From the Digital Divide to Digital Inequality: A Secondary Research in the European Union

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Abstract. The digital divide is nowadays evolving to digital inequality, i.e., the socio-economic disparities inside the 'online population'. This paper examines two main dimensions of the digital inequality, namely 'skills' and 'autonomy' of Internet users. The level of formal education was selected as a representative variable of the skill dimension, as well as the density of population in different geographical areas as a representative variable of the autonomy dimension. The research was focused on the member states of the European Union (EU). The data, provided by Eurostat, included the daily use of computers for the last three months and the average use of the Internet at least once per week. The findings state that the EU already faces the problem of digital inequality to an extended rate, since there are significant disparities among the European countries with regard to the aforementioned variables.

Keywords: Digital divide, digital inequality, digital disparity, ICT.

1 Introduction

During the last decades the use of Information and Communication Technologies (ICTs) has become the key factor for the social and economic development of every country. The advent of World Wide Web has significantly contributed to the diffusion of ICTs, mostly due to the rapid information exchange. Everyday life changes occur in terms of communication, entertainment, learning, shopping, etc. People join into processes that alter not only many aspects of their lives but themselves, too. Moreover, the diffusion of ICTs among firms is widely considered to be one of the primary factors behind their economic growth. E-marketing activities, online sales, as well as work flow automation and resource planning have been fostered considerably. Even though a widespread technology boom is being witnessed, with innovative services and applications able to be rapidly spread through the Internet, the adoption of ICTs is distributed unevenly. It is a fact that, different groups of people are more or less privileged in accessing and using technology. This technological gap is called digital divide. As information revolution spreads rapidly the notion of digital divide becomes even more substantial and therefore gains an increased interest for observation from researchers and policy makers. Moreover, a discussion and debate about the definition and the empirical analysis of its components is on the way.

According to the literature, many attempts to accurately define the notion of the digital divide have been made. The definition, given by the Organization for Economic

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Co-operation and Development (OECD), refers to the digital divide as the '*gap between individuals, households, businesses, and geographical areas at different socioeconomic levels with regard both to their opportunities to access ICTs and their use of the Internet for a wide variety of activities*' [1]. In the same direction, Novak and Hoffman [2], as well as Wilhelm and Thierer [3] also illustrate this ICT gap as a binary classification of ICT '*haves*' and '*have-nots*', pointing to those who have access to new technologies and those who do not. However, this perspective is not dominant. In the last decade, the substantial magnitude of the Internet use penetration brought to surface significant differences among the Internet users' profiles. It has been shown that digital divide is more a complex and multidimensional phenomenon than just a matter of ICT access. Since the digital divide is directly associated with users' characteristics, the potential ICT adoption depends on and embodies to some extent the society's disparities. Cuervo and Menendez [4] describe it as the '*consequence of the economic and social disparities*'. Furthermore, DiMaggio and Hargittai [5] disassociated the inequality of access from digital inequality, while Attewell [6] refers to this distinction as the *first-level* and *second-level* digital divide.

The digital divide occurs in workplaces, home, among countries, groups of people, etc. This technological gap is mainly examined at individual, household, business or geographical area level. According to the level of analysis the factors that contribute to the digital divide widening differ. Furthermore, inequalities in ICT diffusion become more substantial where a great demand for a high degree of information processing and efficient communication procedures exists.

2 Determinant Factors of the Digital Divide

This section consists of a brief review of the available literature so far, divided into two subsections. In the first subsection, the focus is set on studies which explore and analyze the factors that affect ICT adoption regarding the individual, household and geographical area level. At this point it must be declared that, depending on each approach, literature often categorizes certain factors in order to provide a comprehensive framework of research. Examples of frameworks are those proposed by Barzilai-Nahon [7], Selhofer and Hüsing [8], Barclay and Duggan [9]. The current subsection presents these factors due to their importance given by the literature and not based on a specific framework. In the second subsection, an overview of the available literature on the adoption of ICTs by businesses is presented.

As it was mentioned earlier, the notion of the digital divide is so complicated mainly because it mirrors the society's inequalities, at least to some extent. Due to this fact, it is more difficult for researchers and policy makers to develop a concrete research framework. Consequently, the factors proposed and the variables used in the literature vary, depending on the perspective and the methodological approach of each study. The factors, on which literature emphasizes more, are: network infrastructure, ICT cost, education, income, age, gender, and use of ICT, while support, accessibility, language, location, and ethnicity are also gaining increased attention.

Network infrastructure is obviously the most determinant factor of ICT diffusion. The limitations on physical lines, communication channels, ISPs, secure servers, etc. dramatically decrease the diffusion process of the technological innovations especially

regarding to the Internet. The variables mostly used to reflect the development degree of the network infrastructure are: number of Internet hosts, secure servers' density, and access lines. Menkova states that, there is a generic convergence across countries on a worldwide basis regarding the number of Internet hosts [10]. However, Cuervo and Menendez [11] underline the important differences among countries of the EU, in terms of secure servers per million inhabitants (e.g. Greece: 17, Luxembourg: 155). The same result derives from OECD, where the number of Internet hosts per million inhabitants in the United States of America is far greater (more than 250 hosts) than OECD average (88 hosts) and EU average (42 hosts).

The cost of equipment and/or Internet access is highly correlated with ICT penetration [12]. While it is true that ICT access costs decline over time, the higher cost of ICT use negatively affects ICT adoption and is referred as the main reason for people not having Internet at home in fourteen European countries [13]. Additionally, according to OECD [14] the cost of ICTs tends to be higher in rural areas. The data analyzed by Cuervo and Menendez show that Greece has the highest prices for Internet dial up access costs for a residential user among the members of the EU.

Indisputably, the higher the level of education, the more likely it is for a person to have access and use ICTs. Moreover, among individuals with the same income level, those with higher educational background have higher rates of access. The same conclusion was reached by Selhofer and Hüsing [15], who underlined that it is more difficult for low educated people to catch up with those with average education. More specifically, the analysis of the data from a survey conducted in the EU-15 in 2002 revealed that people with university education are 5.1 times more likely to use the Internet than people with primary school education [16]. Finally, the Observatory for the Information Society [17] reports that Greece follows the same rates of ICT adoption by education level with EU-27 average, with the exception that low educated people are notably below the EU-27 average.

Another factor that definitely affects the degree of ICT use and access is income, as it illustrates the extent to which a user can afford the cost of Internet access, PCs, peripherals, etc. Studies mainly focus on individual or household income expressed as the Gross Domestic Product (GDP) per capita or per household, respectively. OECD [18] underlines that household and/or individual income is a key determinant of the presence of a personal computer (PC) at home. Undeniably, higher income positively affects ICT adoption.

The age and gender of the potential ICT users also have a considerable impact on accessing and using ICTs. In general, Internet access and PC use tend to be higher for younger people than for older people. According to data from the OECD, the age group with the most ICT users was the 35 to 45 years old group. A more recent study, in which data of EU-25 were analyzed, indicates that the age group of 16 to 24 leads, having a three times higher proportion of computer or Internet use than the age group of 55 to 74 [19]. The same outcome arises from the report of the Observatory for the Information Society [20], when examining ICT adoption by groups of age in Greece. Consequently, the presence of children in a household significantly increases the potential of having a PC and accessing the Internet. Specifically, the use of PCs at home in Greece for households with dependent children is two times the percentage of households without children [21]. The role of gender in accessing and using ICTs is often examined in parallel with age. However, most studies show that contrary to

what happens with age, gender contributes less to the digital divide widening. The differences in ICT use, regarding gender, are mainly illustrated between older men (over 50) and younger women (up to 45). Men over 50 years old are more likely to use the Internet than women of the same age, while women up to 40s make a greater use when compared with men of the same age [22].

The use of ICTs has been fostered enormously during the last years. Specifically, the number of PCs was raised from 2.5 to 9 per one hundred inhabitants between 1990 and 2001, while in the same period the Internet use was raised from almost zero to 8 percent of world's population [23]. Although there is an increasing use of ICTs worldwide, there are still significant disparities among countries regarding their adoption degree. Cuervo and Menendez [24] underline the major differences existing between countries of the EU, in terms of the number of computers per one hundred inhabitants giving the example of Greece, which is far below Sweden (Greece: 8, Sweden: 56). Moreover, according to Demunter [25] the degree of the Internet and computers' use for Greece is among the lowest when referring to EU of 25 and the lowest among the EU of 15. The same results stand either for household or individual level.

It is obvious that the analysis of the factors presented above can not explain in total the inequalities in ICT adoption because they can not depict the society's disparities in a comprehensive way. Many other factors have been proposed and found to be correlated with the use and access of ICTs. Some of the most important are: support, profession, language, skill, location, ethnicity, etc. Based on Barzilai-Nahon [26], the notion of support involves governmental and social acts and is relevant to policy adopted by the government regarding the promotion of technology use (through investment and funding). It seems that in those cases where the user's profession involves the use of a PC there is a positive effect on ICT uses at home [27]. Undeniably, given that English is the language of the Internet, people who cannot understand English have a great difficulty in using the Internet. The skills of the ICT user also have proved to be very important. The Observatory for the Information Society [28] reports that, 14 percent of those who do not use or have access to the Internet, indicate as main reason the lack of appropriate skills. Moreover, Hargittai [29] found a great variance in people's ability to locate content online. The location of residence within a country and/or the location of a country within a geographical region also affect ICT adoption. Urban areas tend to have better infrastructure and lower prices in contrast with rural ones. Billón *et al.* [30] state that adjacent regions of EU tend to have similar rates of Internet adoption. Finally, ethnicity can prevent groups of people from accessing and using ICTs [31].

As far as the examination focuses on groups of people and countries a brief overview of the major factors which contribute in the widening of the digital divide has been presented. Another field of research, in which the digital divide is apparent, is business. It is true that, the use of ICTs in business has fostered firms' productivity dramatically. Nevertheless, the use of ICTs differs a lot among industries and firms. The literature indicates as factors with greater importance firm size, firm's location, type of industry, external environment, and IT investment. Variables mostly used to examine the diffusion of ICTs among firms are: Internet access, existence of a Web site, number of computers per employee, employee's skills, use of e-mail, browsing, use of ERP, online sales, online purchases, etc.

The size of a firm seems to be the most determinant factor for its performance in using and accessing ICTs. The variable used in order to categorize the firms by size is the total number of employees [32]. Firm size plays a major role not only in accessing and using ICTs, but in IT investment too. Bigger firms are more likely to invest in new technologies. Moreover, the size of a firm in correlation with the external environment shows that small firms expand their use and access to ICTs due to the external pressure of larger enterprises [33]. Since the Internet provides firms the advantage to target not only the local but the national and the global market as well, the competition in terms of ICT uses significantly increases. The external environment pushes firms to invest more on IT and innovation in order to maintain their competitive position [34]. Another factor that significantly affects the diffusion of ICTs among firms is their established location. Similarly to the individuals whose location influences the adoption of ICTs, the location of enterprises affects the extent to which they access and use ICTs. A classification of a firm's location within a country may be rural or urban. There is not a specific definition to accurately describe and distinct the rural from the urban areas. This mostly happens due to the major socio-economic disparities among countries. A convenient variable which is used to classify these areas is the population density. Undoubtedly, enterprises located in urban areas are more likely to confront lower costs of access [35]. Geographical dispersion, as Forman [36] underlines, has less impact on the use of applications than on the use of the Internet. Finally, the type of industry plays a major role in the use and access of ICTs. Moreover, industries that provide information-intensive services such as communication and finance usually have higher penetration rates.

According to the Observatory for the Information Society [37] the location and the size of a firm definitely affect the access and use of ICTs. An example from the tourism industry is given below. Researchers from the Observatory for the Information Society analyzed a sample consisting of 250 hotels and 250 smaller firms ('rooms to let') divided into three groups according to their size (large, medium, and small). It was found that large hotels have a double Internet access rate than smaller ones, while large 'rooms to let' firms have four times higher access rate than smaller ones. The process of selling online is mainly adopted by hotels. The rate of selling online for hotels ranges between 62 to 67 percent, in contrary to 'rooms to let' firms where rates vary a lot (20 to 57 percent) depending on the firm's size. Finally, the possibility for the firms which lack of Internet access, computers, etc. to invest on ICTs seems rather low. While the majority of the firms states their satisfaction from the adoption of ICTs and believes that online sales benefit their business, only a very small percentage of them (10 percent at most) hires an IT expert.

An overall conclusion of this brief literature review could be that the widening of digital divide is mainly influenced by users' characteristics and behaviors, while physical infrastructure and policies also play a major role. Moreover, it should be noted that generally there is a lack of sufficient data, since the available data mostly apply on a national level. Due to this, the process of examining and measuring the digital divide becomes even more difficult.

3 Forms of Digital Inequality

Researchers have recently started to discuss the term 'digital inequality'. This term refers to socio-economic disparities inside the 'online population', such as the quality

and the cost of the connection to the Internet, the skills and the knowledge to find the required information, etc. The primary issue nowadays is not whether there is an Internet access but what people are able to do when they have access to the Internet [38]. There are five broad forms of digital inequality [39]:

- Inequality with regard to technical means
  Internet users, who have no access to powerful and usually expensive means, can not exploit the full range of Internet content.
- Inequality with regard to autonomy of use
  The autonomy of Internet users may be restricted by the constraints of the geographical area or the exact location where the access is feasible. Such constraints might concern the access time (e.g. public libraries), the content itself (e.g. workplaces), the quality of the Internet connection (e.g. urban versus rural areas), etc.
- Inequality with regard to skills
  Internet users differ regarding the level of their expertise, education, and technical skills. The more the knowledge about the medium, the better the exploitation of it.
- Inequality with regard to social support
  The people, whose friends and/or families are more familiar with new technologies, are usually more motivated to adopt and use ICTs too.
- Inequality with regard to purpose of use

The higher the purpose of use of the Internet, the more the knowledge required for it. This means that, if the medium is used only for entertainment then the user usually has limited knowledge; but if the medium is used for the accomplishment of complicated tasks, the user should have extended knowledge.

4 Methodological Approach

In our research, the basic tendencies of some critical parameters of the digital inequality in the EU were examined. We focused our analysis upon the level of formal education, which is a representative variable of the 'skill' dimension, and the density of population in different geographical areas, as a representative variable of the 'autonomy of use' dimension. The level of formal education was considered as a three-scaled ordinal variable: (i) high: university level, (ii) medium: high school level, and (iii) low: lower than high school education. The density of population was also considered as a three-scaled ordinal variable: (i) high: ≥ 500 inhabitants per squared kilometer, (ii) medium: 100-499 inhabitants per squared kilometer, and (iii) low: ≤ 99 inhabitants per squared kilometer.

The measurements we actually used were the daily use of computers for the last three months (every day or almost every day) and the average use of the Internet at least once per week. Our intention was to avoid the random use of new technologies, which would probably be the result of a longer time period selection. Examining the level of education, we dealt with the user group of people between 25 and 54 years old. This is due to the fact that, these ages have mostly experienced the transition from the traditional means to ICTs. The most recent data at the time of writing were employed, published by Eurostat [40]. The purpose of this secondary research is to demonstrate

the differences among the member states of the EU with regard to the aforementioned variables, thus giving evidence of the existence of the digital inequality.

5 Findings

The findings of the secondary research, described in the previous section, are presented in the Figs. 1, 2, 3, 4, 5, and 6. As it can be seen in Fig. 1, the percentages of the daily use of computers, with regard to the individuals with high formal education, are particularly high for all the European countries. Denmark and Slovenia have the leading positions with the highest percentage (91%), while Greece, having the lowest percentage (63%), is far behind the mean value of EU-27 (81%). The average use of the Internet at least once per week, as regards the individuals with a high education level, also receives high values, a little higher than the previously mentioned variable in most cases. The Netherlands and Finland have the highest percentage (97%), while Greece has again the lowest (66%). The mean value of EU-27 is 86%.

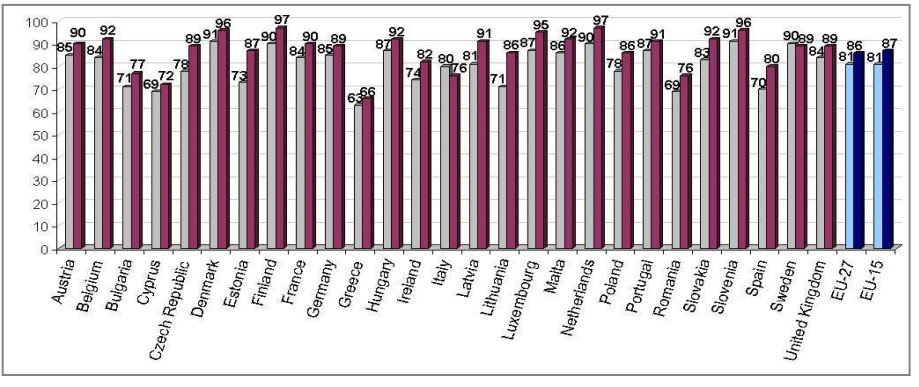

Fig. 1. Percentage of individuals aged 25 to 54 with high formal education, who used a computer every day (first column) and the Internet at least once per week (second column)

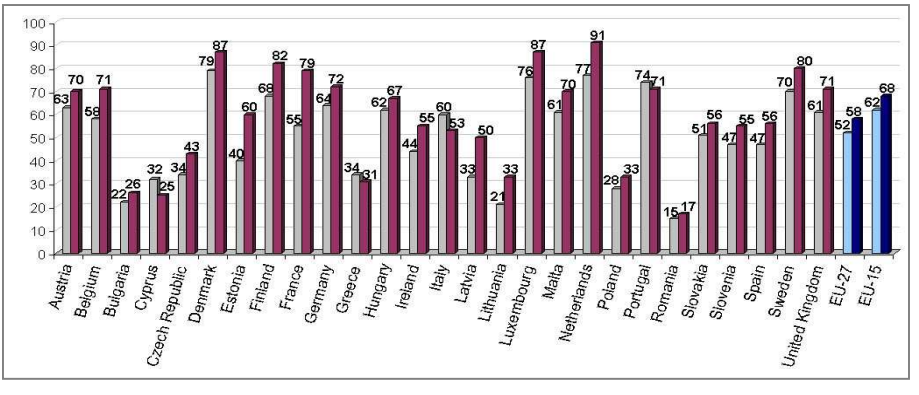

Fig. 2. Percentage of individuals aged 25 to 54 with medium formal education, who used a computer every day (first column) and the Internet at least once per week (second column)

The findings for the sample of individuals with a medium education level are completely different (Fig. 2). The mean values in the EU-27 and the EU-15 are 52% and 62% respectively. Denmark has the highest percentage (79%), while Romania the lowest (15%). Greece (34%) occupies a better position compared to the results in the previous case of highly educated people. Concerning the average use of the Internet by individuals with a medium education level, there are many fluctuations among the European countries. The highest percentage is 91% (the Netherlands) and the lowest only 17% (Romania). The percentage of Greece is one of the lowest (31%). The difference between the mean values of the EU-27 (58%) and the EU-15 (68%) is exactly the same with the respective difference for the daily use of computers.

As it was expected, the low educated individuals use computers, as well as the Internet, at a minimum level (Fig. 3). The Netherlands have the highest percentage, both in computers (61%) and the Internet (76%). On the other hand, Bulgaria has tremendously low percentages, both in computers (1%) and the Internet (lower than 1%). Unfortunately, the percentages of Greece are only slightly better (6% for the daily use of computers and 4% for the average use of the Internet at least once per week).

According to the findings, the density of population has an impact on the daily use of computers and the average use of the Internet. The 79% of Swedish, living in densely populated areas, use a computer every day or almost every day, i.e., the highest percentage, while only 27% of Romanians do the same thing, i.e., the lowest percentage (Fig. 4). The percentage of Greeks is 36%, i.e., the second lowest. This percentage is repeated for Greece, when the average use of the Internet is examined. In that case, the highest percentage is related to Finland (85%) and the lowest to Romania (34%).

In the areas with a medium population density, there were not significant differences compared to the previously mentioned areas, with regard to the daily use of a computer (Fig. 5). The Netherlands have the highest percentage (72%), while Greece and Bulgaria the lowest (22%). Taking into consideration the average use of the Internet, the Netherlands occupy again the first position in the ranking order (84%) and Greece the last position (24%).

In the sparsely populated areas, the daily use of computers seems to be quite limited (Fig. 6). This can be seen by the much lower percentage of EU-27 (37%) compared to 51% (high density) and 48% (medium density). The Netherlands have the highest percentage (65%) and Romania the lowest (6%). The data for the Internet are in correspondence with the data for computers. The average use of the Internet in the EU-27 is only 42%, while it comes to 58% for densely populated areas and 52% for areas with a medium density. Once again the Netherlands have the highest percentage (78%) and Romania the lowest (6%).

Trying to interpret these results we need to make the following comments: northern European countries demonstrate a much more intense use of ICTs than the southern part of Europe. We believe that the most significant factors to this kind of digital divide, which is actually a form of digital inequality, are: (i) the higher family income in northern European countries, (ii) the faster acquaintance of younger people with ICTs at school, (iii) the more effective and efficient education and training systems, and particularly (iv) the much greater development of network infrastructure. It is also a matter of mentality since people in north Europe are more used to sophisticated equipment, and therefore they know how to fully exploit the tremendous possibilities of new technologies. Further analysis of these factors is a prerequisite to making suggestions on how to bridge the digital inequality among the countries of the EU.

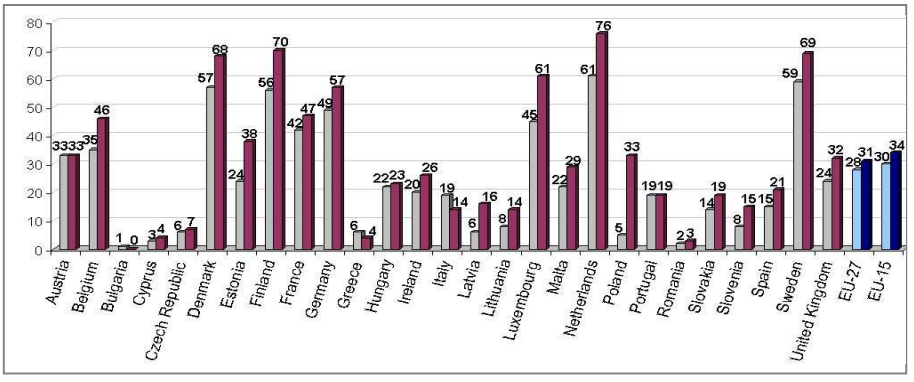

Fig. 3. Percentage of individuals aged 25 to 54 with low formal education, who used a computer every day (first column) and the Internet at least once per week (second column)

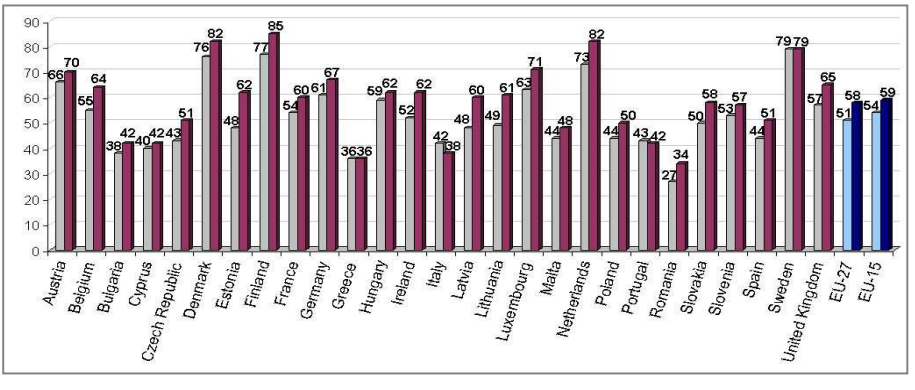

Fig. 4. Percentage of individuals, living in densely populated areas, who used a computer every day (first column) and the Internet at least once per week (second column)

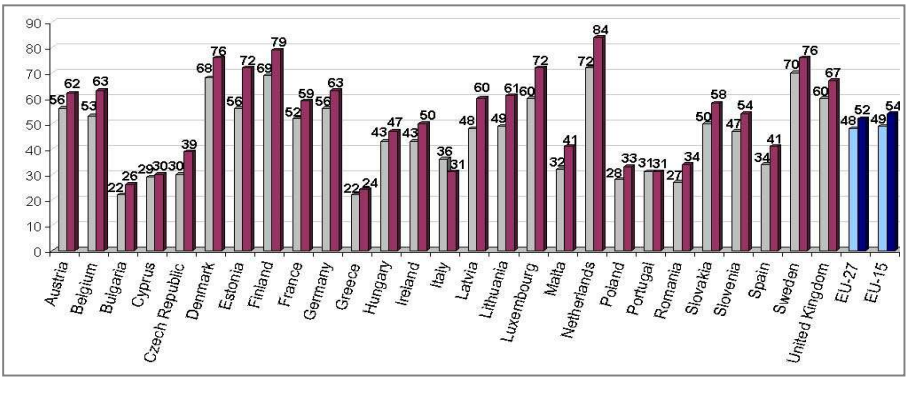

Fig. 5. Percentage of individuals, living in areas with a medium population density, who used a computer every day (first column) and the Internet at least once per week (second column)

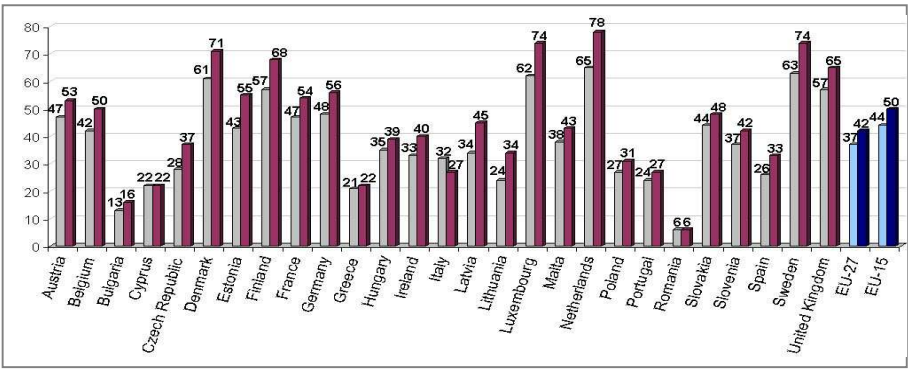

Fig. 6. Percentage of individuals, living in sparsely populated areas, who used a computer every day (first column) and the Internet at least once per week (second column)

6 Conclusion

Analyzing the secondary data provided by Eurostat, we found that there are significant disparities among the member states of the EU. The disparities, which our analysis focuses on, are related with the level of formal education and the density of population in different geographical areas. These disparities are characteristic of the digital inequality among individuals who have access to the Internet. More specifically, the differences in terms of the formal education are connected with the 'skill' dimension of the digital inequality. Moreover, the differences in terms of the density of population are connected with the 'autonomy' of Internet users, i.e., another dimension of the digital inequality. Even if the bridging of the digital divide becomes a reality, the digital inequality is evolving to a crucial problem, which should be confronted with essential and immediate measures by the European leaders.

We also found that, Greece seems to have very low percentages in terms of the daily use of computers and the average use of the Internet. For instance, highly educated Greeks use a computer and the Internet at the lowest rate in the EU. Additionally, Greeks, who live in areas with a medium population density (100-499 inhabitants / km^2), also use a computer and the Internet at the lowest rate among the member states of the EU. These findings are clear indications of the size of the digital inequality in Greece.

It is true that network infrastructure is still under development in many areas of Greece, mostly including rural areas, as well as a few large cities. Consequently the cost for having a broadband Internet connection at home is still quite high. Moreover, in an attempt to explore more the reasons why Greek people are not so familiarized with technology, we can focus on the education system which is not adequately modernized. It must be underlined that the telecommunication companies in Greece started investing on high speed network infrastructure just a few years ago. Nevertheless, Greek authorities and telecommunication companies make efforts to motivate people to increasingly access the broadband Internet.

Finally, we should mention as a limitation of this research the fact that, it focuses only on two dimensions of the digital inequality; further research should be extended to the other three dimensions of the digital inequality, namely technical means, social support, and purpose of use.

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