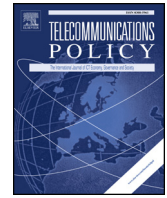




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New insights from a multilevel approach to the regional digital divide in the European Union

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ABSTRACT

This paper contributes to the literature on digital divide by analysing regional- and country level determinants of the regional digital divide in the EU, based on panel data and using the multi-level analysis- the three level random slope model. The results indicate that only a mix of effective regional and national measures could mitigate the regional digital divide in the EU. Stimulating regional economic growth, increasing the tertiary education attainments, boosting R & D expenditure, and discouraging early leaving from education are regional- and national level policy measures that are found to successfully reduce the regional digital divide in the EU.

1. Introduction

Over the last fifteen years, the tremendous development of information communication technologies (ICTs) has strongly enhanced the economic and social development, but it has also induced a new type of inequality which is often referred to as digital divide. Various definitions have been advanced to describe the digital divide, and most of them rely on the gap in access to information and communication, which is likely to generate social disparity and lack of opportunities.

A very large body of literature on digital divide has recently emerged, the uni- and multidimensional definitions and measurement, as well as the analysis of predictors and policy implications being the main research issues. Empirical analyses were conducted using either national surveys or cross-country databases, which led to the “internal” versus “international” approach to digital divide (Chen & Wellman, 2004; Cilan, Bolat, & Coşkun, 2009; Sciadas, 2004). This complex concept has been examined from different angles, in the space of various disciplines such as psychology, computer science, economics, sociology, medicine etc. This has more recently resulted in interdisciplinary approaches aimed to explore new sub-topics, such as the “grey/gender/ethnic digital divide”, or the relationship with e-government, democracy, health literacy and social inclusion.

The digital divide would be particularly important to be examined in more detail at the EU regional level,¹ because it could give insights to a relatively new form of spatial inequality arising in the EU- the regional digital inequality. As reflected by the European Digital Agenda, reducing the digital divide is a hot topic of interest across the EU. The European Digital Agenda is one of the seven pillars of the Europe 2020 Strategy and it aims to better exploit ICTs in order to foster innovation, economic growth and progress. Promoting fast and ultra-fast Internet access for all, as well as promoting digital literacy, skills and inclusion are among the most important objectives on the European Digital Agenda.

Over the last 2-3 decades, the European regional economic convergence has extensively been analysed, because it represents a

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¹ The EU regions are defined based on the NUTS classification which divide up the economic territory of the EU in (1) major socio-economic regions (NUTS1), basic regions for the application of regional policies (NUTS2), and small regions for specific diagnoses (NUTS3).

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policy goal for the European Commission. The empirical evidence has indicated that despite the progress done on the road of convergence at the country level, the regional divergence has increased over time, especially in the aftermath of the global economic crisis. These regional divergences exist in the digital area as well. Even for the most digitally developed countries in the EU, some internal gaps still remain and needs to be addressed (Cruz-Jesus, Vicente, Bacao, & Oliveira, 2016). These findings, along with the availability of regional data collected at different levels of aggregation (e.g. the NUTS2 data provided by Eurostat), have led to a growing strand of regional studies.

Despite the consistent, diverse and growing strand of literature on digital divide, the regional digital divide has seldom been investigated. The innovative contribution that this paper could bring to the literature is the explanation of the regional digital divide within the EU by both regional- and country level socio-economic factors, and not only by regional factors (such as Vicente & López, 2011). In comparison with a series of country-level studies which undertake regional and smaller scale analyses of factors that contribute to digital divides, such as assessments of the capability of digital telecommunications infrastructure (e.g. Philip, Cottrill, & Farrington, 2015; Philip, Cottrill, Farrington, Williams, & Ashmore, 2017), this paper examines the panel of 28 EU countries.

Moreover, our study doesn't examine the factors of the regional digital divide at a single point in time (e.g. Vicente & López, 2011; García, Thapa, & Niehaves, 2014), but the dynamics of these relationships over a timespan of 16 years (2001–2016). In order to reveal the influence of both regional- and country level factors on the regional digital divide in a dynamic perspective, the multilevel analysis is used as econometric framework here, and more specifically the three level random slope model is found to be the model that best fits our hierarchical data.

In the empirical analysis, two variables are used in parallel as indicators of the regional digital divide, i.e. one belongs to the group of second-order digital divide indicators (use of Internet), and another to the group of third-order digital divide indicators (use of e-commerce). This comparative examination allows finding whether the policy measures found to be effective in bridging the second-order digital divide, are also effective in targeting the third-order digital divide.

The analysis is carried out by using a three level random slope model with covariates, which belongs to the class of multilevel models. By clustering years (or repeated measurement occasions) at Level 1, the model allows explaining the dynamics of the relationships between two regional divide indicators and a set of common explanatory variables. In comparison with a cross-sectional model, our approach provides a more comprehensive picture of the regional digital divide in the EU.

The rationale behind our multilevel approach can be shortly described as follows. As regionalisation tends to play an increasingly important role in explaining most disequilibria and disparities within the EU, a better understanding of the digital gap in the EU, as well as the formulation of effective policy measures, would require using (1) regional measures of the digital divide, (2) a mix of regional- and country level explanatory variables, and (3) incorporation of the time dimension.

This paper is structured as follows: The first section is the Introduction; the second section provides a comprehensive presentation of the literature; the third section presents the variables and econometric models used in the empirical part of the paper; and the fourth section discusses the results, formulates policy measures and finally concludes.

2. Literature review

2.1. The multifaceted digital divide – conceptualization and measurement

The gaps that separate individuals, households, businesses and geographic areas at different socio-economic levels into those who are able to take advantage of the ICT opportunities for a wide variety of activities and those who are not, which are also referred to as digital divide (OECD, 2001a, b), represent a popular topic on the agenda of international institutions (e.g. OECD, United Nations, ECDL Foundation and Computer Aid International, USAID). A substantial body of literature is devoted to this concept which has gained increased popularity in last years along with the emergence of adjacent research issues such as the gender/learning/ethnic/regional divide (e.g. Billon, 2008, 2009a,b; Cruz-Jesus et al., 2016, 2012; Haight et al., 2014; Korupp & Szydluk, 2005; Pick, Sarkar, & Johnson, 2015; Van Deursen, Courtois and Van Dijk, 2014). A deep understanding of the digital divide is particularly important for policy makers in the process of designing effective measures (Sciadas, 2004), because bridging the digital divide has often been considered as a solution for economic growth and development, as well as for the inequality and poverty reduction.

In the literature, the analysis of digital divide is conducted at the enterprise, individual, household, regional or country level.

At the level of enterprise, older as well as recent papers find a strong association between the use of ICTs in enterprises and productivity growth and regional development. Using enterprise-level data from twelve transition economies, Clarke (2001) studies whether enterprises in these countries are connected to the Internet, to finally conclude on the role of telecommunications infrastructure on productivity and growth. He finds that foreign-owned enterprises are more likely to have Internet access than other enterprises, and also that employee-owned enterprises are less likely to have access. Billon, et al., (2009a,b) and analyse the neighbouring effects of Internet adoption as measured by the percentage of firms with their own website in the European regions. Ruiz-Rodríguez, Lucendo-Monedero, and González-Relaño (2017) measures the regional digital divide and the regional development of the enterprises in Europe based on the adoption and use of ICTs in enterprises. The construction of a synthetic index of digital development (Enterprise Digital Development Index –EDDI-) for countries in the EU and Spanish regions allow them finding that the Spanish regions have a medium-high level of digital development in Europe, while the digital divide of the Spanish regions is lower than that of European countries.

When addressing the digital divide at the level of individuals, the social exclusion becomes the primary focus. Despite the fact that the digitization of society is worldwide increasing, digital divide continues to exist and to represent a significant factor of exclusion and marginalization all over the world, and in the European Union as well. In the literature, the relationship between the digital

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