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Measurement and characterisation of the Digital Divide of Spanish regions at enterprise level. A comparative analysis with the European context

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ABSTRACT

Until now, a reduced number of research is observed on the adoption and use of ICTs in enterprises and on the digital divide (DD) between them at regional scale in Europe. What is meant by DD are the differences in the levels of digital development of the enterprises; being the digital development the degree of adoption and use of ICTs and e-commerce by the firms. The aim of this piece of work is to characterise and measure the DD in the Spanish regions and those in the countries of the European Union based on the data of their enterprises with more than 10 employees which have used ICTs. The methodology is developed in the following stages: 1) Construction of a synthetic index of digital development (Enterprise Digital Development Index –EDDI-) for countries in the EU and Spanish regions. The production of this index is carried out based on the factors obtained with the factor analysis (FA) with the aim of identifying the key variables which define the different EDDI components. These variables come from the "Community survey on ICT usage and e-commerce in enterprises" of Eurostat. 2) Classification of Spanish regions into the groups of European countries with a similar level of EDDI components based on the discriminant analysis. Those groups are previously obtained by using cluster analysis. And 3) Comparative analysis of the DD between the Spanish regions and those in countries of the EU based on EDDI components and the identified groups. The study provides a synthetic index (EDDI) at European scale comprising 3 dimensions which permits obtaining: i) a ranking from more to less digital development of countries and regions permitting the measurement of the DD among them is established; and ii) a typology of European countries and Spanish regions is defined according to the 3 dimensions of EDDI. The main results of this piece of work show that the Spanish regions at enterprise level: i) are in a medium or higher level of digital development than their European counterparts, presenting, furthermore, a lower DD between them in relation to what happens in European countries; ii) stand out for having a higher digital inclusion than European countries in the ICTs related to infrastructures of internet access and for the interaction with the public authorities; and iii) have a digital development deficit in the integration of ICTs for e-commerce.

1. Introduction

From the end of the 20th century, it is stated that the information and communication technologies (ICT) have a positive impact on

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the productivity and competitiveness of enterprises (Mason & Hacker, 2003; Hernaus, Bach, & Vukšić, 2012; Skrinjar, Bosilj Vuksic, & Indihar Stemberger, 2010) and the capacity for development of innovation and transformation of the rest of economic sectors (Carlsson, Jacobsson, Holmén, & Ricknea, 2002). By ICTs, it is understood the set of tools, normally of an electronic nature, used to collect, store, process, diffuse and transmit information. This brings together both physical devices (computer equipment, telecommunication networks, terminals, etc.) and the software or computer applications which run on these devices (INE, 2017a).

Furthermore, the interest for spatial inequalities in the provision and use of ICTs dates back to the decade of the eighties. In 1984 the report of the International Telecommunication Union (ITU), an organisation attached to the UN, is published. On this report, the important technological imbalance existing between industrialised countries and developing countries is highlighted (ITU, 2003). Subsequently, it will be in the decade of the nineties of the 20th century, when the researchers will try to explain the difference between having or not having, using or not using computers and internet (Yu, 2006). It is at that moment when what is known as digital divide (DD) appears.

From the first years of the 21st century, the definition of DD provided by the OECD (2001) in the scientific literature is widely accepted (Pick & Azari, 2011; Cilan et al., 2009). According to this organisation, DD refers to the differences between individuals, families, enterprises and geographic areas at different socio-economic level with regard to their opportunities to access ICTs and to their use of the internet for a wide variety of activities. Consequently, the DD is defined as a multifaceted problem where researchers try to address and identify the reasons causing these disparities.

The importance of detecting, measuring and understanding the DD comes as a result because it can reveal the existing inequalities in the global society of information (Van Dijk, 2006). These technological inequalities and of access to the ICTs directly affect economic growth and the development of the different countries (Vu, 2011). It was verified that the geographic area, among others, was an important factor in the definition of the DD. This is the reason why, at the end of the last century, the need arises to conduct researches at different spatial scales to assess the provision of infrastructure, the availability and accessibility to computers and the use of the internet (Barzilai-Nahon, 2006; Van Dijk, 2006). These first studies focused mainly on knowing the conditions of access to information by the citizens. The DD was initially understood in a binary way (Cruz-Jesus, Oliveira, & Bacao, 2012) and although it was used to describe social and technological inequalities, they were reductive and imprecise analyses.

At present, the pieces of work are focused on measuring and explaining the DD based on the social and demographic factors and the economic characteristics of the users of the ICTs (Barzilai-Nahon, 2006; Mason & Hacker, 2003; Vehovar, Sicherl, Husing, & Dolnicar, 2006; Zoroja, 2011), from a wider, and more complex conception and with a multidimensional character (Bose & Luo, 2011; Brown & Russell, 2007; Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009). This has entailed that researches on DD are made from different disciplines (sociology, politics, economy, telecommunication engineering, …) addressing opportunities of access to ICTs and to the internet by households and individuals and, to a lesser extent, the aim of the use and the possibility of a greater or lesser exploitation according to their level of training and knowledge. On the contrary, until now, it is observed a reduced number of research about digital integration of enterprises both for the study of the adoption and use of ICTs in the firms and for the analysis of the DD between them.

In the European context, the EU produced the Digital Agenda (European Commission, 2010; Vicente & López, 2011) with the aim of reducing the DD in Europe. In May 2015, adopted a digital single market strategy (European Commission, 2015) as one of its top 10 political priorities. In connection with this, the studies published on ICTs emphasise, above all, the economic effects and the inequalities of use according to countries (Bach, Zoroja, & Vukšić, 2013a; Billon, Ezcurra, & Lera-López, 2009) according to factors such as the GDP, the unemployment rate, the sectoral composition, the educational level, the agglomeration economies. The first studies were focused on bringing to light the spatial inequalities in the use of ICTs between the north and south of Europe (Billon, Ezcurra, & Lera-López, 2008), but always in connection with households and the provision of ICT infrastructure (Tranos & Gillespie, 2009).

Furthermore, there are few specific pieces of work in impact journals on the adoption and use of ICTs of enterprises at a regional scale in Europe (Billon, Marco, & Lera-López, 2017b, 2016; Zoroja & Bach, 2016). All this in spite of the implementation of Strategies for Smart Specialisation (RIS3) which consider, as strategic pillar, the applications of ICTs in the economic sectors at regional scale in Europe (Sánchez-Moral, 2015). This shortage is related to the non-publication of data about "ICT usage in enterprises" at a regional scale for Europe (Cruz-Jesus et al., 2012), unlike what happens with the production of statistics about the "ICT usage in Households and by individuals" of Eurostat and/or the European Commission. As a result, no suitable indexes have been created to measure the level of adoption and use of ICTs by enterprises at a regional level in the European Union.

Therefore, in scientific literature, there are unsolved questions about the level of ICT in the enterprises at a regional scale within the European context. Consequently, this piece of work is focused on the ICT level of enterprises of the Spanish NUTS2 regions to provide answers to: i) Do enterprises in Spanish regions have the same degree of adoption of ICT and e-commerce than those of the European countries?; ii) How profound is the difference in digital development among the Spanish regions and those of European countries at enterprise level?; and iii) Is the DD of the Spanish regions related to a typology of digital development within the European framework? Based on these questions, the main aim of this research is to measure the DD of the Spanish regions at enterprise level within the European context. In order to do so, two specific aims are presented:

a) To know the degree of digital development of the Spanish regions and the European countries at enterprise level. In order to do so, a synthetic index that measures the degree of digital development for European countries is constructed. Subsequently, this index is applied to the Spanish regions to conduct a comparative study. The production of the index entails identifying through factor analysis which variables of the ICTs are key to measuring and characterising the degree of digital development at European level.
b) To verify if the level of digital development of European countries and Spanish regions at enterprise level is related to differentiated performances. This implies, in the first place, the identification and characterisation of the typology of digital development of the