



NOVA

IMS

Information
Management
School

MGI

Mestrado em Gestão de Informação

Master Program in Information Management

ASSESSING THE AGE-RELATED DIGITAL DIVIDE: EVIDENCE FOR THE EUROPEAN UNION-28

Paulo Alexandre Belo Campos

Dissertação apresentada como requisito parcial para a obtenção do grau de Mestre em Gestão de Informação, Especialização em Gestão do Conhecimento e Business Intelligence

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa



NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

**ASSESSING THE AGE-RELATED DIGITAL DIVIDE: EVIDENCE FOR THE
EUROPEAN UNION-28**

por

Paulo Alexandre Belo Campos

Dissertação apresentada como requisito parcial para a obtenção do grau de Mestre em Gestão de Informação, Especialização em Gestão do Conhecimento e Business Intelligence

Orientador: Professor Doutor Tiago Oliveira

Coorientador: Professor Frederico Cruz

Fevereiro 2016

DEDICATÓRIA

Dedico a dissertação de mestrado aos meus pais. Agradeço o apoio incondicional e por acreditarem sempre em mim. Por mais que queira, não conseguirei exprimir o que sinto e quão importantes são para mim.

Quero também dedicar à minha avó Balbina. Durante este percurso o mais difícil não foi dizer-te adeus, mas antes não ter-me despedido de ti.

Sara, o teu incentivo foi precioso para mim.

AGRADECIMENTOS

Aos Professores Tiago Oliveira e Frederico Cruz agradeço o apoio no desenvolvimento da dissertação de mestrado. Estou certo de que foram uma mais-valia na minha aprendizagem.

Gostaria de dar uma palavra de apreço ao Professor Frederico Cruz. Foi inigualável a sua disponibilidade e colaboração em acompanhar-me nesta investigação. Agradeço as suas recomendações e críticas no sentido de procurar incessantemente a excelência.

À NOVA Information Management School por oferecer-me uma formação de elevada qualidade e ao mesmo tempo, de dispor de todos os recursos para desenvolver a minha investigação. Sinto-me extremamente orgulhoso de pertencer a esta comunidade académica.

Agradeço ao Eurostat e ao envolvimento da comunidade académica que contribuiu para a compreensão do fenómeno da divisão digital.

RESUMO

Este artigo centra-se na avaliação da divisão digital relacionada com a idade, considerando dados desagregados para cada geração (a cada 20 anos) de cada país. Os nossos resultados sugerem que a geração desempenha um papel fundamental para diferenciar desigualdades no uso de Internet e das redes sociais, embora não seja diferenciadora para distinguir o uso de e-Services. Os resultados revelam que os Países Baixos e Luxemburgo têm a menor divisão digital doméstica. Em oposição, Croácia e Chipre apresentam as maiores disparidades digitais, particularmente os Baby Boomers (55-74 anos) e Geração Y (16-34 anos). Considerando todas as gerações, os líderes digitais são a Suécia, Países Baixos, Reino Unido e Luxemburgo. Os países europeus mais atrasados são Roménia e Bulgária. Entre gerações, os Baby Boomers estão distantes da Geração Y na adoção das TIC, enquanto a Geração X (35-54 anos) desempenha um papel relevante para interligar gerações. Os resultados apontam para a presença de divisão digital internacional e doméstica relacionada com a idade na União Europeia.

PALAVRAS-CHAVE

Divisão Digital; Idade; Desenvolvimento Digital; TIC; Agenda Digital; União Europeia

ABSTRACT

This paper focuses on measuring the age-related digital divide, i.e., the digital gap between countries, considering data disaggregated for the generation (every 20 years) of their population. Our findings suggest that generation plays a key role to differentiate inequalities in Social Networks and Internet use, although it is not a clear feature to distinguish the use of e-Services. The results reveal that the Netherlands and Luxemburg have the lowest domestic digital divide. In opposition, Croatia and Cyprus present the highest digital disparities, particularly the Baby Boomers (55-74 years) and Generation Y (16-34 years). Considering all generations, the digital leaders are Sweden, the Netherlands, the United Kingdom and Luxemburg. The lagged European countries are Romania and Bulgaria. Among generations, Baby Boomers are far from Generation Y in ICT adoption, while Generation X (35-54 years) plays an important role in bridging both generations. Results point to the presence of an age-related digital divide across the European Union.

KEYWORDS

Digital Divide; Age-Related Digital Divide; Digital Development; ICT; Digital Agenda; European Union

CONTENTS

1. INTRODUCTION	1
2. THEORETICAL BACKGROUND	3
2.1. The concept of digital divide	3
2.2. The age-related digital divide.....	4
2.2.1. Age as a driver of ICT inequalities	4
2.2.2. Relevant generations to study the digital divide	5
3. METHODOLOGY.....	7
3.1. Data	7
3.2. Factor Analysis.....	8
4. DISCUSSION OF FINDINGS	13
5. CONCLUSIONS, LIMITATIONS AND FUTURE WORK.....	18
6. REFERENCES.....	19

CONTENTS OF FIGURES

Figure 3.1 - Generation Y (individuals aged from 16 to 34) of each member state on two dimensions	11
Figure 3.2 - Generation X (individuals aged from 35 to 54) of each member state on two dimensions	12
Figure 3.3 - Baby Boomers (individuals aged from 55 to 74) of each member state on two dimensions	12
Figure 4.1 - All generations of each member state on retained factors	14
Figure 4.2 - Proximity of each generation to the EU in Social Networks and Internet Use.....	15
Figure 4.3 - Proximity of each generation to the EU in e-Services	16
Figure 4.4 - The domestic age-related digital divide through Euclidean distance.....	16

CONTENTS OF TABLES

Table 3.1 - Acronyms, descriptions, and literature support of variables for measuring the age-related digital divide.....	7
Table 3.2 - Correlation Matrix	9
Table 3.3 - Results of factor analysis.....	10

LIST OF ABBREVIATIONS

EC	European Commission
EU	European Union
ICT	Information and Communication Technologies
KMO	Kaiser-Mayer-Olkin
OECD	Organisation for Economic Co-operation and Development
UN	United Nations
US	United States
WSIS	World Summit on Information Society

1. INTRODUCTION

At the World Summit on Information Society (WSIS), sponsored by the United Nations (UN), it was declared that everyone should “*create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life*” (WSIS, 2003). In this sense, Information and Communication Technologies (ICT) can be an enabler to bring benefits in almost every aspect of our daily life, including economic growth, competitiveness, and welfare (European Commission, 2014a). However, the accomplishment of ICT’s full benefits is threatened by the existence of disparities in the rates of adoption and use of these technologies –the so-called digital divide. These divides exist both between and within countries among the different socio-economic groups of the population, and are known as international and domestic digital divides, respectively.

Measuring the digital divide has become a major issue in the literature and for policy makers; however, the two dimensions, international and domestic, have usually been analyzed separately. That is, countries have sought to assess their situation in ICT by comparing their general rates of adoption to other countries without taking into account the internal disparities that may exist within a country’s population (Chinn & Fairlie, 2007; Kraemer, Ganley, & Dewan, 2005). As just one example, the Eurostat reports that the percentage of individuals using e-banking services was roughly the same in Germany, Austria, and Ireland –some 48%. This would lead us to believe that there is no digital divide between these countries in terms of the take up of e-banking services. However, when these general rates of use are looked at according to different age groups, disparities begin to appear. 64% of those from 16 to 34 years old living in Austria use e-banking, whereas only 56% of those living in Ireland do so; 31% of individuals between 35 and 54 years old living in Germany use these services, compared with some 24% in Austria. There are many other examples of domestic digital divides. In fact, a recent World Bank report (2016) concludes that these types of divides “*can be as high as that between countries*”. Hence, the standard measurement of the digital gaps across countries based on national (aggregated) figures may hide internal divides, providing a partial and inaccurate picture of the real situation. This paper seeks to overcome this limitation and presents an analysis that allows assessing the magnitude of the digital gaps across countries, while taking into account domestic divides.

This paper is focused on age for two reasons: first, it is acknowledged as a critical driver of digital inequalities between individuals since, generally speaking, older persons are less prone to use ICT in comparison to younger ones; and, second, because of the particular context of our analysis –the European Union (EU). Consistently in recent decades, most European countries have low birth rates coupled with an increase in life expectancy, which together are transforming the shape of the age pyramid, leading to a higher share of aged population in almost every member state. Hence, in the European context, digital inequalities are being inflated, with even worse future expectations, by demographic factors (European Commission, 2015b). This paper therefore seeks to answer the following research questions:

1. What are the digital divides between European Union countries once we take into account the age-related divides within them?
2. Which are the countries with the greatest internal digital divides regarding age?

3. How close or far are the generations in terms of ICT use across the member states of the European Union?

The remainder of this paper is organized as follows: Section 2 presents the relationship within generation and digital divide; Section three is about variables selection and data collection; the fourth includes the major findings; and the last section includes the conclusions and limitations of this research, and future work.

2. THEORETICAL BACKGROUND

2.1. THE CONCEPT OF DIGITAL DIVIDE

Even today there are doubts about who the first person was to use the term “digital divide” and under what circumstances (Gunkel, 2003), although it is widely understood that the term was presented in the mid-1990s by the former Assistant Secretary for Communications and Information of the United States (US) Department of Commerce, Larry Irving Junior (Dragulanescu, 2002). At that time, he used the term to distinguish those who had the required equipment to participate in the global network of information from those who did not. Hence, in the beginning, there was a binary way to describe digital divide, making a distinction only between “haves” and “have nots” access to ICT. It was the leading criterion to distinguish ICT inequalities, which nowadays is considered as “*reductive and inaccurate*” (Cruz-Jesus, Oliveira, & Bacao, 2012). With the course of time digital divide evolved to refer also to inequalities in ICT use between those who already have access, which is referred to as the second-order digital divide (Riggins & Dewan, 2005). Hence, digital divide may create a loophole for info-excluded individuals who are cut off from access to information and they will be the new illiterates of the XXI century (Unwin & de Bastion, 2009). It is today a belief that as with universal education, ICT literacy is a key factor for building a cohesive society. Hence, the ability to use ICT becomes a required skill for living and working in the information society (Van Deursen & Van Dijk, 2011; Van Dijk & Hacker, 2003), which triggered a growing interest in this topic among academics and policy-makers.

One of the most widely accepted definitions today of the digital divide is the one provided by the Organisation for Economic Co-operation and Development (OECD), which refers to it as “*the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities*” (OECD, 2001). Accordingly, the digital divide can exist at individual, organizational, and global levels. At the individual level, the focus is on how ICT adoption affects individuals or households. From an organizational perspective, it pertains to ICT adoption by firms and organizations. The digital divide can distinguish the most advantaged technological firms (that use ICT to obtain a competitive advantage over the market) from backward firms (Forman, 2005; Riggins & Dewan, 2005). At the global level, it is defined by the differences in ICT adoption between countries, with usual focus on measures that can be taken by policy-makers to promote ICT adoption at individual and organizational levels (Riggins & Dewan, 2005).

In the EU context, research concludes that a digital divide still exists, despite all the political and financial efforts to narrow it in recent years (Billón, Ezcurra, & Lera-López, 2008; Cuervo & Menéndez, 2006). Even in recent studies, it is concluded that the eastern European countries, which are the newest European member-states, are behind in digital development, especially Bulgaria and Romania (Cruz-Jesus et al., 2012). Among other reasons, an explanation for this may reside in the fact that these countries have started to receive resources from the European Commission (EC) later their counterparts. Additionally, the countries with greater economic development differentiate themselves from others as the gap of the digital divide is correlated with economic asymmetries (Billón et al., 2008; Vicente & López, 2011). It reflects inequalities across European countries and simultaneously it is worrying because digital divide works as a constraint to social inclusion and avoids fostering a strong and creative economy. Moreover, most of the studies dedicated to this

subject do not analyze domestic digital divides among EU countries, which makes it impossible to obtain a full “picture” of ICT-related inequalities. In fact, a society in which digital divide exists can hardly be competitive, and most likely will be unable to sustain economic development (Park, Choi, & Hong, 2015).

The literature reports several efforts to measure the digital divide across countries. However, these efforts have mostly ignored the fact that there might also be domestic digital inequalities related to socio-economic factors. In addition, the majority of researchers argue that income, age, and education are the main factors behind the digital divide (Hsieh, Rai, & Keil, 2008; Venkatesh, Thong, & Xu, 2012). Age is even more important in Europe in light of its ageing population, which is one of the greatest social and economic challenges of the present century, with the population turning increasingly “grey” (European Commission, 2015a). Even as early as 2005 an EC survey concluded, *“among 16 to 24 year olds, the proportion of computer or Internet users is three times higher than among persons aged 55 to 74. Despite increasing levels of ICT usage in all sections of society, the divide is not being bridged”* (European Commission, 2005). Nine years later and checking this indicator in Digital Agenda’s data, this does not imply that digital disparities have disappeared between generations. In fact, new divides have appeared associated with the use of services and applications: people 16 to 24 years old use social networks more than five times more than those who are aged 55 to 74. A convincing trend is that youth adopt and use new ICT features faster than older people, and, consequently the digital divide associated with emerging technologies becomes greater still. Despite several efforts to measure the digital divide, there are none that consider both the international (across countries) and domestic (within countries) digital divides simultaneously.

2.2. THE AGE-RELATED DIGITAL DIVIDE

2.2.1. Age as a driver of ICT inequalities

Age, in particular, reveals itself as an essential driver of digital inequalities between individuals because, generally speaking, older persons are less prone to use ICT in comparison to youth. Thus, in order to fully understand the digital divide, considering age-related differences is a matter of critical importance (Barnard, Bradley, Hodgson, & Lloyd, 2013; Hargittai & Walejko, 2008; Mitzner et al., 2010).

At the base of the age-related digital divide are the differences between those who were born and grew up with ICT those who were not born into the digital world, thus establishing two groups of individuals – *“digital natives”* and *“digital immigrants”* (Prensky, 2001). Naturally, this division remains between people belonging to different generations. Youth are “digital natives” as they are “native speakers” of the ICT/digital language, essentially because they grew up in close contact with these technologies, meaning that there was no adaptation period, as there were with individuals belonging to earlier generations. Hence, most of these individuals, at least in developed countries, grew up around computers and Internet (at their homes, schools, etc.) having a normal tendency to use these technologies. As Prensky (2001) argues, *“they have spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age”* (Prensky, 2001). They have not needed to adapt themselves to ICT, since it was part of their growth. In fact, technology has mainly been designed and developed as an environment for users who have grown up in a digital world (Vroman, Arthanat, & Lysack, 2015). The

digital immigrants who, on the other hand, were not born into the digital world have *“become fascinated by and adopted many or most aspects of the new technology are, and always will be compared to them, Digital Immigrants”* and *“like all immigrants, some better than others – to adapt to their environment, they always retain, to some degree, their “accent,” that is, their foot in the past”* (Prensky, 2001). Hence, as these individuals are necessarily older, they tend to have more difficulty in adopting and adapting themselves to ICT, because the technology appeared later in their lives, requiring an adaptation by them. Furthermore, these individuals require more practice to learn successfully, preferring to learn in the context of concrete tasks (Hawthorn, 2000). Consequently, it is harder for them to gain the ability to be proficient in using ICT. Moreover, it is often stated in literature that older persons, once having learned a way to do the tasks, have more resistance to abandon it to learn another efficient way (Hawthorn, 2000). Additionally, they may be less likely to benefit from incidental learning. In opposition, youth prefer discovery-based learning that allows them to explore and actively test their ideas (Brown, 2000).

Additionally, besides the fact of growing up or not in the digital world, there is another fact influencing the relationship between age and ICT adoption: the consequences arising from the natural ageing process, although these tend to affect especially the most elderly. The normal ageing process almost inevitably tends to lead to physical and cognitive disabilities, which may cause digital exclusion (Czaja & Lee, 2007; Fozard & Gordon-Salant, 2001). Limitations such as problems with memory, reduced visual and auditory ability, and restricted mobility issues may difficult ICT adoption. As some examples of these we have physiological changes that may turn simple ICT-related actions (e.g., using the computer mouse) into more challenging tasks (Becker, 2005; Carpenter & Buday, 2007; Czaja & Lee, 2007). Unfortunately, those same people who already have some age-related limitations are those who perhaps could benefit the most from ICT, helping them to overcome their daily barriers. The elderly, as a group of individuals who are more likely to live isolated, could benefit to a greater extent from ICT’s connectivity potential, helping to reduce their common seclusion. As a source of health-related information and medical care, ICT access could also be an important feature for the elderly. Thus, not having access to these technologies may jeopardize a valuable source in seeking health-related information (Czaja, Sharit, Nair, & Lee, 2009; Greenwood & Agarwal, 2015; Heart & Kalderon, 2013; Niehaves & Plattfaut, 2014). Moreover, Internet access clearly has become an enabler for many useful activities such as e-government, especially for those persons with reduced mobility (Czaja & Lee, 2007; European Commission, 2014a). The use of ICT for government purposes can offer a bridge to those who live alone or in remote areas to pay taxes, renew documents, avoid queues, and many other things (Fang, 2002).

2.2.2. Relevant generations to study the digital divide

In order to clarify how age groups are organized, we consider three groups/generations: youth (Generation Y); middle-aged (Generation X); and the elderly (Baby Boomers), split every 20 years, starting with those at the age of 16. Indeed, there is support for considering three groups of people for analyzing different levels of ICT adoption (Murdock, 2002).

The first group comprises Generation Y (Millennials), those between the ages of 16 and 34 years, first mentioned by Strauss and Howe. In line with Prensky (2001), they are called the digital natives although *“internet users in their twenties do not dominate every aspect of online life”* (Jones & Fox, 2009). In this age group the segment within 18-23 years old in this generation play games online

(Jones & Fox, 2009). In addition, they mostly prefer to use social networking sites, which have recently gained significant popularity among young adults. However, there is no clear evidence that age is negatively correlated with intention to use social networking websites (Braun, 2013). They are willing to do multi-tasking, which consists of doing two or more activities at the same time (Brown, 2000; Prensky, 2001). Nevertheless, there is no suggestion in the literature that multi-tasking is exclusive to digital natives (Bennett, Maton, & Kervin, 2008).

The next generation of individuals is the group between 35 and 54 years old, known as Generation X, a term coined by Robert Capa in the early 1950s. In this age group most use social networks, e-banking, online shopping, and e-health applications (Jones & Fox, 2009). We suspect that there is a greater diversity of users in this group. Evidently, there are those who have acquired expertise in using ICT and they coexist with who have not. We hypothesize that this is the most heterogeneous group in terms of ICT adoption, depending on their employment and motivation (Lee & Coughlin, 2015). However, though not always irrefutable, most researchers have emphasized a relationship between experience of using an ICT and attitudes toward it (Todman & Monaghan, 1995).

The elderly are those people who were born in the years soon after World War II - the group usually called Baby Boomers. Many of these may think computers are irrelevant to their daily lives, because they offer no benefits (Selwyn, Gorard, Furlong, & Madden, 2003) and they feel a lack of confidence to use them (Marquié, Jourdan-Boddaert, & Huet, 2002). Baby Boomers use ICT not only for email, as a tool for information search, and for buying products (Jones & Fox, 2009), but also to search for health information and use in daily activities (Czaja et al., 2009; Vroman et al., 2015). There is evidence that the Baby Boomers with higher education or who live with a partner are prone to use ICT, facilitate social interactivity with family, and enhance involvement in leisure and in their accomplishment of daily tasks (Boot et al., 2015). Nevertheless, such behavior changes cannot be applied yet, due to cultural and societal stages. At this time, the most feasible approach is to identify the features of ICT that fit individual's applications to daily life (Vroman et al., 2015).

Last but not least, as a culmination of all earlier points, it is fairly reasonable to assume that the existing European digital divide (Cruz-Jesus et al., 2012; Cuervo & Menéndez, 2006), may even be more severe when considering not only the countries (in the aggregate), but also different age groups; a methodology which, to the best of the authors' knowledge, has never been undertaken. It should be kept in mind that according to the EC, individuals' age plays a "*major role in the digital-divide*" (European Commission, 2005) and one of the main challenges for the EC in the context of the Europe 2020's Digital Agenda, is precisely to "*help people find their way in the digital world*" depending of their intentions (European Commission, 2014a). As discussed, Generation Y and Baby Boomers have different behaviors and needs of ICT that may be reflected in digital divide. For all the above-mentioned reasons, we intend to assess the European age-related digital divide, considering both international and domestic divides.

3. METHODOLOGY

3.1. DATA

In order to measure the age-related digital divide, we have carefully selected variables that best fit this issue (see Table 3.1), following the recommendations found in the literature. As the present research intends to assess the age-related digital divide, using three different generations to classify individuals, the variables are established accordingly. A main concern in collecting the data was choosing a reliable source with harmonized data, enabling reliable comparisons not only within countries, but also among three generations of Europeans. Such a source is Eurostat, the official statistics entity of the European Commission. The data collected pertain to the year of 2014 and are available at country level as well as age level, which is used in the three generations mentioned earlier.

Code	Variable	Support
IntFreq	Percentage of individuals frequently using the internet (every day or almost every day)	(Cruz-Jesus et al., 2012; European Commission, 2005, 2014a; Hargittai, 2003; Riggins & Dewan, 2005)
MobInt	Percentage of individuals using a laptop/tablet to access the internet, away from home or work	(Cruz-Jesus et al., 2012; European Commission, 2012; Kyriakidou, Michalakelis, & Sphicopoulos, 2011; Rice & Katz, 2003)
SocNet	Percentage of individuals participating in social networks, over the internet, last 3 months	(Braun, 2013; Lenhart, Purcell, Smith, & Zickuhr, 2010)
eBank	Percentage of individuals using online banking	(Cruz-Jesus et al., 2012; European Commission, 2014a)
eHealth	Percentage of individuals making an appointment with a practitioner via a website	(Cotten & Gupta, 2004; Cruz-Jesus et al., 2012; European Commission, 2014a)
eGov	Percentage of individuals submitting completed forms to public authorities, over the internet, last 12 months	(Cruz-Jesus et al., 2012; Helbig, Ramón Gil-García, & Ferro, 2009)
IntSrc	Percentage of individuals looking for information about goods and services online	(Lian & Yen, 2014; Sorce, Perotti, & Widrick, 2005)
eCom	Percentage of individuals ordering goods or services online	(Cruz-Jesus et al., 2012; European Commission, 2005, 2014a)

Table 3.1 - Acronyms, descriptions, and literature support of variables for measuring the age-related digital divide

Two of the most basic and popular indicators of ICT adoption are an individual's level of internet access and how often he/she uses it (Riggins & Dewan, 2005). Hence, for measuring this we gathered the percentage of individuals frequently using the internet (IntFreq). Associated and as an extension of this fact, we have considered the individuals using a laptop/tablet to access the internet away from home or work (MobInt). Nowadays, there are diverse devices that enable internet access, which should be considered in this context (Kyriakidou et al., 2011). Not only has the access changed, but the applications of ICT are evolving (European Commission, 2014a). Perhaps the most prominent example is the social networks, which show increasing popularity (Pempek, Yermolayeva, & Calvert, 2009). However, the Baby Boomers are more likely to live isolated and least likely to use social networks (Vroman et al., 2015). On the other hand, the Generation Y are frequent users (Vroman et al., 2015). We therefore expect that participation in social networks over the internet in last three months (SocNet) can be an asset to measure this phenomenon.

Additionally, the Digital Agenda for Europe has attributed exponential importance to emerging ICT applications associated with increasing citizens' welfare, such as e-banking, e-health, e-government, and e-commerce. Hence, we include these variables in our investigation. Moreover, the use of e-banking is frequent in literature to support analyses about digital divide, was and we therefore added (eBank) (Cruz-Jesus et al., 2012; European Commission, 2014a). The EC views e-health as a priority due to Europeans living longer than ever, and it is critical to keep healthcare affordable and accessible, so it is indispensable to consider the variable making an appointment with a practitioner via a website (eHealth) (European Commission, 2014a). Another feature addressed by the EC in the Digital Agenda for Europe is the online interaction between individuals and public authorities (European Commission, 2014a). Also, research has suggested that customer-orientation is one of the most important aspects to attempt to improve the quality of services and that it has the potential to deliver better services to individuals (Helbig et al., 2009). Hence, we take into consideration the individuals submitting forms to public authorities over the internet in the last 12 months (eGov).

Once again, the Digital Agenda for Europe is also concerned about improving the European Union's rules on the digital single market to make e-commerce easier (European Commission, 2014a). It is therefore reasonable to consider two other variables: percentage of individuals looking for information about goods and services online (IntSrc) and percentage of individuals ordering goods or services online (eCom). The first is related with the intentions of online consumers. In fact, the Generation Y searches for more information on the internet, but does not buy more than Baby Boomers (Sorce et al., 2005). Nevertheless, this variable gains special importance when investigating digital divide because in progressively ageing societies, the older persons have time and money to participate in several e-commerce activities (Lian & Yen, 2014). Even so, the online buying varies by product category and it is predicted by age-related interests (Sorce et al., 2005). The second variable exposes the e-commerce and it is often used to assess digital divide (Rensel, Abbas, & Rao, 2006). According to the latest report of Digital Agenda for Europe, "*e-commerce remains insufficiently developed in the EU*" (European Commission, 2014a). In sum, we consider eight variables that best measure the generationally-related digital divide in the EU. As demonstrated in literature, the digital divide is a multidimensional issue (OECD, 2001; Riggins & Dewan, 2005; Viard & Economides, 2014), so a method should be applied that able to exploit it.

3.2. FACTOR ANALYSIS

The technique applied in our investigation is factor analysis. It is a useful procedure for examining relationships of variables and allows exploring concepts that are not easily measured directly by collapsing variables into a few interpretable underlying factors (Sharma & Kumar, 2006). For this analysis to work, variables must have an underlying correlation structure to guarantee useful results. The factor analysis proceeds in steps: first verify the correlation between variables through correlation matrix, then corroborate this perception with adequacy of Kaiser–Mayer–Olkin (KMO). In this stage, we can verify if our convictions on selected variables make sense and select the extraction method to be applied. Finally, we evaluate the number of factors that should be retained and understand them. Thus, we reduce the number of variables to their essence and represent them with a few factors that capture the patterns seen.

The starting point in our analysis is observing the values of correlation matrix (see Table 3.2). There are some correlations that must be emphasized, for instance, the 0.94 level of association between

percentage of individuals frequently using the internet every day or almost every day (IntFreq) and percentage of individuals looking for information about goods and services online (IntSrc). Also important is the correlation of 0.90 between percentages of individuals frequently using the internet every day or almost every day (IntFreq) and individuals using a laptop/tablet to access the internet, away from home or work (MobInt). However, there remain some variables with lower correlations. Moreover, the percentage of participants in social networks over the internet in the last three months (SocNet) with percentage of making an appointment with a practitioner via a website (eHealth) has a correlation of 0.33. As established, these are essential variables to consider, due to emerging areas related with ICT. Despite this, keep in mind that variables ideally must have a high correlation in order to belong to only one factor, as that means that all variables are measuring the same target. Even so, we remain confident about performing the current analysis. Supporting our analysis, the KMO indicator, which checks the degrees of inter-correlations between variables, was 0.87. This also shows that it is suitable to apply a factor analysis.

	MobInt	IntSrc	IntFreq	eBank	eHealth	SocNet	eCom	eGov
MobInt	1	0.87**	0.90**	0.74**	0.49**	0.81**	0.92**	0.72**
IntSrc		1	0.94**	0.82**	0.52**	0.80**	0.90**	0.75**
IntFreq			1	0.77**	0.46**	0.91**	0.90**	0.67**
eBank				1	0.65**	0.56**	0.85**	0.83**
eHealth					1	0.33*	0.51**	0.70**
SocNet						1	0.73**	0.51**
eCom							1	0.75**
eGov								1

Table 3.2 - Correlation Matrix

* - Correlation is significant at the 0.05 level (2-tailed); ** - Correlation is significant at the 0.01 level (2-tailed)

The next step is applying the extraction method. Here we do not set the number of factor to hold, essentially because our intention is retain the number of factors that can provide convincing interpretations. Nevertheless, we kept in mind the main principles for defining the number of factors mentioned in literature, such as Person's, Kaiser's and Cattell's scree test criteria (Sharma, 1996). Person's criterion calls for retaining the factors that explain at least 80% of total variance. Kaiser settled on retaining only factors with eigenvalues greater than 1. Unless a factor extracts at least as much as the equivalent of one original variable, we drop it. Cattell's criterion established retaining those factors that are above the elbow plot. As assumed in the previous section, the digital divide is a complex issue that depends on several indicators, so it is essential to reduce complexity. Applying all methods, the results suggest retaining two factors, here explaining 87% of variance. We then consider useful rotation factors to match initial variables in only one factor. Once again, we consider the best practices mentioned in literature, these are Varimax and Quartimax rotations, and we opted for the one that produces the greatest explanation of factors' compositions. Varimax rotation was preferred, as it leads to better results.

At the end of this process, the retained factors are interpreted based on the most contribution associated with the original variables. Convincingly, two latent dimensions can explain the digital divide. As shown in Table 3.3, the first dimension comprises essentially the contribution of the following variables: participation in social networks (SocNet); frequency of access to the internet (IntFreq) and the use of handheld devices to be online, out of home or work (MobInt); and use of ICT

as way to search information about offers (IntSrc). It expresses the access to the internet and the most primary tasks while using ICT. Hence, this dimension is named **Social Networks and Internet Use**. The second is composed mainly through interaction with public authorities via web platforms (eGov); contact with a professional by using ICT to obtain medical advice (eHealth); and connection to electronic banking (eBank). Note that the variable goods or services ordered online (eCom) does not fit neatly into either of the dimensions. The second dimension is focused mostly on the purpose of using ICT. As a result, people are oriented to use a specific feature. In fact, the second dimension comprises variables that express a concrete activity. Hence, this dimension is labelled as **e-Services**.

Rotated factor model: Varimax		
	Factor 1	Factor 2
SocNet	0.93	0.24
IntFreq	0.85	0.49
IntSrc	0.74	0.60
MobInt	0.71	0.59
eGov	0.32	0.87
eHealth	0.05	0.86
eBank	0.44	0.82
eCom	0.65	0.68
Variance (%)	46%	41%
Variance Total	42%	87%
Cronbach's α	0.97	0.88

Table 3.3 - Results of factor analysis

By comparing the generations, we can easily look into the country and gain some insights that could be hidden in an aggregate analysis. Despite this, the standard in literature is analysis performed at country level. While a country can be on average well positioned, there might be groups in its population suffering from digital exclusion. In order to explore this further, we applied a drilldown analysis across generations, which allow us to discover findings beyond country level research. We have plotted each generation of each member state and compared all countries/generations on the two dimensions previously extracted (see Figures 3.1, 3.2, 3.3, and 4.1). In order to ease the analysis and interpretation, we present a series of plots with the generations' positions in the two dimensions identified early (see Figures 3.1-4.1). The first, **Social Networks and Internet Use**, is plotted on the horizontal axis; the second, **e-Services**, is on the vertical. Each of the axes represents the EU-28 average for each of the national generations. Accordingly, the upper-right quadrants include those that score higher than the average in both dimensions. The lower-left quadrant shows just the opposite situation, national generations that perform below the mean in both dimensions.

We first plotted the Generation Y of each member state (see Figure 3.1). As we can see, they have the greatest Social Networks and Internet Use. In fact, they are quite distant from the other generations and countries taken together. Hence, this alone shows that digital divide among youth is not mainly about access, but about the inequality of usage. In the current context, the digital divide is mainly the second order effect. As discussed above, we expect to confirm this condition, due to the fact that they never needed to adapt to ICT. Generation Y is somewhat behind the aggregate of generations in use of e-Services. This dimension results from combining e-government, e-health, and

e-banking and typically youth have less use for these applications. Germany has the most Social Networks and Internet Use; Denmark and Finland have not only the most use of e-Services, but are also the leaders in these two dimensions. Romania and Bulgaria have the worst indicators in both dimensions. As mentioned above, access is not the main feature for differentiating countries in the current generation, although there is a gap between some countries, i.e., Romania versus Germany and Bulgaria versus Denmark.

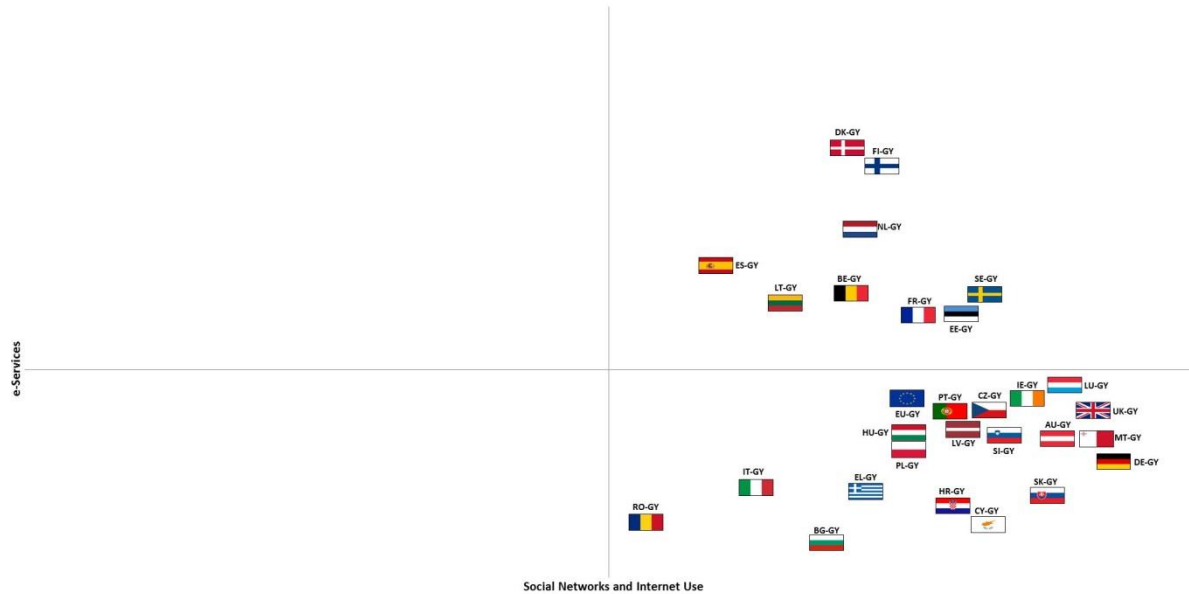


Figure 3.1 - Generation Y (individuals aged from 16 to 34) of each member state on two dimensions

Classified as Generation X are the individuals from 35 to 54 years old. We plot them as before (see Figure 3.2). The EU aggregated in current generation is slightly higher in both dimensions. Luxembourg and the United Kingdom (UK) are the leaders in Social Networks and Internet Use, while Finland and Denmark are ahead in using e-Services. Sweden and the Netherlands are positively well adjusted countries and opposed to this are Romania and Bulgaria.

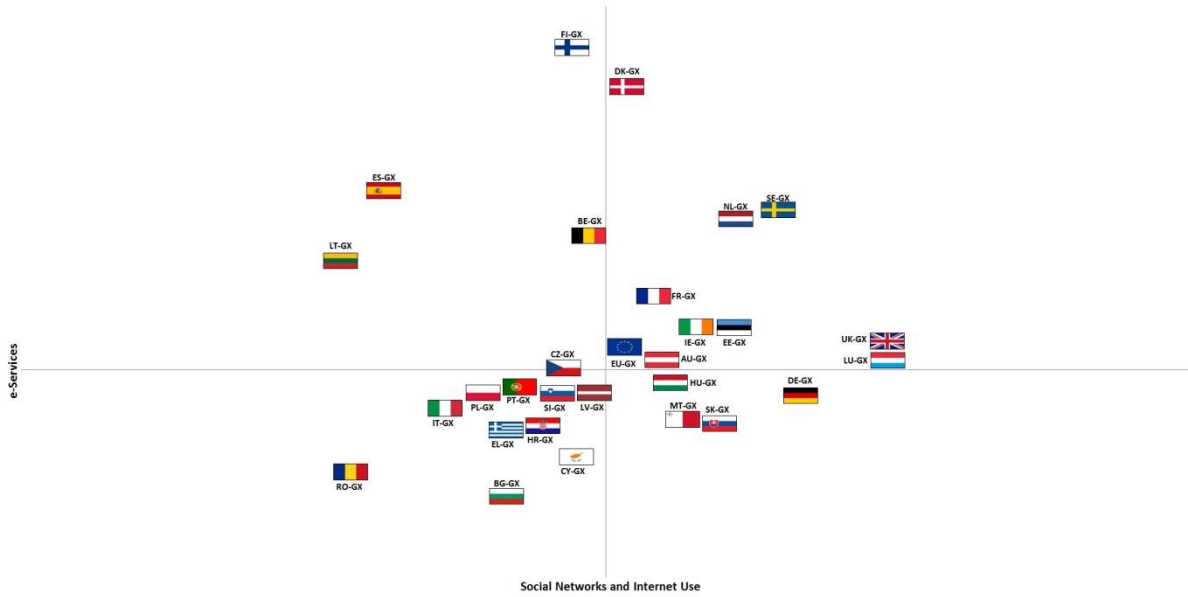


Figure 3.2 - Generation X (individuals aged from 35 to 54) of each member state on two dimensions

Lastly, we plotted the Baby Boomers of each member state. As expected, they generally have less Social Networks and Internet Use in relation to the average of the EU in all generations (see Figure 3.3). Only Luxembourg is above of EU average in Social Networks and Internet Use. Sweden, the Netherlands, the UK, and Luxembourg are positively well adjusted countries in current generation. Denmark and Finland are the leaders in e-Services. Note that there is a large group of countries with low e-Services use in relation to the EU average of current generation. Romania and Bulgaria are the worst placed in both dimensions.

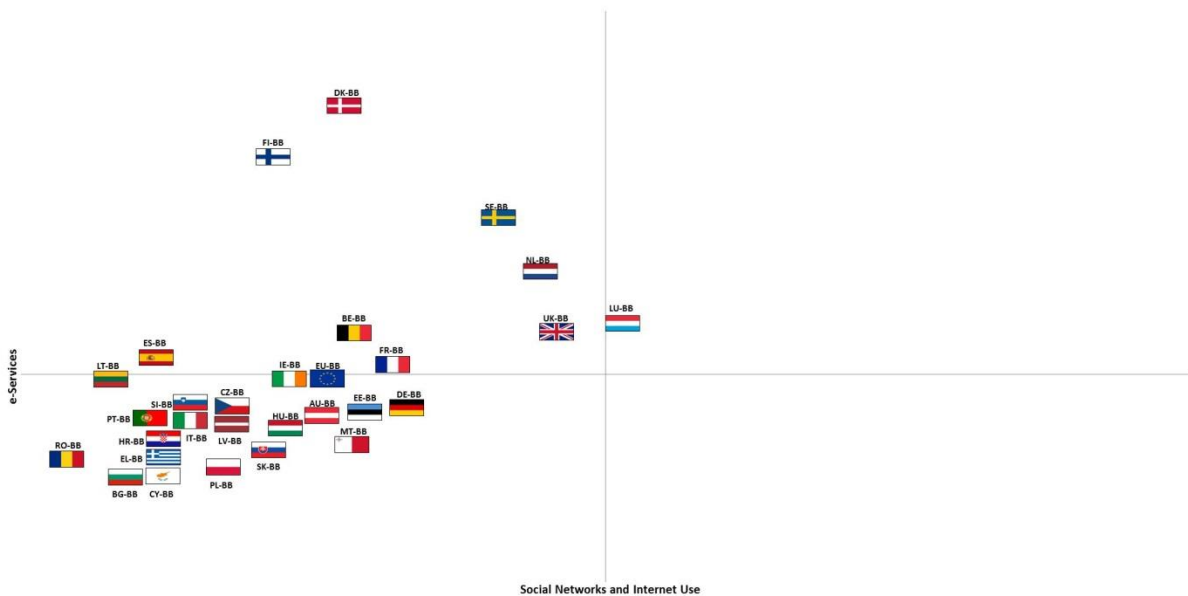


Figure 3.3 - Baby Boomers (individuals aged from 55 to 74) of each member state on two dimensions

4. DISCUSSION OF FINDINGS

Considering all generations together in the same plot, there is a clear partition between them. We can easily distinguish the generations along the first dimension (see Figure 4.1). Hence, the gap in the first dimension, which separates Generation Y, and Generation X, and Baby Boomers is evident. In a generational approach, the digital divide has to do with the Social Networks and Internet Use. Thus, the age-related digital divide is intrinsically associated with the first dimension found. In the second dimension, there is no evidence that generations are of special importance for digital divide. One might argue that the divide in this dimension is closer to motivation of individuals or any socioeconomic issue, making other aspects play the primary role.

There are some countries consistently well ranked, such as Sweden, the Netherlands, the UK, and Luxemburg. They are the most advantaged countries when compared to the rest of the EU, for every generation within itself. Finland and Denmark routinely present the greatest use of e-Services among generations. Typically, all of these countries have high standards of social-welfare. Additionally, these countries are the best-placed European countries in the ICT Development Index (ITU, 2014). The worst ranked countries are Romania and Bulgaria, as they have a greater distance. Moreover, among generations Bulgaria has the lowest indicators of advanced use of ICT. A shared characteristic is that Romania and Bulgaria have both been EU members since 2007. Furthermore, there is some evidence that in the literature newer member states tend to present lower digital developments (Cruz-Jesus et al., 2012), although that does not appear to happen with Croatia – the newest member of the EU. Hence, more than ever, this issue deserves policies that are based on the reality of each country.

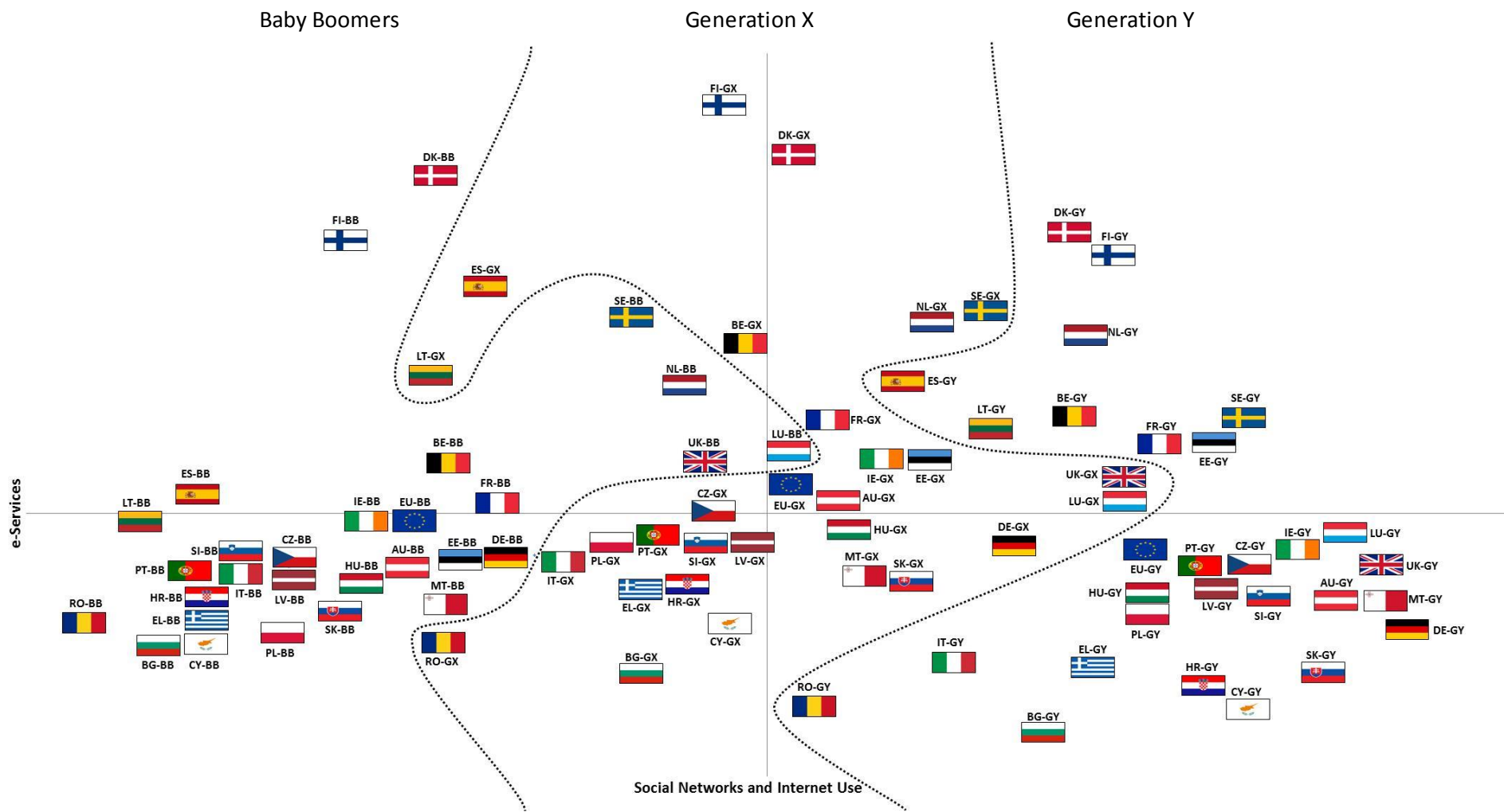


Figure 4.1 - All generations of each member state on retained factors

In order to make the interpretation of our results easier, Figures 4.2 and 4.3 shows which generations for each member state are above or below in comparison to the EU average, respectively, for the two dimensions of the digital divide found. As expected, the Baby Boomers are often below the EU average in all countries in Social Networks and Internet Use (see Figure 4.2). Only Luxembourg has all individuals above. Austria, Denmark, Estonia, France, Germany, Hungary, Ireland, Malta, the Netherlands, Slovakia, Sweden, and the UK have only the oldest generation below to EU global average.

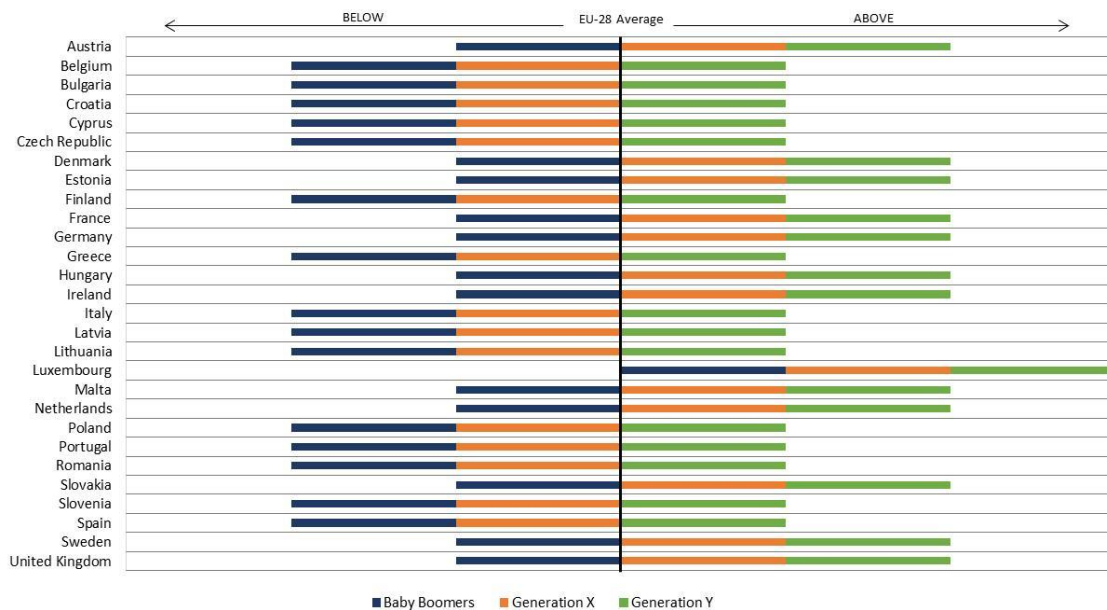


Figure 4.2 - Proximity of each generation to the EU in Social Networks and Internet Use

In the e-Services dimension, a more dispersed distribution is clear. Only a few member states are completely above the EU average, namely: Belgium, Denmark, Finland, France, Netherlands, Spain, and Sweden (see Figure 4.3). In contrast, there are groups of countries that have all their generations below the EU average: Bulgaria, Croatia, Cyprus, Germany, Greece, Hungary, Italy, Latvia, Malta, Poland, Portugal, Romania, Slovakia, and Slovenia.

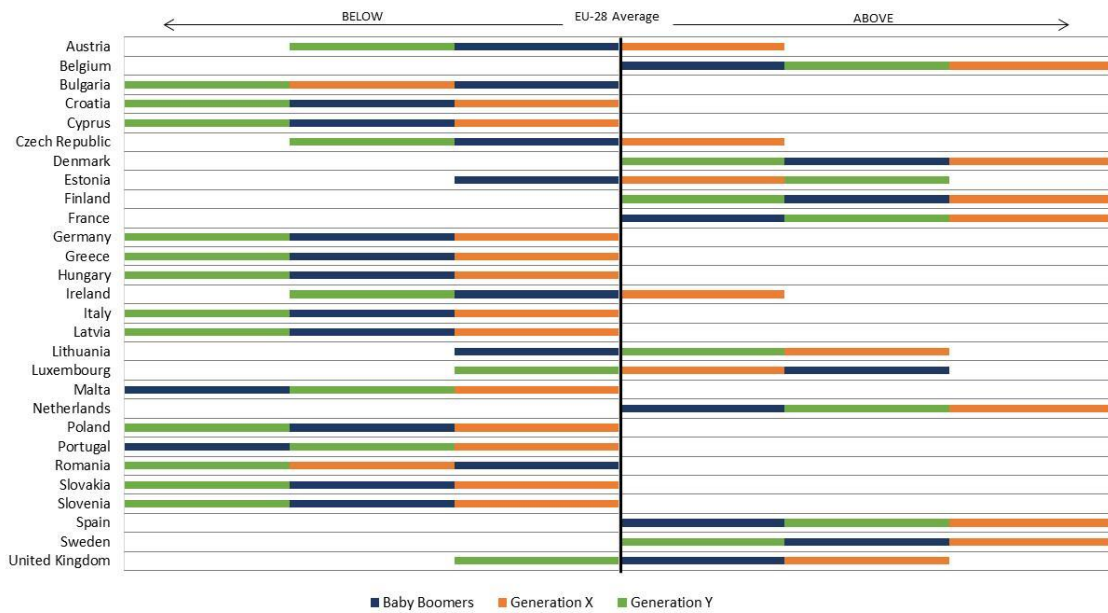


Figure 4.3 - Proximity of each generation to the EU in e-Services

In order to assess the age-related domestic digital divide, we calculated the Euclidean distance between two dimensions for each country, including all generations to check for internal disparities (see Figure 4.4). Naturally, given the results presented above, Baby Boomers and Generation Y are the farthest generations among EU countries. The middle-aged individuals who belong to Generation X have an important role bridging between Baby Boomers and Generation Y, since they are so close to Baby Boomers and Generation Y. As for the results, the highest age-related digital divide (comparing Generation X with Baby Boomers) are Cyprus and Croatia. Interestingly, Bulgaria and Romania do not have the highest domestic digital divide, which shows that they are backward in the EU. In opposition, the Netherlands and Luxembourg have the lowest overall domestic digital divide among generations, being at the same time, two of the most digitally developed countries.

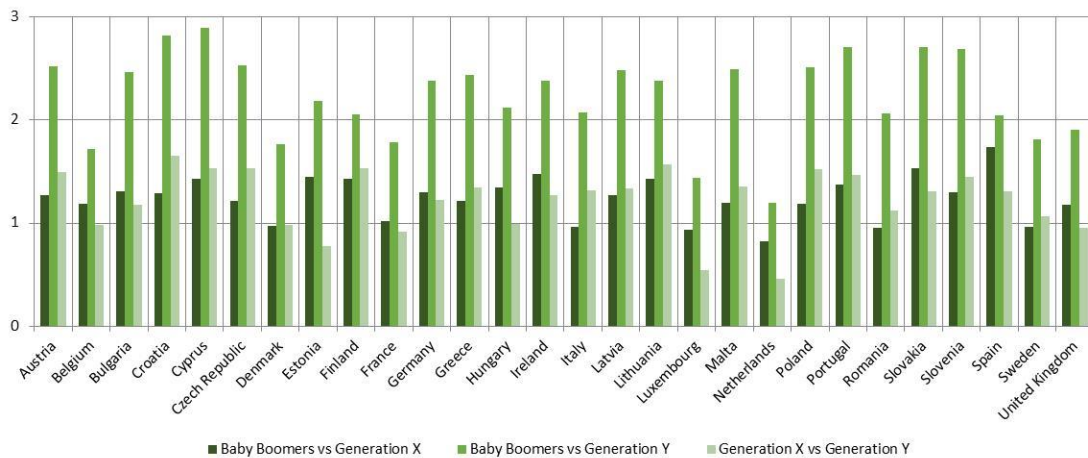


Figure 4.4 - The domestic age-related digital divide through Euclidean distance

According to our investigation, there are several differences between Baby Boomers and Generation Y, passing through the Generation X. The two dimensions found allow us to highlight interesting insights. The individuals who belong to Generation Y are truly digital natives, essentially because they have the most use of Social Networks and Internet Use as measured in the first dimension, than any other generation. Generation X has a crucial role to intermediate Baby Boomers and Generation Y, as they are approximately in the middle in both dimensions. Baby Boomers are the most backward generation in ICT adoption. In order to correct this, the decision-makers should consider some policies oriented to the Baby Boomers, such as encourage using and understanding the usefulness of ICT; decrease the cost of training courses, or subsidize them; design targeted applications, due to the elderly's lack of expertise with ICT; provide healthcare assistance remotely, which allows optimizing the healthcare service, reduce costs and improve the well-being of individuals. It is an embarrassing situation, since the Baby Boomers generally have more time and money, and at the same time have great opportunities to improve their well-being through ICT.

The member states with reduced digital divide in EU are Sweden, the Netherlands, the UK, and Luxemburg. In opposition, the digital laggards compared to the EU aggregate are Romania and Bulgaria. Some effects of year of membership in EU and the socioeconomic disparities in digital divide are clearly visible. The European countries are in different stages of development and the EU should follow policies depending on country/generation.

5. CONCLUSIONS, LIMITATIONS AND FUTURE WORK

The Digital Agenda target of 75% of the population regularly using the internet was reached in 2014 (European Commission, 2014b). This does not mean that all European individuals have identical access and use of ICT. Typically, cross-country analyses are hiding interesting insights that can be useful for a better perception of the digital divide phenomenon. The current research provides a drilldown analysis across generations, which allows us to discover findings beyond country level research.

The digital divide in general, and age-related issues in particular, in the EU are still far from being resolved. From the outset, we have assumed that the digital divide could be an age related phenomenon. Our findings suggest that generation plays a key role in differentiating inequalities in the use of Social Networks and Internet Use, although it is not a clear feature to distinguish in e-Services. Furthermore, we intended to assess domestic and international digital divide and compare between them. In our research, we found significant generational differences within member states, indicating that much progress remains to be achieved. The countries with lowest age-related digital divide are the Netherlands and Luxembourg, while Croatia and Cyprus present the highest domestic gap. From a national (overall) perspective, Sweden, the Netherlands, the UK and Luxemburg are consistently the countries with most Social Networks and Internet Use in the EU. In opposition, Romania and Bulgaria have the greatest digital divide in the EU.

Despite our best efforts to find patterns in the digital divide, we would like to acknowledge some limitations. First, our investigation focused on a generational approach, although there are others aspects like income or education that influence the digital divide as a multidimensional issue. Hence, we recommend that future studies address these matters. Moreover, despite our efforts to choose the best suitable variables in the current context, we should be aware that there may be some aspects that are not well covered due to being constrained in choosing a set of variables. Even with the Eurostat, the number of variables with data available at the age level is very limited. As future work, it may be useful to assess the role of government to mitigate the digital divide, specifically to bridge youth and the elderly.

6. REFERENCES

- Barnard, Y., Bradley, M. D., Hodgson, F., & Lloyd, A. D. (2013). Learning to use new technologies by older adults: Perceived difficulties, experimentation behaviour and usability. *Computers in Human Behavior, 29*(4), 1715-1724.
- Becker, S. A. (2005). E-government usability for older adults. *Communications of the ACM, 48*(2), 102-104.
- Bennett, S., Maton, K., & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology, 39*(5), 775-786.
- Billón, M., Ezcurra, R., & Lera-López, F. (2008). The spatial distribution of the internet in the European Union: Does geographical proximity matter? *European Planning Studies, 16*(1), 119-142.
- Boot, W. R., Charness, N., Czaja, S. J., Sharit, J., Rogers, W. A., Fisk, A. D., . . . Nair, S. (2015). Computer proficiency questionnaire: Assessing low and high computer proficient seniors. *The Gerontologist, 55*(3), 404-411.
- Braun, M. T. (2013). Obstacles to social networking website use among older adults. *Computers in Human Behavior, 29*(3), 673-680.
- Brown, J. S. (2000). Growing up: Digital: How the web changes work, education, and the ways people learn. *Change: The Magazine of Higher Learning, 32*(2), 11-20.
- Carpenter, B. D., & Buday, S. (2007). Computer use among older adults in a naturally occurring retirement community. *Computers in Human Behavior, 23*(6), 3012-3024.
- Chinn, M. D., & Fairlie, R. W. (2007). The determinants of the global digital divide: a cross-country analysis of computer and Internet penetration. *Oxford Economic Papers, 59*(1), 16-44.
- Cotten, S. R., & Gupta, S. S. (2004). Characteristics of online and offline health information seekers and factors that discriminate between them. *Social Science & Medicine, 59*(9), 1795-1806.
- Cruz-Jesus, F., Oliveira, T., & Bacao, F. (2012). Digital divide across the European Union. *Information & Management, 49*(6), 278-291.
- Cuervo, M. R. V., & Menéndez, A. J. L. (2006). A multivariate framework for the analysis of the digital divide: Evidence for the European Union-15. *Information & Management, 43*(6), 756-766.
- Czaja, S. J., & Lee, C. C. (2007). The impact of aging on access to technology. *Universal Access in the Information Society, 5*(4), 341-349.
- Czaja, S. J., Sharit, J., Nair, S. N., & Lee, C. C. (2009). Older adults and Internet health information seeking. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 53*(2), 126-130.
- Dragulanescu, N.-G. (2002). Social impact of the "digital divide" in a central-eastern European country. *The International Information & Library Review, 34*(2), 139-151.

- European Commission. (2005). The digital divide in Europe. *Statistics in Focus*, Luxembourg.
- European Commission. (2012). Internet use in households and by individuals in 2012 *Statistics in Focus*, Luxembourg.
- European Commission. (2014a). Digital Agenda for Europe. Brussels.
- European Commission. (2014b). Half of Europeans used the internet on the go and a fifth saved files on internet storage space in 2014. *Statistics in Focus*, Luxembourg.
- European Commission. (2015a). The 2015 Ageing Report: Economic and budgetary projections for the 28 EU Member States (2013-2060). Brussels.
- European Commission. (2015b). Population structure and ageing. Luxembourg.
- Fang, Z. (2002). E-government in digital era: concept, practice, and development. *International Journal of the Computer, the Internet and Management*, 10(2), 1-22.
- Forman, C. (2005). The corporate digital divide: determinants of Internet adoption. *Management Science*, 51(4), 641-654.
- Fozard, J. L., & Gordon-Salant, S. (2001). Changes in vision and hearing with aging. *Handbook of the Psychology of Aging*, 5, 241-266.
- Greenwood, B. N., & Agarwal, R. (2015). A double digital divide? Two-sided markets and HIV incidence among the digitally disadvantaged. *Management Science*.
- Gunkel, D. J. (2003). Second Thoughts: Toward a Critique of the Digital Divide. *New Media & Society*, 5(4), 499-522. doi: 10.1177/146144480354003
- Hargittai, E. (2003). The digital divide and what to do about it. *The New Economy Handbook*, ed. D. Jones, 822-841. San Diego, CA: Academic Press.
- Hargittai, E., & Walejko, G. (2008). The participation divide: content creation and sharing in the digital age. *Information, Community and Society*, 11(2), 239-256.
- Hawthorn, D. (2000). Possible implications of aging for interface designers. *Interacting with Computers*, 12(5), 507-528.
- Heart, T., & Kalderon, E. (2013). Older adults: are they ready to adopt health-related ICT? *International Journal of Medical Informatics*, 82(11), 209-231.
- Helbig, N., Ramón Gil-García, J., & Ferro, E. (2009). Understanding the complexity of electronic government: Implications from the digital divide literature. *Government Information Quarterly*, 26(1), 89-97. doi: <http://dx.doi.org/10.1016/j.giq.2008.05.004>
- Hsieh, J. P.-A., Rai, A., & Keil, M. (2008). Understanding digital inequality: Comparing continued use behavioral models of the socio-economically advantaged and disadvantaged. *MIS Quarterly*, 97-126.
- ITU. (2014). Measuring the Information Society Report. Geneva.

- Jones, S., & Fox, S. (2009). Generations online in 2009. *Pew Internet & American Life Project*, Washington, DC.
- Kraemer, K. L., Ganley, D., & Dewan, S. (2005). Across the digital divide: A cross-country multi-technology analysis of the determinants of IT penetration. *Journal of the Association for Information Systems*, 6(12), 10.
- Kyriakidou, V., Michalakelis, C., & Sphicopoulos, T. (2011). Digital divide gap convergence in Europe. *Technology in Society*, 33(3), 265-270.
- Lee, C., & Coughlin, J. F. (2015). Older adults' adoption of technology: an integrated approach to identifying determinants and barriers. *Journal of Product Innovation Management*, 32(5), 747-759.
- Lenhart, A., Purcell, K., Smith, A., & Zickuhr, K. (2010). Social Media & Mobile Internet Use among Teens and Young Adults. Millennials. *Pew Internet & American Life Project*.
- Lian, J.-W., & Yen, D. C. (2014). Online shopping drivers and barriers for older adults: Age and gender differences. *Computers in Human Behavior*, 37(0), 133-143. doi: <http://dx.doi.org/10.1016/j.chb.2014.04.028>
- Marquié, J. C., Jourdan-Boddaert, L., & Huet, N. (2002). Do older adults underestimate their actual computer knowledge? *Behaviour & Information Technology*, 21(4), 273-280.
- Mitzner, T. L., Boron, J. B., Fausset, C. B., Adams, A. E., Charness, N., Czaja, S. J., . . . Sharit, J. (2010). Older adults talk technology: Technology usage and attitudes. *Computers in Human Behavior*, 26(6), 1710-1721.
- Murdock, G. (2002). Tackling the digital divide: evidence and intervention. *Paper presented given to British Educational Communications and Technology Agency seminar*, 19.
- Niehaves, B., & Plattfaut, R. (2014). Internet adoption by the elderly: employing IS technology acceptance theories for understanding the age-related digital divide. *European Journal of Information Systems*, 23(6), 708-726.
- OECD. (2001). Understanding the Digital Divide.
- Park, S. R., Choi, D. Y., & Hong, P. (2015). Club convergence and factors of digital divide across countries. *Technological Forecasting and Social Change*.
- Pempek, T. A., Yermolayeva, Y. A., & Calvert, S. L. (2009). College students' social networking experiences on Facebook. *Journal of Applied Developmental Psychology*, 30(3), 227-238.
- Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the horizon*, 9(5), 1-6.
- Rensel, A. D., Abbas, J. M., & Rao, H. R. (2006). Private transactions in public places: an exploration of the impact of the computer environment on public transactional web site use. *Journal of the Association for Information Systems*, 7(1), 2.

- Rice, R. E., & Katz, J. E. (2003). Comparing internet and mobile phone usage: digital divides of usage, adoption, and dropouts. *Telecommunications Policy*, 27(8), 597-623.
- Riggins, F. J., & Dewan, S. (2005). The digital divide: Current and future research directions. *Journal of the Association for Information Systems*, 6(12).
- Selwyn, N., Gorard, S., Furlong, J., & Madden, L. (2003). Older adults' use of information and communications technology in everyday life. *Ageing and Society*, 23(05), 561-582.
- Sharma, S. (1996). *Applied Multivariate Techniques*. John Wiley & Sons.
- Sharma, S., & Kumar, A. (2006). Cluster analysis and factor analysis. *The Handbook of Marketing Research: Uses, Misuses, and Future Advances*, 365.
- Sorce, P., Perotti, V., & Widrick, S. (2005). Attitude and age differences in online buying. *International Journal of Retail & Distribution Management*, 33(2), 122-132.
- Todman, J., & Monaghan, E. (1995). Qualitative differences in computer experience, computer anxiety, and students' use of computers: A path model. *Computers in Human Behavior*, 10(4), 529-539.
- Unwin, T., & de Bastion, G. (2009). Digital divide. *International Encyclopedia of Human Geography*, Elsevier, Oxford, 191-197.
- Van Deursen, A., & Van Dijk, J. (2011). Internet skills and the digital divide. *New Media & Society*, 13(6), 893-911.
- Van Dijk, J., & Hacker, K. (2003). The digital divide as a complex and dynamic phenomenon. *The Information Society*, 19(4), 315-326.
- Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly*, 36(1), 157-178.
- Viard, V. B., & Economides, N. (2014). The effect of content on global Internet adoption and the global "digital divide". *Management Science*, 61(3), 665-687.
- Vicente, M. R., & López, A. J. (2011). Assessing the regional digital divide across the European Union-27. *Telecommunications Policy*, 35(3), 220-237.
- Vroman, K. G., Arthanat, S., & Lysack, C. (2015). "Who over 65 is online?" Older adults' dispositions toward information communication technology. *Computers in Human Behavior*, 43, 156-166.
- World Bank. (2016). *World Development Report 2016: Digital Dividends*. Washington, DC.
- WSIS. (2003). World Summit on the Information Society: declaration of principles. *World Summit on the Information Society*, Geneva.