percentage growth as of macroeconomic circumstances whose analysis is out of the scope of this research. Nevertheless, it was found that most countries from the Lower level innovators (modest and medium innovators by Innovation Scoreboard 2019) have ICT as a key priority of their RIS3 strategies where this priority is more frequent in the Lower level innovators group than in the Upper-level innovators group of countries. In a group of Lower-level innovators, on average the countries with ICT as a key priority in RIS3 had a larger annual GDP per capita percentage growth than the comparable ones that didn't define ICT as a key priority. As of the limitations of the research stated in the previous chapter these conclusions are indicative but can be of use for policy-makers on regional, national and EU level as they point to the fact that the countries that are focused on digital technologies are achieving higher and stable growth.

Future research should analyze the implementation of RIS3 priorities on a regional level for the purpose of identifying the existing problems and actual benefits. As well, it would be important to assess the expediency of strengthening the ICT sector and asses its impact on the rest of the economy including the spatial spillovers. (Billon, 2016)

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References

Asheim, B.T., 2019. Smart specialisation, innovation policy and regional innovation systems: what about new path development in less innovative regions? *Innovation: The European Journal of Social Science Research*, 32(1), pp.8–25.

Balland, P.A., Boschma, R., Crespo, J. and Rigby, D.L., 2018. Smart specialization policy in the European Union: relatedness, knowledge complexity and regional diversification. Regional Studies. *Regional Studies*, 53(9), pp.1252-1268.

Balland, P.A. and Boschma, R., 2019. *Exploring the impact of inter-regional linkages on regional diversification in Europe in the context of smart specialisation*. European Commission. [pdf] Available at: <https://ec.europa.eu/regional_policy/sources/docgener/brochure/impact_ir_linkages_en.pdf> [Accessed 7 April 2020].

Balog, M., 2020. *Slovak R&d Strategic Infrastructures And Smart Specialization*. Varazdin: Varazdin Development and Entrepreneurship Agency (VADEA), [online] Available at: <https://search-proquest-com.am.e-nformation.ro/docview/2387309064?accountid=136549> [Accessed 27 February 2020].

Bestvina Bukvić, I. and Đurđević Babić, I., 2019. *Catching the it development trends: what are the odds?* [pdf] Available at: <https://bib.irb.hr/datoteka/1044252.Pages_from_Megatrends_and_Media_Digital-Universe-3.pdf> [Accessed 27 February 2020].

Billon, M., Marco, R. and Lera-Lopez, F., 2016. Innovation and ICT use in the EU: an analysis of regional drivers. *Empirical Economics*, 53(3), pp.1083–1108.

European Council, 2020. *Investment plan for Europe*, [online] Available at: <https://www.consilium.europa.eu/en/policies/investment-plan/> [Accessed 28 March 2020].

European Union, 2019. *Reflection Paper Towards a Sustainable Europe by 2030*. [pdf] Available at: <https://op.europa.eu/en/publication-detail/-/publication/3b096b37-300a-11e9-8d04-01aa75ed71a1/language-en/format-PDF> [Accessed 29 March 2020].

Eurostat, 2020. *Real GDP per capita*. [online] Available at: <https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table> [Accessed 8 March 2020].

Foray, D., Morgan, K. and Radosevic, S., 2018. *The Role of Smart Specialisation in the EU Research & Innovation Policy Landscape*. European Commission. [pdf] Available at: <https://ec.europa.eu/regional_policy/sources/docgener/brochure/smart/role_smartspecialisation_ri.pdf> [Accessed 28 March 2020].

Hassink, R. and Gong, H., 2019. Six critical questions about smart specialization. *European Planning Studies*, 27(10), pp.2049-2065.

Hollanders, H. Es-Sadki, N. and Merkelbach, I., 2019. *Innovation Scoreboard 2019,* [online] Report of the European Innovation Scoreboards (EIS) project, Brussels: European Commission, 2019. Available at: <https://ec.europa.eu/docsroom/documents/38781/attachments/1/translations/en/renditions/native> [Accessed 28 March 2020].

Jurlin, K., Samardžija, V., Basarac Sertić, M., 2018. *Konkurentnost, pametna specijalizacija i investicije u novim državama članicama EU-a i Hrvatskoj.* Zagreb: POLO-Cro28 Policy Paper, Institut za razvoj i međunarodne odnose – IRMO.

Keil, S., 2019. Smart Specialisation in Moderately Innovative Regions – A Qualitative Study of Poland and Lithuania. *Studia i Materiaÿ*, 1(30), pp.5–19.

Landesmann, M. and Stöllinger, R., 2020. *The European Union's Industrial Policy: What are the Main Challenges?* Policy Notes and Reports 36, The Vienna Institute for International Economic Studies, [online] Available at: <https://ec.europa.eu/eurostat/web/products-datasets/-/sdg_08_10> [Accessed 6 April 2020].

Mäenpää, A., 2020. *The Challenges of Public Organisations in Coordinating Smart Specialisation and a Connectivity Model as One Solution*. Acta Wasaensia, 438, Doctoral thesis by publication, University of Vaasa, [online] Available at: <https://osuva.uwasa.fi/bitstream/handle/10024/10254/978-952-476-898-6.pdf?sequence=2&isAllowed=y> [Accessed 10 April 2020].

Murzyn, D., 2020. Smart growth in less developed regions – the role of EU structural funds on the example of Poland. *Innovation: The European Journal of Social Science Research*, 33(1), pp.96–113.

Pacheco, V., Araújo, N., and Rocha, L., 2020. Open Innovation: from OI to OI2. In: *International Conference on Economics*, January 23-25, Porto, Portugal.

Papamichail, G., Rosiello A. and Wield, D., 2019. Capacity-building barriers to S3 implementation: an empirical framework for catch-up regions, Innovation. *The European Journal of Social Science Research*, 32(1), pp.66-84.

Pavone, P., Pagliacci, F., Russo M. and Giorgi, A., 2019. *R&I smart specialisation strategies: classification of EU regions' priorities.* Results from automatic text analysis, DEMB Working Paper Series N. 148. [pdf] Available at: <https://www.alpine-space.eu/projects/alpgov/deliverables/ag1/ag1-t3.1.2_pavone_pagliacci_russo_giorgi_r-i_smart_specialisation_strategies.pdf> [Accessed 9 April 2020].

Sörvik, J. and Kleibrink, A., 2015. *Mapping Innovation Priorities and Specialisation Patterns in Europe*. European Commission, JRC-IPTS, S3 Working Paper Series No. 8. [pdf] Available at: <https://danube-inco.net/object/document/14997/attach/JRC95227_Mapping_Smart_Specialisation_Priorities.pdf> [Accessed 28 March 2020].

Trippl, M., Zukauskaite, E. and Healy, A., 2019. Shaping smart specialization: the role of place-specific factors in advanced, intermediate and less-developed European regions. *Regional Studies*, pp.1–13.

Varga, A., Szabó, N. and Sebestyén, T., 2020. Economic Impact Modeling of Smart Specialization Policy. Which Industries should Prioritization target? [online] *Papers in Regional Science*, pp. 1–22, online. Available at: <https://rsaiconnect.onlinelibrary.wiley.com/doi/epdf/10.1111/pirs.12529> [Accessed 9 April 2020].