Contribution of ESIFs to the digital society development in the EU

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Abstract. COVID-19 pandemic has accelerated the transition of EU economies toward a higher level of digital society development. The European Commission set digitalization as one of its most important priorities for 2019-2024. As both the Cohesion Policy and the Next Generation EU aim to support the realization of EC priorities, in this paper we focus on examining and evaluating the allocations from European Structural and Investment Funds (ESIFs) to the digital society performance. The research results subverted expectations, revealing that ESIFs spending on ICT does not contribute to the digital society development. This highlights the need for more investment into the ICT to reduce the gap in performances of the EU member states.

Keywords: European structural and investment funds (ESIFs), digital society, DESI, EU

JEL Classification: F15, F21, F36, O30

1. INTRODUCTION

European Commission (2022) included the priority "A Europe fit for the digital age - Empowering people with a new generation of technologies" in the framework of the 6 main goals for the 2019-2024. UNCTAD's World Investment Report (2017) defined the digital economy as "the application of digital

technologies to the production and trade of goods and services". Therefore, digital economy includes ICT and parts of other sectors that have been integrated with digital technology.

The COVID-19 pandemic has had a significant impact on the EU's economy and on EU society. It has significantly changed the role and perception of digitalization in our economies and societies, and accelerated its pace.

Digital society development can be measured with different indicators such as Networked Readiness Index developed by the World Economic Forum, Global ICT Development Index developed by the International Telecommunication Union, E-commerce Readiness developed by UNCTAD, and Digital Economy and Society Index (DESI) (OECD, 2018; UNCTAD, 2021). For the European Union, the Digital Economy and Society Index (DESI) is especially important as it observes Europe's overall digital performance. It is a composite index that summarizes relevant indicators on Europe's digital performance and tracks the evolution of EU Member States across five main dimensions: Connectivity, Human Capital, Use of Internet, Integration of Digital Technology, and Digital Public Services (European Commission, 2022c).

Kersan-Škabić (2021) provided the analysis of specific digital trade and society indicators in the EU and found heterogeneity in the level of ICT implementation in the EU member states, indicating that there is potential in the common market that should be better exploited. The EU and its member states should promote the development and strengthening of the understanding that presence (of businesses, government services, etc.) on the Internet, social networks (media), and specific platforms is not a matter of choice but necessity.

Through the European structural and investment funds (ESIFs) within the framework of EU cohesion policy there are many possibilities to finance the EU's development priorities. Total budget for ESIFs for the 2014-2020 period was 351.8 billion EUR (one third of the EU budget) aimed to contribute to the achievements of Europe 2020 goals through the 11 thematic priorities. The second one refers to:" Enhancing access to, and use and quality of, information and communication technologies" that is the core of our interest in this research. In 2021-2027 the cohesion policies set up the following priorities: "a more competitive and smarter Europe; a greener, low-carbon transitioning towards a net zero carbon economy; a more connected Europe by enhancing mobility; a more social and inclusive Europe; Europe closer to citizens by fostering the sustainable and integrated development of all types of territories" (European Commission, 2022d). It is important to observe both financial perspectives because results in the DESI index achievements in the actual period (or year) are the consequence of multi-year effort and investments (from both, EU and national; private and public sources).

The aim of this paper is twofold. Firstly, we will provide an overview of the digital society indicators for the EU member states and secondly, we will research the impact of ESIFs payments for Information & Communication Technology (Theme 2) in the 2014-2020 period and DESI- Digital Economy and Society Index for the EU member states. Under the broad theme of "Information & Communication Technologies" the European Regional Development Fund (ERDF) and European Agricultural Fund for Rural Development (EAFRD) invest in a range of investment and union priorities to enhance the access, usage and quality of information and communication technologies (ICT). Regarding the Theme 2, Budget for 2014-2020 was 12.67 billion EUR from the EU, that adding the national component results in total of €17.9 billion EUR.

The hypothesis is that the higher amount of received money for ICT (Theme 2) positively influences the DESI index and that the countries that absorbed high amount from ESIFs showed better improvement in the field of digital society development. We will apply statistical and econometric analysis.

The paper is structured as follows. Section 1 presents the theoretical background- explanations of DESI and digital society together with the literature reviews on these issues. Section 2 explains the

methodology and data, while Section 3 presents the results of the research, including the discussion on the findings and policy recommendations. The last section offers the conclusion.

2. LITERATURE REVIEW

Literature about the ESIFs absorption for digital purposes covers several aspects. Some papers have connected the ESIFs (or cohesion policy) with the national (or regional) targets in the domain of R&D; ICT infrastructure; while others researched relationship and causality between ESIFs and competitiveness. Also, we included our research due to the non-existence of similar researches that examine the importance of ESIFs for the digital society (as a composite variable).

Gabroveanu (2016) analysed the investments of Structural Funds in the research and innovation and made comparison between EU member states regarding the absorbed funds and improvement in the R&D. He pointed out that Romania is on 27th place regarding the rate of absorption but on the 4th place in reaching the national targets in ICT sectors in the 2007-2013 programme period. Reggi and Scicchitano (2014) connected the cohesion policy of the EU with the regional digital strategies. They identified three digital strategies: development of ICT infrastructure; e-services and a policy mix that includes the improvement of broadband networks together with the adoption and use of ICT in enterprises. By implementing the econometric analysis, they found unexpected results i.e. less-developed regions in the EU tend to invest their financial resources in the strategic goals which already showed relatively good performance. In that way they will improve their strengths rather than focus on the weaknesses that emerge from the regional information society context. Sá et al (2021) focused on the definition and coverage of digital society after the COVID-19 pandemic. The results demonstrate the importance of literacy and unavoidable promotion of sustainability in a digital society. Pandemic pushed the development of different aspects of digital services and implementation of various aspects of digitalization in the education, providing services, selling and buying products contributing to the development of smart societies that connect real world with the virtual one.

Arnaldi et al (2010) pointed out the importance of programme COST to the promotion of ICT development (among other investment areas). Kutnjak et al (2020) have analysed three methods in DESI index for identification of key indicators. They pointed out that this analysis can act as a guide for developing and adjusting country's strategy to improve digital competitiveness. In that way the countries will find out the areas where they should put more effort to become more digitally competitive in the market. Chernetsky et al (2021) provided an analysis of the financing the e-government projects in the EU member states and Ukraine. They made the comparison that resulted with the conclusion of the best practice in providing the financial resources for such kind of projects in Ukraine.

Jendricko and Mesaric (2019) analysed the financing ICT infrastructure from the European Regional Development Fund (ERDF) in Croatia in order to create digital society. For that priority the allocation within Croatian Operational Programmed Competitiveness and Cohesion is EUR 307.95 million, out of 6,881 billion. According to the DESI for 2016, 2017 and 2018 Croatia is on the EU's bottom, particularly regarding the deployment of broadband infrastructure and its quality, and the digitization of public services. They warn that the allocation should be oriented to the modernisation of public administration according to the „smart government" principles, i.e. digitalization of business and administrative process. These changes towards the development of digital society will contribute to the competitiveness of Croatian economy. They also discussed some projects financed from that priority area. This allocation must be directed towards the development of the innovative e-services of modern public administration by the "smart government" principles, including providing full services, digitizing business and administrative processes, and opening public administration information through various channels available at anytime,

anywhere through different devices. The main purpose is to improve the lives of Croatian citizens and to boost the competitiveness of the economy by supporting the development of the digital economy to include the unique EU digital market.

European Commission prepares the evaluation reports of the implementation of ESIFs. The evaluation for the 2014-2020 period will be adopted in 2025, so here we will include the data for the period 2014-2020 available till the September 2022.

The overview of relevant papers clearly indicates that they are usually oriented to the analysis in one country with a need for a more systematic analysis that will cover the entire EU member states. Furthermore, we will add the econometric analysis of the EISFs contribution to the DESI index in the EU member states which will be the main contribution in this paper.

3. METHODOLOGY

ESIFs financing domain covers a large set of priorities, and the ICT is one of them. Priority areas are in accordance with the European Commission priorities. Digital society is difficult to be defined and measured with just one indicator, and due to that we decided to use the data for Digital economy and society (DESI) index that represents summary index of many indicators on Europe's digital performance and tracks the progress of EU countries. By implementing the econometric analysis, we will create a model that explains a list of variables that can impact their value on ICT development, with special highlight on ESIF.

Firstly, we will show a descriptive statistic for chosen DESI indicators but also for ESIFs by member states. It is necessary to distinguish the allocation amount from spent money from ESIFs. Furthermore, indicator of successful implementation of cohesion policy is share of amount of payments in allocation amount.

In the second step, we will employ regression analysis for the 2021. As the data are not available for long time period (especially for DESI index), we are limited to implement simple methodology, i.e. ordinary least square (OLS) analysis. We have performed linear model regression with the main goal of finding out the impact of ESIFs spending on ICT on the digital development in the EU. We have calculated three equations with different dependent variables. The first variable of our interest is DESI total index that comprises a set of indicators that measure development of digital economy. Then we continued with the e-government index as dependent variable due to the fact that government and its executive bodies have possibilities to absorb the ESIFs for ICT implementation and upgrading. The third group of models refers to dependent variable that reflects the firms, i.e. we took the variable enterprises with high level of digital skills as dependent to see if the ESIFs have contributed to their development.

The models are in form:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \varepsilon_i$$

where y is dependent variable, and $x_1 \ldots x_i$ are set of independent variables. The values are in % or in log form that we can explain the results as the elasticities.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Statistical overview of DESI index and ESIFs

Total amount in the EU budget for the period 2014-2020 for the ICT was €17.9 billion (EU and national component together). It is important to mention that this amount is intended only for projects that belong to the mentioned domain and it doesn't include the amount for projects that partially belong to ICT, but mainly to other financing area (or for projects that were financed from more than one priority) It is

assumed that the total amount for different purposes and parts in the ICT is higher than we showed in the analysis.

Even the ERDF and EAFRD total budget amounted billion 364,63 EUR in 2014-2020 period, the amount for ICT was surprisingly small just 12.69 billion EUR (together with national sources 17,9 billion EUR) that represent about 3.5% of total EFRD and EAFRD allocation. The ERDF financed: extending broadband deployment and the roll-out of high-speed networks; developing ICT products and services and e-commerce; strengthening ICT applications for e-government, e-learning, e-inclusion, e-culture and e-health (European Commission, 2022d).
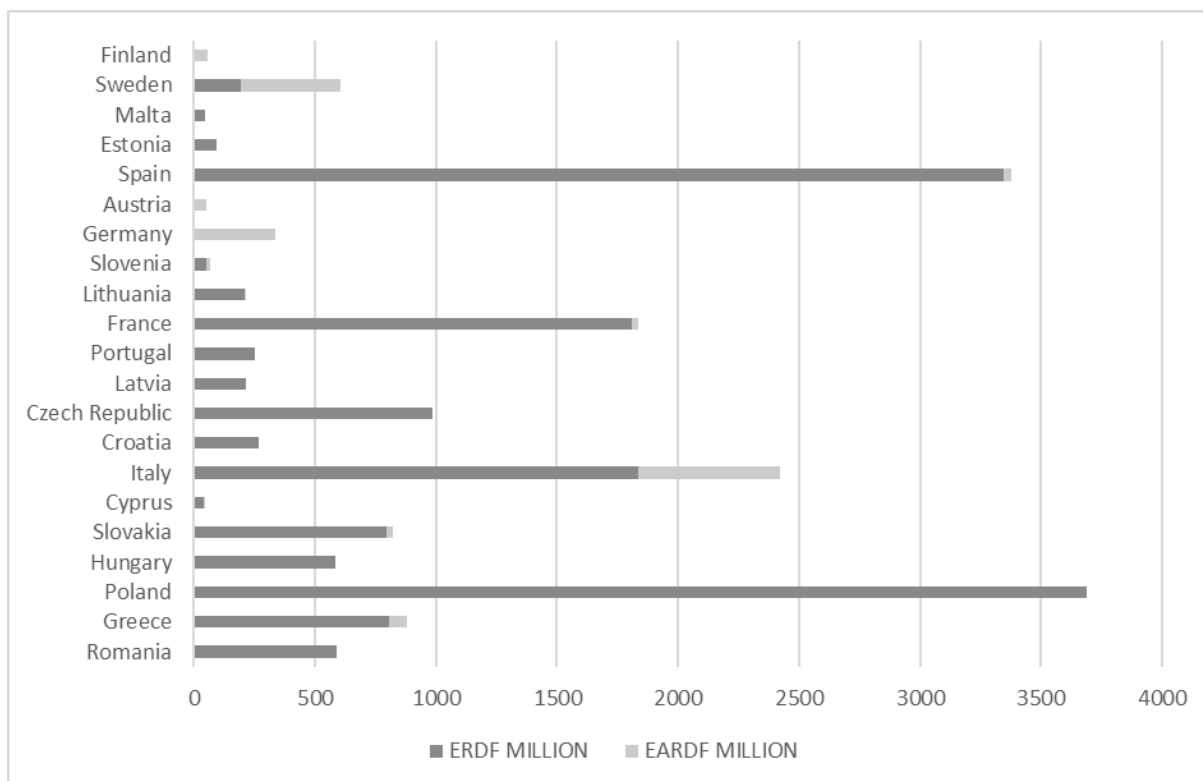
Figure 1 The ERDF and EAFRD budget for ICT in 2014-2020 in mil EUR
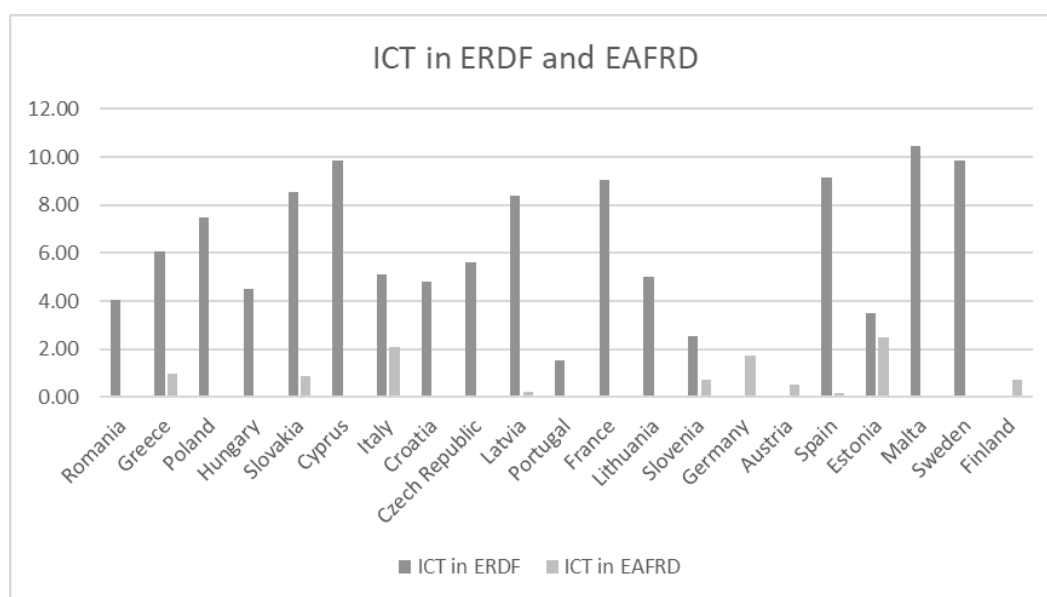*Source:* European Commission (2022b).

Figure 2. Allocation for ICT in the ERDF and EAFRD budget in 2014-2020
Source: European Commission, (2022b).

Table 1

Implementation of ESIFs for ICT in the EU

	ESIF 2014-2020: Implementation by country for Information & Communication Technology - total cost of selection and spending as % of planned (bullet chart, excluding multi-thematic allocations) in million euros			Decided/planned (%)	Spent/panned (%) (absorption rate)
	Planned	Decided	Spent		
Romania	591.64	947.74	390.37	160.19	65.98
Greece	357.76	463.71	171.65	129.61	47.98
Poland	3.494.00	3.422.35	2.331.92	97.95	66.74
Hungary	435.41	470.01	277.56	107.95	63.75
Slovakia	823.40	682.98	200.31	82.95	24.33
Cyprus	40.01	75.62	25.14	189.00	62.84
Italy	2.373.32	2.471.22	1.308.86	104.13	55.15
Croatia	266.31	378.40	38.47	142.09	14.44
Czech R.	532.90	767.93	322.54	144.10	60.52
Latvia	216.83	193.33	131.94	89.17	60.85
Portugal	118.83	119.00	89.36	100.15	75.20
France	1.709.06	2.008.61	2.258.31	117.53	132.14
Lithuania	216.53	219.84	156.60	101.53	72.32
Slovenia	64.66	154.73	23.90	239.28	36.97
Germany	353.02	471.34	160.86	133.52	45.57
Austria	53.20	53.09	5.95	99.80	11.18
Spain	3.127.08	3.785.83	1.972.72	121.07	63.09
Estonia	93.15	96.12	86.22	103.20	92.57
Malta	47.44	43.04	40.18	90.72	84.70
Sweden	629.44	749.16	330.62	119.02	52.53
Finland	57.10	40.84	26.69	71.53	46.75

Source: European Commission (2022b).

The successfulness of countries in absorbing the EU funds for ICT development varies from 11.18 in Austria to 132.14 in France. Although, the financing perspective is behind us, the financing is still possible due to the rule od "n+3" so the presented data aren't the final ones that will probably be higher.
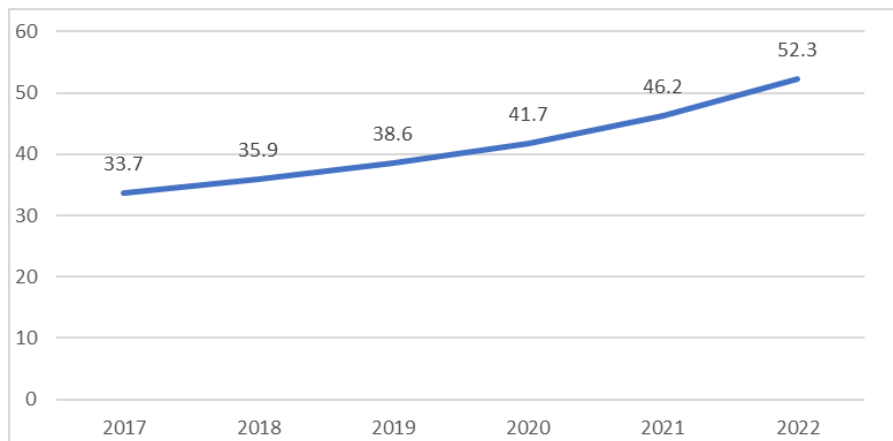

Figure 3 DESI index 2017-2022
Source: European Commission (2022a).

DESI index has growing trend from 2017-2021 from 33.7 to 52.3 meaning the countries were making improvements in the set of DESI components.
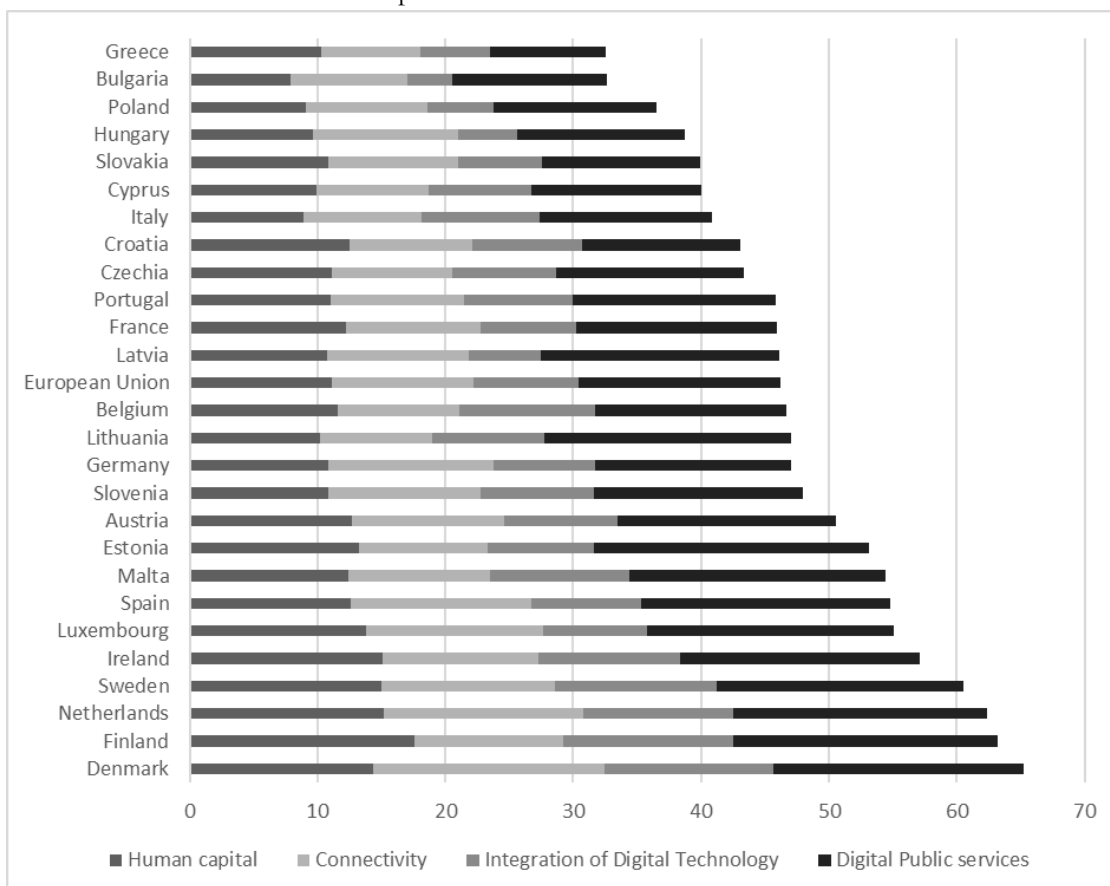
Figure 4. DESI index by components and by member states in 2021
Source: European Commission (2022a).

From the Figure 4 the existence of big gap in total DESI index among EU member states is obvious. Expectedly, the highest values of indexes are presented in the North Europe: Denmark, Finland, Netherlands and the lowest values are in Romania, Greece and Bulgaria. Looking on the sub-indexes and within the more detailed data we can point out the areas with the big differences among the best and the worst performers:

- Sub-index Connectivity: mobile broadband
- Sub-index Human capital: internet users' skills
- Sub-index Integration of digital technology: digital intensity; digital technology for business.
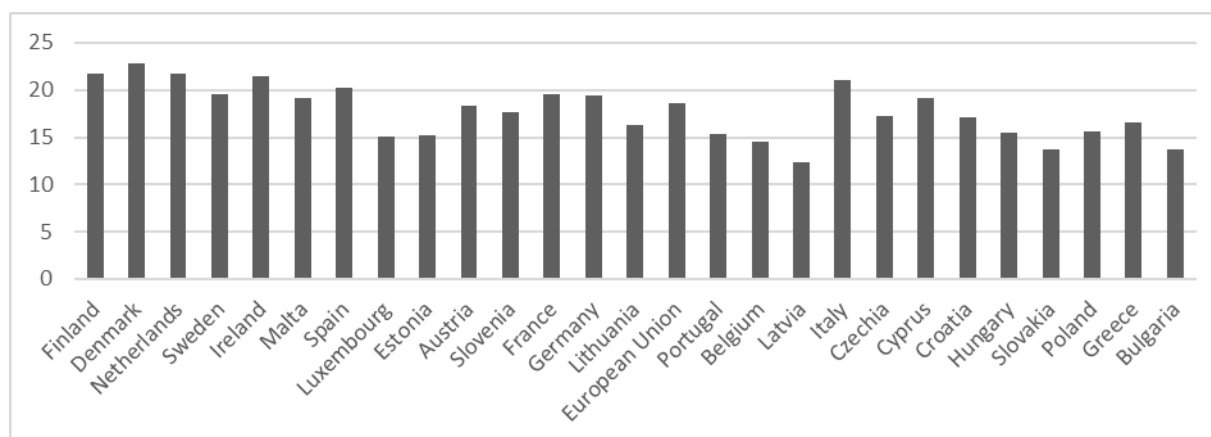
Figure 5. Improvement in DESI index from 2017-2022 (in percentage points)
Source: European Commission (2022c).

Figure 5 provides the difference in total DESI index in 2022 in comparison with 2017. The highest improvement was in Finland, Denmark, Netherlands, Ireland and Italy (above 20 pp) while, on the other side, the improvement in Latvia, Luxembourg, Estonia, Belgium, Slovakia and Bulgaria was below 15 pp. it is interesting and useful to find out if the ESIFs for ICT purpose make some contribution to the pointed-out areas.

4.2. Results of econometric analysis

The descriptive statistics and correlation matrix of chosen variables are presented in Appendix together with the testing the normality of residuals.

The variables that are included in the analysis are described in table 2.

Beside the described variables, we have included also three variables related to spending the European structural and investment funds for ICT: allocation of funds, spent amount and ratio spent/allocation (successfulness in absorption of the ESIFs)[1].

In the following tables we are presenting the results that include only independent variables with significant impact on dependent ones.

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[1] https://cohesiondata.ec.europa.eu/themes/2

Table 2

Variables for the analysis

Name	Definition	Abbreviation	unit	Source
Digital economy and society index	summarises indicators on Europe's digital performance and tracks the progress of EU countries	DESI	%	Shaping Europe's digital future, https://digital-strategy.ec.europa.eu/en/policies/desi
Gross domestic product per capita	country's GDP divided by its total population.	GDPp.c.	EUR	Eurostat, https://ec.europa.eu/eurostat/web/national-accounts/data/database
ICT specialists	Employed ICT specialists. (ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers).	ictspec	% of total employment	Eurostat - Labour force survey (isoc_sks_itspt)
Internet users' skills	Individuals with 'above basic' digital skills in each of the following five dimensions: information, communication, problem solving, software for content creation and safety	iuas	%	Eurostat - European Union survey on ICT usage in Households and by Individuals
ICT graduates	Individuals with a degree in ICT	ictgrad	% (share of total graduates)	Eurostat - ICT education - a statistical overview
enterprise providing ICT education	Enterprises who provided training in ICT to their personnel	entict	%	Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_ITT2)
e-government	Composite index (scoreboard)	egov	index	The eGovernment Benchmark 2022, DESI
digital technology for businesses	DESI sub-dimension	dtb	weighted score (0 to 100)	Digital technology for business, DESI

Sources: DESI index, Eurostat.

Table 3

Determinants of DESI index (total); *DESI index*-dependent variable

Variables	Model 1	Model 2	Model 3
logGDPpc	2.506428 (1.044352) **	2.48054 (1.199845)**	3.189745 (1.215027)**
Ictspec		1.174502 (0.5757807)*	
iuas			0.8973181 (0.2458557)***
ictgrad	0.8065561 (0.278937)***		
egov	0.3276483 (0.040758)***	0.3561796 (0.0454351)***	0.3420485 (0.0518438)***
dtb	0.5537802 (0.1080673)***	0-528768 (0.1237635)***	
Rsq	0.9571	0.9408	0.9328
F-test	122.82 (0.000)	121.94 (0.000)	106.44 (0.000)

Source: authors' calculation. All models include constant variable. Standard errors are in parenthesis. ***p statistically significant at 1%; **p statistically significant at 5%; *p statistically significant at 10%.

Based on the Models 1-3 (Table 3) we can emphasize common characteristics: GDP per capita as the measure for development has positive and significant impact on the digital society development. In all models, variables connected with the people skills (share of ICT graduates in total graduates; internet users with above average skills; ICT specialists) are significant and positively impact on the DESI index

Development of e-government and digital technology development also have positive impact on digital society while variables e-commerce and enterprises providing ICT education aren't significant. The variables of our interest- ESIFs (spent on ICT; Theme 2), considers as allocation, spent and absorption rate, don't have significant impact on digital society development.

Table 4

Impact of ESIFs on e-government; dependent variable*: e-government* (index)

Variables	Model 1	Model 2
Ictspec	4.205889 (1.960532) *	
iuas	2.074944 (0.732559) ***	3.552521 (0.7894987) ***
esif spent/aloc		0.1652249 (0.0909732) *
Rsq	0.6298	0.6072
F-test	20.41 (0.000)	13.91 (0.000)

Source: authors' calculation. All models include constant variable. Standard errors are in parenthesis. ***p statistically significant at 1%; **p statistically significant at 5%; *p statistically significant at 10%.

The development of e-government services can just partly be explained with the chosen variables with the positive and significant impact of internet users with above average skills, and ICT specialist. The

variable connected with ESIFs; spent/allocation) has small positive impact on the e-government development (while the other two variables, related to ESIFs allocation or spent, aren't significant).

Table 4

Impact of ESIFs on enterprises; dependent variable- *enterprises with high level of digital skills*

Variables	Model 1	Model 2	Model 3
Ictspec	2.874864 (1.541511)**	5.905492 (1.252918)***	
iuas	1.628162 (0.5759904)**		2.37528 (0.4338855)***)
Rsq	0.6028	0.4705	0.5452
F-test	18.21 (0.000)	22.22 (0.000)	29.97 (0.000)

Source: authors' calculation. All models include constant variable. Standard errors are in parenthesis. ***p statistically significant at 1%; **p statistically significant at 5%; *p statistically significant at 10%.

In analysing determinants on enterprises with high level digital skills we found significant impact of the skills: variables *ict specialists* and *internet users with above averages skills* positively influence on the dependent variable while the variables of our interest (ESIFs) are not significant.

5. CONCLUSION

In our analysis we connected two of the most important priorities of the EU development: digital society, and the cohesion policy of the EU (as the main investment policy) that finance many different areas/policies and which are the main EU investment policies.

Implementing the empirical analysis, we didn't find any significant impact of ESIFs spending (allocation or absorption rate) on ICT on the development of digital society which is in one way disappointing taking in consideration compatibility of ESIFs spending and the EU's or European Commission goals. On the other side, looking at the share of spending on ICT in total cohesion policy budget; the shares are very small and the obtained results are in accordance with these numbers.

Second explanation can be found in the fact that digital society is very broad term and that its aspects can be financed through ESIFs but probably not always from the "ICT sector" budget. All these financing that are provided outside of the ICT sector are not covered in the analysis due to shortcomings in collecting the data and estimation the contribution of different projects to the development of digital society. The third explanation lies in the fact that the highest DESI index was remarked in the high developed EU member states, many of which are net contributors in the EU budget and they don't depend on the ESIF absorption in the way that lagging countries do.

Nevertheless, the research points out the necessity to provide more investment in the digital society dimensions due to the big differences among EU member states, and to be able to keep up with their main competitors on the global market. In the financial perspective 2021-2027 European Commission is giving higher accent on the digital society that is visible in: the Digital Europe Programme- a new programme aimed to better exploitation of digital technologies in business, in society and in public administration. It will finance projects in five key capacity areas: supercomputing, artificial intelligence, cybersecurity, advanced digital skills and wide use of digital technologies across the economy and society. The planned overall budget is EUR 7.5 billion (European Commission, 2022e). Also, it's important to highlight the Digital Compass that pointed out a list of concrete objectives that EU wants to achieve in the Digital Decade. They include four areas: skills, public services, infrastructures and business (European Commission, 2021b).

Digital society development nowadays is precondition for the growth and innovation; for increasing of productivity; higher export and higher level of development. The EU through its activities proved that it recognizes this.

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APPENDIX

Table 1

Summary statistics

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Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+-----------------------------------------------------------
internetus~e |        27    9.940741    3.666303        2.8       18.5
ictgraduat~e |        27    4.437037     1.60747        1.3          8
enterprise~o |        27    21.05556    7.664219        5.9       37.7
fixedbroad~s |        27    21.06667    22.89824        7.1      133.7
egovern~0100 |        27    63.24444    15.53763       18.2       82.5
-------------+-----------------------------------------------------------
digitaltec~e |        27    22.45185    6.707136       11.4       37.3
desiind~0100 |        27    47.34074    9.800756       27.4       65.3
spentesifo~t |        21    4.51e+08    6.89e+08    5946888   2.07e+09
     logGDPpc |        27     10.0625    .6056117   8.808369   11.34439
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Table 2

Correlation matrix

```
       | spenta~t intern~e ictgra~e enterp~o ictspe~s ego~0100 digita~e
-------------+-------------------------------------------------------------
spentalloc~t |   1.0000
internetus~e |   0.1962    1.0000
ictgraduat~e |  -0.0124    0.2287    1.0000
enterprise~o |   0.0067    0.6619    0.1424    1.0000
ictspecial~s |   0.1333    0.6955    0.4189    0.7017    1.0000
egovern~0100 |   0.4066    0.7475    0.2441    0.6005    0.7114    1.0000
digitaltec~e |   0.1467    0.8074    0.1019    0.8181    0.7405    0.7019    1.0000
desiind~0100 |   0.2276    0.8763    0.3121    0.7383    0.8314    0.9078    0.8689
digitalint~s |  -0.1368   -0.7743   -0.0605   -0.8482   -0.7071   -0.7303   -0.9293
     logGDPpc |   0.1246    0.6865    0.0933    0.6426    0.6817    0.5813    0.7219

       | des~0100 digita~s logGDPpc
-------------+-------------------------
desiind~0100 |   1.0000
digitalint~s |  -0.8573    1.0000
     logGDPpc |   0.7428   -0.7426    1.0000
```
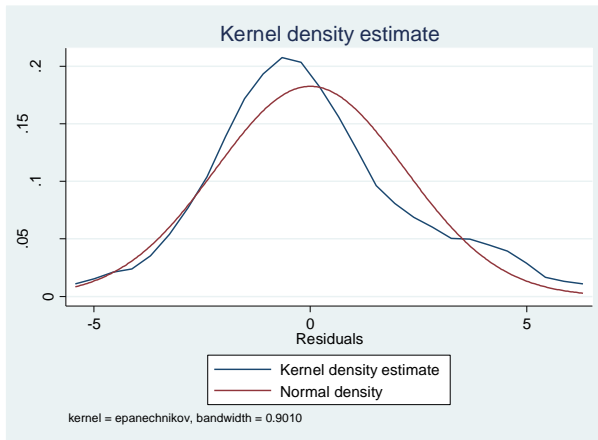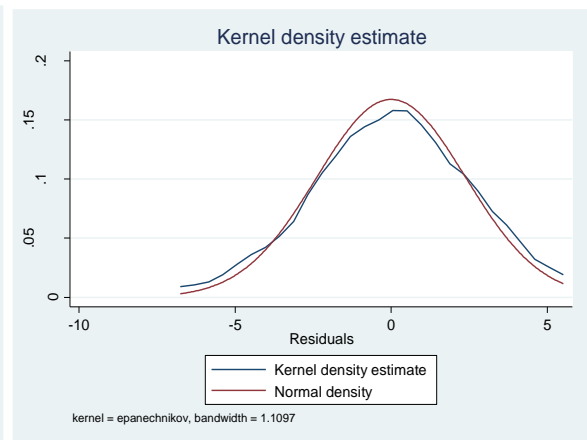
Table 3- Model 1

Table 3- Model 2

Table 3- Model 3
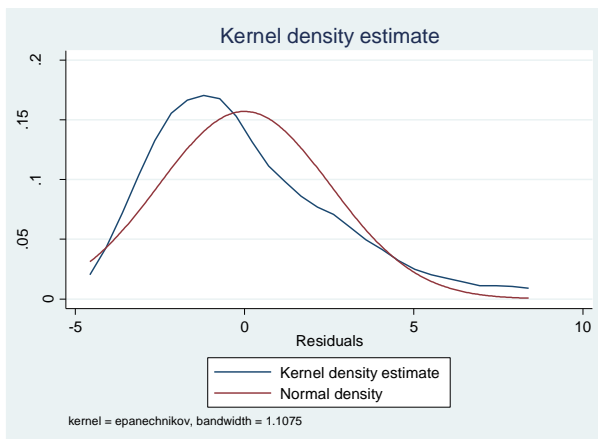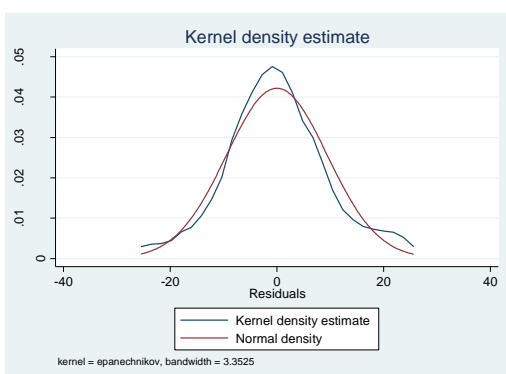

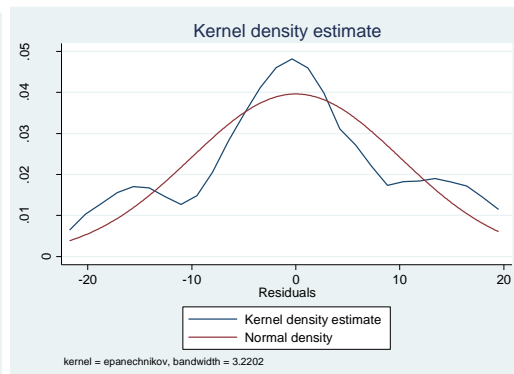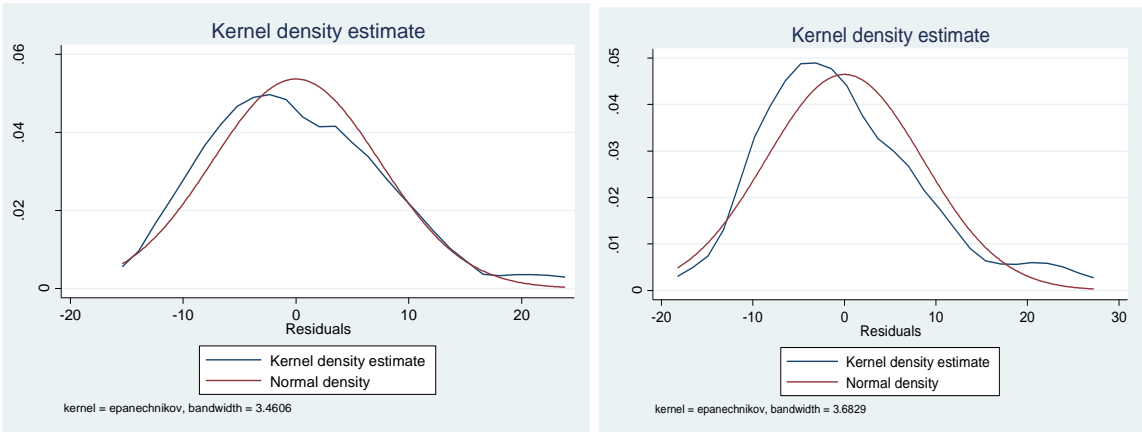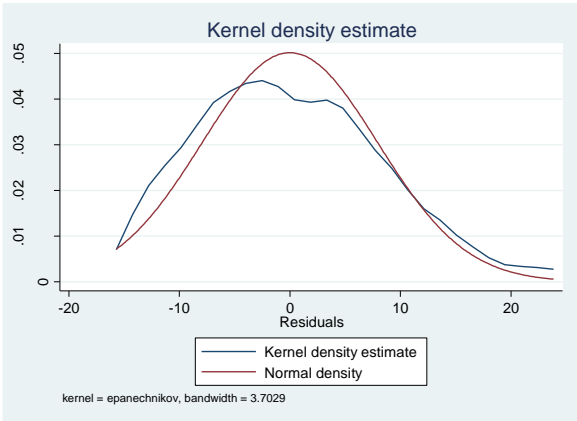Table 4- Model 1

Table 4- Model 2

Table 5- Model 1

Table 5- Model 2

Table 5- Model 3

Figure 1. Kernel-density estimates