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DIGITAL GOVERNMENT PLATFORMS: ISSUES AND ACTIONS IN EUROPE DURING PANDEMIC TIME

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Abstract. The aim of the present research is to measure and assess the rise and consolidation of the digital government platforms effectiveness in the period 2016-2020 within European Union. A breakdown between countries based on their GDP expenditure share in ICT (Information and Communication Technology) is developed, in order to identify the spending propensity of the members EU 28 in the digital economy. Furthermore, with the support of the Digital Effectiveness Performance Index (DEPI). Starting from the Government Effectiveness Index (GEI), according to the five DESI dimensions, aims at identifying the sources of digital platforms effectiveness for each country. The cross national comparative study shows that in order to reduce the gap within the EU Member States, it is strategic to develop an ambitious government actions to support the remote working in terms of opportunities, challenges, drivers, processes, and consequences of the single performances, in digital dimensions, of European countries.

Keywords: Digital Effectiveness Performance Index (DEPI); effectiveness; digital platforms; cross national comparative study; European policy

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JEL Classifications: L2, L26

1. Introduction

The COVID-19 outbreak (Donthu et al., 2020) has upset the worldwide. The effects of the covid-19 crisis on working life (Waizenegger et al., 2020) are profound and complex. The changes in our work and social life have been rapid and full of pitfalls. The rise in unemployment and remote work has increased throughout the world. The economic and social (Keogh-Brown et al., 2010) psychological impact (Capone et al., 2020) of the pandemic has yet to be determined, but it will be significant (Marino et al., 2021). In this framework, public remote work (Skyrme, 1994; Staples et al., 1999; Scandura et al, 1997; Spreitzer et al., 2017) and digital platforms (Baiyere et al 2020; Mariani et al., 2020), impressing a smart rise in terms of both opportunities (Barsness, et al., 2005;

Carillo et al, 2020) and challenges. In order to understand possible future outcomes, it is interesting to note that digital government and market effectiveness represent key elements of the European Union's (EU) development strategy. In fact, different targets have been established in order to develop this strategy.

2. Theoretical background

The European Commission (2016 - 2020) has reported that a Digital Single Market with effectiveness and efficiency characteristics could contribute €415 billion per year to EU economy and allow for the creation of hundreds of thousands of new jobs. The report highlights the disparities between European countries capabilities should be considered when realizing and developing policies in the long term. Furthermore, taking European countries capacities within a set of dimensions, it could be strategic to assess the digital platforms effectiveness. As discussed by European Parliament in December 2015, reducing the digital divide may raise Gross Domestic Product (GDP) by 1-1.5%, and in the next ten years, 90% of jobs will require relevant digital skills. Moreover, the digital divide has been substantially reduced over the last decade in Europe, but the reduction of the gap remains a strategic goal to economic development of EU countries. This is in line with the results obtained by World Bank Report (2016). Furthermore, it is interesting to note that digital divide has been declined also as geographic area (Chipeva et al., 2018) and gender (Brännström, 2012). Different authors tackled the issue of investigating the digital platforms in different contexts. A benchmarking and measurement of digital government platforms has been developed by Cattaneo et al. (2007), a survey on Italian Digital government platforms by Assinform and Confindustria (2017), as well as the issue of digital divided both in the rural areas by Kos-Łabędowicz (2017), Matuzeviciute and in developed countries, i.e. Germany (Schleife, 2010). Furthermore, Jardas et al., (2012) proposed a case study of Croatian local e-government, Butkus et al., (2017) analyzed, at international level, the relationship between the technological innovation and the unemployment, J. Wallis et al., (2018) developed a study on e-government effectiveness. For example, Kos-Łabędowicz et al. (2017) analyzed the digital divide and the factors influencing the lack of digital convergence with particular emphasis on rural areas of the European Union, where the main highlighted limit was the aging of the population and the progressive depopulation of the countryside. Moreover, Assinform and Confindustria (2017) examined the impact that the implementation of digital government may have on business, operational and service models in the different sectors of the Italian market. Instead, Wallis et al., (2018) analyzed the relationships between government effectiveness and digital government development, particularly with reference to the e-Government development (Marino et al., 2020). The study analyses such relationship utilizing five levels trust model in public context (Castaldo et al., 2010; Song et al., 2020). A model of public trust in which the importance of communication, task design and incentives for cooperation even in the presence of geographical distance, is strategic in this pandemic time (Metiu, 2006). Digital government platforms should be considered as a strategic driver for the government actions in order to improve their effectiveness. Kauffmann et al. (1999, 2010), starting from 1996, developed the methodology of the Worldwide Governance Indicators based on six composite indicators which include the Government Effectiveness Index (GEI). In this line the same authors (Kauffmann et al., 2007) highlight the strategic importance of governance indicators measure linked to digital platforms. The strategic relationship between government platforms effectiveness and digital government is reinforced by OECD (2019). OECD encourages governments to adopt strategic approaches to use technologies in order to promote more open, participatory and innovative governments. To support this aim in terms of digital government effectiveness in the European context, it is necessary to understand how the countries are organized and creating and developing more specific and effective digital platforms policies. The digital platforms are a complex matrix in which different dimensions are strictly related each other. A classification of digital platforms should consider the following dimensions: Connectivity (Olson 1983; Olson et al., 2000), Human Capital (Marino et al., 2021; Rocco, 1998), Use of Internet Service, (Lau et al., 2020; Hodgson et al., 2020). Integration of Digital Technology, (Venkatesh et al., 2000; Majchrzak et al., 2000; Nambisan et al., 2017), Digital Public Services (Cairncross, 1997; Davis et al., 1989; Davis, 1989; Allen et al., 2015). In order to measure and assess the digital platforms effectiveness, each of these dimensions is weighted and splitted in sub dimensions. The digital platforms performance combines more than 30

indicators as indicated in Table 1. The European Commission addressed this issue by measuring the digital government platforms performance of the EU Member States through the brainchild of Digital Economy and Society Index (DESI). DESI is a composite index that summarizes relevant indicators on Europe's digital performance. It aims to help EU countries identify areas requiring priority investments and actions in order to create a truly Digital Single Market (European Commission 2017). Each dimension includes a particular aspect that contributes to the definition of a framework of the EU Member States digital platforms performance. Despite these set of indicators, DESI does not show a clear measure of digital government platforms effectiveness. This matter attracted the interest of many researchers, who tried to assess digital government platforms effectiveness. Asgarkhani (2005), has developed a study on effectiveness of e-Service in local Government, Bicking et al., (2006), proposed a scenario for e government in 2020, Arendsen, et al., (2014), analyzed the relationship between e-government and administrative burden. Bracken (2015), studied the topic of digital infrastructure through a government as platform and Janowski (2015), proposed a study on the evolution of Digital Government. Furthermore, digital transformation is changing citizens' expectations of governments, particularly in pandemic time, those linked to the ability to provide high-value, real-time digital services. Digital transformation means changing their operational methods to improve public service delivery. This process is not yet systemic (Xu et al., 2011), but should be realized short-term (Mergel et al., 2019). Following this approach, a preliminary study aimed at developing a systemic vision could be supported with semantic-based Decision Support System based on BPMN (Business Process Model Notation) that helps some of the core actors in adoption of some solutions (Pérez et al., 2004; Arpaci, 2017) in digital transformation processes (Di Martino et al., 2019). In Europe there are many bottlenecks related to digital platforms and its systemic process. In particular, Asgarkhani (2005) with a case study examined the value and the effectiveness of key aspects of digital government platforms within the public sector with a focus on four specific facets of effectiveness. Furthermore, Arendsen, et. al. (2014) analysing the scenario in Netherlands, elaborated an assessment of the business to government system. The study highlights the organizational characteristics as strategic tools to reduce the administrative burden and develop effective government policies. Janowski (2015) presents a four-stage Digital Government Evolution Model that considers pressures on government and how digital innovation is applied to address such pressures. The study analysed the high impact of Digital Government on its external environment when technological, organizational, socioeconomic (Fenner et al., 2010) and sectorial knowledge are used to ensure planning, and implementation of effective measures. On the hand, the reviewed literature shows how the digital government platforms is a driver to develop government effectiveness and how important it is to measure this effectiveness in a new digital context. Moreover, when analysing a geographic area, as the Europe, the heterogeneity of the considered countries becomes a very relevant element in function of an existing wide variability in terms of economic structure and conditions. These elements may be responsible for the gaps in terms of government platform effectiveness performances within the 28 EU Member States. A deeper analysis can be developed in order to comprehend in detail, which are the sources of the effectiveness. As shown in the elaboration of DESI (EU 2017), digital performance and competitiveness can be decomposed based on DESI dimension in order to identify measures that can be considered enhancers of platforms government effectiveness. On the other hand, in literature there is a lack of studies focusing on the effectiveness analysis of the digital government platforms and governance effectiveness at the same time, so as to allow an eventual comparison and discussion. In light of this, the present paper aims at bridging this gap introducing the Digital Effectiveness Performance Index.

In particular, digital platform government effectiveness is taken into consideration separately in the 28EU Member States for the period 2016-2020. The effectiveness analysis is based on the five DESI dimensions in order to elaborate the Digital Effectiveness Performance Index (DEPI). Moreover, a breakdown in terms of groups effectiveness for each DESI dimensions is proposed so as to establish the contribution of such dimensions to the effectiveness level of each analysed country. It is supposed that the present study will allow to support the comprehension, more in detail, on the level of the effectiveness in the field of digital platforms performance and governance in the 28 EU Member States. Furthermore, this analysis can help the quantitative identification of the contributions behind the achieved trend of platforms effectiveness and identify the countries, as best practices, to

increase the effectiveness. It is forecasted that the present analysis will be of interest for policy makers and government planners, who can acquire information for the development of government policies in long term plans. In the next sections an articulated discussion on the methodology will be developed, furthermore a deep analysis on the trend of the government effectiveness according to the digital platforms' performances in EU28 in the period 2016-2020 will be presented. Moreover, section 4 highlights the obtained results and the related discussions. Finally, section 5 shows the conclusion of the paper.

3. Research objective and methodology

Starting from Government Effectiveness Index (GEI) methodology, one of the six dimensions of Worldwide Governance Indicators (WGI) elaborated by Kauffmann et al., it has been developed DEPI. GEI defines the effectiveness of policy actions related to the public services. Through the analysis of several variables, the GEI contributes to the construction of the WGI. It can be considered as a synthetic benchmark of government effectiveness. The Digital Effectiveness Performance Index (DEPI), starting from the assumption of the GEI, captures the effectiveness performance of digital government strategies. It includes, as variables to analyse, the five DESI dimensions providing strategic information. DEPI derives from the theories of GEI and the digital transformation (Kehal, et al., 2003). DESI has developed an analysis linked to the relationship between two variables and their distributions share, particularly related to its five dimensions, but it does not allow to capture the effectiveness of each dimension. DEPI was formalized using the min-max method starting from the normalization of DESI 2016. The values of share and probability distributions are involved between 0 and 1. DEPI consists on a linear projection of each indicator onto a scale between 0 and 1 (indicators with positive trend 0 min value; 1 max value). Min-Max method allows to normalize indicators in order to have an identical range [0, 1] by subtracting the minimum value and dividing by the range of the indicator values. Consequently, from the analytical point of view, the values do not diverge from each other and, therefore, the DEPI can be extended to other research fields.

Equation Min Max Method:

$$I_{qc}^t = \frac{x_{qc}^t - \min_c(x_q^{t_0})}{\max_c(x_q^{t_0}) - \min_c(x_q^{t_0})}$$

The digital platforms are a complex matrix in which different dimensions have a strictly relation each other. A classification of digital platforms should consider the following dimensions. A different weight, according to their characteristics, was given to each of the five dimensions.

Table 1. Dimensions and their sub-dimensions our elaboration on DESI

<i>Dimension weights</i>	<i>Sub Dimension weights</i>
1 Connectivity 25%	1.1 Fixed Broadband 8,5%
	1.2 Mobile Broadband 5,5%
	1.3 Speed 8,5%
	1.4 Affordability 2,5%
2 Human Capital 25%	2.1 Basic Skills and Usage 12,5 %
	2.2 Advanced Skills 12,5 %
3 Use of Internet Services 15%	3.1 Content 5%
	3.2 Communication 5 %
	3.3 Transactions 5%
4 Integration of Digital Technology 20%	4.1 Business Digitization 12%
	4.2 E-commerce 8%
5 Digital Public Services 15%	5.1 E-Government 13,5 %
	5.2 E-Health 1,5%

The repartition of specific weights follows these criteria:

25% Connectivity and Human Capital. This weight, which represents the highest, has been assigned (European Commission, DESI 2018 Digital Economy and Society Index Methodological note) because it shows the countries' investments in IT (Connectivity) and Digital Economy (Human Capital).

20% Integration of Digital Technology. This dimension captures the use of ICT by businesses.

15% Use of Internet Services and Digital Public Services. These are the last two enabling dimensions where the first captures the use of internet by citizens and the second displays the digitization of public services.

DESI methodology does not give a clear measure of digital government platform effectiveness because it is an investment measure and does not capture how the investments improve the digital government platform effectiveness. Starting from this assumption, DEPI can be calculated in the following way:

$$1. \quad y(w,s) = \alpha(s) + \beta(s)(g(w) + \varepsilon(w,s))$$

List of Abbreviations

w Country, w = 1,2,...,W

s Sub Dimension of DESI, s=1,2...S

y (w,s) observed score on indicator s for country w

g(w) Unobserved performance. g(w) is assumed to be in the form of a normally distributed random variable with mean 0 and standard deviation 1.

$\varepsilon(w,s)$ Disturbance term also mentioned to as error term. It reports the perception and measurement error and variation of sample. Furthermore, it displays the imperfect relationship between the particular concept measured by indicator s and the corresponding broader aspect of effectiveness.

$\alpha(s)$, $\beta(s)$ Coefficients are useful to map, together with the disturbance term $\varepsilon(w,s)$, unobserved governance into the observed data.

$\sigma_{\varepsilon}^2(s)$ Variance of the disturbance terms of indicator s common to all countries s

Digital service effectiveness is also structured by unobserved components. In order to assess these unobserved components, the effectiveness is measured by algebraically summing the scores we have obtained on each dimension $y(w;s)$. Starting from this assumption, it is possible estimate the unknown performance $g(w)$ but it is suitable to set jointly the error term with $g(w)$ into brackets.

The model includes the following assumption:

1) The random terms (disturbance terms) $\varepsilon(w,s)$, are not correlated with each other, i.e. perception errors are not correlated across dimensions and countries. In order to identify the model parameters is essential to consider that the mean of $\varepsilon(w,s)$ is zero for all w,s.

2) The disturbance term has the same variance, $\sigma_{\varepsilon}^2(w)$, among countries within a set indicator but may have a different variance among dimensions.

3) Unobserved governance and observed indicators are linearly related.

4) $\varepsilon(w,s)$ are statistically independent of $g(w)$ for all w and s.

5) Both $g(w)$ and $\varepsilon(w,s)$ have a joint normal distribution.

Starting with Min Max method, MLE estimates of $\alpha(s)$, $\beta(s)$ and $\sigma_{\varepsilon}(s)$ are achieved and this model is founded on the next Likelihood function:

$$2. \quad L [w; \alpha, \beta, \sigma_{\varepsilon}^2(1), \dots, \sigma_{\varepsilon}^2(S)] = \prod_{w=1}^w (2 \cdot \pi)^{-\frac{w}{2}} |\Omega|^{-\frac{1}{2}} \exp[y(w) - \alpha] \exp[y(w) - \alpha]' \Omega^{-1} [y(w) - \alpha]$$

S = Score of dimensions

W = number of countries

y(w) = the Sx1 vector of the y(w,s)'s for country w

y = the WSx1 vector of the y(w,s)'s for all countries α = Sx1 vector of the $\alpha(s)$'s

β = Sx1 vector of the $\beta(s)$'s

$$\Omega = \beta \beta' + \text{diag} \{ \sigma_{\varepsilon}^2(s) \cdot \beta(s)^2 \}$$

The formula 3 (weights p) expresses a relationship in which each indicator in the aggregation procedure is inversely proportional to its error variance, i.e. the greater the variance of the error term the smaller the weight.

$$3. p(s) = \frac{\sigma_{\varepsilon}^2(s)^{-2}}{1 + \sum_{s=1}^{S(w)} \sigma_{\varepsilon}^2(s)^{-2}}$$

Considering Kaufmann et al., DEPI by equation 3 measures the performance basing itself on a weighted average of the rescaled observed scores. These rescaled scores are obtained when $\alpha(s)$ is subtracted from each observed score $y(w,s)$ and the result is then divided by $\beta(s)$. In this way it is possible rewriting equation 1 and assuming a mathematical expectation. As this is of a calculation of expected values we can hypothesize that the expected value of the disturbance term, $\varepsilon(w,s)$, is by assumption 0. The assumptions of equation 4 (mean) and 5 (standard deviation) imply that the conditional distribution of unobserved governance $g(w)$ is normal.

$$4. E[g(w)|y(w), \alpha, \beta] = \sum_{s=1}^{S(w)} p(s) \cdot \frac{y(w,s) - \alpha(s)}{\beta(s)}$$

$$5. sd[g(w)|y(w), \sigma_{\varepsilon}^2(1), \dots, \sigma_{\varepsilon}^2(S)] = \left[\sum_{s=1}^{S(w)} \sigma_{\varepsilon}^2(s)^{-2} \right]^{-1/2}$$

The equation 5 wanes in the number of specific indicators in which a particular country appears and raises in the variance of the $\varepsilon(w,s)$ on each of these indicators. In so doing, each indicator is re scaled in order that higher outcomes are equivalent to better outcomes. An additional re scaling is reached by first subtracting the minimum possible score and then dividing by the difference between the minimum and maximum possible score. The estimates of the $\alpha(s)$, $\beta(s)$ and $\sigma_{\varepsilon}^2(s)$, are achieved using MLE (Eq. 2). The low level of $\sigma_{\varepsilon}^2(s)$ means that indicators will show similar results with the other indicators. If the indicators are uncorrelated with the other indicators will have larger error variances. This correlation of scores underlies of the concept of effectiveness and not directly correlated to the perception errors. In the weight calculation, the indicators that highlight a highly correlation will express a larger weight than other indicators, because the results of equation 3 are inversely proportional to their imputed error variance. Equation 4 can now be estimated for each country so that an estimation of the level of performance $g(w)$ is obtained. Finally, equation 5 provide the calculation of the standard error of these estimates. The estimates of effectiveness for each country are re scaled by subtracting the mean across countries and dividing by the standard deviation across countries. The scores are in the range between -2.5 and 2.5. The standard error (Equation 5) is re calculated.

4. Data analysis

The analysis is built up in relation with data over the period 2016-2020 recovered from Eurostat (Eurostat, 2020), which reports official statistics for EU. The first elaboration by European Commission of DESI for all the countries in EU28 is available from 2016 onward. The years before 2016 offered a reference framework with only partial data and thus not reliable for a complete analysis. However, this range is rather meaningful because many changes happened to the EU digital structure due to a set of concomitant trends. Namely speed and significant growth of IT, radical changes in digital government (de Reuver, et al., 2017), relationship between countries and economic growth (Gustova, 2017; Posvyanskaya, 2018) and the full implementation of the EU Digital government (OECD, 2014; The Digital Assembly, 2018). In the present study, firstly, the 28 EU member states are ranked on the basis of the ratio between annual GDP and ICT investments and are grouped with quartiles methodology based on DEPI scores. Table 2 reports the considered countries and the corresponding results (GDP/ICT) during the period of the analysis. This division helps to understand the possible absence of

expenditure propension in ICT investments of the countries. Moreover, the first column of Table 2 reports a breakdown of the countries based on geographic criteria. It can be observed that geographic areas show countries with a similar structure and investments conditions. It can be observed that Table 2 shows the expenditure share of GDP in ICT, and the data highlight a progressive decrease of investment share. Malta shows the highest decrease with a negative variation with a value equal to – 1,5%. The average share of investment, for the period 2016 -2020 and for all countries, is equal to 3,81%. Considering this average value, 13 countries, out of total of 28, are above the average and 15 are under such value. Analysing the 13 countries (above the average value), it can be observed that the positive deviation from this value swings in a range with a minimum value equal to 0,13%, displayed by Luxembourg, and a maximum value equal to 1,5% of the UK. Examining the other 15 countries (under the average value), the negative deviation from it swings between -0,07 and – 1,22. The data highlight reflexions to do both about geographical groups and regarding the deviation from the average value of the ICT investments that will be object of subsequent analysis.

Table 2. Breakdown European Countries 2016– 2020 our elaboration from Eurostat data

Breakdown European Countries 2016 - 2020																	
Member States	Groups	2016	GDP2016	ICT/GDP2016	2017	GDP2017	ICT/GDP2017	2018	GDP2018	ICT/GDP2018	2019	GDP2019	ICT/GDP2019	2020	GDP2020	ICT/GDP2020	Average 16-20
Austria (AT)	G1	11.126	329.296	3,38%	11.630	339.896	3,42%	11.610	350.875	3,31%	11.630	369.899	3,14%	11.638	388.923	2,99%	3,25%
Belgium (BE)	G1	13.539	400.643	3,38%	14.016	409.407	3,42%	14.106	421.607	3,35%	14.045	439.052	3,20%	14.072	456.497	3,08%	3,29%
Bulgaria (BG)	G4	2.136	42.751	5,00%	2.155	44.162	4,88%	2.152	45.708	4,71%	2.219	51.663	4,29%	2.272	57.618	3,94%	4,56%
Croatia (HR)	G4	1.886	43.020	4,38%	2.003	43.897	4,56%	2.018	44.775	4,51%	2.028	48.990	4,14%	2.059	53.205	3,87%	4,29%
Cyprus (CY)	G3	702	17.394	4,04%	734	17.421	4,21%	744	17.543	4,24%	753	19.571	3,85%	766	21.599	3,55%	3,98%
Czech Republic (CZ)	G4	6.765	154.739	4,37%	7.522	166.964	4,50%	7.612	172.190	4,42%	7.700	191.722	4,02%	7.773	211.254	3,68%	4,20%
Denmark (DK)	G2	13.326	260.582	5,11%	13.658	266.179	5,13%	13.625	271.795	5,01%	13.612	292.808	4,65%	13.647	313.821	4,35%	4,85%
Estonia (EE)	G4	728	19.963	3,65%	767	20.461	3,75%	781	20.991	3,72%	804	23.615	3,41%	820	26.239	3,13%	3,53%
Finland (FI)	G2	10.296	205.268	5,02%	10.730	209.149	5,13%	10.724	212.265	5,05%	10.705	223.892	4,78%	10.760	235.519	4,57%	4,91%
France (FR)	G3	88.090	2.132.449	4,13%	89.103	2.181.064	4,09%	89.538	2.225.994	4,02%	89.083	2.291.705	3,89%	89.281	2.357.416	3,79%	3,98%
Germany (DE)	G1	112.771	2.915.650	3,87%	118.174	3.032.820	3,90%	119.682	3.123.501	3,83%	119.878	3.386.000	3,54%	120.262	3.648.499	3,30%	3,69%
Greece (EL)	G3	4.784	177.559	2,69%	4.698	176.023	2,67%	4.603	175.178	2,63%	4.534	180.218	2,52%	4.517	185.258	2,44%	2,59%
Hungary (HU)	G4	4.430	104.239	4,25%	4.937	108.748	4,54%	4.998	112.924	4,43%	5.059	124.050	4,08%	5.146	135.176	3,81%	4,22%
Ireland (IE)	G2	6.319	189.046	3,34%	6.853	255.815	2,68%	6.959	276.434	2,52%	6.864	294.110	2,33%	6.863	311.786	2,20%	2,61%
Italy (IT)	G3	52.287	1.611.884	3,24%	53.285	1.636.372	3,26%	53.451	1.663.863	3,21%	53.706	1.724.955	3,11%	53.948	1.786.047	3,02%	3,17%
Latvia (LV)	G4	713	23.581	3,02%	773	24.378	3,17%	798	25.146	3,18%	809	27.033	2,99%	819	28.920	2,83%	3,04%
Lithuania (LT)	G4	1.058	36.444	2,90%	1.142	37.124	3,08%	1.187	38.519	3,08%	1.198	42.191	2,84%	1.215	45.863	2,65%	2,91%
Luxembourg (LU)	G1	2.048	48.898	4,19%	2.112	52.113	4,05%	2.118	54.510	3,89%	2.108	55.299	3,81%	2.105	56.088	3,75%	3,94%
Malta (MT)	G3	351	8.106	4,33%	372	8.806	4,22%	375	9.334	4,02%	375	11.295	3,32%	375	13.256	2,83%	3,74%
Netherlands (NL)	G1	31.287	662.770	4,72%	33.249	676.531	4,91%	33.515	691.009	4,85%	33.548	772.694	4,34%	33.697	854.379	3,94%	4,55%
Poland (PL)	G4	14.304	410.845	3,48%	15.573	427.737	3,64%	15.790	445.189	3,55%	15.968	467.167	3,42%	16.086	489.145	3,29%	3,48%
Portugal (PT)	G3	7.475	173.446	4,31%	7.522	179.369	4,19%	7.493	183.620	4,08%	7.428	194.614	3,82%	7.408	205.608	3,60%	4,00%
Romania (RO)	G4	4.475	150.230	2,98%	4.901	160.353	3,06%	5.101	171.207	2,98%	5.184	187.517	2,76%	5.231	203.827	2,57%	2,87%
Slovakia (SK)	G4	2.798	75.561	3,70%	2.977	78.071	3,81%	2.977	80.717	3,69%	3.012	84.851	3,55%	3.028	88.985	3,40%	3,63%
Slovenia (SLO)	G4	1.435	37.303	3,85%	1.511	38.543	3,92%	1.517	39.017	3,89%	1.512	43.000	3,52%	1.515	46.983	3,22%	3,68%
Spain (ES)	G3	40.285	1.041.160	3,87%	41.324	1.081.190	3,82%	41.343	1.116.437	3,70%	40.969	1.206.878	3,39%	40.558	1.297.319	3,13%	3,58%
Sweden (SE)	G2	21.632	430.642	5,02%	22.437	444.617	5,05%	22.521	466.404	4,83%	22.508	475.224	4,74%	22.662	484.044	4,68%	4,86%
United Kingdom (UK)	G2	128.313	2.254.297	5,69%	145.685	2.575.719	5,66%	148.009	2.619.506	5,65%	147.074	2.930.192	5,02%	146.601	3.240.878	4,52%	5,31%

Starting from the application of DEPI methodology, Figure 1 reports Connectivity scenario. This scenario is a prerequisite for the functioning of digital platforms. The connectivity dimension takes into account both fixed and mobile broadband by considering supply and demand. Under fixed broadband, it assesses the availability as well as the take-up of basic, fast (digital natives) and ultrafast broadband. The availability of 5G and the adoption of mobile broadband are considered on mobile broadband. Digital Connectivity must be considered as a social right and network (Wellman et al.,1996), in the EU state members. A comparative assessment of Connectivity dimension displays, as reported in Fig.1, the Nordic countries (Finland and Denmark) as the strongest performers of effectiveness measured by DEPI. While the lowest scores were registered by Greece and Croatia.

Table 3 reports the breakdown of EU 28 countries in quartiles. The first quartile (Q1) presents the lowest level of platform effectiveness, whereas belonging to the fourth quartile (Q4) show the highest platform effectiveness level based on DEPI scores on Connectivity Dimension.

Table 3. Decomposition in quartiles scores in Connectivity

COUNTRIES	2016	2017	2018	2019	2020
Austria	Q2	Q2	Q2	Q2	Q1
Belgium	Q4	Q4	Q4	Q4	Q4
Bulgaria	Q1	Q1	Q1	Q1	Q1
Croatia	Q1	Q1	Q1	Q1	Q1
Cyprus	Q2	Q2	Q2	Q2	Q2
Czech Republic	Q2	Q1	Q2	Q2	Q2
Denmark	Q4	Q4	Q4	Q4	Q4
Estonia	Q3	Q4	Q4	Q4	Q4
Finland	Q4	Q4	Q4	Q4	Q4
France	Q1	Q2	Q2	Q1	Q1
Germany	Q3	Q3	Q2	Q3	Q3
Greece	Q1	Q1	Q1	Q1	Q1
Hungary	Q2	Q2	Q2	Q2	Q2
Ireland	Q3	Q3	Q3	Q3	Q3
Italy	Q1	Q2	Q1	Q1	Q2
Latvia	Q3	Q3	Q3	Q3	Q3
Lithuania	Q3	Q3	Q3	Q3	Q3
Luxemburg	Q3	Q4	Q3	Q3	Q3
Malta	Q4	Q3	Q4	Q4	Q4
Netherlands	Q4	Q4	Q4	Q4	Q4
Poland	Q1	Q1	Q1	Q1	Q1
Portugal	Q3	Q2	Q2	Q2	Q3
Romania	Q1	Q1	Q1	Q1	Q1
Slovakia	Q2	Q1	Q1	Q2	Q2
Slovenia	Q2	Q2	Q3	Q2	Q2
Spain	Q2	Q3	Q3	Q3	Q2
Sweden	Q4	Q4	Q4	Q4	Q4
United Kingdom	Q4	Q3	Q3	Q3	Q3

Source: Marino, Pariso on Eurostat Dataset

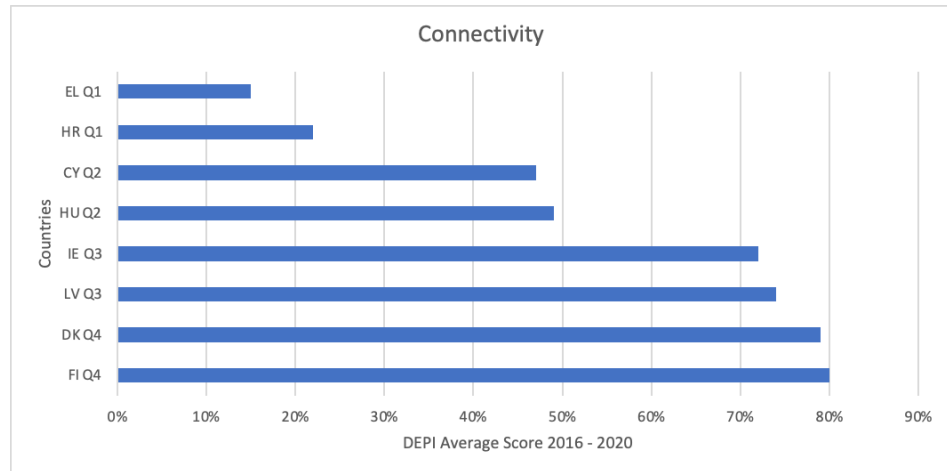


Fig. 1 DEPI Average scores 2016-2020 Connectivity

Source: Marino, Pariso on Eurostat Dataset

Figure 2 shows the Human Capital dimension score of DEPI.

Strategic importance, in this case, is given by digital skills. Remote work should be supported by investments in both traditional and innovative educational sector.

Digital skills, i.e. the ability to use digital platforms for work, leisure and communication competently and safely. It is composed by two sub dimensions, namely “basic skills and usage” and “advanced skills and development”.

Basic skills and usage sub dimension involve indicators on platform use by individuals and digital skills (basic). The other sub dimension includes indicators on ICT specialist employment and graduates in STEM – (Marino et al., 2019).

Science, Technology Engineering and Mathematics disciplines (advanced). Finland and Sweden are the top performers; instead, Romania and Bulgaria rank in the lowest overall on Human Capital dimension. Table 4 reports the breakdown of EU 28 countries in quartiles.

The first quartile (Q1) presents the lowest level of platform effectiveness, whereas the fourth quartile (Q4) shows the highest platform effectiveness level based on the DEPI scores on Human Capital Dimension.

Table 4. Decomposition in quartiles scores in Human Capital

COUNTRIES	2016	2017	2018	2019	2020
Austria	Q3	Q3	Q3	Q3	Q3
Belgium	Q4	Q3	Q3	Q3	Q3
Bulgaria	Q1	Q1	Q1	Q1	Q1
Croatia	Q1	Q2	Q1	Q1	Q2
Cyprus	Q2	Q2	Q2	Q2	Q2
Czech Republic	Q2	Q2	Q2	Q2	Q2
Denmark	Q3	Q3	Q3	Q3	Q3
Estonia	Q3	Q4	Q4	Q4	Q4
Finland	Q4	Q4	Q4	Q4	Q4
France	Q3	Q3	Q3	Q3	Q3
Germany	Q3	Q4	Q4	Q4	Q4
Greece	Q1	Q1	Q1	Q1	Q1
Hungary	Q2	Q1	Q2	Q2	Q2
Ireland	Q4	Q4	Q4	Q4	Q4
Italy	Q1	Q1	Q1	Q1	Q1
Latvia	Q1	Q2	Q2	Q1	Q1
Lithuania	Q3	Q3	Q3	Q3	Q3
Luxemburg	Q4	Q4	Q4	Q4	Q4
Malta	Q2	Q2	Q2	Q2	Q1
Netherlands	Q4	Q4	Q4	Q4	Q4
Poland	Q1	Q1	Q1	Q1	Q1
Portugal	Q3	Q2	Q2	Q2	Q3
Romania	Q1	Q1	Q1	Q1	Q1
Slovakia	Q2	Q1	Q1	Q2	Q2
Slovenia	Q2	Q3	Q3	Q2	Q2
Spain	Q2	Q2	Q2	Q2	Q2
Sweden	Q4	Q4	Q4	Q4	Q4
United Kingdom	Q4	Q3	Q3	Q3	Q3

Source: Marino, Pariso on Eurostat Dataset

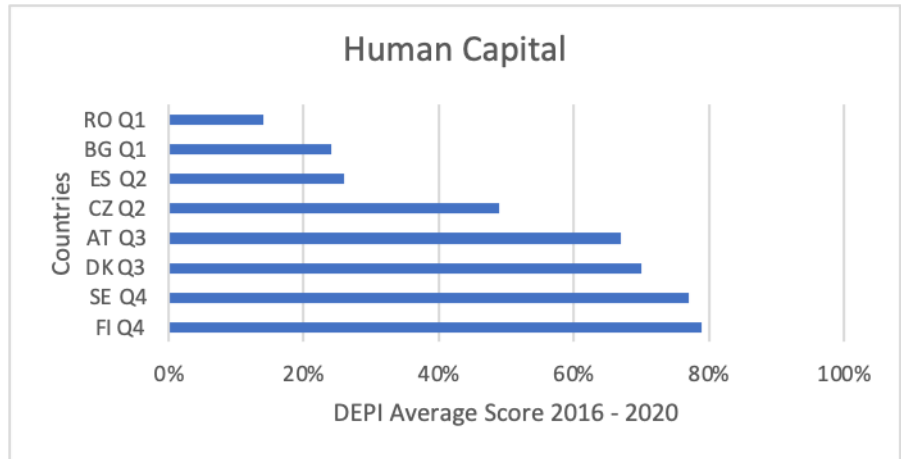


Fig. 2. DEPI Average scores 2016-2020 Human Capital

Source: Marino, Pariso on Eurostat Dataset

Figure 3 displays the Use of Internet services dimension, which is made up of three sub dimensions: Citizens' use of Content, Communication and Online Transactions.

This dimension is related to digital services platforms and its services delivery, i.e., to protect personal data (Barth et al., 2017) and privacy (Acquisti et al., 2005; Acquisti et al., 2015; Awad et al., 2006). The first sub-dimensions measure the extent to which a country's platform users get online content. Furthermore, the second measures the extent to which the same users communicate and interact online via their broadband connections.

Online Transactions, instead, measures the propensity of Internet users to perform transactions online. The best performers on DEPI scores are Sweden and Denmark and the worst are again Romania (see fig. 2) and Italy. Table 5 reports the breakdown of the 28 EU countries in quartiles.

The first quartile (Q1) presents the lowest level of platform effectiveness, whereas the fourth quartile (Q4) shows the highest platform effectiveness level based on DEPI scores on Use of Internet services dimension. Figure n.4 reports Integration of Digital Technologies dimension based on the DEPI scores.

This dimension highlights the difficulty of integration between the platforms and the software that manage the information exchange relationships and the transactions between the business and government processes. It has two sub dimensions, Business digitization and e-commerce both measured by use of digital technologies.

The Business digitization sub-dimension shows the level of adoption of digital technologies by a country's businesses. The e Commerce sub-dimension measures the use of the online sales channel by a country's small and medium enterprises. Finland and once again Sweden (see fig. 2) are at the top positions of European ranking and on once again Romania (see fig. 3) and Poland occupy the last positions.

Table 5. Decomposition in quartiles scores in Use of Internet Services

COUNTRIES	2016	2017	2018	2019	2020
Austria	Q2	Q2	Q2	Q2	Q2
Belgium	Q4	Q3	Q3	Q3	Q3
Bulgaria	Q1	Q1	Q1	Q1	Q1
Croatia	Q2	Q3	Q3	Q2	Q3
Cyprus	Q3	Q3	Q3	Q3	Q2
Czech Republic	Q2	Q2	Q2	Q2	Q2
Denmark	Q4	Q4	Q4	Q4	Q4
Estonia	Q3	Q4	Q4	Q4	Q4
Finland	Q4	Q4	Q4	Q4	Q4
France	Q2	Q2	Q2	Q2	Q1
Germany	Q3	Q4	Q4	Q4	Q4
Greece	Q1	Q1	Q1	Q1	Q1
Hungary	Q2	Q1	Q2	Q2	Q2
Ireland	Q1	Q2	Q2	Q1	Q1
Italy	Q1	Q1	Q1	Q1	Q1
Latvia	Q3	Q3	Q3	Q3	Q3
Lithuania	Q3	Q3	Q3	Q3	Q3
Luxemburg	Q4	Q4	Q4	Q4	Q4
Malta	Q3	Q3	Q3	Q3	Q3
Netherlands	Q4	Q4	Q4	Q4	Q4
Poland	Q1	Q1	Q1	Q1	Q1
Portugal	Q3	Q2	Q2	Q2	Q3
Romania	Q1	Q1	Q1	Q1	Q1
Slovakia	Q2	Q1	Q1	Q2	Q2
Slovenia	Q1	Q3	Q1	Q1	Q2
Spain	Q2	Q2	Q2	Q2	Q2
Sweden	Q4	Q4	Q4	Q4	Q4
United Kingdom	Q4	Q3	Q3	Q3	Q3

Source: Marino, Pariso on Eurostat Dataset

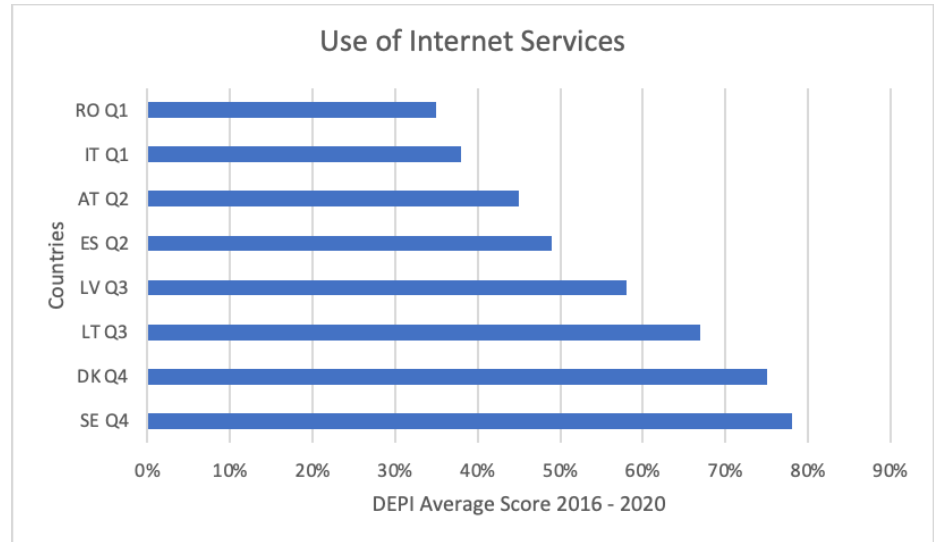


Fig. 3. DEPI Average scores 2016-2020 Use of Internet Servicesa

Source: Marino, Pariso on Eurostat Dataset

Table 6 reports the breakdown of 28 EU countries in quartiles. The first quartile (Q1) presents the lowest level of platform effectiveness, whereas the fourth quartile (Q4) shows the highest platform effectiveness level based on the DEPI scores on Digital Technologies dimension.

Table 6. Decomposition in quartiles scores in Integration of Digital Technology

COUNTRIES	2016	2017	2018	2019	2020
Austria	Q3	Q2	Q2	Q2	Q3
Belgium	Q4	Q4	Q4	Q4	Q4
Bulgaria	Q1	Q1	Q1	Q1	Q1
Croatia	Q2	Q3	Q3	Q2	Q3
Cyprus	Q3	Q3	Q3	Q3	Q2
Czech Republic	Q1	Q2	Q2	Q2	Q2
Denmark	Q4	Q4	Q4	Q4	Q4
Estonia	Q2	Q2	Q2	Q2	Q2
Finland	Q4	Q4	Q4	Q4	Q4
France	Q2	Q2	Q2	Q2	Q2
Germany	Q3	Q3	Q3	Q3	Q3
Greece	Q1	Q1	Q1	Q1	Q1
Hungary	Q1	Q1	Q1	Q1	Q1
Ireland	Q4	Q4	Q4	Q4	Q4
Italy	Q2	Q1	Q2	Q2	Q2
Latvia	Q1	Q3	Q1	Q1	Q2
Lithuania	Q3	Q3	Q3	Q3	Q3
Luxemburg	Q2	Q2	Q2	Q1	Q1
Malta	Q2	Q2	Q2	Q2	Q2
Netherlands	Q4	Q4	Q4	Q4	Q4
Poland	Q1	Q1	Q1	Q1	Q1
Portugal	Q3	Q3	Q3	Q3	Q3
Romania	Q1	Q1	Q1	Q1	Q1
Slovakia	Q2	Q1	Q1	Q2	Q1
Slovenia	Q3	Q3	Q3	Q3	Q3
Spain	Q3	Q4	Q4	Q4	Q4
Sweden	Q4	Q4	Q4	Q4	Q4
United Kingdom	Q4	Q3	Q3	Q3	Q3

Source: Marino, Pariso on Eurostat Dataset

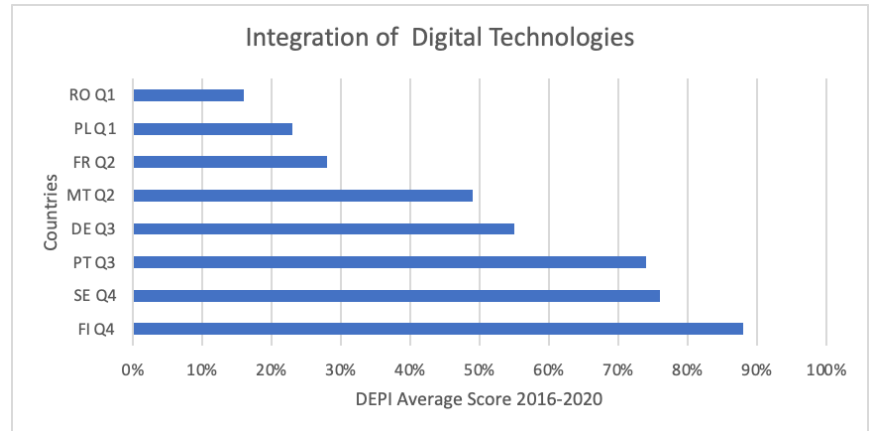


Fig. 4. DEPI Average scores 2016-2020 Integration of Digital Technology

Source: Marino, Pariso on Eurostat Dataset

Figure 5 shows the effectiveness of digital public services dimension by DEPI. The digital public services dimension consists of two sub dimensions: the e Government and e Health. E - government platforms measures the extent of interaction, through digital services delivery, between the public administration and its stakeholders. In line with the previous sub dimension, e Health assesses the percentage of people who used health and care

services provided online. The DEPI score European ranking shows on the top once again Finland (see figs. 2 and 4) and the United Kingdom and at the bottom, once again, Greece (see fig.1) and Hungary. Table 7 reports the breakdown of the 28 EU countries in quartiles. The first quartile (Q1) presents the lowest level of platform effectiveness, whereas the fourth quartile (Q4) shows the highest platform effectiveness level based on the DEPI scores on digital public services dimension.

Table 7. Decomposition in quartiles scores in Digital public services

COUNTRIES	2016	2017	2018	2019	2020
Austria	Q4	Q4	Q4	Q4	Q4
Belgium	Q2	Q2	Q2	Q2	Q2
Bulgaria	Q1	Q1	Q2	Q2	Q1
Croatia	Q2	Q2	Q1	Q1	Q2
Cyprus	Q3	Q3	Q3	Q2	Q3
Czech Republic	Q1	Q2	Q2	Q1	Q1
Denmark	Q4	Q4	Q4	Q4	Q4
Estonia	Q4	Q4	Q4	Q4	Q4
Finland	Q4	Q4	Q4	Q4	Q4
France	Q3	Q3	Q3	Q3	Q3
Germany	Q1	Q3	Q1	Q1	Q2
Greece	Q1	Q1	Q1	Q1	Q1
Hungary	Q1	Q1	Q1	Q1	Q1
Ireland	Q3	Q3	Q3	Q3	Q3
Italy	Q2	Q1	Q2	Q2	Q2
Latvia	Q3	Q3	Q3	Q3	Q3
Lithuania	Q3	Q3	Q3	Q3	Q3
Luxemburg	Q2	Q2	Q2	Q2	Q2
Malta	Q3	Q3	Q3	Q3	Q3
Netherlands	Q4	Q4	Q4	Q4	Q4
Poland	Q1	Q1	Q1	Q1	Q1
Portugal	Q3	Q3	Q3	Q3	Q3
Romania	Q1	Q1	Q1	Q1	Q1
Slovakia	Q2	Q1	Q1	Q2	Q1
Slovenia	Q2	Q2	Q2	Q2	Q2
Spain	Q2	Q2	Q2	Q2	Q2
Sweden	Q4	Q4	Q4	Q4	Q4
United Kingdom	Q4	Q4	Q4	Q4	Q4

Source: Marino, Pariso on Eurostat Dataset

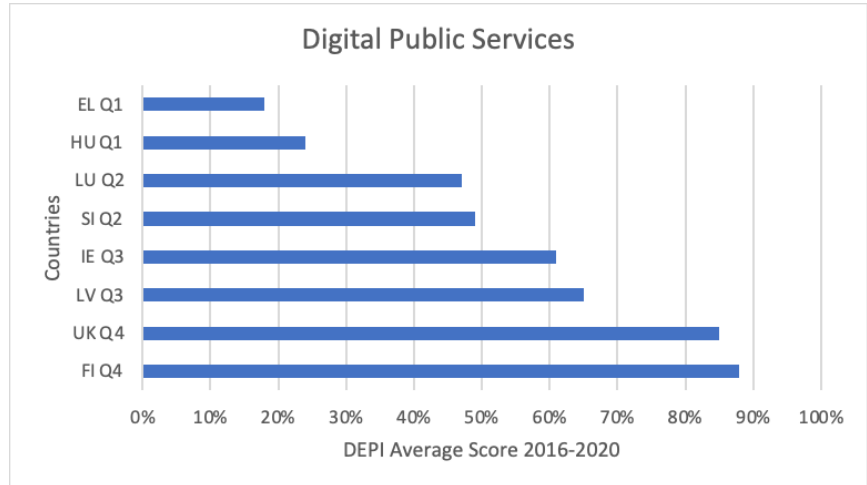


Fig. 5 DEPI Average scores 2016-2020 Digital public services

Source: Marino, Pariso on Eurostat Dataset

The present data analysis confirms the peculiar situation of the 28 EU countries during the period 2016-2020 and highlights the heterogeneous conditions among the countries. Furthermore, each country displays a specific trend related to expenditure propension of the ratio of ICT/GDP and results of DEPI application in the five different DESI dimensions. At this stage some leader countries emerged by data analysis and also country profiles with deep weaknesses are shown. For these reasons, the development of a more sophisticated investigation appears appropriate.

4. Results

From the analysis by geographic area of the 28 EU countries, the following profiles related to ICT/GDP investment emerge. In the G4 Area (Table n.2 - Eastern Europe), except Bulgaria, Croatia and Czech Republic which show an investment share above the average value, the other 7 countries invest a lower than average amount. In these countries, a consolidation of digital platforms is needed in terms of opportunities and challenges to improve remote working (Daniels et al., 2001) and offer change processes to companies and in particular to the public sector. Particularly, for two of them, Romania and Lithuania, compared to the average value (3,81%), the negative deviation ranges between -0,9 (RO) and - 1 (LT). Southern Europe (G3 group) offers a framework in which, out of total of 7 countries, three of these are slightly above the average value and the other four are below it. Greece, in this group, shows a negative deviation compared to the average value for a percentage equal to - 1,3%. In the central Europe (G1 group) Netherlands and Luxembourg are slightly above the average value and the lowest score is achieved by Austria with a negative deviation compared to the average value for a percentage equal to - 1,6%. Northern Europe (G2 group) ranks four, of its five countries, in the first five position, out of total of the 28 EU Member States, in which Ireland, instead, shows a negative deviation compared to the average value for a percentage equal to - 1,2%. Data analysis shows that the countries (Finland, Sweden and Denmark) with the highest share of ICT/GDP ratio investments in 2014 (year of DESI introduction) preserve their leadership until 2018 also in a general framework in which there is an overall decrease of the ICT/GDP ratio investments for the period 2014-2018. Starting with these first results, in the next sub sections a detailed discussion of DEPI dimension results will be provided. Figure 1 reports the trend of DEPI for Connectivity dimension and the sub dimensions taken into account, namely Fixed Broadband, Mobile Broadband, Speed, Affordability. Connectivity is a pre requisite to support digital platforms and its opportunity. Connectivity is a competitive investment in terms of both, development and consolidate the information and communication technology. This dimension highlight Finland is the best performer and Greece the worst. A representation among DEPI, related to Finland and Greece's connectivity sub dimensions performances, calculated by using the level values of the sub dimensions and considering their weighted parameters, is depicted respectively in Fig. 1(a) and Fig. 1(b). It can be observed that the values of these scores are different, but some common patterns can be identified. In particular, DEPI calculated on level values and weighted on the four sub dimensions of Connectivity has a similar trend related to the homogeneous European areas. Finland displays a DEPI average score for the considered period (2014-2018) equal to 1,98, and for the same period, Greece shows a total average score equal to 0,23. On the one hand, Finland achieves its best score in this dimension in the 2018 with a DEPI equal to 2,20. On the other hand also Greece obtains the best DEPI performance in Connectivity dimension with a score equal to 0,68. Related to the connectivity sub dimensions, the strategic gap is the "affordability", in fact in Finland DEPI scored 2,01 but in Greece 0,19. This means that Greece should activate appropriate policies in order to enhance affordability in different sectors. Analyzing the results of Table n.3 it can be detected that Finland is always in Q4 and Greece always occupy Q1 position.

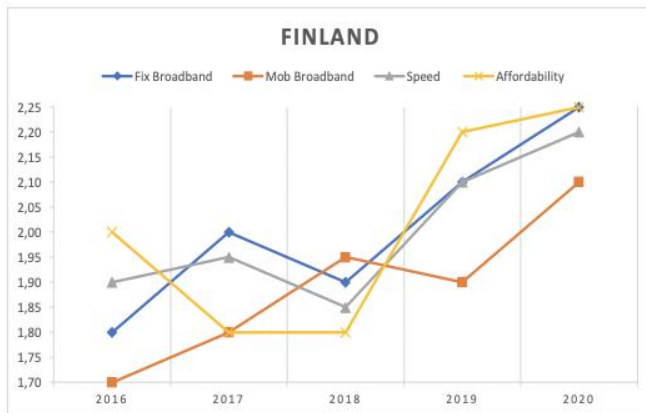


Fig. 1a Connectivity Finland

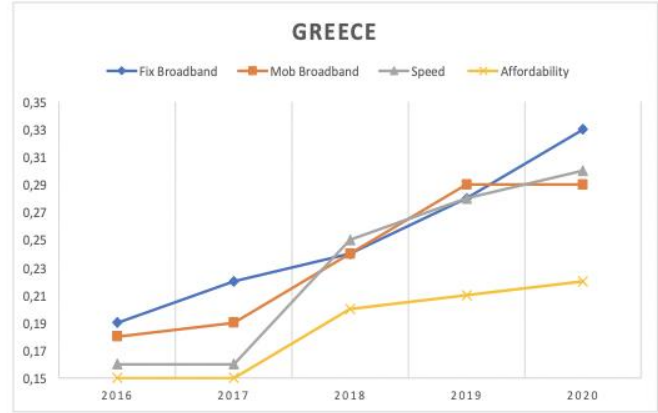


Fig. 1b Connectivity Greece

Similar considerations can be drawn when the index is referred to the Human Capital dimension. DEPI scores have different values but show a very similar trend in the Connectivity dimension. Finland (Fig. 2.a) confirms a leading position also in Human Capital with a DEPI average score for the considered period (2016-2020) equal to 1,98, and the worst performer, belonging to the Eastern European countries, is Romania (fig. 2.b) with a score equal to 0,24. Therefore, also in this case it can be said that the Human Capital dimension distribution, Basic skills and usage and Advanced skills highlight significant differences between the two countries. In the considered period, Finland displays DEPI average scores for each sub dimension equal to 1,99 (Basic) and 1,93 (Advanced). On the opposite side, the scores are 0,27 (Basic) and 0,22 (Advanced) for Romania.



Fig. 2a Human Capital Finland

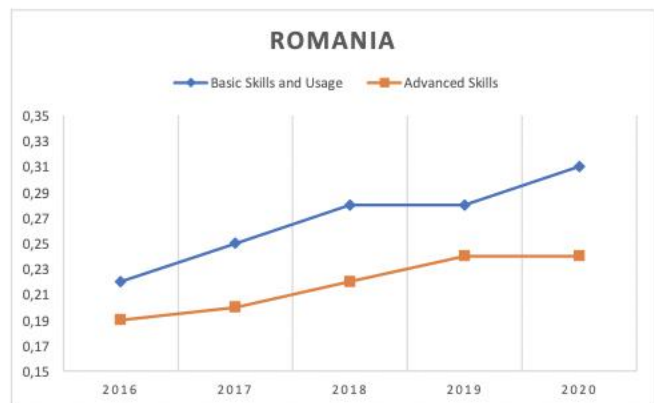


Fig. 2b Human Capital Romania

The DEPI scores calculated on the basis of the Use of Internet Services dimension follow the previous trends whereas the first two positions as held by the northern European group by contrast, there are two countries belonging to the eastern and southern European group, as shown also in Connectivity dimension. In this case the last positions are occupied by Italy and Romania, the first two, instead, by Sweden and Denmark. Those based on the GDP have different values, but the same trends. Sweden's DEPI average score (Fig. 3.a) in this dimension, for the considered period (2016-2020), is equal to 2,04, and Romania's (Fig. 3b) 0,15. Related to the Use of Internet Services sub dimension, the strategic gap is the "transaction", in which Sweden achieves a DEPI average score, for the 5 years, equal to 2,09 and Romania equal to 0,15. It could be mean that in these two countries deep differences in terms of culture in the use of digital technologies for daily transaction by citizens are present, and in this way the first step should be to act towards a reduction of digital divide. This is in line with the general framework in this dimension displays Sweden and Denmark achieve scores linked to Q4, and Italy and Romania always occupy Q1 positions. Furthermore, in relation to the Use of Internet Services sub dimensions, Sweden has

the best average scores in “Content” (2,03) and “Transaction” (2,09), instead Romania reaches its best score in “Communication” (0,23).

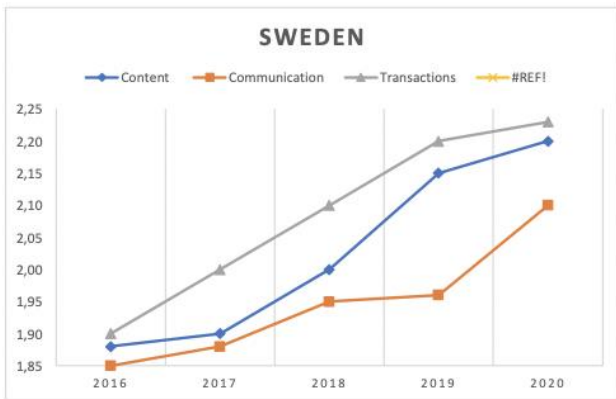


Fig. 3a Use of Internet Services Sweden

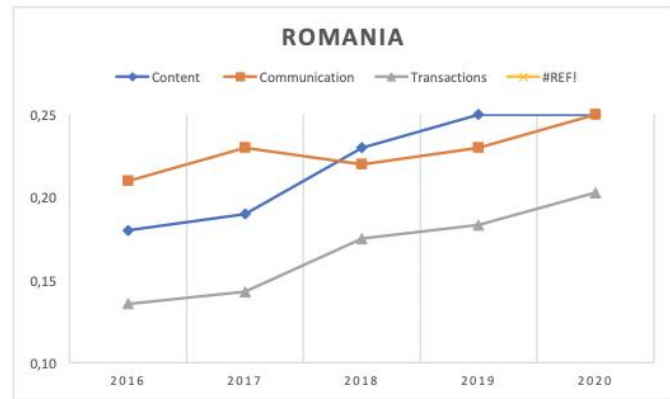


Fig. 3b Use of Internet Services Romania

Figure 4.(a) reports the DEPI score index calculated on the basis of Integration of Digital Technologies dimension for Finland that maintains, also in this dimension, a leadership with a DEPI average score, for the 5 analyzed years, equal to 2,16. Romania (Fig. 4.b) shows once again a low profile of performance with an average score equal to 0,30. The trend is confirmed by the positions occupied by these two countries in the table n. 6 in which Finland is for the five years in Q4 and whereas Romania always places itself in Q1. Analyzing the two sub dimensions of the Integration of Digital Technologies, it can be observed that both countries have the best score in E-commerce sub dimension (Finland 2,20; Romania 0,32).



Fig. 4a Integration of Digital Technologies Finland

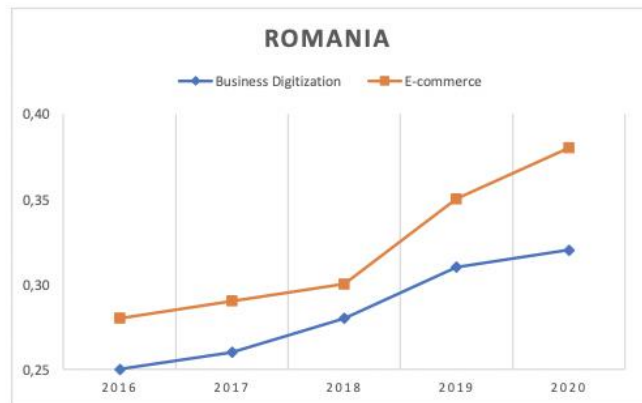


Fig. 4b Integration of Digital Technologies Romania

Figure 5 represents the trend of DEPI for Digital Public Services dimension and its two subdimensions, namely E-government and E-Health. As seen for the Connectivity dimension, Finland is the best performer and Greece the worst. A representation among DEPI, related to Finland and Greece’s Digital Public service sub dimension performances, calculated by using the level values of the sub dimensions and considering their weighting parameters, is depicted respectively in Fig. 5(a) and Fig. 5(b). Finland obtained a DEPI average score for the analyzed period (2016-2020) of 1,91, and Greece shows a total average score equal to 0,31. Both countries realize their best average scores in the E-government sub dimension even if the difference between the two is significant, in fact Finland’s score is 1,97 and Greece’s score is 0,35. This difference, equal to 1,59, is also present in E Health sub dimension. Table n.7 shows that Finland is always in Q4 and Greece always in Q1 position. At this level of results, a first polarization emerges in relation to the DEPI scores, in fact the first two countries belong to the Northern area (G2 group) and show a leadership in all dimensions, as shown in the graphs. The last two countries belong to the Eastern (G4 group) area and display many weaknesses. Furthermore, similar conclusions

can be drawn from the analysis of Tables from 3-7 and it can be observed that Finland is always in Q4, and Greece and Romania are for the entire period in Q1.

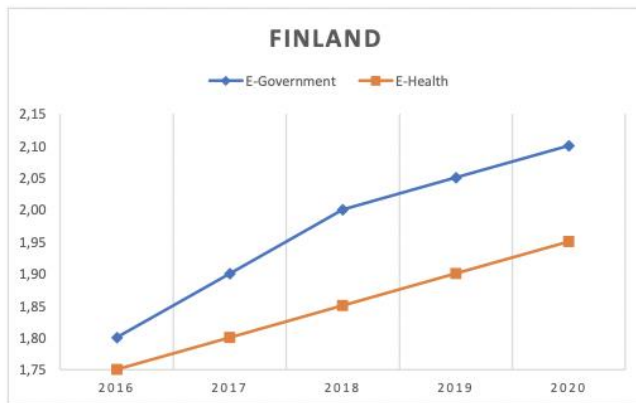


Fig. 5a Digital Public Services Finland

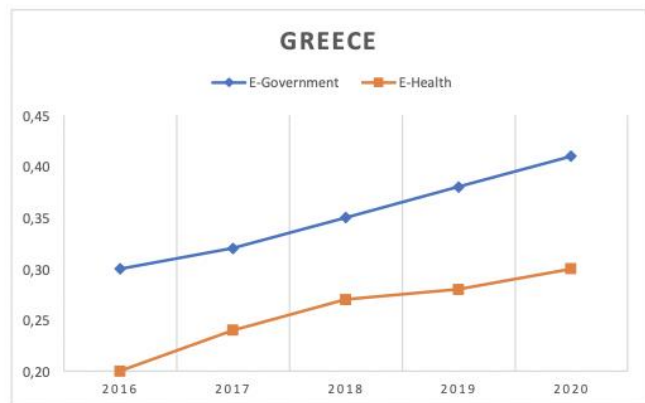


Fig. 5b Digital Public Services Greece

5. Discussion

By analysing the results above reported, representative countries profiles emerge in order to develop a deeply discussion. The comparisons, cross-countries allow to reveal consistent patterns and practical value. Finland, as reported in the previous graphs, shows an effectiveness leadership. Finland has been able to transform challenges into opportunities, consolidating public digital platforms, promoting remote work. The digital public platforms is managing and driving change in this pandemic phase. This leadership has been built with both planning and government actions, in fact Finland developed a Government program with goals of productivity in public services and the private sector by utilizing the digitalization as driver and reducing the red tape. Furthermore, Finland set itself the objective of delivering public services primarily in digital way. In fact, Finland displays a high level of the ICT/GDP ratio within the 28 EU Members State (see Table n.2). Furthermore, the implementation of this program started with an open letter by the government requesting proposals on how to contribute to digitalization. In twelve months, the government has received from public administration, businesses, NGOs and citizens more than 260 proposals and through the appointment of a working group some of these proposals have received funding (i.e. Income register and Virtual hospital - E-Health). This country's leadership profile is sustained, developed together with other northern European countries. It is interesting to note that this shared approach to the creation of public digital platforms, is a model that also other northern European Member States are devoting attention to consolidate and guide the relationship with citizens and stakeholders in this pandemic phase. In particular, Northern countries cooperate on their e-government effectiveness strategy and implementation. Northern European Member States are leading the digital platforms processes and highlight some good practices, such as the one described above. In fact, Denmark, Finland, Norway and Sweden share their national e-government actions and together promote both big data and open data (Ferraris et al., 2020) platforms. The big data (Wamba et al., 2015) represent a strategic step in the creation of a digital platforms service linked to consolidation of the community area. It can be observed, based on this, that the DEPI average scores show as leaders, for each dimension, these countries (G2 group). In particular, for the Connectivity dimension, the first two positions are Finland and Denmark (Fig. 1) and in the considered period, these countries always occupy Q3 or Q4 position (see Table 3). This trend is confirmed also in the other dimensions, Human Capital displays as leaders Finland and Sweden (Fig. 2) with always Q4 or Q3 position (see Table 4), Use of Internet Services shows Sweden and Denmark as the best performer (Fig. 3) and once again with a positioning for both in Q4 (see Table 5). Similarly, Integration of Digital Technology shows Finland and Sweden in the first two positions (Fig. 4) and table n. 6 always displays both countries in Q4 position. Finally, in Digital Public Services, the best performers are Finland and UK (Fig. 5) and in Table 7 it is possible to verify that both countries are always in Q4 position. On the opposite side, the most representative countries' profiles are given by Greece (G3 group) and Romania

(G4 group), belonging respectively to the Southern and Eastern European areas. The worst performances breakdown by DEPI average score assigns to Greece the last position in Connectivity and Digital Public Services and Romania the other three dimensions. Greece, as reported in the previous graphs shows, a low level of government platforms effectiveness compared to the average of the 28 EU Member States. In line with these performances Table n.2 shows, for the entire period, the lowest ICT/GDP ratio. In particular, it can be observed that this low profile is also related to weak government actions that do not emphasize the digitalization and specific planning tools for the government. Particularly, Greece has shown deficiencies in advanced digital infrastructures and interconnection of the State. In fact, Fig. 1.b highlights Greece as one of the European countries with the lowest DEPI scores in Affordability, one of the Connectivity sub dimensions. Furthermore, it could be strategic to interconnect the registers in the entire country, because it is an important element to the development of government platforms effectiveness. Moreover, Greece shows other important limits related to the modernization of the State and Public Administration and in the reconnection of the citizens with State and Public Administration. In fact, these are two strategic objectives of the Country to improve Digital Public Services. Actually, show a very below level of performance the average compared to the other Member States. These low performances are shared with other southern countries, in fact also in Italy, in the considered period the average of ICT/GDP ratio shows a significant difference with the European average share. Moreover, as to Connectivity (Table 3), together with Greece, also France, Italy and Cyprus always occupy positions between quartiles 1 and 2. Analyzing Human Capital (table 4), it can be observed that these low performances (Q1 and Q2 position) are shared by Greece, Cyprus and Italy. In the Use of Internet Services, Greece, Italy, France, and Spain are again in Q1 and Q2 positions (Table 5). This trend is confirmed in Integration of Digital Technology that shows Greece, Italy and France positioning in quartiles 1 and 2 (Table 6). Finally, in Digital Public Services once again Greece and Italy always occupy Q1 and Q2 positions (Table 7). On the basis of this, it can be concluded that in Southern European countries Greece and Italy show a lot of shared weaknesses.

Starting with the description of Greece's profile it can be assumed the Romania's performance in terms of government platforms effectiveness is very similar, in fact, also this country shows the lowest average in the ICT/GDP ratio and achieves below average effectiveness performances in each dimension. In particular, Romania occupies the last position in the DEPI average scores in relation to Human Capital, Use of Internet Services and Integration of Digital Technology dimensions. These scores are in line with the national framework. Despite many attempts to develop effectiveness government strategies, such as the creation of the National Interoperability Framework (NIF), Romania was not able to create, enforce and support policies aimed at minimising the costs and maximising the efficiency of the public administration, and at the same time to ensure a better service delivery to citizens and businesses. The Country, in fact, is not yet able to promote a public administration that uses shared ICT, reusable assets and a standardised approach to implement government platforms effectiveness. In line with the trend reported for Finland and Greece, also the performances showed by Romania are a common element with some other eastern countries. In fact, on one hand also Lithuania, Poland, Latvia, Slovakia and Slovenia, in the analyzed period, invest an average share of the ICT/GDP ratio that is below the European average share. On the other hand, also the DEPI average scores in the five dimensions express many similarities. In particular, in Connectivity dimension (Table 3), Poland, Croatia, and Bulgaria show, together with Romania, performances that rank in the first quartile and other three countries (Slovakia, Hungary and Czech Republic) are positioned in Q2. Analyzing Human Capital dimension (table 4), it can be observed that these low performances (Q1 and Q2 position) are shared also by Poland, Croatia, Bulgaria, Slovakia, Hungary, Latvia and Czech Republic. In line with these performances, also in Use of Internet Services, Integration of Digital Technology, and Digital Public Services, Bulgaria, Czech Republic, Hungary, and Slovakia performances are in line with that of Romania and positioned in quartiles 1 and 2 (Table 5, 6, 7). The reported three country profiles that reflect the trend of three different European group areas, it can be observed that the G2 area represents a country profile with a high propensity in ICT investments. This propensity is linked to actions capable of creating government effectiveness as shown by their DEPI average scores, to an inclination of taking advantage of digital government platforms, and to an ability of acquiring top positions in the long run. Despite these top positions,

there is a country, namely Ireland, that shows in considered period and in all dimensions, significant differences in the DEPI average scores. On the contrary, G3 and G4 areas show a countries' profiles with common regional capability deficiencies in relation with possible outcome of government platforms effectiveness. Particularly, these lacks are linked to connectivity, use of internet services and digital public services. Moreover, there is no integrated strategy between central and local public administration. The lack of these strategies also affects the educational system, particularly with relevance to digital skills training in central and local public administration. DEPI, as an assessment tool for digital government platforms effectiveness, shows that the countries in each geographic area show similar features and the imbalance within the rank is due to the differences existing among the geographic areas. The research limitations, especially in the field of choosing methodology are linked to the necessity to capture how the investments, improve the digital government platform effectiveness in relation to DESI dimensions.

Conclusions

The present paper presented a detailed analysis on the digital government platforms effectiveness of diverse country typologies within Europe. DEPI was elaborated in order to have a synthetic measure of the platform's effectiveness. It is built up by considering its five dimensions. This permitted to investigate in detail the sources of platforms effectiveness in the 28 EU Member States, grouped in quartiles according to the level of DEPI scores. Thus, is an investigation on the relationship between effectiveness and single countries within geographical groups with respect to the digital government platforms development was developed. The analysis demonstrated a stable trend in the platforms' effectiveness, independently of the weighting dimension considered, e.g. Connectivity, Human Capital or Digital Public Services. The situation changes when the countries' profiles are investigated in relation to ICT/GDP ratio, in which a general decreasing trend is observed. This means that the countries investments share in ICT does not have similar distributions but rather a common decreasing investment trend. Analysing DEPI within the same areas the last countries' profiles do not reach different positions in the analysed period, i.e. Ireland (G2 group) holds the last position, and the same consideration is also true for Greece (G3 group), that belongs to a weak European area. Therefore, it is necessary to study thus more in depth, and in the long term, because the weak countries' profiles within different European areas maintain such positions at least in the considered period. This issue is of fundamental relevance for the achievement of EU targets in terms of digital government platforms effectiveness. Similarly, it can be said that in the best performer areas, the leader countries remain such in the considered period, which implies that the different economic structure and adequate government actions of the countries play an important role in the implementation and maintenance of digital government platform development. Moreover, it can be observed that in order to support an effective European digital government policy, it is essential to work on improving, in the respect of the concrete restraints, the mix of government actions of the countries with low performances, in order to reduce both the divergences and the inequality with leader countries. In this way it is possible to reduce both gaps and lacks the worst countries and it could be simpler to set gradual European government targets. In practical terms, it is necessary to support the transition of countries belonging to Q1 and Q2 to effective government systems based on digital government platform. In particular, the effectiveness of many of these areas it is unbalanced towards some countries, in which the outflow of resources is constantly below EU28 average share of ICT/GDP ratio. The share of these investments should be consolidated by increasing the amount of effective government actions. Furthermore, digital government platform development also can help to improve a social issue, because it can ensure employment for a relevant amount of people in territories characterized by higher un-employment rates. Therefore, investments of the Europe are strategic particularly in these areas (e.g. firstly Romania and Bulgaria (G4), Greece and Italy (G3), Ireland (G2) in order to support government policies which could create new work opportunities in the digital government industry. Furthermore, the infrastructural gap should be bridged, especially in terms of Connectivity. As well, as is strategic to ensure a stable supply and to reach a stable efficient network, in order to enhance digital skills, and offer employment to the digital generation. At the same time, more investments in Digital Public Services are necessary, especially for E-government but this requires the reduction

of digital divide, which is very wide. In conclusion, it can be said that in order to reduce the gap within the 28 EU Member States, it is necessary to develop ambitious government actions to support the improvement of the single performances, in the digital dimensions, of European countries. This would necessitate a relevant amount of investments of the 28 EU Member States, but would also promote a development of the government platforms effectiveness at European level. The future is not a destiny but a project, digital platform consolidation is an open question, and must be under constant development and reinterpretation.

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