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THE INFLUENCE OF RESEARCH AND DEVELOPMENT EXPENDITURE AND LEVEL OF INTERNET ACCESS ON EMPLOYED ICT SPECIALISTS IN ROMANIA

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Abstract: The ICT sector and digitalization play a key role in the development of any economy. In the current pandemic context, this role has grown considerably. Level of internet access in households, level of internet access of the population, but also expenditures on research and development in this sector have led to an increasing number of specialists employed in the field. The purpose of this paper is to analyze the influence of research and development expenditures as a percentage of GDP and households with internet access on the number of ICT specialists employed in this field in Romania. A strong positive correlation was identified between these variables, showing a growth in these process. However, it is essential, that this sector to continue to develop, so that Romania can have the number of specialists that develop countries from European Union have.

Keywords: Digitalization, European Union, Romania, Internet Access.

INTRODUCTION

In the last years, the subject of digital skills was a priority for European Union, as we can see in A Digital Agenda for Europe (2010) and A Digital Single Market Strategy for Europe (2015), through the importance of ICT sector in the economy and society. Also, around the world the things went in the same direction, as we can see in the SkillSET initiative of the World Economic Forum (2018).

According to Digital Organizational Frameworks and IT Professionalism report (2019),„...the European industry and the national education & training systems have over the last three years managed to create significantly more than originally estimated ICT jobs and ICT employees (8.5 million as opposed to an estimated 8.2 and 7.8 million in our estimates from 2017 and 2015). „ Also, one of the two scenarios that European Commission presented in the same report, the „moderate growth scenario", shows that „the ICT specialist workforce in Europe will grow from 8.5 million in 2016 to 9.0 million in 2020, of which 7.6 million will be ICT practitioners and 1.5 million ICT management and analysis level employees. Demand is increasing despite the modest economic circumstances, from 8.9 million in 2016 to 9.6 million in 2020. „The second scenario of the same

report presents the following: „the ICT specialist workforce in Europe will grow from 8.5 million in 2016 to 9.5 million in 2020, of which 8.1 million will be ICT practitioners and 1.4 million ICT management and analysis level employees. Demand is increasing by 3.6% per year, from 8.9 million in 2016 to 10.3 million in 2020."

The subject of digitalization, digital skills, access to internet and the impact of it on the society it's an important concern also for the researchers. According to Rivza and CO (2019): „In order for digitalized activities to emerge, the territory where the activities develop has to have a digital environment, i.e. Fiber to the Premises (FTTP), meaning the Internet is available to any group of individuals interested in the use of it".

According to Babucea and Rabontu (2019) „people using digital technologies on the job every day, having necessary skills for using it, but many employed persons in Romania do not have digital skills, yet." Also" Bologna and Lupu (2017) highlighted a deficit of ITC specialist in the EU, which will lead to a demand on the Romanian labor market for the ICT specialists. So, in Romania, the investments on the research and development IT sector needs to grow, because to gain good specialists in ITC sector, you don't need only the access to internet in order to develop digital skills, but also some investments in this sector. In the last years, Romanian Government supported the ICT sector not only by investments but also by some incentives and tax breaks. All these financial measures adopted, led (since 2016) to a growth regarding the net average monthly earnings, which almost doubled comparative to the level of the national economy.

METHODOLOGY AND DATA DESCRIPTION

When we talk about the digital economy, we mean a wide range of economic activities and the huge volumes of data generated. Now, there are many new sources of information but largely unstructured for statistical purposes. Thus, statistical agencies are required to play a new role in data management, which involves the application of efficient and secure practices for data storage, manipulation and dissemination.

The demand for new data, indicators and measurement tools is acute in the digital economy due to the growing role it plays in world economies and in everyday life. The toolkit for measuring the digital economy brings together different methodological approaches and indicators that can be used to monitor the digital transformation and highlights the critical gaps and challenges facing countries.

Digitization is progressively changing the way we understand our world, by creating new business models and processes, generating new smart products and services with lower costs and faster delivery, all of which reshape consumer behavior.

Major questions arise about the ability of the conventional instrument set to measure economic activity in the face of such changes. Digital products, services and means of economic interaction make the task of identifying economic phenomena more difficult, especially for economic and financial statistics.

In this sense, we created that aims to identify the extent to which the percentage of ICT employees is influenced by the percentage of households with internet access and research and development expenditures in Romania:

EICTS=C (1) +C (2)*HLIA+C (3)*RDESF+ εt

where:

EICTS= Employed ICT specialists

HLIA- Households - level of internet access

RDESF= Research and development expenditure, by sectors of performance

C (1) = represents the coefficients of the intercept

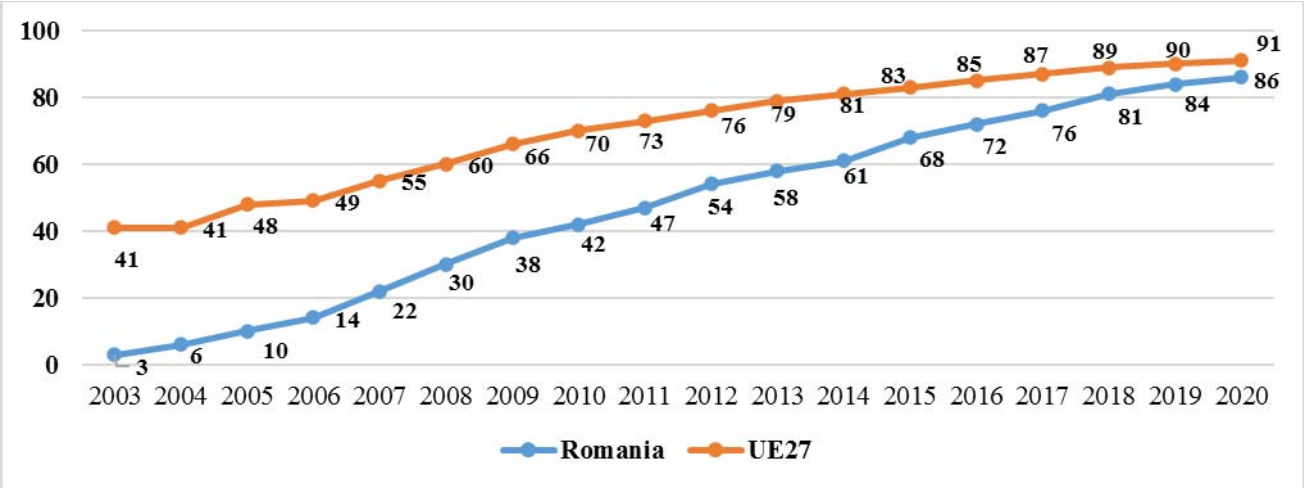
C (2) = represents the coefficients of the Households - level of internet access

C (3) = represents the coefficients of the Research and development expenditure, by sectors of performance

εt = represents the residues.

The variables chosen in the model were chosen due to their relevance, and the data series are from 2003 to 2020. The data of the three selected indicators were followed from the point of view of the evolution at EU27 level, but also of Romania in order to be able to perform a comparative analysis.

Fig. 1 Households - level of internet access between 2003-2020



Source: own processing based on data from Eurostat

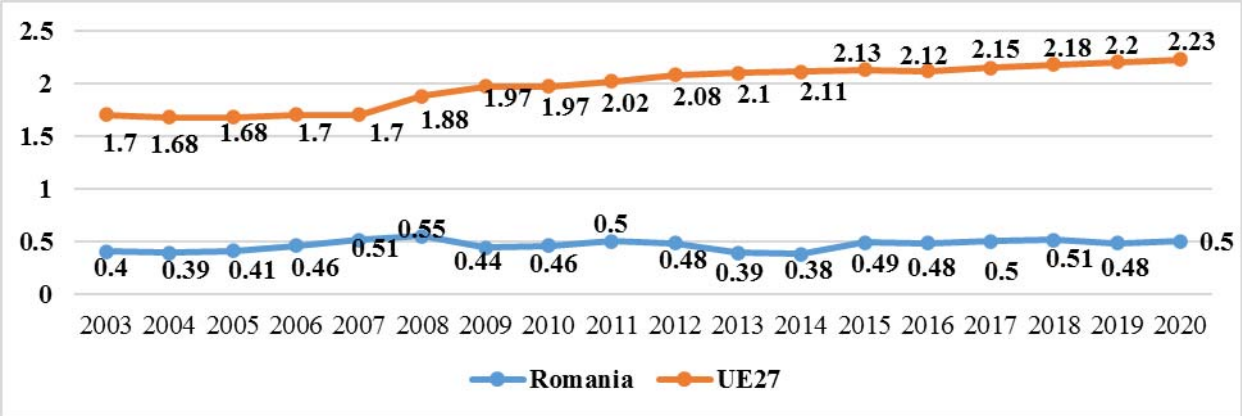
Compared to 2003, the percentage reached in 2020 is over 28 times higher. The increases in the first five years were between 35 and 100%. After that, starting with 2008, the increases gradually

decreased to 2.38% (the increase registered in 2020). Regarding the share of households with internet access, Romania is only on the seventh place, together with Slovakia, with 86%.

In 2020, the total share of EU-27 households with internet access reached a new high of 91%. The increase by one percentage point compared to the previous year continued the trend of improving household access, which can be seen throughout the European Union.

The Netherlands is ranked first with an access of 97%, even if it registered a decrease of 1% compared to the previous year, followed by Finland and Germany with 96%, and at the bottom of the ranking is Bulgaria with 79%.

Fig. 2 Research and development expenditure by sectors of performance, in the period 2003-2020



Source: own processing based on data from Eurostat

Research and development (R&D) is a major driver of innovation, and research and development spending and intensity are two of the key indicators used to monitor global science and technology resources. Thus, research and development spending is a key factor in government and in private sector efforts to gain a competitive edge in science and technology.

Compared to the previously presented indicator, the evolution of the share of research and development as a percentage of GDP has significant fluctuations and thus has reached over the year's increases and decreases. Compared to 2003, the year 2020 shows an increase of only 25%. Thus, Romania, closes the ranking on the last position with only 0.50%, far from the European average and the targets proposed at national level.

At EU level, Austria ranks well above average, reaching 3.19%, followed by Germany with 3.18% and Denmark with 2.91.

Fig. 3 Employed ICT specialists in the period 2003-2020

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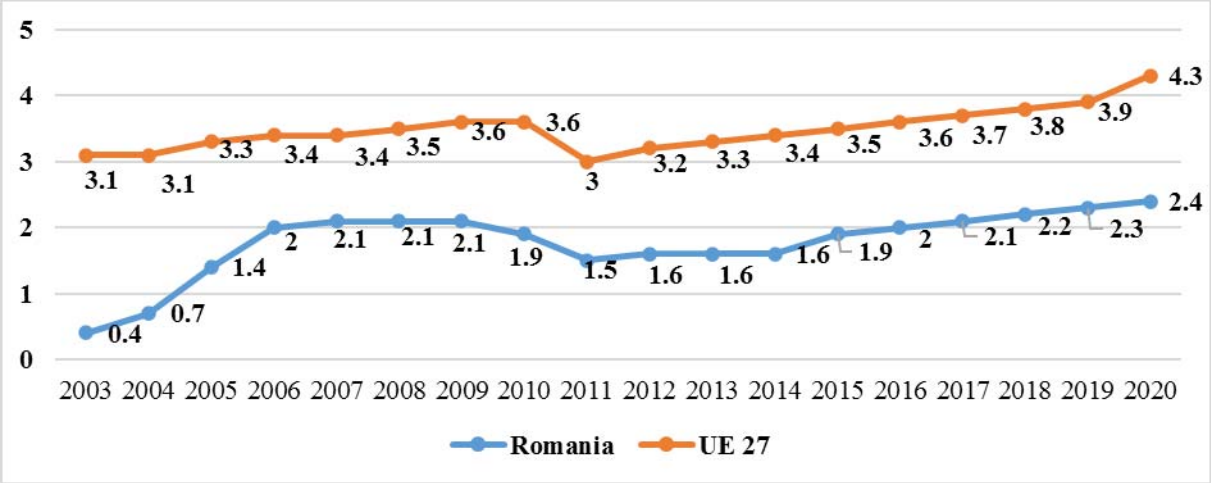

Source: own processing based on data from Europa.eu

Regarding the share of specialists employed in the field of ICT, there is a percentage six times higher in 2020, compared to 2003, however Romania ranks below the European average with a share of 2.4%,

In terms of the situation at EU27 level, Finland reached the highest figures when it comes to the share of ICT workers with 7.6%, followed by Sweden with 7.5% and Estonia with 6.5%, and the last position is occupied by Greece with only 2%.

The introduction of new technologies and digitalization - often referred to as the Fourth Industrial Revolution - has an impact on society through changes in the way people live, work and interact with each other. ICTs have already caused significant changes in production methods and employment patterns in the European Union. Therefore, policy makers and researchers have an interest in tracking employment developments for ICT specialists, because they influence a country's comparative advantage in the development, installation and service of ICT.

We performed a primary analysis that allows us to detach an important conclusion regarding the correlation between the indicators.

Table 1: Descriptive of Statistical evidence for the indicators used

	EICTS	HLIA	RDESF
Mean	1,92	49,94	47,53
Median	2	54	48
Stand. Dev.	0,30	26,61	0,04
Kurt.	1,95	1,79	3,25

Skew.	-0,30	-0,25	-0,81

Source: Author's own results

The processing of data on the distribution of the weights of specialists employed in the field of ICT, led to the determination of an average share of 1.9%. On average, in half of the total years, the share is less than 2%, and in the rest of the years, the rest of the shares are higher than the determined value. The value of the standard deviation is not low, which means that the vast majority of values did not take values around the average. Skewness has a negative value, which indicates an asymmetry to the right, the median being placed to the right of the average on the graph. The value distribution is platikurtic, because Kurtosis is less than 3, which shows us that the series has values scattered over a larger range around the mean. The normal distribution of the weights of specialists employed in the field of ICT is highlighted by the Probability value of the JB test of 0.99 which is significantly higher than the significance threshold of 5% ($p > 0.05$).

The central trend of the distribution of the share of households with internet access is given primarily by the average share of 50%. The value closest to the average (median: 54%) was in 2012. It is observed that the value of the standard deviation is not low, which means that the vast majority of the weights did not take values around the average. Skewness has a negative value, which indicates an asymmetry to the right. The justification is the value of the median which is placed to the right of the average on the graph and the value of the asymmetry coefficient of -0.254 which approaches the limit 0. The distribution of the values of the share of households with internet access is platikurtic, because Kurtosis is less than 3, which shows us that the series has values scattered over a larger range around the average. The probability associated with the JB test of 1.21 is higher than the significance threshold of 0.05, which shows that the data are normally distributed

As a result of the processing of data on the share of research and development expenditures as a percentage of GDP, as the main indicator of the central trend, the average share is 48%. In half of the total years, on average, the share of research and development expenditure as a percentage of GDP is less than 48%, and in the rest of the years the weights recorded are higher than the determined value. Given that the value of the standard deviation is relatively small, it can be seen that most values have taken shape around the mean. Kurtosis has a value above 3, which indicates more values around the average and thicker tails, respectively a high probability for extreme values. Skewness has a negative value, which indicates an asymmetry to the right, respectively to the regression slope, the values are oriented to the right. The probability associated with the JB test (1.68), being significantly higher than the significance threshold of 5% ($p > 0.05$) indicates a normal distribution.

EMPIRICAL RESULTS AND DISCUSSION

Granger causality is a way of investigating causality between two variables in a series of time. The method is a probabilistic account of causality; uses empirical data sets to find correlation models.

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Table 2. Granger test

Null Hypothesis:	Obs	F-Statistic	Prob.
X2 does not Granger Cause X1	13	3.21906	0.0943
X1 does not Granger Cause X2		0.59868	0.5724

Source: Author's own results

As can be seen in the table above, the variables do not show causality which does not produce negative effects on the influence that the two independent variables have on the dependent variable. This is demonstrated by the probability values> 0.05, respectively 0.0943> 0.05 and 0.5724> 0.05.

After testing its validity and estimating the parameters, the model can be written as:

EICTS=0, 65-0, 04*HLIA+2, 4*RDESF+ εt

This regression model allowed us to establish a number of aspects regarding the relationship between the variables, the most important being that between them there is a significant direct relationship. The most relevant results are:

The Significance F value has a value of 0.012; which leads to the fact that the results are significant. Also, R Square indicates that 76% of the variation of ICT specialists is explained (influenced) by independent variables, while Tte adjusted R-squared is 62%, which means that the introduction of additional variables could add value to the model, in a proportion of 62%.

Value of the HLIA variable <0.05, respectively 4% <5% which means that the influence of the HLIA variable on the EICTS variable is significant. The share of households with internet access influences the share of ICT employees; if the share of households with internet access increases by one unit, the share of ICT employee's decreases by 0.04%. The level of internet access in households facilitates the formation of IT skills. Society generally focuses on developing and strengthening individual skills, allowing the individual to contribute and participate in processes of different types and sizes. Thus, we deduce that all types of skills are included, including basic skills such as reading, writing, arithmetic. Higher level skills such as creativity, solution-oriented thinking and action are fundamental because without them it would not be possible to find ways, concepts and techniques that would make us succeed in reaching the desired point. The deeper these processes are affected, the greater the chance of increasing the number of ICT specialists.

Value of the RDESF variable <0.05, respectively 2% <5% which means that the influence of the RDESF variable on the EICTS variable is significant. The share of research and development expenditures as a percentage of GDP, influences the share of ICT specialists; if the share of research and development expenditures increases by one unit, the share of ICT employee's increases by 2.84%. The level of investments in research and development leads to the development of the IT sector and to the increase of the individuals' desire to specialize in this sector, which implicitly leads to more certified ICT specialists.

It is very true that, in determining the increase in the number of ICT specialists, not only economic but also institutional and social factors must be taken into account, and in this sense the model also shows that other indicators can be taken into account.

CONCLUSION

Digital technologies are advancing rapidly, connecting people around the world and creating new and exciting opportunities. More than ever in history, people have access to knowledge, services and resources as a result of technological advances. The impact of automation, artificial intelligence and the Internet of Things (IoT) is felt almost everywhere, in all countries, industries and even in everyday life. However, although the impact of digitization is widespread, the benefits it produces are unevenly distributed.

The paper presents the indicators in terms of changes over time, both at the level of the European Union and Romania. The first indicator, the share of households with internet access, shows a significant evolution in the period 2003-2020. The second indicator, the share of research and development expenditure as a percentage of GDP, shows relatively small changes and not always in a positive sense, or in a constant sense, but also in the sense of decreasing data. Thus, the progress achieved in 2020 is quite modest compared to the data in 2003. The third indicator considered changes in the share of ICT employees. Like the previously mentioned indicator, in this situation the growths are slow, but the times we face seem to bring important premises in the sense of development.

As technologies become mature and try to create strong societies with increased digital capabilities, not all countries (including Romania) are able to use them effectively. These benefits can only be provided through planning and concerted investment by both the public and private sectors in activities ranging from raising basic needs and education to improving technological infrastructure and strengthening digital skills in the workforce.

This forced dependence on digital systems will undoubtedly accelerate the process of evolution and have a profound impact on the state of confidence in the digital economy. An additional essential lesson that this pandemic has taught us is that achieving and resilient digital infrastructure, but also the quality of digital inclusion can no longer be an option, but an obligation that our nation owe to citizens.

Today, we are in the midst of the greatest information and communication revolution in human history, and we must take advantage of this rapid technological change to make the world more prosperous and inclusive.

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