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The Global Digital Divide:
Evidence and Drivers

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ABSTRACT

This article presents an analysis of the global digital divide, based on data collected from 45 countries, including the ones belonging to the European Union, OECD, Brazil, Russia, India, and China (BRIC). The analysis shows that one factor can explain a large part of the variation in the seven ICT variables used to measure the digital development of countries. This measure is then used with additional variables, which are hypothesised as drivers of the divide for a regression analysis using data from 2015, 2013, and 2011, which reveals economic and educational imbalances between countries, along with some aspects of geography, as drivers of the digital divide. Contrary to the authors' expectations, the English language is not a driver.

KEYWORDS

BRIC, Digital Development, Digital Divide, European Union, ICT, OECD

1. INTRODUCTION

Information and communication technologies (ICT) play an important role in the global economy (Lee, Gholami, & Tong, 2005; World Bank, 2016). The belief that greater adoption and use of ICT may foster economic growth and development, trumping the present economic difficulties, has been supported by some of the most important nations and world organisations, such as the United Nations (UN) (United Nations, 2016), the United States of America (USA) (e.g., US Department of Commerce, 2000), the Organisation for Economic Co-operation and Development (OECD) (e.g., OECD, 2011), and the European Union (EU) (e.g., European Commission, 2010a, 2013, 2015). These have developed some type of strategy for promoting digital development and intensified the use of ICT to engender economic growth and development. Besides its economic importance, it is widely accepted that these technologies also positively influence the individual´s quality of life and welfare (Dewan & Riggins, 2005; Kim, Lee, & Menon, 2009). At the World Summit on the Information Society (WSIS), sponsored by the UN and International Telecommunications Union (ITU), it was declared that the global challenge for the new millennium is to build a society "…where everyone can 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, 2005), a commitment reinforced some 10 years later (WSIS, 2013, 2014).

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Despite the recognised importance that ICT may have for economics and welfare, helping countries to achieve sustainable growth, the fact is that research about these issues is still, in some ways, limited. Within academia, two main types of studies regarding the global digital divide can be distinguished: some studies focus on measuring the divide, while others focus on explaining what drives it (Cruz-Jesus, Vicente, Bacao, & Oliveira, 2016). Although this work covers both types simultaneously, the authors are particularly interested in the second type of research, i.e., to understand the divide´s drivers. The authors believe that measuring the global digital divide is indeed a subject worth investigating. However, to effectively design and deploy efficient measures to narrow it, some light must be shed on the divide´s causes. Moreover, considering that most of the studies emphasising this particular aspect of the global digital divide are mostly related only with the use of Internet *per se* (Billon, Marco, & Lera-Lopez, 2009), the authors also intend to provide a more comprehensive view of ICT adoption and use across countries. To accomplish this aim, in this paper, measures of the digital development of countries other than merely the Internet usage are considered.

Another gap in the literature that the authors believe is noticeable while surveying the literature is the fact that studies regarding the digital divide across countries tend to be limited to specific (groups of) countries, usually developed or developing, and/or in specific geographic areas (e.g., the European Union), probably because of the difficulty in finding relevant and comprehensive data. Studies with a significant number of countries are difficult to conduct because metrics/variables of ICT adoption are often not comparable. This paper helps to fill these gaps, measuring and understanding the digital asymmetries across countries, taking a snapshot in terms of digital development of 45 countries in three distinct years – 2011, 2013, and 2015. These countries were selected based on the trade-off between width and depth of the analysis – the more countries one tries to include, fewer available variables are. As such, the authors concentrated their efforts to include a comprehensive “sample” of developed and developing countries, comprising every member-state of the international block that, perhaps, more attention pays to the issue of the digital divide (see, e.g., European Commission, 2010a, 2010b, 2013, 2015), every member country of the OECD, as well as some of the leading developing countries for which there is data available: Brazil, Russia, India and China (BRIC). The authors expect to help policy makers deploy efficient measures by providing a complete-as-possible and up-to-date analysis of digital asymmetries between developed and rapidly developing countries, by answering the following research questions:

1. What are the digital development levels of the 45 countries studied?
2. What drives asymmetries in the digital development of countries, i.e., the global digital divide?
3. To what extent have the drivers of digital development of countries changed between 2011 and 2015?

In answering these questions, this paper is organized as follows: The second Section includes a literature review of the digital divide; The third one presents the theoretical background and the conceptual model for understanding the digital development of countries and, hence, the global digital divide; The fourth Section has the methodology; The fifth the results; The sixth section has the discussion, implications, and the limitations of findings. Finally, Section 7 presents the conclusions.

2. LITERATURE REVIEW

In recent decades, one sees an intense proliferation in development and use of ICT (Cruz-Jesus, Oliveira, & Bacao, 2012). These technologies are here to stay, playing a decisive role in improving practically every aspect of our societies (Unesco, 2003; World Bank, 2009), such as the way individuals and firms interact and communicate, do business, pursue economic growth, improve welfare, and even the way politics are conducted (H. Zhao, Kim, Suh, & Du, 2007). Internet browsing, email, blogs, multimedia online streaming, social networking, on-line job seeking, wiki-sites, access to online libraries, e-commerce, and services like e-government, e-health, e-learning, and e-banking are examples of new possibilities that are shaping a new type of (improved) communication and interaction between individuals and organizations (Çilan, Bolat, & Coskun, 2009; Facer, 2007; Forman, 2005; Hajli, 2014; Krishnan & Lymm, 2016; Mutula & Brakel, 2006; Niehaves & Plattfaut, 2013; Vicente & Gil-de-Bernabé, 2010; Vicente & Lopez, 2010b).

The impact of ICT in the economic field is such that these technologies are classified as general-purpose technologies (GPT) – defined as technological innovations that have the potential to improve most industries and society sectors (Bresnahan & Trajtenberg, 1995; Doong & Ho, 2012; European Commission, 2013), and have in the past also revolutionised the economy such as, the 19th century´s transportation and communications technologies, the Corliss steam engine, the internal combustion engine, and the electric motor (Carlsson, 2004; Cruz-Jesus et al., 2012; Cuervo & Menéndez, 2006). Moreover, ICT appears to have an even greater impact on economic development than those GPT since "…it affects the service industries (e.g., health care, government, and financial services) even more profoundly than the goods-producing industries, and these service sectors represent over 75% of gross domestic product…" (Carlsson, 2004).

Jalava and Pohjola (2008) have empirically demonstrated that the ICT contribution to Finland's GDP between 1990 and 2004 was three times greater than the contribution of electricity from 1920 to 1938. ICT helps to create new industries that generate new employment opportunities (Castells, 2007; Castells & Himanen, 2002). Shirazi et al. (2009) addressed the relationship between ICT and economic freedom, and found that ICT expansion in Middle East countries has, in fact, been effective in supporting it, as demonstrated in the "Arab Spring" revolution (Sandoval-Almazan & Ramon Gil-Garcia, 2014). Even in politics, the Internet and other ICT related technologies are playing an increasingly important role, as in the awareness of individuals toward the differences in the ideologies within a political dispute (Kim et al., 2009; Wattal, Schuff, Mandviwalla, & Williams, 2010). The notion of literacy has also changed due to ICT, considering that the inability to use these technologies is creating an entirely new group of disadvantaged persons who were considered "literate" in the past (Unwin & de Bastion, 2009). Andrade and Doolin (2016) addressed the benefits that ICT could bring to refugees and concluded by interviewing 53 of them in New Zealand, that ICT could benefit them by improving their communication with the society, improving their understanding of it, and expressing their cultural entity, thereby being more socially connected.

The advent of information technologies (IT) – initialised with the spread of personal computers (PC) and Internet – created, during the 1980s, the (utopian) idea of a whole new world of endless opportunities liberated from problematic sociocultural aspects, such as gender, age, race, and geography (Gunkel, 2003). However, it soon became clear that access (and later, use) of ICT was limited by specific constraints and should not be assumed by researchers and policy makers to be either universal or instantaneous. It was within this context that the term "digital divide" appeared. Although the literature and forums on the subject regularly attribute the term to Larry Irving Junior, former Assistant Secretary for Communications and Information of the US Department of Commerce, the fact is that it was not authored by him, as he himself admitted years later (Gunkel, 2003). The "digital divide" term became popular in the third "Falling Through the Net" report, from the US Department of Commerce's National Telecommunications and Information Administration (NTIA) (US Department of Commerce, 1999), which defined it as "…the divide between those with access to new technologies and those without…" Within the series of these reports (US Department of Commerce, 1995, 1998, 1999, 2000, 2002) the definition of digital divide evolved from PC ownership, to the inclusion of Internet access, and later, to the availability of broadband connections. Today however, the digital divide should be thought of in terms of a mother that is 50 years old and cannot get a job because she does not know how to use a computer nor knows how to use the Internet; a student that cannot make his thesis properly because he does not have access to on-line libraries; a firm that has closed because it was unable to reach its customers through a website; or a government that is not able to communicate on-line with its citizens because most of them do not have access to ICT; amongst so many other examples of what the inability to access and use ICT may cause.

These factors are drawing strong distinctions and inequalities between those who have access to privileged information and those who have not (Brooks, Donovan, & Rumble, 2005), a reason why the original understanding of this phenomenon evolved from the binary understanding between "*has*" versus "*has not"* to focus on the reasons why disparities in access and use of ICT really exist. As a consequence, it was discovered that geographic areas (urban vs. rural) were an important factor in defining the divide between information haves and have-nots (US Department of Commerce, 1995). Individuals belonging to ethnic minorities, or with lower incomes, were also more vulnerable to asymmetries in the access to digital technologies (US Department of Commerce, 1998). In other words, the understanding of the digital divide phenomenon underwent considerable evolution as the subject started to be understood as a multidimensional issue. Thus, it is widely recognised today that the initial binary definition was narrow, since other factors need to be considered (Brandtzæg, Heim, & Karahasanovic, 2011). One of the most widely accepted definitions of digital divide is provided by the OECD (2001), 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 ICT and to their use of the Internet for a wide variety of activities.

The digital divide is a phenomenon that can occur at different dimensions/levels. In terms of adoption units, digital asymmetries may exist between individuals, households, organisations, and countries (Dewan & Riggins, 2005). At an individual level, digital inequalities are more likely to exist between economically and sociologically disadvantaged individuals, i.e., those with lower incomes or education levels, those with disabilities, living in rural areas, belonging to ethnic minorities, women, and the elderly (Azari & Pick, 2005; Crenshaw & Robison, 2006; Ferro, Helbig, & Gil-Garcia, 2011; Hilbert, 2011; Lengsfeld, 2011; Payton, 2003; Vicente & Lopez, 2006; Vicente & Lopez, 2008, 2010b, 2010c). In addition to these sociodemographic characteristics of individuals, Venkatesh and Sykes (2013) found that social network aspects are also significant in explaining ICT use, and even value. In terms of organisations as adoption units, it is usually accepted that larger firms (as they usually possess more resources) tend to be more prone to adopt technological innovations, although some authors do not agree with this notion because larger firms are also more likely to suffer from inertia (Dewan & Riggins, 2005; Oliveira & Martins, 2010; Rogers, 2005). Finally, at a country (global) level – individuals and organisations in aggregate – inequalities in terms of ICT access and use may occur between and within countries, which are named, respectively, international and domestic digital divides. With respect to the international digital divide, research usually indicates that economic wealth and education are key factors in explaining the digital development level of a country (Cruz-Jesus, Oliveira, Bacao, & Irani, 2016; Cruz-Jesus, Vicente, et al., 2016; James, 2011; Shirazi, Gholami, & Higón, 2010). However, even in countries recognised as examples of digital development, there is evidence that domestic divides may exist. In the Netherlands, for example, van Deursen and van Dijk (2015) found that those who are younger, more highly educated, and with higher incomes, are more likely to have higher levels of ICT adoption.

Besides the type of adoption unit, the digital divide may also be related to access to ICT or its use, which may appear to be the same but in truth are not. Hsieh et al. (2008, 2011) showed noticeable differences in ICT access and use patterns between those who are economically advantaged and those who are disadvantaged. Besides the intrinsic motivations for access to ICT, these persons also have very different post-implementation behaviour regarding the use of these technologies. Hsieh et al. concluded that economically advantaged people have a "…higher tendency to respond to network exposure…" using ICT with much more confidence than the disadvantaged. These two types of inequalities about access to and use of ICT are known as first- and second-order digital divides

(Dewan & Riggins, 2005). In the first-order digital divide the inequalities regard access to ICT, while in the second-order the problem is postulated in terms of different use patterns and intensity amongst individuals/organisations that already have (very similar) access to ICT (e.g., using the Internet just for web-browsing or email vs. using it for e-learning, social-network, applying to jobs online, e-banking, e-health, etc.). As noted by Epstein et al. (2011), different types of inequalities (first- or second-orders) require different actions from different entities. Hence, inequalities in ICT access may be bridged through the subsidisation of these technologies, which governments and organisations may well provide; whereas for inequalities in ICT usage patterns, possible solutions reside in the hands of educational institutions and individuals themselves. As stated by the World Bank (2016), in order for ICT "…to benefit everyone everywhere requires closing the remaining digital divide, especially in internet access…"

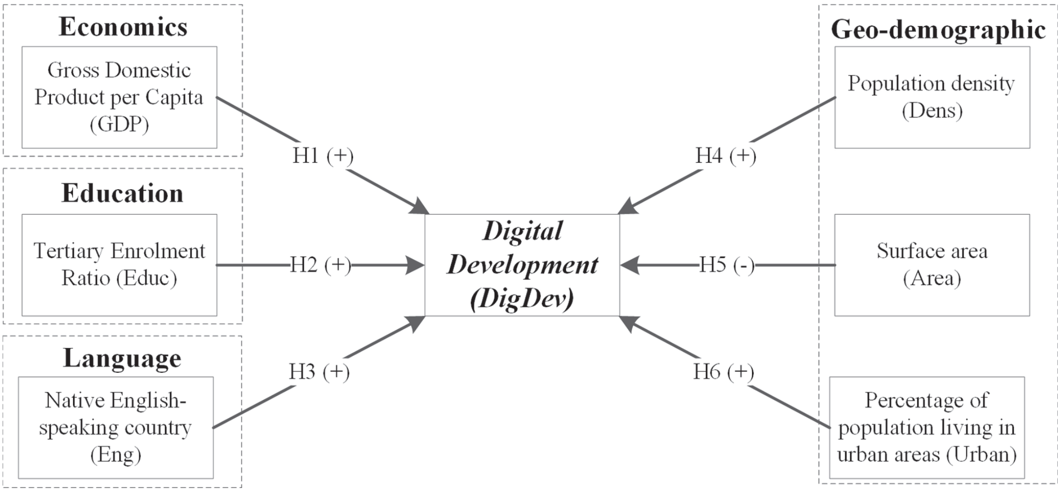
3. THEORETICAL BACKGROUND AND RESEARCH MODEL

The first research question of this paper can be answered by measuring the digital development of countries. However, as it is intended to go beyond the mere measure of the global digital divide (differences in digital development levels across countries), to shed some light on what drives the divide, it is necessary to turn to the specific literature about why there are inequalities in terms of ICT adoption. Within the specialised literature of the subject, one can find several aspects that, allegedly, contribute to the digital divide across countries, such as economic, educational, demographic, geographic features, etc. However, those same studies are usually limited in terms of width (number of countries) or in terms of depth (number of indicators).

To effectively understand the digital asymmetries across nations the authors need to develop a conceptual model for the digital development of countries, so that it is possible to empirically test it. This conceptual model is grounded on the digital divide literature together with the diffusion of innovations (DOI) theory (Rogers, 2005), one of the most prominent frameworks for understanding how and why innovations diffuse (Oliveira & Martins, 2011; Zhu, Dong, Xu, & Kraemer, 2006). In this context, DOI is adapted to the general ICT adoption at country-level (note that DOI was originally developed for understanding innovations' adoption at individual- and firm-level). As a result, the conceptual model comprises three contexts of a country that the authors believe influence its digital development level: economic, educational, and geo-demographic. Additionally, countries in which English is the native language were also marked with a binary variable, as there is evidence that this factor can work as a driver of digital adoption. The conceptual model is shown in Figure 1.

The link between economic development, especially gross domestic product per capita (GDP), and access to ICT is well supported in the literature (see, e.g., Beilock & Dimitrova, 2003; Cruz-Jesus, Oliveira, et al., 2016; Hargittai, 1999; Kauffman & Techatassanasoontorn, 2005). Considering that newer technologies, usually with greater perceived relative advantage, tend to be more expensive than those they supersede, naturally presenting higher risks for those who decide to adopt them, the DOI theory (Rogers, 2005) claims that wealthier individuals and firms - and thus wealthier countries in the aggregate - are more likely to adopt technological innovations (as is the case of ICT). Rogers (2005) posits that not only "…the initial cost of an innovation may affect its rate of adoption…", but also that it certainly influences the perceived relative advantage. Moreover, the digital revolution took place within the western developed world, i.e., almost all new products and technologies, particularly the case of ICT, originate in developed countries (James, 2011). These effects combined led the developed countries to rapidly adopt and increase their use of ICT for a wide variety of activities (e.g., individuals started using PC for personal purposes and firms for business). The developing countries, on the other hand, did not possess the same resources to effectively acquire ICT, and did not benefit from its use at the same scale as did the richer countries. During the early years of ICT, the growing adoption rate was unquestionably several times higher in richer countries (Zhang, 2013). Whether this is still occurring today is not clear. Nevertheless, even today, countries with stronger

Figure 1. Conceptual model of the drivers of digital development



economies are more likely to have the possibilities to use ICT. Moreover, as these countries tend to have more developed economies, in terms of information-, financial-, and innovation-based industries, the likelihood of presenting higher levels of ICT adoption is also greater.

In order to measure the economic development level of a country, GDP is, perhaps, the most popular and accurate single indicator of economic development, measuring the overall output of the economy (Dewan, Ganley, & Kraemer, 2005). In academia, GDP has been routinely tested as a would-be driver of digital development. This hypothesised relationship started with the study of Hargittai (1999), which pointed to economic wealth as a driver of the digital divide. A similar conclusion was pointed to by Beilock and Dimitrova (2003), although these authors also found that the relationship was non-linear. Later, Dewan et al. (2005) studied the global digital divide using OLS and quantile regressions for three distinct generations of ICT – Mainframes, PCs, and the Internet, finding that GDP is, indeed, significant in explaining digital development. This finding is in line with those from other studies (see, e.g., Park, Choi, & Hong, 2015; Zhang, 2013). One of the few exceptions is the work of Zhao, Collier, and Deng (2014), in which, with relative surprise, GDP is not found to be a significant driver of the digital development of countries. Nevertheless, from the above, the following hypothesis is drawn:

H1: The GDP is positively associated with digital development.

Education and economics are often identified as predictors of digital development of countries (Cruz-Jesus, Vicente, et al., 2016; Kiiski & Pohjola, 2002; Park et al., 2015; Shirazi, Ngwenyama, & Morawczynski, 2010). As it is intended to understand digital inequalities across countries, the focus on international socio-economic asymmetries is indispensable, especially considering that income and education exert the greatest influence in explaining ICT adoption versus non-adoption (Hsieh et al., 2008). As with the income, one can find theoretical support from DOI for the role that education has on ICT adoption. The diffusion of innovations´ theory claims that complexity is a major obstacle for technology (as in the case of ICT) adoption (Rogers, 2005). Thus, the ease of use of a technology is important to its adoption rate (Katz & Aspden, 1997). This fact makes educational aspects of individuals play an important role, considering that when facing a technical challenge, more educated individuals are more prone to flexibly and effectively overcome ICT complexity´s constraints (H. Zhao et al., 2007). Thus, when interacting with an ICT, the relatively higher educational attainment should make it easier to cope with the complexity of the technology, thus minimizing the impact of the difficulties (Hsieh et al., 2008). In this sense, education facilitates the absorption and assimilation of information.

It is also reasonable to hypothesise that more educated individuals are more likely to work in information-intensive industries, thus using ICT more often at work. As Peng et al. (2011) demonstrated, individuals who use a PC at work or school are more likely to adopt ICT. A consistent finding has been demonstrated by Tengtrakul and Peha (2013), who conclude that "…the higher the educational level of students, the stronger the increase in likelihood of a household adopting ICT…" At a country-level, some authors have found evidence that education, measured in different ways, such as tertiary education rate, compulsory education, average years of schooling, among others, is a significant driver of the digital development of countries (see, e.g., Billon, Marco, et al., 2009; Chinn & Fairlie, 2007; Dewan et al., 2005; Oyelaran-Oyeyinka & Lal, 2005). To measure how educated a country is the authors chose the tertiary enrolment ratio (Educ). Hence:

H2: Education is positively associated with digital development.

As the spread of ICT, especially through the Internet, began in the USA, most websites are in English. This trend continues and English is still the most commonly used language on the World Wide Web. Even for native-speakers of other languages, English is still the major international language, thus linking people of different areas and cultures. Hence, even those for whom English is not the native language end up contributing to its spread if their Web content is directed to foreign targets. This trend is also true in operating systems and other IT (Hargittai, 1999). For these reasons, some authors point to evidence that English-speaking ability is positively associated with ICT access and use (Ono & Zavodny, 2008). The authors argue that native English-speaking countries (Eng) are more prone to be digitally developed, considering that their individuals will be more likely to speak English and thereby have easier understanding and proficiency in using the PC and the Internet. For these reasons, it is expected that:

H3: English is positively associated with digital development.

Considering that population, and its characteristics in terms of demographic and geographic distributions, has an effect on information and knowledge about ICT, which is often transmitted through personal communications (Billon, Marco, et al., 2009), these contexts of countries may also have some influence on the digital development. The impact of these effects is, however, ambiguous (Dewan et al., 2005).

In the literature, there are simultaneously studies that empirically demonstrate the effect of demographic and geographic characteristics in the digital development, while others do not (Bharati, Zhang, & Chaudhury, 2014; Billon, Ezcurra, & Lera-López, 2009; Billon, Marco, et al., 2009; Zhang, 2013). The authors argue that denser and smaller areas are easier to connect than those that are more dispersed or larger. In denser areas, it is more likely that innovations spread faster (Rogers, 2005), as innovations are more observable by other potential adopters. Thus, the population density (Dens) serves as a proxy variable for measuring the degree to which ICT are observable. This belief is consistent with Agarwal et al. (2009), who found a positive, although marginally statistically significant, moderated relationship between households´ density and the probability of adopting Internet in the USA.

With respect to countries´ surface area (Area), there are contradictory beliefs on its influence in ICT adoption. On one hand, some authors argue that larger areas are more likely to adopt ICT because of the advantage of these technologies in replacing other ways of communication, which are usually more expensive as distance increases (Forman, 2005). On the other hand, other authors posit that larger areas tend to be more heterogeneous, as they are harder to connect (Cruz-Jesus et al., 2012; Emrouznejad, Cabanda, & Gholami, 2010). Additionally, the authors argue that countries with greater surfaces tend to need larger amounts of resources to be connected in terms of infrastructure coverage of all their territories (e.g., the price of optic fibre is significant for greater distance). Finally, there is evidence that the greater the proportion of persons living in urban areas (Urban), the greater is the demand for information-intensive products and services (Billon, Marco, et al., 2009; Chinn & Fairlie, 2007; Dewan et al., 2005). For these reasons, it is expected that:

H4: Density is positively associated with digital development.
H5: Area is negatively associated with digital development.
H6: Urbanisation is positively associated with digital development.

4. METHODOLOGY

4.1. Data for Measuring the Global Digital Divide

As the authors wish to analyse the digital divide between different countries (global/international instead of intranational digital divide), the recommendations of the OECD were followed, which defends that indicators for these studies should have to do with the aggregated national reality of each country in terms of ICT availability and use. Hence, the data consist of seven variables that were chosen by combining their availability with the support from other relevant studies in the past. The rationale behind the inclusion of each variable is as follows:

- One major aspect of the digital development of a country is its ICT infrastructure (Cruz-Jesus et al., 2012). Thus, the percentage of households with computer (HsPC) and connected to the Internet (HsInt) is often used in the literature to measure the digital development/divide, expressing a country´s connectivity level in terms of ICT infrastructure and general adoption;
- As the Internet is constantly evolving, in order to take full advantage of it, a broadband connection is often necessary, since the majority of websites contain bandwidth-intensive applications such as audio and video streaming, animated content, or interactive applets (Prieger & Hu, 2008). Therefore, the broadband (BroRt), which is a pre-requisite to participate fully in cyberspace, was included;
- As with fixed (wired) broadband, mobile wireless connections are becoming a significant and increasingly popular way to access the Internet in places other than the household or workplace (International Telecommunication Union, 2011). For this reason, the authors also included the mobile broadband subscriptions per 100 inhabitants (MobRt) in the analysis;
- As the Internet speed is probably one of the most important characteristics of Internet service (Vicente & Gil-de-Bernabé, 2010), the international Internet bandwidth per Internet user (Speed) was included;
- The Internet secure servers (Serv) are a specific ICT infrastructure of e-commerce, allowing secure electronic business transactions. For this reason, it too is considered in the study;
- Finally, web browsing is probably the most general and popular action that individuals can perform using ICT. Hence, the percentage of population regularly using the Internet in the analysis (IntPop), which is an effective way to assess the use of ICT of individuals for general purposes, was used.

As mentioned, the variables were extracted from the ITU and from The World Bank´s databases, and are for the years of 2015, 2013 and 2011. The data, their source, and the respective theoretical and empirical support are in Table 1. These ICT-related variables will be combined into a unique (and stronger) measure of digital development (DigDev) of countries. Asymmetries across countries in this measure will provide us with the evidence regarding the extent to which there is a global digital divide.

Table 1. Acronyms, descriptions, and literature support of variables for measuring DigDev

Code	Variable	Source	Support
HsPC	Percentage of households with computer	ITU	(Billon, Marco, et al., 2009; Chinn & Fairlie, 2007; Cruz-Jesus, Oliveira, et al., 2016; Cuervo & Menéndez, 2006)
HsInt	Percentage of households with Internet	ITU	(Billon, Marco, et al., 2009; Brandtzæg et al., 2011; Chinn & Fairlie, 2007; Çilan et al., 2009; Cruz-Jesus et al., 2012; Cruz-Jesus, Oliveira, et al., 2016; Cuervo & Menéndez, 2006; Vicente & Lopez, 2010a)
BroRt	Fixed (wired)-broadband subscriptions per 100 inhabitants	TWB	(Billon, Marco, et al., 2009; Brandtzæg et al., 2011; Çilan et al., 2009; Cruz-Jesus et al., 2012; Cuervo & Menéndez, 2006; Dwivedi & Irani, 2009; Vicente & Lopez, 2010a)
MobRt	Mobile (wireless)-broadband subscriptions per 100 inhabitants	ITU	(Cruz-Jesus, Oliveira, et al., 2016; International Telecommunication Union, 2011; Thompson Jr & Garbacz, 2011)
Speed	International Internet bandwidth (bit/s) per Internet user	ITU	(Billon, Marco, et al., 2009; Vicente & Gil-de-Bernabé, 2010)
Serv	Number of secure servers per million inhabitants	TWB	(Billon, Marco, et al., 2009; Brandtzæg et al., 2011; Çilan et al., 2009; Cruz-Jesus et al., 2012; Cuervo & Menéndez, 2006)
IntPop	Percentage of individuals regularly using the Internet	TWB	(Billon, Ezcurra, & Lera-López, 2008; Billon, Marco, et al., 2009; Çilan et al., 2009; Cruz-Jesus et al., 2012; Cruz-Jesus, Oliveira, et al., 2016; Vicente & Lopez, 2010a)

Looking at each of the variables included in the analysis separately, i.e., using univariate analysis, these show considerable disparities across the 45 countries: in the countries belonging to the EU 80% of the households, on average, are connected to the Internet, while in the members of OECD, this value is 82%, and in the BRIC 50%. There is, on average, almost twice the percentage of individuals regularly using the Internet in the EU countries belonging to the EU or the OECD than in the BRIC. In 2011 these values were, respectively, 71%, 74%, and 29%. Individually speaking, in India only 14% of the households have a PC, while in Iceland this value stands at 99%. In 2011 these two countries were already the ones with the highest and lowest levels, with 10% and 95% respectively. While in India there are seven secure Internet servers per million inhabitants, in Iceland there are more than 3,400. Extreme asymmetries in the overall profile of the 45 countries is also noticeable. Iceland is the highest ranked country in three of the seven variables used, while India is the poorest ranked in all of them. These uneven distributions tell us a great deal about the digital divides that exist between these countries. Nevertheless, with the dimensionality of the data used – seven variables – combined with the 45 countries included, it becomes impossible to address digital divides with simple univariate statistics. For this reason, the authors grounded their research in a multivariate approach for measuring the global digital divide. The descriptive statistics of the variables are in Table 2.

With the seven ICT-related indicators for each of the 45 countries, the first step of the analysis was to measure the digital development of each. For this purpose, factor analysis was employed, which uses the correlations between the variables in order to find latent dimension(s) within them (Spicer, 2005). This technique reduces data's dimensionality, transforming the seven original variables into a smaller number of new dimensions that maximises the information originally presented. This multivariate approach entails several advantages over the popular alternative, which is to use one of the popular digital divide indices available (Bruno, Esposito, Genovese, & Gwebu, 2010), such as elimination of data redundancy and weighting each variable according to its importance (Vehovar, Sicherl, Husing, & Dolnicar, 2006). Although this analysis is recognised as a robust technique, without demanding too many assumptions, some steps to conduct it efficiently are required. As the use of

Table 2. Descriptive statistics of the variables used for measuring the digital development

Variable (2015)	Mean	Std. Dev.	Minimum	Maximum
HsPC	76.84	15.62	14.08	98.50
HsInt	77.79	15.56	20.00	98.79
BroRT	28.43	9.42	1.34	44.79
MobRt	78.00	27.11	9.36	143.99
Speed	323,709	1,066,316	5,725	7,186,378
Serv	1,023	920	7	3,407
IntPop	77.28	15.12	26.00	98.20

this technique depends on the correlation structure within the input data, the first step is to confirm that this correlation exists, otherwise the factor analysis may provide weak results (Hair, Anderson, Tatham, & Black, 1995). For this purpose, the correlation matrix was calculated (see Table 3), which shows that all the variables are significantly correlated.

After the analysis of the correlation matrix, the suitability of the data for factor analysis, using the Kaiser–Mayer–Olkin (KMO) measure will be assessed; decide how many factors should be extracted, basing the decision on the Kaiser's, Pearson's and Scree Plot's methods; evaluate the reliability of the analysis, in this case using the Cronbach's Alpha; and finally, analyse the results.

4.2. Data for Explaining the Global Digital Divide

To empirically test the conceptual model for the digital development of countries; Table 4 presents the hypothesised explanatory variables included in it to be tested. It should be kept in mind that data availability limits this set of variables. Thus, it is possible that other potentially important digital divide explanatory factors are not included. The data were gathered from the 20th Edition/December 2016 of the ITU's World Telecommunication/ICT Indicators (WTI) database (http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx) and from The World Bank's database (http://data.worldbank.org/indicator). The years of the analysis are 2011, 2013, and 2015.

The analysis of the digital divide's drivers starts with the univariate analysis of the data presented above for explaining the global digital divide (please see Table 5). As with the ICT-related variables use to measure the digital divide, the ones used to explain it reveal high asymmetries across countries. The GDP per capita, for example, ranges from 1.60 in India to 101.45 in Luxembourg, over 63 times more. Besides income disparities, those regarding education are also noticeable. The tertiary

Table 3. Correlation Matrix

Variable	HsPC	HsInt	BroRt	MobRt	Speed	Serv	IntPop
HsPC	1	0.94**	0.84**	0.59**	0.25	0.71**	0.93**
HsInt		1	0.85**	0.66**	0.24	0.73**	0.93**
BroRt			1	0.51**	0.22	0.78**	0.85**
MobRt				1	0.04	0.53**	0.63**
Speed					1	0.40**	0.26**
Serv						1	0.75**
IntPop							1

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

Table 4. Digital divide´s explanatory factors included and their respective support

Code	Variable	Support
GDP	Gross Domestic Product per Capita (thousands of USD)	(Billon et al., 2008; Billon, Ezcurra, et al., 2009; Cruz-Jesus et al., 2012; Cruz-Jesus, Oliveira, et al., 2016; Cuervo & Menéndez, 2006; Dewan et al., 2005; Hargittai, 1999; Ono & Zavodny, 2007; Vicente & Lopez, 2010a)
Educ	Tertiary enrolment ratio	(Cruz-Jesus et al., 2012; Cruz-Jesus, Vicente, et al., 2016; Cuervo & Menéndez, 2006; Ono & Zavodny, 2007; Vicente & Lopez, 2006; Vicente & Lopez, 2008, 2010a)
Eng	Native English-speaking country (Y=1/N=0)	(Billon, Marco, et al., 2009; Hargittai, 1999; Ono & Zavodny, 2008; Vicente & Lopez, 2010a)
Dens	Population density (thousands / square-miles)	(Agarwal et al., 2009; Billon et al., 2008; Billon, Ezcurra, et al., 2009; Billon, Marco, et al., 2009; Cruz-Jesus et al., 2012; Vicente & Lopez, 2010a)
Area	Surface area (million square-miles)	(Cruz-Jesus et al., 2012; Emrouznejad et al., 2010; Forman, 2005)
Urban	Percentage of population living in urban areas	(Billon, Marco, et al., 2009; Chinn & Fairlie, 2007; Dewan et al., 2005)

Table 5. Descriptive statistics of the digital divide's explanatory factors

Variable	Mean	S.D.	Minimum	Maximum
GDP	31.13	22.02	1.60	101.45
Educ	70.53	18.30	24.94	111.18
Dens	158.56	218.06	2.91	1300.84
Area	1,599.26	3,541.68	0.32	16,376.87
Urban	75.51	13.93	32.75	97.86

enrolment ratio ranges from 24.94 in Iceland to 111.18 in Japan. It is expected that these kinds of socio-economic disparities across countries will lead to digital disparities as well.

To test the conceptual model, an integrative perspective is proposed through an ordinary least squares (OLS) model for each of the three years under analysis, mathematically expressed as follows:

$$DigDev_i = \beta_0+\beta_1*GDP_i+\beta_2*Educ_i+\beta_3* Eng_i+\beta_4*Dens_i+\beta_5*Area_i+\beta_6*Urban_i+ \varepsilon_I \quad (1)$$

where β_0 is the constant term and β_1 through β_6 are the coefficients to be estimated by the OLS, ε_i is the error term of the i^{th} country, GDP_i = the gross domestic product of the i^{th} country, $Educ_i$ = tertiary enrolment ratio of the i^{th} country, Eng_i = 1 if the country has English as native language, and 0 if not, $Dens_i$ = the population density of the i^{th} country, $Area_i$ = the area of the i^{th} country, and $Urban_i$ = the percentage of population living in urban areas of the i^{th} country.

5. RESULTS

5.1. The Global Digital Divide: Evidence

The second step was confirming the suitability of the data, which is generally done using the Kaiser–Mayer–Olkin (KMO) measure. Its value is 0.86, which expresses a very good suitability to conduct this analysis (Sharma, 1996). To decide on the number of factors to extract, both the context of the analysis as well as the statistical criteria were considered. The Pearson's, Kaiser's, and the Scree Plot criteria point to a one-factor solution. Accordingly, the context of the analysis – in which it is intended to transform the seven ICT-related variables into one new metric that can properly classify the countries in terms of digital development – encourages this one-factor solution. Finally, to test its reliability, Cronbach's Alpha was calculated. It measures the internal consistency of each factor within itself, and a value over 0.7 is generally considered good (Nunnaly, 1978). The value returned is 0.91, which confirms the extremely high reliability of the one-factor solution. The results of the factor analysis are shown in Table 6. As seen there, the percentage of variance retained with this solution is 70%. Thus, the seven ICT-related variables were reduced into a single new measure of digital development with a minor loss of information.

Based on factor analysis, the digital development score (DigDev) for all the countries was obtained (see Table 8, in Appendix). Iceland, the Netherlands, Denmark, Sweden, and South Korea are the most digitally developed countries. These countries present the highest levels in the digital development dimension extracted from factor analysis. At the other end of the spectrum, as the least digitally developed countries, is India, Mexico, China, Brazil, Turkey, and Chile. The results from the factor analysis – the DigDev score – allow measuring the digital development of countries, thus answering the first research question of the paper. As this study also includes the analysis of the digital development of countries in the years 2013 and 2011, a similar analysis using the same variables pertaining to the respective years was also conducted. For a matter of space limitation and simplification these results are not described as they were very similar to those regarding 2015.

5.2. The Global Digital Divide: Drivers

In the previous subsection, the digital development across 45 countries was measured, thereby answering the first research question of the paper. However, being aware of the differences in digital development of countries (i.e. the digital divide), although useful for some purposes, does not allow to understand what drives it. To determine this the authors need to test if the national features of countries referred to in Section 3 and theorised as possible explanatory factors of the digital development of countries, work as such.

The OLS was estimated using the software Statistical Analysis System (SAS®). As recommended by Neter et al. (1974). The authors conducted a series of tests in order to confirm the suitability of the OLS, analysing the residual´s distribution to confirm its normality. Visually, the residual´s normal distribution assumption appears to be verified (see Figure 4, in Appendix). In order to demonstrate the normality assumption, the Shapiro-Wilk test (1965) was performed, and for a 5% significance level, the assumption of the residual's normality is not violated ($p > 0.10$). The correlations between the

Table 6. Results of factor analysis and Cronbach's alpha

Original Variables	DigDev 2015	DigDev 2013	DigDev 2011
IntPop	0.96	0.97	0.97
HsInt	0.96	0.97	0.98
HsPC	0.94	0.96	0.96
BroRT	0.91	0.92	0.94
Serv	0.85	0.85	0.85
MobRt	0.71	0.78	0.78
Speed	0.33	0.31	0.32
Variance (%)	70%	73%	73%
Cronbach´s Alpha	0.91	0.92	0.93

explanatory variables and values for variance inflation factors (VIF) indicate that multicollinearity is not a problem, considering that in this case the highest value is 1.60, well below the limit of 10 (Belsley, Kuh, & Welsch, 1980; Dewan et al., 2005). With respect to a possible heteroscedasticity problem in the model, the White´s test (White, 1980) was employed, which indicated no presence of heteroscedasticity ($p > 0.10$), confirming the visual analysis of the DigDev´s residuals (see Figure 5, in Appendix). The models were also tested for endogeneity, which was concluded not to exist. For a 1% significance level, the overall model is significant ($p < 0.01$). The results are in Table 7. For comparison purposes, the OLS estimated for the previous years of 2013 and 2011 were also included. These models also fulfilled all suitability criteria mentioned above.

Looking at the year of 2015, the GDP (H1: $\hat{\beta}_1 = 0.0280$, $p < 0.01$), the Educ (H2: $\hat{\beta}_2 = 0.0120$, $p < 0.05$), and the Urban (H6: $\hat{\beta}_6 = 0.0146$, $p < 0.10$) are confirmed to be statistically significant drivers of the digital development of countries. In contrast to the authors' expectations, the Eng (H3: $\hat{\beta}_3 = -0.2832$, $p > 0.10$), Dens (H4: $\hat{\beta}_4 = 0.0005$, $p > 0.10$), and Area (H_5: $\hat{\beta} 5 = -0.0001$, $p > 0.10$) have no significant impact on the digital development of countries. Overall, the model explains 75% of the variation (R-Square) of DigDev. The hypotheses H1, H2, and H6 appear to be supported. It is also interesting to verify that the Area was, as hypothesised, an inhibitor of the digital development of countries, but only in the year of 2011 ($\hat{\beta}_5 = -0.0001$, $p < 0.10$).

6. DISCUSSION

This study analysed the global digital divide across 45 countries, from different contexts and realities, in the years of 2015, 2013, and 2011. To do so the authors grounded this work on a multivariate framework to measure and understand digital disparities across countries. The first aim was to measure the digital development of the countries. The results showed that Luxembourg, Iceland, Denmark, Norway, and the Netherlands are, respectively, the most digitally developed countries of

Table 7. Results of ordinary least squares models for 2015, 2013, and 2011

Ordinary Least Squares Models' Results						
Variable	2015		2013		2011	
	Parameter $\hat{\beta}$	VIF	Parameter $\hat{\beta}$	VIF	Parameter $\hat{\beta}$	VIF
Intercept	-2.8001		-2.7788		-2.9126	
GDP	**0.0280*** **	1.531	**0.0235*** **	1.494	**0.0226*** **	1.451
Educ	**0.0120** **	1.444	**0.0129** **	1.459	**0.0166*** **	1.422
Eng	-0.2832	1.325	-0.1180	1.461	0.0338	1.250
Dens	0.0005	1.469	0.0006	1.245	0.0007	1.431
Area	-0.0001	1.273	-0.0001	1.622	**-0.0001* **	1.249
Urban	**0.0146* **	1.602	**0.0140* **	1.270	**0.0125* **	1.580
R-Square	74.69%		73.46%		77.81%	
F	18.69 (p < 0.001) ***		17.53 (p < 0.001) ***		22.20 (p < 0.001) ***	

Note: ***Effect is significant at the 0.01 level (2-tailed); ** Effect is significant at the 0.05 level (2-tailed);
* Effect is significant at the 0.10 level (2-tailed).

those analysed (see Table 8 in Appendix). At the other end of the spectrum, with no surprise, India, Mexico, China, Turkey, and Brazil appear as the least digitally developed. It is interesting to note that the European countries are the ones leading the digital development in 2015, considering that nine of the top-ten digitally developed countries are from the Continent, and that of these, six belong to the EU. Moreover, it came as some surprise that the eastern European countries are doing relatively well in ICT in comparison to what the authors had expected. Estonia, Slovenia, the Czech Republic, Slovakia, Latvia, and Croatia present higher digital development levels than other older EU countries such as Italy, Portugal, and Greece. Policy makers of these countries should learn from their European counterparts the measures to improve their digital performance. The USA, the country that originated the digital revolution during the 1980s, occupies a relatively modest 16th position in the ranking in 2015. The BRIC countries are all within the bottom-ten countries in terms of DigDev. Russia stands in 36th position, Brazil 41st, China 43rd, and India occupies the 45th position. Of the bottom-ten digitally developed countries only three belong to the EU (Bulgaria, Romania, and Greece). This is in line with the findings of Cruz-Jesus et al. (2012), in which these countries were classified as the least digitally developed EU countries.

In the authors' attempt to understand what drives the international digital divide the authors made use of OLS models. As DigDev´s explanatory factors six characteristics of a country were hypothesised. The OLS confirmed three of them (GDP, Educ and Urban). Contrary to the authors' expectations, although the Dens and Area have some influence over the countries´ DigDev, these are not strong enough to be statistically significant. The Eng, on the other hand, was completely rejected by the OLS as a significant driver of digital development. According to the authors' expectations, the GDP per capita, Education, and percentage of individuals living in Urban areas explain the digital asymmetries across countries. The area of the country also contributed, but only for the year 2011.

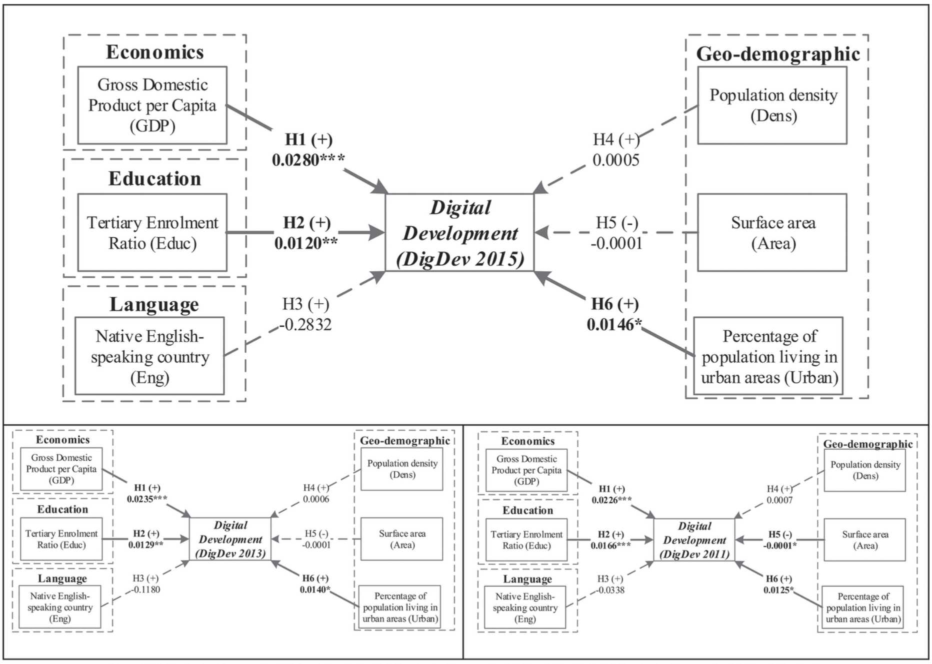
To obtain a more fine-grained understanding of the impact of each digital development´s explanatory factors, the authors graphed their effects. For each statistically significant explanatory variable, in each of the three years in the study, three levels were presented, calculated as one equal to the average (μ) level of the variable; another adding another standard deviation (σ); and another by subtracting one from the average (see Figure 2). In other words, the standardised OLS parameter (β) was plotted. All the digital development´s explanatory factors, except the Area, show positive slopes, per the respective parameter (β). Moreover, the range (and consequently the impact) is highest for the GDP (1.2333), followed by the Education (0.4395), and finally the Urban (0.4075), following, as expected, the same order as the significance level (p) of the OLS. As the GDP is the variable that has the greatest effect on digital development, it seems that digital inequalities are mainly a direct consequence of economic ones. It is also worth mentioning that the slopes of each significant explanatory variable barely change across the three years studied, thereby reinforcing the robustness of the results.

6.1. Theoretical and Practical Implications

The theoretical implications are that up to the year of 2015, two of the three predictors of the digital development that proved to be significant were supported by the diffusion of innovations (Rogers, 2005). Hence, although the original diffusion model dates from 1962, it seems that it still provides an effective framework for understanding innovations' adoption. On the other hand, from an ICT point of view, it is interesting to note that the antecedents of adoption in these technologies are, to some extent, similar to other innovations, given DOI's ability to identify them.

As broadly mentioned in the literature, income disparities still remain as the most important antecedent of digital asymmetries across countries. Despite the increasing affordability in technology prices, as long as newer ICT applications are considered, countries with different economic output will also have different levels of digital development. Thus, despite the different strategies to promote ICT adoption, whether based on subsidisation or providing public access (e.g., in Internet kiosks, community centres, etc.), the fact is that those who live in poorer countries are still

Figure 2. Results of ordinary least squares models for 2015, 2013, and 2011. Note: ***Effect is significant at the 0.01 level (2-tailed); ** Effect is significant at the 0.05 level (2-tailed); * Effect is significant at the 0.10 level (2-tailed).



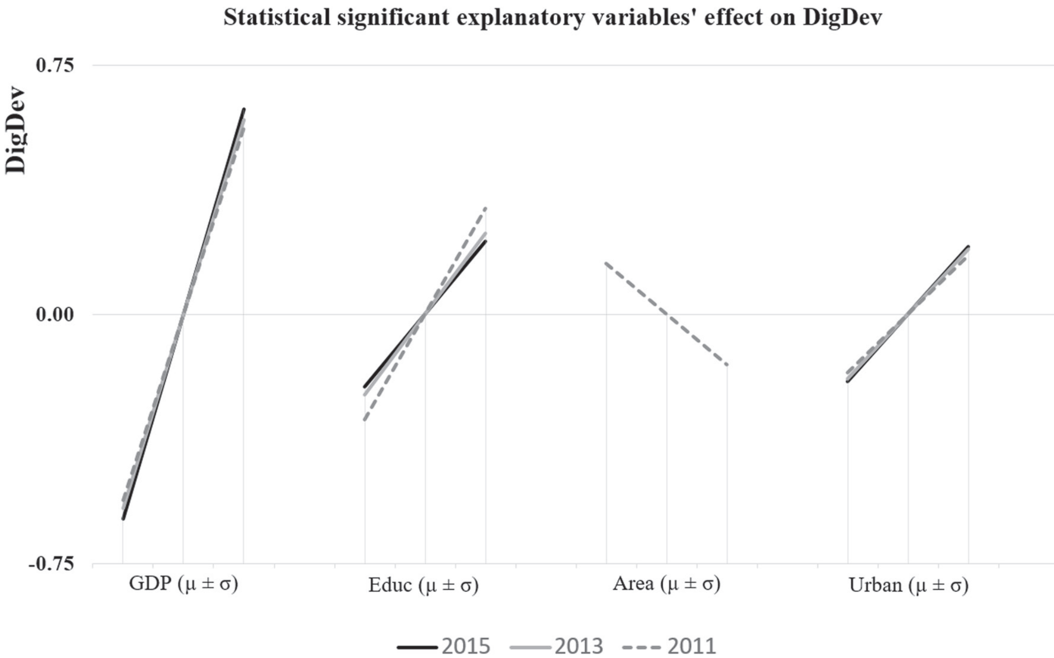
Note: ***Effect is significant at the 0.01 level (2-tailed); ** Effect is significant at the 0.05 level (2-tailed); * Effect is significant at the 0.10 level (2-tailed).

disadvantaged concerning ICT. Perhaps practitioners should then aim at strategies that mitigate the role of economic/financial ability in acquiring these technologies, especially the newer ones, as these are the most expensive.

As for education, the authors believe it was well demonstrated that, like income, the digital divide will be hard to bridge as long as meaningful education disparities across countries exist. One might think, perhaps optimistically, that as time goes by an increasing number of individuals will have been born into the digital world, grown up surrounded by ICT, and that this will make them more likely to better assimilate these technologies, and cope with their complexity, than those who need to adapt to them at some point in their lives. This is the difference between digital immigrants and digital natives (Günther, 2007; Prensky, 2001). The results seem to support this hypothesis, at least, to some extent. Although the time between the first and last moments of analysis was only four years (2011 and 2015, respectively), there is some evidence that the role of education as driver of the digital divide decreased (see Figure 3), as the slope of Education trends downward across those years. From a practical point-of-view, as (formal) education asymmetries across countries are difficult to bridge as this process is a very long (and expensive) one, to engender digital development, more attention to specific ICT-related training programmes could be provided. This would mitigate the role of complexity in ICT adoption.

As for the population density, although it was hypothesised that it would affect ICT adoption by increasing its observability, it seems that greater observability of ICT does not necessarily lead to higher adoption rates. Thus, ICT adoption is not affected by its exposure at the same level of other technological innovations. This result does not contradict Roger´s DOI theory, since it posits that there are different degrees to which "…the results of an innovation are visible to others…" and, consequently affect its adoption rate (Rogers, 2005). Moreover, a possible reason why Dens was not found to be significant is that ICT are already largely widespread (and therefore visible) in one's daily contexts, making this attribute lose its importance. Urban, as hypothesised, was confirmed as a

Figure 3. Statistically significant (p < 0.10) explanatory variables' effect on digital development, maintaining all the others constant (= μ) for the years 2011, 2013, and 2015



driver of digital development. The urban- vs rural-areas digital divide is already broadly analysed and discussed in the literature, and the empirical findings seem to confirm its importance. Because it is reasonable to expect that, as it is at the international-level, this effect takes place at an intra-national one, too, policy-makers should pay special attention to rural areas as well as urban ones. Regarding the Area, it appears that the argument that wider areas are harder to connect was valid only until recently (around 2011). Hence, it may be possible that larger areas are also more likely to adopt ICT because of the advantage of these technologies in comparison to other ways of (more expensive) communications, balancing the higher costs of connecting greater distances, which, by the way, is diminishing as time goes by. In practical terms, therefore, the hypothetically more expensive costs associated with connecting larger areas are losing importance as far as the digital divide is concerned.

Finally, considering the rejection of Area as a driver of digital divide, it seems that although it is possible that English native speakers were more prone to use ICT in the beginning, as most websites and IT were in English, this proficiency is no longer necessary, nor is it important for using the Internet and other related technologies effectively.

6.2. Limitations and Future Work

Despite the authors' effort to offer a complete and multidimensional analysis, some limitations must be recognised. Firstly, although 45 countries were included in the analysis, the empirical application consists of just seven variables and, therefore, some features of the information society may not be covered. This limitation also affects the ability of variables to explain the divide. Secondly, the digital divide was analysed at a country level, which means that all indicators used were concerned with aggregate national realities, meaning that internal, domestic digital divide gaps may not be covered. Thirdly, the analysis refers to the digital divide at three specific points in time – the years of 2015, 2013, and 2011. Given the dynamic nature of ICT, demonstrated by the OLS results in these three years, changes in this context are likely to occur rapidly, and these findings may soon become outdated. The fourth limitation regards the inclusion of countries. The authors intend to expand this base in the future, to make it more representative of the globe, especially giving more attention to developing countries such as those from Africa and South America, where unfortunately the absence of available data is clear. Thus, although useful, it should be noted that caution should be exercised when extrapolating the results of these analyses to other contexts, namely other geographic areas. Finally, the explanatory factors of the digital development and divide also present some limitations, especially regarding the economic context.

7. CONCLUSION

Based on multivariate statistical methods, the digital divide between the countries of the EU, OECD, and BRIC was analysed. There is a severe digital divide between these 45 countries. The most digitally advanced countries are mainly in Europe, while the BRIC and eastern EU members are at the other end of the spectrum. The digital divide appears to be a direct consequence of economic and educational asymmetries among countries, whereas the size (area) of countries also has a word to say in this matter. Moreover, there is some evidence that the domestic digital divide, specifically the differences between urban and rural areas, also appears to influence the digital development of a country.

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APPENDIX

Table 8. List of countries ordered by digital development (2015)

Rank	Country	DigDev 2015	DigDev 2013	DigDev 2011
1	Luxembourg	1.697	1.612	1.550
2	Iceland	1.504	1.477	1.471
3	Denmark	1.280	1.437	1.405
4	Norway	1.244	1.242	1.305
5	Netherlands	1.233	1.321	1.430
6	Switzerland	1.211	1.041	0.923
7	Korea (Rep.)	1.062	1.179	1.455
8	Finland	1.062	1.140	0.990
9	Sweden	1.013	1.182	1.275
10	United Kingdom	0.828	0.931	0.879
11	Japan	0.771	0.834	0.735
12	Germany	0.728	0.546	0.574
13	Estonia	0.603	0.393	0.081
14	New Zealand	0.567	0.397	0.539
15	Australia	0.515	0.645	0.763
16	United States	0.500	0.514	0.491
17	Canada	0.469	0.506	0.628
18	Malta	0.410	0.392	0.364
19	France	0.399	0.403	0.364
20	Belgium	0.308	0.339	0.247
21	Austria	0.249	0.296	0.279
22	Ireland	0.242	0.246	0.380
23	Czech Republic	0.008	-0.109	-0.124
24	Slovakia	-0.079	-0.152	-0.231
25	Spain	-0.098	-0.169	-0.215
26	Israel	-0.231	-0.178	0.000
27	Latvia	-0.252	-0.192	-0.302
28	Slovenia	-0.252	-0.157	-0.127
29	Croatia	-0.401	-0.459	-0.440
30	Italy	-0.460	-0.456	-0.435
31	Hungary	-0.474	-0.378	-0.375
32	Poland	-0.525	-0.437	-0.294
33	Lithuania	-0.528	-0.416	-0.415
34	Portugal	-0.534	-0.638	-0.594

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Table 8. Continued

Rank	Country	DigDev 2015	DigDev 2013	DigDev 2011
35	Cyprus	-0.546	-0.562	-0.443
36	Russian Federation	-0.592	-0.551	-0.911
37	Greece	-0.669	-0.795	-0.758
38	Romania	-0.917	-1.044	-1.217
39	Bulgaria	-0.996	-0.949	-1.037
40	Chile	-1.118	-1.151	-1.218
41	Brazil	-1.278	-1.386	-1.451
42	Turkey	-1.332	-1.418	-1.311
43	China	-1.513	-1.617	-1.655
44	Mexico	-1.822	-1.874	-1.834
45	India	-3.286	-2.982	-2.740

Figure 4. Visual analysis of OLS' residuals normal distribution assumption (2015)

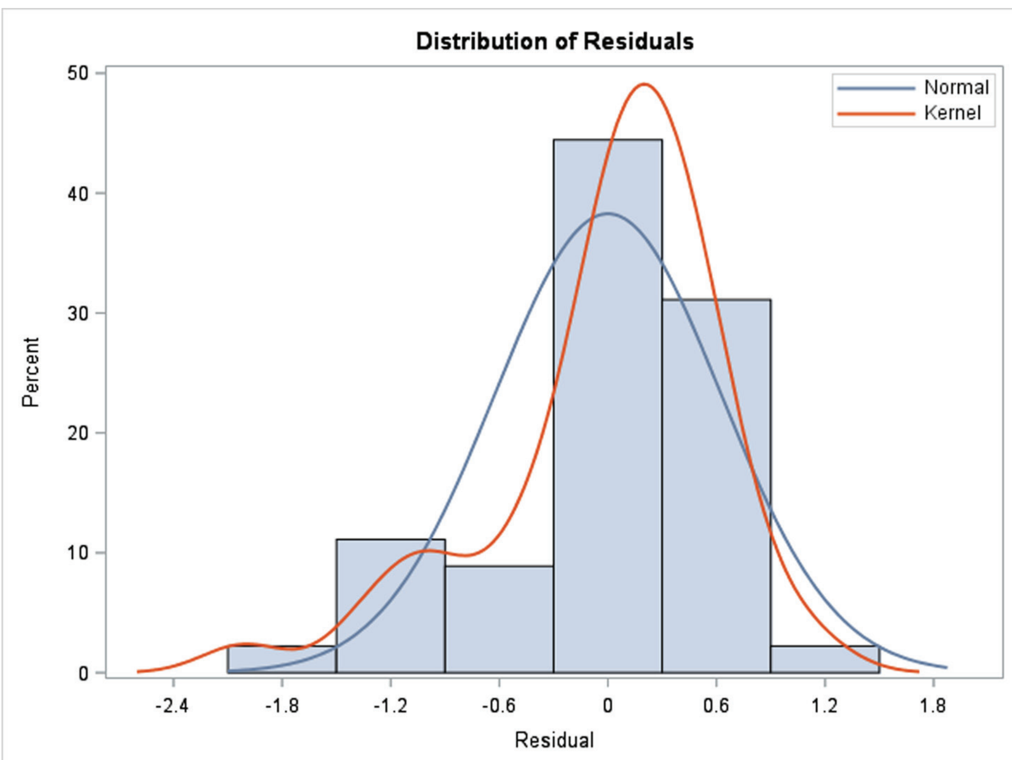
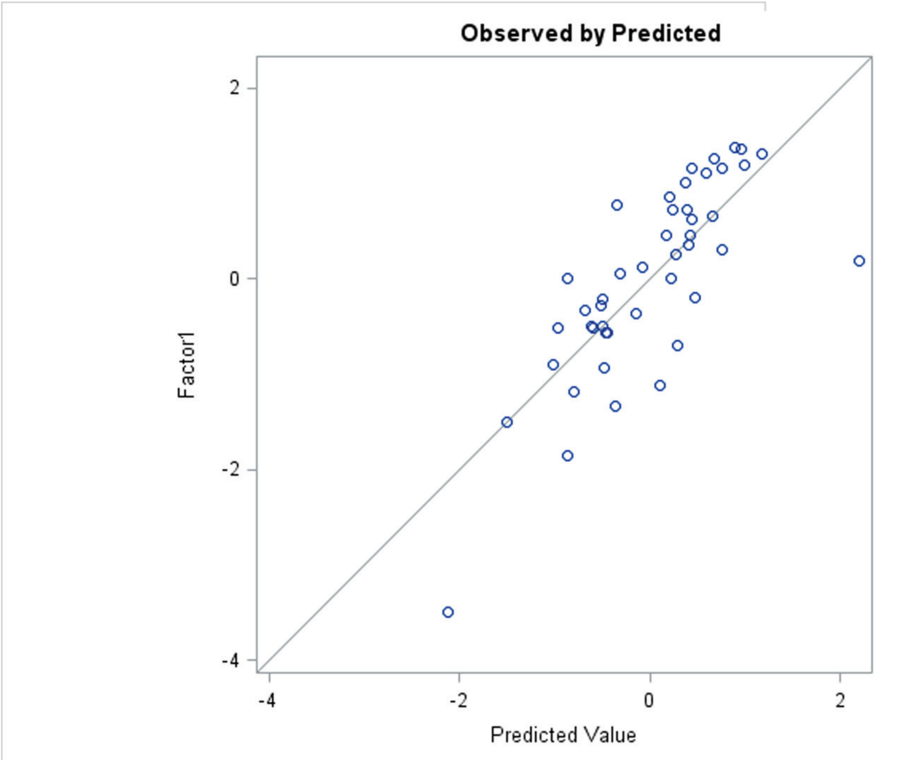


Figure 5. Visual analysis of OLS' possible heteroscedasticity problem (2015)



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