DIGITAL INEQUALITY AND USAGE GAP IN THE V4 REGION

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Abstract: *The V4 countries have achieved different levels of digital transformation due to distinctions in their individual technical infrastructure and human capital characteristics. The success of digital transformation cannot be measured solely by the achieved level of digitalization; the distribution of favorable outcomes of internet use within a country should also be considered. The level of digital skills and usage patterns differ among social groups, therefore capability to translate internet access and use to tangible (offline) benefits varies. The aim of our paper is twofold. Firstly, we quantify the extent of the digital inequality in terms of usage gap in the V4 countries. We indicate the dynamics of inequality by comparing the development of such inequality between the years 2015 and 2019. Secondly, we identify socioeconomic and sociodemographic factors, which are connected to differences in internet usage patterns and therefore affect the capability of an individual to benefit from internet use. In common with other studies carried out in the Western world, we show that internet access and possession of formal digital skills are not the most important determinant of probability of being a digital beneficiary; individual characteristics, especially education and age, predict the probability of being a digital beneficiary to a higher degree of accuracy. As to the extent of digital inequality in the individual countries, we come to conclusion that although the V4 countries are relatively homogeneous concerning socioeconomic inequalities, the level of digital inequality among them differs – Hungary being somewhat unequal as compared to the most equal Czechia. In all four countries, equality increased within an observed period.*

Keywords: *Digital transformation, digital divide, digital inequality, digitally vulnerable social groups, digital inclusion, V4 countries.*

JEL Classification: *J24, F36, O57.*

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Introduction

The digitalization of economies and societies has been one of the key elements in the development of countries worldwide for more than 30 years. However, countries differ in their achieved level of digitalization due to distinctions in technical infrastructure development and human capital characteristics. The four countries of the Visegrád region, Czechia, Hungary, Poland, and Slovakia, were facing the beginning of the digitalization of their economies (in the 1990s) in the period of their ongoing transition processes from centrally planned to market economies. Thus, the resources for the digitalization of these countries were limited in the last decade of the twentieth century. However, the beginning of the new century was marked by a catching-up process of the V4 countries to the other European Union Member States in all areas of social and

economic life, including digitalization aspects. This catching-up process was characterized by the fact that the whole V4 region has consisted of rather heterogeneous areas at the level of NUTS3 regions (Szakálné Kanó & Lengyel, 2021) and the current state of digitalization can differ across countries, as well as within the countries.

Today, the EU optics represented by the EU digital strategy (e.g., Digital Compass for the EU's digital decade) is aimed at the EU Member States' development, deployment, and uptake of new technologies in the daily lives of citizens. The V4 countries are also involved in this strategic focus, although the values of the scores comprising the Digital Economy and Society Index (DESI index) persist below the European average in all V4 countries. Consequently, national and regional initiatives (such as the Digital V4 initiative) are implemented to foster policies that support digitalization in the V4 region. In general, after the period when policies were primarily oriented to the development of broadband infrastructure leading to a high level of connectivity of citizens to ICT, current policies face new challenges concerning the level of the population skills needed to take advantage of the possibilities offered by a digital society. In this context, human capital aspects are analyzed from the perspective of the level achieved, but the distributional aspects become extremely relevant as well. The dispersion of digital skills in the population is one of the important factors influencing positive outcomes (benefits) that a population can gain from internet services use. The unprecedented COVID-19 pandemic experience has been the catalyst that has underlined the importance and relevance of these issues. Due to these effects, the microeconomic perspective approach to analysis becomes more appropriate, relying on individual data presenting eventual unequal distribution of digital skills and benefits. In this context, our paper attempts to provide an inside view of the problems of digital inequality and its extreme case – the digital divide – in the V4 countries region.

The discussion about the digital divide and digital inequalities falls under the scope of widely discussed inequality topics. Traditionally in economics, inequality research focuses on income or wealth distribution across the population. Other forms of economic

Tab. 1: Chosen measures connected to traditional forms of economic and social inequality

	Czechia	Hungary	Poland	Slovakia	EU-27 average
GDP per capita (in PPS, 2020)	93	74	76	70	100
Gini coefficient (2019)	24.0	28.0	28.5	22.8	30.2
Ratio of income of top 80% to bottom 20% (2019)	3.34	4.23	4.37	3.34	4.99
Share of the population aged 65 and over (2020)	19.9	19.9	18.2	16.6	20.6
Share of the population achieved low education level (ISCED levels 0–2), 2020 (%, 25–54 years)	5.6	13.3	5.9	6.7	18.6
Share of the population achieved high education level (ISCED levels 5–8), 2020 (%, 25–54 years)	26.9	29.2	38.0	29.6	35.9
Share of the population achieved low education level (ISCED levels 0–2), 2020 (%, 55–74 years)	10.2	20.6	14.2	12.0	32.8
Share of the population achieved high education level (ISCED levels 5–8), 2020 (%, 55–74 years)	15.2	20.5	15.9	16.1	21.8

Source: EUROSTAT online data

(e.g., employment) and social (e.g., education level) inequalities are either at the origin, or potentially are the consequence, of these traditional economic inequalities. Thus, an unequal distribution of ICT usage in the population can also play both the role of a catalyst or an attenuator of traditional economic forms of inequality.

Tab. 1 presents some indicators connected to economic and social inequality aspects in the V4 countries. Compared to the European average, the portions of the population aged 65 and over are currently lower in the four Visegrád countries; however, due to a low birth rate the problem of an ageing population will soon be even more actual in this region than in other European countries. Concerning the education level, Tab. 1 describes its more equal distribution in V4 region than in the EU generally, with the domination of medium education level for both age groups under question. Czechia and Slovakia are the countries with the most egalitarian education system results compared to the other V4 countries and to the EU average.

The indicators of income distribution (Gini coefficient, percentiles shares) confirm a relatively lower occurrence of income inequality problems in post-communist countries. Czechia and Slovakia are again examples of countries with low levels of income inequality measures. It should be noted that the real GDP per capita values in both countries are higher than in Hungary and Poland, although they remained quite distant from the average value in 2020.

Digital technologies are often discussed from the perspective of the economic and social inequalities they can bring. Van Deursen et al. (2017) point out that authors work with two hypotheses; the normative hypothesis suggests that interest in digital technologies in higher income groups leads to a decrease of the price and makes it affordable for lower income groups. This process can lead to mitigation of digital inequalities and consequently the off-line inequalities. On the other hand, the stratification hypothesis states that internet structures replicate offline social structures and offline human capital carries over to the online world, therefore digital inequality has the potential to replicate and even amplify existing social inequalities.

Our research intention is to increase the awareness of socioeconomic patterns of digital inequality in the V4 countries. The aim of our paper is twofold. Firstly, we quantify the extent of the digital inequality in terms of the usage gap in the V4 countries. We indicate the dynamics of inequality by comparing the development of such inequality between the years 2015 and 2019. Secondly, we identify socioeconomic and sociodemographic factors, which are connected to differences in internet usage patterns and therefore affect the capability of an individual to benefit from internet use. Thus, we try to contribute to the discussion about necessary policy measures to mitigate the modern forms of the digital divide and to foster digital inclusion in contemporary economies.

1. Theoretical Background

Policymakers and social scientists have dealt with the distribution of internet access since the emergence of the internet as a mass medium in the mid-1990s (DiMaggio & Hargittai, 2001). The massive arrival of information and communication technologies (ICT) was not spread equally in terms of geography and its use did not affect everyone comparably. This inequitable access to ICT has had implications for the productivity and economic growth of rich and poor countries (Quibria et al., 2003). Similarly, it was evident that the introduction of new ICT in the global economy parallels widening asymmetries among countries and even regions within countries (Antonelli, 2003). The first official report documenting these inequalities was published in 1995 by the National Telecommunications Information Administration and was called “Falling Through the Net: A Survey of the Have Nots in Rural and Urban America”. The report documented systematic gaps in the use of computer networks by socioeconomic status, educational background, race, gender, and geographic location (Epstein et al., 2011). These inequalities have been labeled as a digital divide. Commonly, it is defined as the gap between those who have and do not have access to computers and the internet (Hargittai, 2002; Quibria et al., 2003; van Dijk, 2006). Antonelli (2003) defines it as the gap between the digital rich and the digital poor. According to OECD (2001), the term ‘digital divide’ refers to the gap between individuals, households, businesses, and geographic areas at different socioeconomic levels regarding both their opportunities to access ICTs and to their use of the internet for a wide variety of activities.

However, there are other perspectives that look at the digital divide as a part of social systems and processes; and from a policy standpoint, the goal of using ICT with marginalized groups is not to overcome a digital divide, but rather to further a process of social inclusion (Warschauer, 2002).

In the last 25 years, digital divide research and policy has expanded to three levels (Scheerder et al., 2017). The dichotomous view of the digital divide as a distinction between people who do and do not have internet access was natural and appropriate at the beginning of the diffusion process (DiMaggio & Hargittai, 2001). Having some type of computer and internet connection for everybody was the main objective (van Dijk, 2020). At that time, the motivation to get access was growing rapidly (van Dijk, 2017). Today, internet penetration is increasing in many countries, but the gap in access persists and inequalities in accessing the internet may be observed both between countries (global digital divide) and within countries (Ragnedda & Kreitem, 2018). Public investment in human capital, telecommunications infrastructure, and the regulatory infrastructure could help to mitigate the gap in digital technology and internet use (Chinn & Fairlie, 2007). The first-level digital divide still requires attention because, besides having or not having an internet connection, differences in material infrastructure must be considered (van Deursen & van Dijk, 2019). It includes the means required to maintain the use of the internet over time, such as computer devices (e.g., desktops, tablets, smart TVs), software (subscriptions), and peripheral equipment (e.g., printers, additional hard drives).

As investigations has continued over the years, researchers and policy makers have become convinced that digital literacy or skills and usage are in fact more important regarding digital inequality (van Dijk, 2020). While the traditional access-oriented thinking in the first level focused on measures such as ownership, availability, and affordability of infrastructure, the focus later moved beyond technology to the users (Barzilai-Nahon, 2006). Equal access to the internet does not ensure equal usage of the internet (Brandtzæg et al., 2011). This is called the second level of the digital divide. Within this level, inequalities in terms of motivation, skills, and purpose of use are examined (Ragnedda & Ruiu, 2017). Skill is defined as the ability to find the information efficiently and effectively on the web (Hargittai, 2002). The results of many researchers who examine this level of the digital divide suggest that individuals have various ways of accessing and using ICTs, and that multiple layers of access and use are often determined by a variety of factors that include not only socioeconomic and demographic elements but also physical, psychological, cultural and ecological factors (Min, 2010). Hargittai (2002) also confirms that there is great variation in people's ability to locate content online.

Since about 2015, the outcomes of computer and internet use came forward in a third level of research and policy on the digital divide (van Dijk, 2020). By analyzing the third level of the digital divide, scholars started to put emphasis on social implications and inequalities in the outcomes gained from the different forms of access and use of the internet (Lucero Ortiz et al., 2020; Ragnedda & Kreitem, 2018). The third-level digital divide concerns disparities in the returns from internet use within populations of users who exhibit broadly similar usage profiles and enjoy relatively autonomous and unfettered access to ICTs and the internet infrastructure (van Deursen & Helsper, 2015; Zhao et al., 2022). Specifically, whether concerning education, work, health or other areas, what matters is that individuals have the resources to deploy skills in ways that bring about tangible outcomes that benefit them (van Deursen & Helsper, 2018). These offline outcomes that could be achieved through the utilization of digital resources include finding a job, quicker access to information, having more contact with people, and buying products at a discount online compared to buying in a physical store (Ogbo et al., 2021). Within the last decade, not only positive outcomes were observed but also negative ones. Examples include cybercrime, illegal hacking, hate and disinformation on social media and smartphones, and internet or game addiction (van Dijk, 2020).

Internet access has become a standard for most western populations. As a result, digital divide research shifted to focus on determinants of internet skills, uses and outcomes (Scheerder et al., 2017). Zillien and Hargittai (2009) suggest that differential payoffs from internet use depend on the user's socioeconomic background. According to

van Dijk (2012), when examining the digital divide and digital skills the most important distinction are the categories of employment, managers and executives, individuals with high and low levels of education, women and men, young and old, parents and children, ethnicity, and natives and migrants.

This broader perspective corresponds to Bourdieu's (1986) capital theory. According to this theory, people's actions are shaped by the social space they live in, as defined by field, capital, and habitus. This idea has become central in many approaches to inequality and stratification across the social sciences; capital especially, in the sense of digital capital, is a key concept in studies of digital inequality (Ignatow & Robinson, 2017). Such studies have shown how the same kinds of informational engagements yield different payoffs for more and less disadvantaged groups (Ignatow & Robinson, 2017). For instance, Witte and Mannon (2010) use representative survey data to show that inequalities in IT access and internet usage both augment and mirror inequalities in offline resources such as economic and cultural capital. The same was shown by Calderón Gómez (2018), whose research focused on understanding how traditional forms of capital (economic, cultural, and social) are converted into digital capital, as well as the reverse processes or reconversion of digital capital back into economic, cultural and social capital. Following Bourdieu, other scholars also stress that it is important to not just consider economic capital, but also include social and cultural capitals to determine one's status and position (Scheerder et al., 2017). Helsper (2012) explains that by cultural capital the researchers understand shared norms of behavior. They are represented by beliefs, ways of interpreting the information and activities learned by socialization, which can either enable or limit the capacity of an individual to take up opportunities. Social capital relates to involvement in networks of other people, which offers the individual instrumental or emotional support. In addition to economic capital, cultural and social capital are related to access, skills, attitudes and motivation to use digital resources and can either mitigate or deepen the digital gap.

Brandtzæg et al. (2011), Ertl et al. (2020) state that the most important factor influencing the level of digital skills is age. Older people on average have a lower frequency of ICT and internet use than younger individuals (Blank & Groselj, 2014; Helsper & Reisdorf, 2017). At the same time, older individuals are less likely to use the internet, smartphones, and social media (Anderson & Perrin, 2017). On the other hand, skills vary both within and across age groups, even among the oldest in society, and it is necessary to take into consideration the socioeconomic circumstances and educational attainment of the older people (Hargittai et al., 2019). Considering the benefits from internet use, Blank and Lutz (2018) state that elderly individuals benefit more than younger ones. This contrasts with previous research.

The second frequently examined factor is income, which is an important determinant of digital skills in both developing and developed countries; it affects internet access, usage, and the diversity of ICTs that individuals own (Robinson et al., 2020). The results of research led by Fuchs (2009) show that income inequality measured by the Gini coefficient is an important factor influencing the overall level of skills in addition to per capita income, the degree of urbanization, and the level of democratization. When looking at the expansion of internet use, low-income individuals are less likely to use the internet than higher-income individuals, or they start using it later (Martin & Robinson, 2007).

At the advent of ICT, gender was a significant factor influencing the level of digital skills (Zillien & Hargittai, 2009), but at present its influence has significantly weakened (Ono & Zavodny, 2002). Some studies (Campos-Castillo, 2015) even state that in some countries, age-related results have reversed, and women are those with better internet access and associated with better digital skills. Cooper (2006) suggests that the digital divide is fundamentally a problem of computer anxiety whose roots are deep in the socialization patterns of boys and girls, and that interact with the stereotype of computers as toys for boys.

In terms of education, it can be observed that users of computers require a certain level of education to use the computer effectively, whereas telephones and the internet do not require any specific education (Dasgupta et al., 2001). Two sections of Dutch people – one educated to a lower level and the other with disabilities – spend more of their spare time using the internet than higher educated people and employed people (van Deursen & van Dijk, 2014). Highly educated users benefit most

Tab. 2: Literature review of digital divide determinants

Determinant	Scholars	Time coverage	Region coverage
Age	Brandtzæg et al. (2011)	2004–2006	Norway, Sweden, Austria, United Kingdom, Spain
	Blank and Groselj (2014)	2003–2014	United Kingdom
	Blank and Lutz (2018)	2013	United Kingdom
	Anderson and Perrin (2017)	2016	USA
	Helsper and Reisdorf (2017)	2005–2013	Sweden, Britain
	Hargittai et al. (2019)	2013	USA
	Ertl et al. (2020)	2013	Germany
Income	Martin and Robinson (2007)	1997–2003	USA
	Fuchs (2009)	2005	126 countries
	Robinson et al. (2020)	2018	Netherlands
Education	Robinson et al. (2003)	2000–2002	USA
	Dasgupta et al. (2001)	1999	World Bank data for many countries
	van Deursen and van Dijk (2014)	2011	Netherlands
	Blank and Lutz (2018)	2013	United Kingdom
Gender	Ono and Zavodny (2002)	1997–2001	USA
	Cooper (2006)	1987–2006	Studies for many countries
	Zillien and Hargittai (2009)	2004	Germany
	Campos-Castillo (2015)	2007–2012	USA

Source: own

from using the web (Blank & Lutz, 2018). Education is also an important predictor for the types of activities that people engage in online (Robinson et al., 2003).

In addition to the variables presented in Tab. 2, some authors (e.g., Robinson et al., 2020) report other factors affect the level of digital skills, such as sexual orientation, race and nationality, presence of disability, level of health care, and location of residence (whether rural or urban). However, their roles seem to be rather limited.

Tab. 2 summarizes the main determinants of the digital divide identified by scholars in their empirical studies. According to them, we can identify the risk groups in the population, which are predominantly elderly people, people with a lower education, and low-income groups. These groups are most at risk of getting stuck in the digital divide. To our knowledge, none of the existing studies focus on Eastern European countries to a wide extent, so our paper attempts to partially fill this gap. The only study that deals with the digital divide in Eastern European countries is the study from Ragnedda and Kreitem (2018). The authors analyze three tangible outcomes (eGovernment service competition and use, eHealth, and eCommerce) on a macroeconomic level. They do not pay special attention to the individual-level determinants of the digital divide connected to internet use outcomes.

2. Research Methodology

The aim of our analysis is twofold. Firstly, we want to quantify the extent of digital inequality in terms of usage gap in the V4 countries. To do so, we have modified the procedure of calculating the digital divide index proposed by Hüsing and Selhofer (2002, 2004). This index expresses the ratio of percentage of digital beneficiaries in individual risk groups to the percentage of digital beneficiaries in the whole population. In the original version, the digital beneficiaries were people who have access to a computer and to the internet. As

Tab. 3: Definition of usage domains

Domain	Description
Economic: e-commerce	Buying or ordering goods; Selling of goods or services; Internet banking; Arranging accommodation through the internet.
Economic: professional life	Looking for a job or sending a job application.
Social	Sending/receiving e-mails; Telephoning over the internet/video calls; Participating in social networks.
Institutional: e-governance	Obtaining information from web sites or apps; Downloading/printing official forms; Submitting completed forms online.
Institutional: e-health	Seeking health-related information.
Political	Posting opinions on civic or political issues via websites in the last three months; Participating in online consultations or voting to define civic or political issues.
Educational	Doing an online course; Using online learning material other than a complete online course; Communicating with instructors or students using educational websites/portals.

Source: own based on van Deursen and Helsper (2015)

our focus is usage gap, we identified digital beneficiaries based on their usage of digital technologies in a particular domain. To describe population groups who benefit the most from internet use in V4 countries, we adapted the approach of van Deursen and Helsper (2015), who identified five domains of online activities (economic – including both e-commerce and professional life activities; social; institutional – including both e-governance and e-health activities; political; and educational), reflecting activation of economic and non-economic forms of digital capital. An individual is considered as a beneficiary of a specific domain if he/she uses at least one of the possibilities stated in the description of the domain presented in Tab. 3.

In our analysis, we calculate the summary digital divide index (DDI) as an arithmetic mean of partial digital divide indices (D_i) by usage domains. The partial digital divide index for individual risk groups is calculated as follows:

$$D_i = 100 \times \frac{1}{m} \sum_{j=1}^{m} \frac{p_{ij}}{p_j} \quad (1)$$

where:
p_{ij} – percentage of digital beneficiaries in given risk group for each usage domain;
p_j – percentage of digital beneficiaries in the whole population for each usage domain;
m – number of usage domains.

Based on our literature review results, we work with three risk groups from the general population in our calculations: individuals older than 55 years, individuals with low level of education (at lower secondary education level) and individuals belonging to the first income quartile.

Secondly, we use logit regressions to estimate the determinants of the probability of being a digital beneficiary in an individual usage domain. To distinguish between the differences in internet usage outcomes due to various digital skills and the activation of economic and non-economic capital, we use a dummy variable. This variable indicates a person with – at the very least – basic digital skills. The dummy variable is calculated based on software digital skills measured by Eurostat. The respondents with, as a minimum, basic digital skills are considered digitally skilled for the purposes of our research. To indicate activation of economic and non-economic capital (Bourdieu, 1986) we include the following demographic characteristics: age category, gender, educational category,

Tab. 4: Research sample composition

	2015			2019		
	Number of respondents	Internet users	% of internet users (weighted)	Number of respondents	Internet users	% of internet users (weighted)
Czechia	7,256	5,506	81.32	6,287	5,232	87.03
Hungary	6,421	4,742	72.83	5,904	4,807	80.37
Poland	8,153	5,334	68.00	9,860	7,367	80.44
Slovakia	4,500	3,459	73.96	3,273	2,547	82.85

Source: own

income quartile, and the country in which the respondent lives. We also include control variables indicating degree of urbanization and individuals living alone and working. For ease of interpretation, we report average marginal effects form the logit model.

The study examines data from Eurostat Community Survey on ICT use in households and by individuals collected in 2015 and 2019, as they offer the earliest and latest available data covering both outcomes of internet usage and information about digital skills. The data sample is weighted and representative of the countries. The age of the respondents ranges from 16 to 74. Tab. 4 shows the composition of the research sample in years 2015 and 2019.

Tab. 5 depicts the ratio of digital beneficiaries in individual domains for each country. Not surprisingly, the ratio of internet beneficiaries differs among the domains. Social use dominates in all countries followed by economic use in the field of e-commerce. On the other hand, the internet is used the least frequently within the political domain and connection to professional life.

3. Research Results

Using Eurostat Survey microdata, we quantify the level of the digital divide index in V4 countries in the years 2015 (the earliest year for which necessary data are available) and 2019 (Tab. 6). The values close to 100 indicate a perfect digital equality in a society, i.e., risk groups benefit from using the internet as much as the average population do, whereas values close to 0 signal the opposite situation. Although V4 countries seem to be relatively homogeneous concerning other socioeconomic forms of inequalities when comparing them to the average of EU Member States (Tab. 1), the

Tab. 5: Portion of digital beneficiaries (in % of internet users)

	CZ	HU	PL	SK	Total
Economic use					
E-commerce	87.30	77.62	79.63	85.89	81.22
Professional life	6.99	18.47	10.91	17.63	11.93
Social use	96.37	97.53	91.01	95.65	93.32
Political use	14.72	15.04	18.38	14.14	16.87
Institutional use					
E-governance	61.70	65.06	50.15	69.46	56.07
E-health	64.87	75.23	58.93	63.54	62.78
Educational use	17.85	12.92	16.11	17.91	16.10

Source: own

level of digital inequality differs, with Hungary being somewhat unequal as compared to the most equal Czechia (Tab. 6). The variability is even more obvious when it comes to the partial digital divide indices and their change over an observed period. In Czechia, people older than 55 years lagged behind the average population usage; the same group experienced the lowest change in inequality between the years 2015 and 2019. The movement toward equality was led mainly by people with a low education, whose usage of digital technologies was similar to the average of the population in 2019.

Hungary presented the highest digital inequality among V4 countries. In contrast with the other three countries, in 2015 the extent of inequality was nearly the same for all the risk groups. In 2019, the inequality index even decreased for the first income quartile. Summary DDI remains low and does not reach the level of the second worst performing country in 2015.

Poland has the consistently lowest values of digital inequality indices for people older than 55. The results for the other risk groups are better. The decrease in inequality in 2019 was mainly improved by people with a low education, although the first income quartile showed a slight worsening of the situation.

In Slovakia, the decrease in inequality was the result of a significant increase in the digital divide indices for first income quartile. On the other hand, the inequality has worsened for people with a low education; those people older than 55 experienced only minor changes.

To identify vulnerable groups specific to the V4 region, we model the probability of being a digital beneficiary in five domains of digital usage given individual socioeconomic attributes – age, gender, education, income quartile, and country of residence. We also include control variables indicating the degree of urbanization and individuals living alone and working. The models are estimated using microdata from V4 countries. Tab. 7 shows the average marginal effects of individual socioeconomic attributes.

3.1 Economic Domain

The factor that decreases the probability of using the internet for buying and selling goods is lower education. The probability also decreases with age (and is especially low for the age category of 55 years and over). As to the country of residence, people tend to use the internet less for this purpose in Hungary. Concerning professional life, the differences among social groups are lower. The most important factor of looking for a job online is the status of being unemployed, which increase the probability of using the internet for this purpose by nearly 30%. The probability decreases with age. The effect of possessing digital skills is positive and significant, although it is small in comparison to the afore-mentioned factors. Paradoxically, the country with most developed

Tab. 6: Partial and overall digital divide indices for V4 countries in 2015 and 2019

	CZ	HU	PL	SK
2015				
Older than 55	50.97	43.40	38.23	45.61
Low level of education	75.80	49.56	56.18	76.09
First income quartile	64.36	41.14	71.78	60.46
Summary DDI	63.71	44.70	55.40	60.72
2019				
Older than 55	56.92	52.69	44.62	47.66
Low level of education	89.66	56.54	68.27	66.12
First income quartile	70.22	35.89	69.06	78.92
Summary DDI	72.27	48.37	60.65	64.24

Source: own

Tab. 7: Average marginal effects of independent variables

Variable	Economic use		Social use	Political use	Institutional use		Educational use
	E-commerce	Professional life			E-governance	E-health	
Digital skills (ref. no skills)							
At least basic skills	0.1830***	0.0426***	0.0893***	0.1116***	0.2601***	0.1572***	0.1340***
Age cat. (ref. 16–24)							
25–34	0.0154	−0.0616**	−0.0193***	−0.0032	0.0971***	0.0790***	−0.0786***
35–44	−0.0239	−0.0960***	−0.0446***	−0.0430*	0.1018***	0.0938***	−0.0889***
45–54	−0.0599**	−0.1295***	−0.0818***	−0.0559**	0.0770***	0.1175***	−0.0839***
55–64	−0.1257***	−0.1692***	−0.1118***	−0.0824***	0.0635**	0.1230***	−0.1171***
65–74	−0.1705***	−0.2086***	−0.1098***	−0.0667***	0.0254	0.1447***	−0.1464***
Gender (ref. male)							
Female	0.0173**	−0.0125*	0.0218***	−0.0264***	0.0325***	0.2077***	0.0077
Education cat. (ref. tertiary)							
Upper secondary	−0.0866***	−0.0006	−0.0410***	−0.0410***	−0.1744***	−0.0489***	−0.1343***
At most lower secondary	−0.2218***	−0.0237	−0.0732***	−0.0525**	−0.3452***	−0.1491***	−0.1723***
Income quartile (ref. 4th)							
3rd	−0.0405***	−0.0026	−0.0028	−0.0385***	−0.0471***	0.0116	−0.0171*
2nd	−0.0643***	0.0149	−0.0121	−0.0134	−0.0457***	0.0118	−0.0254**
1st	−0.0878***	0.0267*	−0.0225**	−0.0333**	−0.0744***	−0.0035	−0.0141
Country (ref. CZ)							
HU	−0.1119***	0.1072***	0.0106*	−0.0068	0.0377**	0.1244***	−0.0516***
PL	−0.0589***	0.0283***	−0.0465***	0.0432***	−0.0856***	−0.0338***	−0.0171*
SK	−0.0098	0.0931***	−0.0080	−0.0024	0.0904***	0.0033	−0.0034
Type of household (ref. not living alone)							
Living alone	0.0032	0.0117	0.0162**	0.0242*	0.0023	−0.0319*	0.0263*
Employment sit. (ref. employed)							
Unemployed	−0.0677***	0.2869***	0.0114	0.0010	−0.0461*	−0.0127	−0.0262
Student	−0.0733**	−0.0301**	−0.0262	0.0016	−0.0282	−0.0711**	0.2293***
Other not employed	−0.0473***	0.0345**	−0.0131*	0.0077	−0.0669***	0.0640***	−0.0356***
Degree of urbanization (ref. densely populated areas)							
Intermediate density area	−0.0053	−0.0432***	−0.0078	−0.0198*	−0.0417***	−0.0195	−0.0377***
Thinly populated area	−0.0291***	−0.0446***	−0.0244***	−0.0639***	−0.0756***	−0.0251*	−0.0505***
McFadden's R^2	0.2000	0.1037	0.2765	0.0628	0.1679	0.0948	0.1981
Wald χ^2	1,995.95	910.24	1,100.79	591.18	2,372.10	1,235.03	1,586.37

Source: own

labor market – the Czech Republic – has the lowest probability of using the internet in this sphere.

3.2 Social Domain

The social domain is used by most of the respondents. Age is the most important determinant of the decreasing probability of using the internet in this domain. Possessing digital skills are of relatively low importance for social use. The differences among countries (Poland and Hungary) are statistically significant, but small.

3.3 Political Domain

In common with the social domain, the probability of benefiting from using the internet in this field decreases mainly with age. On the other hand, using the internet in the political domain could be not attributed to a certain typical socioeconomic or sociodemographic group. In comparison to these variables, digital skills are of relatively high importance. The differences among the V4 countries are mostly insignificant or small.

3.4 Institutional Domain

In regard to e-government, we can observe a considerable difference among the probability of being a digital beneficiary for people with a lower education. Paradoxically, for all the age groups (with the exception of the oldest) the probability of using e-governance is slightly higher than for the reference group. The probability of using e-governance is the lowest in Poland and the highest in Slovakia. For e-health the situation is also worse for low educated people. Women and elderly people have the highest probability of being digital beneficiaries, with Hungary having the highest usage for this purpose.

3.5 Educational Domain

The status of being a student is the most important determinant of having any benefit from this domain. Otherwise, the pattern is similar to the other domains – low education and a higher age prevents people from making the most of the internet.

4. Discussion

Widespread internet connection has the potential to make access to various economic and social advantages (variety of goods and services, social networks, education, political life participation) easier and less costly. The content available on the internet is mostly egalitarian, the same information and opportunities being available to anybody. Therefore, it has the potential to bring benefits to the most disadvantaged social groups, which are not available for them in the 'offline sphere'. Coming from this logic, it should be mainly the socially and economically disadvantaged social groups who benefit from internet use and therefore be motivated to use it intensively for these purposes. As research worldwide has shown, the opposite is true. In the beginning of the digitalization era, the reason for this used to be the fact that economically and socially disadvantaged people tend to be late technological adopters, as the costs of the newest technologies are high. This is not the issue any longer. Internet penetration is high in most developed countries. The V4 countries, in which mass digitalization was delayed due to economic transformation and political priorities, are experiencing a rapid catching-up process and rates of internet usage are higher than 80% of the adult population. However, similarly to the countries with a high digital maturity, there are significant differences among socioeconomic and sociodemographic groups – not only in the regard of internet access and digital skills, but also in prevalent usage of digital resources. This has consequences for the opportunities of the social groups to benefit from the available possibilities.

In this paper we have shown that, similarly to the other studies carried out in the Western world, internet access and possession of formal digital skills are not the most important determinants of the probability of being a digital beneficiary. Other individual characteristics, especially education and age, predict the probability of being a digital beneficiary to a higher extent.

The relative importance of digital skills, coupled with sociodemographic and socioeconomic characteristics, differs for individual usage domains. There are domains, namely e-commerce and e-governance, for which possession of digital skills contributes notably to the probability of usage of these services and therefore the probability of benefiting from the usage. Such services need to provide additional security in terms of

data protection and potential misuse, which result in their websites being more difficult to navigate and consequently requiring the user to have some level of technical competence. However, the results show that, regardless of holding digital skills, low educated people have a significantly decreased chance of making use of these services.

Unlike e-commerce and e-governance, there are usage domains for which neither digital skills nor individual characteristics play a big role, namely looking for a job online and social and political use. If an individual is motivated to use the internet for these purposes, there seem to be only minor obstacles to overcome. This effect is especially visible for job-searching online, which is mostly determined by unemployment status, and there is no difference between people with a high or low education. Motivation seems to be the main reason for searching for health information, where the probability of this usage increases with age. In this domain, the dominant factor is the female gender, which could be explained by the role of primary caregiver, which is traditionally female in the V4 countries.

Belonging to the first income quartile makes relatively low difference (or no difference for e-learning and e-health) in comparison to the factors of education and age. The highest gap between the richest and the poorest was observed for e-commerce and e-governance usage domains.

Our findings are in line with Blank and Lutz (2018), who studied the use of the internet in the United Kingdom. They found that highly educated users benefit most from using the web. In relation to e-commerce, our conclusions are very similar to Ragnedda and Kreitem (2018), who also claim that people in Hungary use the internet for e-commerce the least of all the V4 countries. Van Deursen and Helsper (2015) found that individuals with medium and high levels of education were more likely to experience economic outcomes related to e-commerce than less educated individuals. This conclusion is partially in contrast to our research, where the probability of having benefits from internet use in the economic domain also decreases for people possessing upper secondary education. In other domains we came to the same conclusion as the aforementioned study. With reference to unemployed people, Kuhn and Mansour (2014) found that unemployed persons who look for work online are re-employed about 25% faster than comparable workers who do not search online. In this case, the status of being unemployed is helping by getting positive benefits from internet use in the economic domain 'professional life'. Our conclusions are complemented by the study of Cotton et al. (2013), who found that using the internet may be beneficial for decreasing loneliness and increasing social contact among older adults in assisted and independent living communities.

In respect of the dynamics of the digital divide, we observed differences between the years 2015 and 2019, which are the earliest and latest periods with availability of necessary data. Due to the relatively short period of time, we cannot assess the development with much certainty, only point out certain aspects and recommend further investigation. Our findings, however, suggest that the capacity to enable risk groups to benefit from internet usage differs significantly in the V4 countries.

Conclusions

In our paper, we present the first inside view on the digital divide problem for the V4 region countries. These countries still register a lag in their digital transformation progress compared to some of the other EU Member States. To a large extent, this lag is formed by human capital characteristics: a generally lower level of digital skills in the population (presented by lower than EU average levels of human capital in DESI) and a higher digital inequality (presented by higher levels of constructed digital divide index than in other EU Member States). Although some positive tendencies could be underlined (digital divide index increased between 2015 and 2019 in all countries of the V4 region), we can identify the sources of the potential persistence of the digital divide in V4 countries. The identification of these sources is based on an appropriate recognition of digitally vulnerable groups among the population. We used individual-level data to capture the socioeconomic characteristics of most risky groups of the population in seven domains of online activities: e-commerce activities, professional life activities (e.g., searching for jobs), social activities (social network use), e-government activities, e-health activities, political use (active citizenship activities) and e-learning. We found that education level and

age contribute the most to the persistence of the digital divide persistence in the V4 region.

We need to stress that our results are based on data from 2019 (the last available data at the moment). We expect new data coming from the pandemic year of 2020 to prove the accelerated process of the digitalization of EU economies (remote working, e-learning etc.). The forthcoming data would help to identify the level of persistence of the digital divide problems in new circumstances, boosting the motivation for digital skills upgrade. These data can eventually contribute to change in the ranking of factors responsible for the digital divide (for example, age could become a more influential factor than it was before the pandemic).

We would also like to emphasize that the outcomes were perceived as positive outcomes in our study; however, we are aware that the outcomes also represent several negative effects of computer and internet use on people's daily lives, which deserves our attention.

In general, our findings from the V4 countries show that an unequal distribution of ICT usage in the population is playing the role of a catalyst, rather than a mitigator of traditional economic forms of inequality. Thus, the targeted strategies to increase the digital skills and to bridge the digital divide in an economy are necessary at the individual, company, national, as well as supranational level to approach the socioeconomic objectives of the countries and their citizens. An example of these targeted strategies could be identified at the level of ongoing national Recovery and Resilience Plans (RRP). These plans are in line with the ambition of the EU to assume a sustainable and inclusive recovery after the global pandemic. Digital inclusion can bring economic, social and political implications. The evaluation of national plans by the European Commission is clearly communicated against the target of 20% of expenditure to promote digital transition. Within this expenditure package, the EU encourages reskilling and upskilling programs to increase digital skills, and thus the European population reaps the benefits from ICT.

However, national plans can differ in their choice of reforms and investment. From the procedural perspective, all four countries of the V4 region have submitted official plans; two countries (Czechia and Slovakia) have received European Commission endorsements, and both countries have also received prefinancing payments (March 2022). All V4 countries meet the criterium of 20% for digitalization, and Slovakia and Poland set up the structure of their RRP according to this lower limit (almost 21% in Slovakia). The Czech Republic decided to invest 22.1% in digitalization from its RRP volume; in Hungary this figure was 23%.

A more detailed view could be found when focusing on reskilling and upskilling strategies (education and training to support digital skills, including support for e-learning) as one of seven flagship areas for investment and reforms defined by the European Commission. Based on the Bruegel dataset on the recovery and resilience plans of European Union countries (Darvas et al., 2021), we can identify the financial coverage of the RRP objectives of the EU priorities specified in national RRP. According to this dataset, 11.38% of the total RRP program would be invested in re-skilling and upskilling strategies in the EU. It is not surprising that most of the V4 region countries are planning to invest more to fill their gap in digital skills and digital divide mitigation: 30.44% in Czechia (the highest portion in the EU), 24.67% in Slovakia (2nd highest portion in the EU), 20.38% in Hungary (the 3rd highest portion in the EU). However, a surprising finding concerns Poland with only 3.93% (the 3rd lowest portion in the EU) of investment oriented to projects increasing digital skills.

Moreover, the third-level digital divide perspective motivated us to compare the V4 countries according to their readiness to prioritize different internet use domains. Concerning e-government (digitalization of public administration, including e-health) Slovakia seems to be a leader in this area, planning to invest 17.01% of its total RRP amount, followed by Poland (12.63%) and Czechia (6.57%). On the contrary, Hungary is planning to invest only 0.74% of the total RRP amount to the digitalization of its public services. The comparisons of these plans with our findings (Tab. 4) confirm that the RRPs include a potential of increased cross-country heterogeneity among the V4 countries. The e-business and e-commerce activities could also be boosted by RRP investment in the form of increased data cloud capacities and sustainable processors. Hungary and Slovakia are not planning to invest in these measures, while Poland is planning to invest to a limited extent (0.68% of the total RRP amount) and the

Czech Republic to the highest extent (5.69% of the total RRP amount) in the V4 region. Thus Czechia, Luxembourg and France, represent the top three EU Member States planning to invest the highest proportions of their RRP to this specific area. For now, Czechia seems to be the V4 leader in e-commerce beneficiaries (Tab. 4) and the RRP application can further boost this leadership in the future.

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