Cuadernos de Economía (2022) Volume 45, Issue 127, Page 140-155

Asociación Cuadernos de economía

Cuadernos de economía

www.cude.es

ARTÍCULO

The Spanish Tourism Sector: Digital Transformation and Total Factor Productivity

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Jel Codes:

L83, O47, O32

Keywords: Tourism, TFP, efficiency, ICT, website, Spain.

Abstract: The primary purpose of this study is to examine the relationship between TFP growth and ICT use. It also examines the number of people within the firm devoted to R&D and the usage of a website for large firms and SMEs in the Spanish tourism sector from 2011 to 2017. There are 581 companies in the sample, with the information coming from SABI and a total of 4067 observations. The TFP estimation approach of J. Levinsohn and Petrin (2003) and the SEM method were used for data processing. The research has revealed that non-border enterprises have a greater average growth rate than frontier firms, and tourism firms in Spain are highly productive in terms of TFP. Second, the study demonstrates the relationship between TFP growth and investment in R&D, ICT use, and R&D personnel. This positive relationship between technological development and economic growth demonstrates that, in terms of policy implications, administrations must maintain the policies that have facilitated this success, despite the need for improvements in the implementation of digitization policies, particularly in SMBs.

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https://doi.org/10.32826/cude.v1i127.612

1. Introduction

The activities associated with tourism, as well as tourism itself, have been increasing in recent decades, a fact that has boosted its position as one of the most important economic activities in the world (Brida, Lanzilotta, & Risso, 2008; Dwyer, 2015; Khurramov, 2020; Lang & O'Leary, 1997). From this perspective, there has been a strong quantitative expansion in the total volume of recorded travel worldwide in recent years. This condition has been accompanied by a very rapid development in the field of innovation, primarily characterized by the diffusion and use of New Information and Communication Technologies (ICT) (Wagaw & Mulugeta), as well as the high level of digitalization (Khurramov, 2020), which drive and animate, day after day, new forms of commercialization. (Capó-Vicedo, Expósito-Langa, & Masiá-Buades, 2007; Li, Hu, Huang, & Duan, 2017; Melián-González & Bulchand-Gidumal, 2016; OECD, 2005).

We cannot forget the importance of tourism in Spain, which is one of the most important sectors of the Spanish economy. It contributes a wealth of 176,000 million euros per annum, representing 14.6% of the GDP in 2021 (Arunmozhi & Panneerselvam, 2013).

At this point, the following question arises: is there a real use of new technologies in society? Considering the use of the internet as a basic tool of digitalization, how widespread is it in society?

62% of EU inhabitants use the internet daily. In contrast, the percentage of Spanish houses with Internet connection (70%) falls below the EU average (79%) of households with Internet access (Eurostat, 2013). 74% of travellers arrange their vacations using the internet, compared to 13% who use travel agents.

There is a clear increase in internet usage among Spanish households and, consequently, the Spanish economy (Ballestar De las Heras, Carmiña, Díaz Chao, & Torrent Sellens, 2020; Rial, Gómez, Varela, & Braña, 2014). Nonetheless, what is the digital landscape of the tourism industry? In recent years, there has been an undeniable surge in the use of ICT and the internet in the tourism industry (Bagger, Christensen, & Mortensen; Yeşil, 2013). The usage of information and communication technologies (ICT) in the Spanish lodging industry (hotels and campgrounds) in 2016 demonstrates high values in using new technologies, with all variables exceeding 80 percent.

Table 1. Use of ICT in accommodation (hotels and campsites). The year 2016 (Expressed as a %)

ICT	European Firms	Spanish Firms
Internet connection	99	100
Website availability	95	97
Catalogue acesss or price list	88	84
Orders or reservations made online	77	82

Source: Prepared by the authors from data drawn from Eurostat and ETICCE (INE)

In light of these findings, it is clear that tourism is no stranger to this new reality that enables tourists to rapidly book hotels or other types of tourist accommodations anywhere in the globe, as well as to express their opinion on social networks and purchase plane tickets, among other things (Jonathan & Tarigan, 2016; Uwamariya, Cremer, & Loebbecke, 2015). Therefore, there is a clear transition from a unidirectional model with set channels to an interaction model in which the client can conduct direct research on the information of interest to them and choose the tourism products that best meet their demands (Vega, Gil, & Del Vecchio, 2014; Vrana & Zafiropoulos, 2006).

In general, economic activities are increasingly influenced by new waves of innovation and investment in R&D, ICT, robotization, the Internet of Things (IoT), artificial intelligence (AI), and collaborative platforms, among others, which have constituted a new way of structuring businesses with negative and positive effects on the productive gap (Ballestar, Díaz-Chao, Sainz, & Torrent-Sellens, 2020; Camino-Mogro, Armijos-Bravo, & Cornejo-Marcos, 2018).

In this setting, the variety of tourism products offering their locations on the internet is expanding (Buhalis & Law, 2008; Ilic & Nikolic, 2018). Thus, quality and innovation become essential for success and productivity enhancement in the tourism industry (Arenas, Goh, & Urueña, 2019; Carvalho & Sarkar, 2014). Among the primary reasons for undertaking this research is an interest in analyzing the most significant changes in the Spanish tourism industry over the past few years. Among the factors described in the research, the intensification of rivalry, the exploitation of economies of scale, and the possibility of adopting foreign technologies stand out (Blazquez, Domenech, & Debón, 2018; Navío-Marco, Ruiz-Gómez, & Sevilla-Sevilla, 2018).

In contrast, there has been an increase in the micro-level study of the evidence about the efficiency and productivity of firms in the tourism sector over the past few decades. However, the significance of theoretical-empirical analysis concerning productivity studies in the Spanish tourism sector is constrained (Alberca Oliver, Parte Esteban, Muñoz Merchante, & Such Devesa, 2012; Alberca & Parte, 2013).

Similarly, specialized literature confirms the existence of production heterogeneity between enterprises; this demonstrates an analysis of divergence (convergence) in a nation's economic sectors (Bartelsman, Dobbelaere, & Peters, 2015). In this view, the literature describes frontier enterprises (those deemed the most productive on average) relative to non-frontier firms (the remaining businesses) (Andrews, Criscuolo, & Gal, 2016; Syverson, 2004). Since the third quarter of 2007, the international crisis has profoundly impacted the productivity of economies, industries, and businesses (Abril, Guajala, Mantilla, & Moyolema, 2015). This truth has not been lost on Spain, whose output during this era has also been reduced. Thus, TFP growth was -0.4 percent during the pre-crisis period (2001-2007) and -0.8 percent during the crisis period (2008-2013). However, TFP growth for 2014-2016 was favorable at 0.8%. (Fu & Moral Benito, 2018). Andrews et al. (2016); Andrews, Criscuolo, and Gal (2015); Iacovone and Crespi (2010); van der Wiel, Creusen, van Leeuwen, and Van der Pijll (2012), among others, have created an abundance of literature analyzing the distance between enterprises' border and non-frontier at the international level. It is important to note that frontier companies (also known as "gazelles") are essential for job development (Bartelsman et al., 2015; Henrekson & Johansson, 2010).

This research tries to give evidence about the factors that lead to productivity convergence (divergence) between enterprises. In particular, we analyze the elements that determine the technological gap between lagging enterprises and the leading firms. We examine how firms and economic characteristics of the Spanish tourism sector between 2011 and 2017 affect a firm's relative position in total factor productivity (TFP) relative to the production frontier (Andrews et al., 2016; Andrews et al., 2015). Similarly, a study is conducted on the productive reality and economic impact of tourism in the many

autonomous communities (Autonomous Communities) that comprise the national geographical landscape of Spain.

While a comparative analysis of the impact of new technologies on efficiency in the Spanish tourism sector has been conducted Abril et al. (2015); Alberca Oliver et al. (2012); Alberca and Parte (2013); Andrews et al. (2016), this article examines the impact of new technologies on the growth of TFP during the crisis period (from 2011 to 2014) and post-crisis (2014 to 2017) for the Spanish case.

Therefore, the significance of this research resides in its theoretical analysis of the divergence (convergence) of the TFP of enterprises in the Spanish tourism industry, using the digitalization of the analyzed economic sector as its reference factor. To examine the behavior of enterprises and test the various relationships between divergence, digitalization, and TFP, we analyzed data from a panel of 581 industrial firms in Spain from 2011 to 2017, yielding a total of 4067 observations. The remainder of the report is structured as follows: The second section defines the state of the inquiry; the third section discusses the methodological issues and data utilized to conduct the study; the key results gained are then presented and discussed, and the final section discusses the limitations and future directions.

2. Theoretical background and hypotheses

2.1 Divergence (convergence) and TFP

The endowment of productive elements and their combined effectiveness play a significant role in explaining competitive advantage (Porter, 1991). This circumstance merits additional emphasis because it is associated with an increase in the productivity of businesses (Ciuriak, Lapham, Wolfe, Collins-Williams, & Curtis, 2015; Goya, Vayá, & Suriñach, 2011). Thus, there is a binding relationship between international competitiveness and innovation in terms of productivity enhancement Camino-Mogro et al. (2018); as this enhances the abilities of workers or the innovation processes' triggers (Bloom et al., 2017; Bloom, Draca, & Van Reenen, 2016; Bloom, Sadun, & Van Reenen, 2012; Cabiddu, Lui, & Piccoli, 2013). Noting the existence of certain uncertainties regarding the correct application of R&D and the fact that manufacturers utilizing new technologies rarely achieve commercial viability until after a lengthy period of experimentation and learning-by-doing is important Brynjolfsson and Hitt (1998); Carone, Denis, Mc Morrow, Mourre, and Röger (2006); Tambe and Hitt (2012).

Productivity is crucial since it is the primary measure of an economy's long-term growth potential (Comin, 2017). Díaz-Chao, Miralbell-Izard, and Torrent-Sellens (2016) The specialized literature demonstrates a direct relationship between productivity growth concerning capital intensification (capital per person or hour worked) and the efficiency of the combined factors of production (TFP). Therefore, the optimal mix of these criteria permits sustainable economic growth over the long term (Timmer, Inklaar, O'Mahony, & Van Ark, 2010).

This perspective emphasizes corporate heterogeneity's significance in total production (Crespi, 2013). In this context, there has been considerable disagreement in the economic literature over the actuality of convergence-divergence between frontier (leading) enterprises and non-frontier firms. While, specialized research demonstrates that frontier or gazelle enterprises comprise 10% of the most productive firms on average, whereas non-frontier or follower firms account for the remaining 90%. (Andrews et al., 2016; Syverson, 2004).

Productivity is defined as "the ratio of output to input index" (Mohnen & Hall, 2013). The simplicity of the concept should not be confused with the accuracy of its estimation, as the development of this index comprises various constructs for outputs and inputs (Mohnen & Hall, 2013; Van Ark, Hao, Corrado, & Hulten, 2009; Van Beveren, 2012; van der Wiel et al., 2012). Consequently, historically, the productivity variable has been connected with macroeconomic theory, where its examination began with (Solow, 1957).

According to economic research, the productivity gap between the frontier and non-frontier enterprises has expanded over the past decade, and the within-industry productivity convergence has halted (Andrews et al., 2016; Ballestar De las Heras et al., 2020; Bharadwaj, 2000). Consequently, and as emphasized by Bagger et al. , "it is vital to understand not only the relationship between perceived wage disparities and productivity but also how structural changes such as globalization and digitalization affect this relationship."

In this regard, the literature describes frontier enterprises (those deemed the most productive on average) as opposed to non-frontier firms (the remainder) Alberca and Parte (2013); Andrews et al. (2016); Andrews et al. (2015); Arenas et al. (2019); (Iacovone & Crespi, 2010; Syverson, 2004); van der Wiel et al. (2012) are only a few of the studies that have analyzed the distance between the frontier and non-frontier enterprises at the international level at the firm level. However, little literature analyzes this notion in-depth in the tourism industry, which is the focus of this investigation.

Similarly, it should not be ignored how periods of crisis influence the rise of productivity (Perez & Benages, 2017). And in this regard, the travel industry is no exception. During the 2008 financial crisis, hotel sector productivity in Spain was severely impacted (Alberca & Parte, 2013; González-Rodriguez, Martín-Samper, & Giuliani, 2015). Nonetheless, the absence of an examination of the tourism industry as a whole in terms of TFP enables us to expand the scope of analysis, which is a distinctive feature of this article. The purpose of this work is indicated by the analysis of convergence-divergence in total factor productivity (TFP) of frontier and non-frontier enterprises. This will help us better comprehend the productive state of the Spanish tourism industry and test the first hypothesis.

Hypothesis 1: The divergence in total factor productivity between leading and trailing firms in the Spanish tourism sector has increased.

2.2 Productivity and ICT

Understanding this concept as the explicit variable that affects the competitive process of firms Abril et al. (2015) has historically been one of the primary concerns in the economic literature Comin (2017), with the concept being viewed as the explicit variable that influences the competitive process of firms (Bernard & Wagner, 2001).

Not only are productivity numbers significant for nations but also for all economic actors, including public and private organizations, scholars, and policy users. As a component of the engine that drives economic growth and prosperity, governments actively pursue the promotion of all variables that foster a rise in productivity (OCDMatsuo, Sirilli, & Gault, 2002). This is why, throughout time, productivity has become one of the most significant measures of an economy's potential for long-term growth (Díaz-Chao et al., 2016).

In this environment, the emergence of ICT has had an oscillating effect on society, and it is indisputable that this has directly affected businesses (Tambe & Hitt, 2012). Thus, organizations adapt to the present by reorganizing outdated organizational forms (Córdova-Morán & Freixa Font, 2017; Cuadrado, Moral-Benito, & Solera, 2020). In this regard, the development of ICT has been accompanied by a clear progression of internal (from bureaucratically vertical to horizontal) and external (network

firm) organizational models (Jabłoński, Timmers, & Sarkis, 2020).

In the new economic environment that the society of the past decade has created, information has assumed a crucial role in economic development. This situation is characterized as a network economy (Torrent-Sellens, Ficapal-Cusí, Boada-Grau, & Vigil-Colet, 2016). Consequently, the paradigm of the industrial economy has been shifting due to the revolution of new technologies, digitization, and robotization, among others. This circumstance explains the new paradigms that have led to the knowledge economy (Tocan, 2012). Crespi (2013); Dettori, Marrocu, and Paci (2012) describes the network company as "the convergence of the organizational changes mentioned above and the adoption of new digital technologies." Castells (1997) asserts that a company must seek defined flexibility to become more efficient and successful. However, it appears that the reality of the Spanish industrial fabric leads us to conclude that the structure engaged in using ICTs is underutilized (Torrent-Sellens, 2016).

In this regard, and taking into account one of the economic sectors with the highest weighted weight in the Spanish economy, the tourism sector has been one of the economic sectors most affected by the massive introduction of ICT in recent years (Arunmozhi & Panneerselvam, 2013; Bernard & Wagner, 2001; Buhalis & Law, 2008; Buil-Fabregà, del Mar Alonso-Almeida, & Bagur-Femenías, 2017). Compared to traditional channels, ICT has succeeded in encouraging the marketing and promotion of tourism enterprises at national and international levels (Bernard, Jensen, Redding, & Schott, 2011; Díaz-Chao et al., 2016; Vega et al., 2014). In addition, other levels, such as the adoption of smart technologies (Internet of Things (IoT), Big Data, artificial intelligence, etc.), appear to be increasing in importance (Lombardi, 2019; Trequattrini, Shams, Lardo, & Lombardi, 2016).

The transformation process has compelled the sector to evolve to adapt to the new market, whether in terms of the way it operates, the need to generate new infrastructures, the need to have a more prepared and specialized human capital, or the adaptation of its products or marketing and distribution systems to obtain competitive advantages, among others Cabiddu et al. (2013); OECD (2005).

Consequently, ICTs have exploded into the marketing processes of products and services, as web portals have improved the contact between the company and the client or end-user Corrado, Hulten, and Sichel (2009); Mankiw (2000). These procedures involve the customer or end-user in the firms' quality assurance and enhancement operations (Maqueda Lafuente, Gil Lafuente, Guzmán-Parra, & Gil Lafuente, 2013; OCDMatsuo et al., 2002; O. M. Oecd, 2005; Olley & Pakes, 1992). Similarly, businesses adapt naturally to the technological imperative to the extent that businesses must adapt to technology (Bharadwaj, 2000; Buhalis & Law, 2008; Navío-Marco et al., 2018). In this line, it should be highlighted that physical and human capital investments are required for productivity increase. Ugarte Cataldo (2013) This capital must consider the necessity for this human capital to have a better understanding of ICT use to provide greater added value.

Given this state of transformation, communication tactics centered on promoting firms that are a part of the tourism economy have evolved; firms who invest in modernizing their manner of communicating and selling their services are the ones that see an increase in sales. However, this makes it possible to boost the international competitiveness of enterprises in the tourism industry (Abril et al., 2015; Alberca & Parte, 2013).

Similarly, the determinants of Spanish tourism competitiveness can be summed up in its geographical position, as this determines the country's excellent tourist supply conditions: climate, natural and cultural resources, etc., consolidating its added-value (Vrana & Zafiropoulos, 2006).

This gain in competitiveness is a result of the increasing inter- and intra-industrial contacts within the industry and other economic sectors as tourism becomes increasingly mobile. A summary of the other variables (advanced, generalized, and specialized) demonstrates that thanks to new investments in infrastructure and airport and maritime facilities, as well as an improvement in ICT, Spain has been able to enhance and expand its tourism activities (Teran, 2015). However, these conditions can lead to an increase in the overuse of public services and infrastructures and a deterioration of the country's terrain and natural environment (van der Wiel et al., 2012; Vrana & Zafiropoulos, 2006).

In this regard, each Autonomous Community (AC) has its quirks regarding the search for new realities in the consumption forms of tourism (Rodríguez-Zulaica, Pastor, & Ara, 2017). From this perspective, the use of new technologies leads to the mediation of policies by the governments of the various Autonomous Communities to improve the transformation process, as well as the involvement of tourism firms, promoting the transition to a new multichannel strategy (Rodríguez-Antón, del Mar Alonso-Almeida, Rubio-Andrada, & Pedroche, 2016; Rodríguez-Zulaica et al., 2017).

Currently, two new digital waves are being discussed (Camina, Diaz-Chao, & Torrent-Sellens, 2020; Camino-Mogro et al., 2018). The first digital wave is shaped by ICT as a whole, as well as the age of the non-interactive Internet (Castells, 1997). A second wave is governed by digitalization, investment, and innovation in intangible assets such as products, production processes, organizational innovation, business process designs, and staff skills (Brynjolfsson & Hitt, 2003; Brynjolfsson, Rock, & Syverson, 2018).

The tourism sector has seen an organizational revolution as a result of the use of ICT, with both the organization and its employees being more open to innovation and a more horizontal method of collaborating with other businesses allowing for a more efficient transfer of knowledge (Buhalis & Law, 2008; Cabiddu et al., 2013; Carone et al., 2006; Carvalho & Sarkar, 2014).

The website, design, and user involvement are identified as the most influential factors in the perceived value of tourism services, pricing signals, and purchase intent (Vega et al., 2014). The website is framed as part of the use of ICT, as an innovation in operations and marketing in the tourism sector that has benefited the firm's survival (Blazquez et al., 2018; Campo, Diaz, & Yagüe, 2014). Even though 97 percent of Spanish companies utilize websites to direct sales to potential clients, which could be evidence that they increase competitiveness, what effect do they have on productivity? (Minondo, 2014; Miró, 2021; Miró & Pereira, 2017).

Therefore, the profile of the modern tourist, steeped in the so-called information and knowledge society, is becoming increasingly conscious of the need to implement more sustainable production and consumption practices (Torrent-Sellens, 2016). In the backdrop of this paradigm change, today's tourists are more demanding and conscientious of the environment and its resources (Rodríguez-Zulaica et al., 2017; Roy, Das, & Pal, 2017; A. M. Sánchez & Roura, 2014).

In this line of research, an analysis of the TFP status of enterprises in the Spanish tourism sector concerning ICT usage from 2011 to 2017 is conducted. This line of work permits the establishment of the following working hypothesis:

Hypothesis 2: ICT and website user has a positive and causal impact on improving TFP.

Firms in the tourism sector must make a permanent effort to adapt to changes and technological advances to be more competitive and guarantee the success of their business activity. In this sense, those firms that promote and position themselves towards innovation will obtain a clear improvement in productivity (Blazquez et al., 2018; Haustein, Maier, & Uhlmann, 1981; Ramstad, 2014). In this context, firms are increasingly tending towards this organizational flexibility in a framework of the symbiosis of knowledge flows with ICT that allows for greater decentralization of the firm, as well as the greater interconnection between the elements that give value to economic activity (Bharadwaj, 2000; Díaz-Chao et al., 2016).

Likewise, this article aims to analyze the reality of the volume of workers dedicated to R&D concerning the increase in TFP, where the literature shows a positive relationship between both variables (Graetz & Michaels, 2018). Although the literature refers to the manufacturing industry, in this case, we want to analyze this relationship in the tourism sector. This is why we propose the following hypothesis:

Hypothesis 3: A higher volume of R&D workers tends to increase TFP.

3. Methodology

The necessity of analyzing the impact of ICT on business organizations compels us to evaluate the total factor productivity of firms in the Spanish tourism sector between 2011 and 2017. This section presents the hypotheses formulated in greater detail, the methodology used to test them, and the database selected to detail the appropriate variables for estimating TFP.

3.1 Total factor productivity

This research model is based on estimating a Cobb-Douglas production function containing three productive components. This production function is one of the simplest and most frequently employed in the literature (Bharadwaj, 2000; Bloom et al., 2012; Dettori et al., 2012; Edquist & Henrekson, 2017; Mankiw, 2000; Miró, 2021; Miró & Pereira, 2017; Tambe & Hitt, 2012).

$$Y_{it} = A_{it} L_{it}^{\beta_l} K_{it}^{\beta_k} M_{it}^{\beta_m} \quad [1]$$

Where *Y* is the revenue of firm *i = 1, N* for period t = 2011, 2017, which depends on variable *A* defined as the TFP, 2017, which depends on variable A defined as the TFP, *L* is the labor factor, *K* is the quasi-fixed capital factor, and *M* is the intermediate inputs. To work linearly, neperian logarithms are applied, which allow the transformation from an exponential function to a linear one, as shown in equation [2]:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + w_t + u_t \quad [2]$$

The lower-case letters are the representation of the neperian logarithms. B_0 measures the level of TFP common to all firms in the sample. The error term is divided into two components, where u_{it} and w_t include all those unobservable factors of reality, those due to external circumstances, or the non-inclusion of explanatory variables to simplify the analysis model.

The function [2] is directly related to the technology index or TFP. Therefore, if we rewrite the function [2], we obtain [3].

$$\ln(A_{it}) = \beta_0 + u_{it} \quad [3]$$

For the estimation of the parametric function, it uses the methodology proposed by (Wooldridge, 2006) and the demand for intermediate inputs as a control function proposed by (J. Levinsohn & Petrin, 2003; J. A. Levinsohn & Petrin, 1999).

$$\ln(A_{it}) = y_{itc} - \widehat{\beta_l} l_{itc} - \widehat{\beta_k} k_{itc} - \widehat{\beta_m} m_{itc} \quad [4]$$

It is worth mentioning that the LP method resorts to the use of a proxy for unobserved productivity shock with intermediate inputs since the use of investment as a proxy leads to the following problem: investment is an unequal variable (Lumpy) because it incorporates substantial adjustment costs and therefore does not respond "smoothly" to productivity shocks (J. Levinsohn & Petrin, 2003).

This method introduces a set of assumptions that allow estimating the parameters even though they have estimation biases (J. Levinsohn & Petrin, 2003; Van Beveren, 2012). The first assumption is that materials depend on productivity and capital, i.e., $m_{it} = m_{it}(a_{it}; k_{it})$ The second (which follows from another set of additional assumptions) is that demand it is a monotonic function increasing concerning ait, so that there is a function $a_{it} = a_{it}(m_{it}; k_{it})$. The third is that a first-order Markov process governs ait, i.e.:

$$a_{it} = E(a_{it}|a_{i,t-1}) + \epsilon_{it} \quad [5]$$

Where ϵ_{it} is an uncorrelated error with the kit but may be correlated with the work lit, where *i* is firm and *t* is time.

3.2 The SEM method

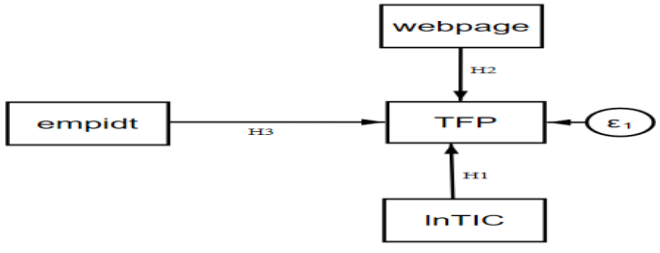
Structural equation modeling is used to observe the relationship between TFP with ICT-associated variables, which allows the study of causal relationships between directly observable data (Henrekson & Johansson, 2010; Hoyos Chaverra & Valencia-Arias, 2012; Sutawa, 2012). The SEM methodology is widely used in the economic literature (Brida et al., 2008; Brynjolfsson & Hitt, 2003; Buhalis & Amaranggana, 2013; Buil-Fabregà et al., 2017).

This model revolves around the correct estimation between continuous variables as dependent variables and taking the independent variables as continuous, binary, and/or categorical (Jöreskog & Sörbom, 1982). One of the main advantages of this method is associated with the fact that the directions of the existing relationships between variables can be proposed. However, a second advantage is using latent variables and considering measurement error.

Based on the model given in this research that explains the productivity of enterprises in the Spanish tourism industry, our general study has developed three testable hypotheses with TFP as the dependent variable (previously calculated using the model of (Lara, Osma, & Noguer, 2006; J. Levinsohn & Petrin, 2003; J. A. Levinsohn & Petrin, 1999). Figure 1 illustrates the model, variables, and assumptions.

First, the relationship between ICT investment and TFP is examined (H1) (Tambe and Hitt, 2012); then, the use of a website or not (H2) (Miró, 2021); and lastly, the number of workers devoted to R&D activities and its relationship to TFP (H3) (Camino-Mogro et al., 2018).

Figure 1. Explanatory model of the TFP of firms in the tourism sector



As the SEM method is based on examining covariance structures, it enables us to evaluate hypotheses based on theory and past research (Martínez Ávila & Fierro Moreno,

2018). This allows us to examine the subject of two of our hypotheses.

4. Information source and variables

Spain has established itself as an interesting case study, especially within the tourism sector, as it has experienced a growth in investment over the last decades to boost the sector's competitive positioning (Jackute, 2014; Santos & Gómez, 2009).

The database used for this research is extracted from the Iberian Balance Sheet Analysis System (SABI) published by INFORMA D&B and Bureau Van Dijk. It contains the historical data of the Financial Statements registered in the Central Mercantile Register of more than 1,200,000 Spanish firms, with a historical record of annual accounts of up to 12 years.

SABI covers companies from all productive sectors in Spain. Due to the significance of this research, which is established by selecting enterprises directly associated with the tourist sector and those subsectors indirectly related, firms without a CNAE-2009 activity code are omitted. In light of this, the codes recommended by the United Nations Statistical Commission are outlined in Table 2.

Table 2. Tourism CNAE-2009 accounts

CNAE 2009	Economic Activity
55 and 56	Hotel and Catering
491	Inter-urban transport and rail passengers
493	Other ground transport passengers
501	Shipping passengers
503	Passenger transport via inland waterways
511	Airlines passengers
522	Activity ancillary to transport
791	Travel agency activities and tourist operators
799	Other reservation services and activities related to the same
771	Rental of motor vehicles
773	Rent of other machinery, equipment, and tangibles goods
900	Creative activities, artistic and shows
910	Libraries, archives, museums, and other cultural activities
931	Sporting events
932	Entertainment and recreational activities

Source: Prepared by the authors based on the Spanish Institute of Tourism (Turespaña)

All enterprises with a turnover and total assets less than or equal to zero, with added value or number of employees equal to zero, and those that do not meet specific standards of information dependability (those with negative equity) were omitted from the study's selection of firms (J. A. Levinsohn & Petrin, 1999). SABI evaluates only corporate and individual legal structures, ignoring local corporations, religious groups, and undefined associations.

Once the firms meeting the CNAE-2009 requirements have been identified, the variable of interest, defined as the net turnover, is chosen, resulting in a total of 581 firms for the full sample over the period 2011-2017, yielding 4067 observations.

Based on this classification and the application of the inclusion and exclusion criteria, we obtain the sample described below (Table 3).

Table 3. Total firms by CNAE-2009 code (The year 2015)

CNAE 2009	Reference	Frequency	Percentage
5510	Hotel and similar accommodation	265	45.61
5520	Tourist and other short stay accommodation	10	1.72
5530	Campsites and parking areas for caravans	5	0.86
5590	Other accommodation	3	0.52
5610	Restaurants and food stands	90	15.49
7911	Travel agency activities	112	19.28
7912	Tourist operator activities	6	1.03
7990	Other reservation services and related activities	4	0.69
9102	Museums	3	0.52
9103	Place management historic buildings	2	0.34
9104	Botanical gardens and zoological parks	2	0.34
9311	Sporting facility management	15	2.58
9312	Sports club activities	22	3.79
9313	Gym activities	3	0.52
9319	Other sports activities	10	1.72
9321	Theme parks and attractions	9	1.55
9329	Other recreational activities and entertainment	20	3.44
Total		**581**	**100.00**

Within the tourism sector, the subsector of hotels and similar accommodation, corresponding to code 5510 of the CNAE-2009, is revealed as an important subsector since it accounts for 45.61% of the total number of firms that make up the Spanish tourism sector, followed by the subsector of travel agency activities with 19.28%.

The industry-specific index deflates the selected variables. The consumer price index compiled by the National Statistics Institute (INE) (Miró & Pereira, 2017) deflated labor, capital, and material costs.

5. Results

This research focuses on the Spanish tourism sector, where the results allow us to verify in a quantitative and reasoned way how the TFP has evolved during the years under study. They are the Autonomous Communities with the highest average productive value (in an aggregate way). Finally, they have also allowed us to determine whether the ICT variable has a positive effect on improving the TFP.

5.1 Total factor productivity measure

In the current context of increasing global competitiveness in the tourism sector, an analysis of business TFP is required to observe the aggregate Spanish trend. The model is approached from the perspective of using ICT to improve Spanish tourism firms' competitive position (López & García, 2014; Tocan, 2012; Torrent-Sellens, 2016; Torrent Sellens & Díaz-Chao, 2014). This section's primary purpose is to compare the performance of various firms in the sector over a specified period. The obtained results allow us to verify quantitatively and rationally how the TFP of the tourism sector has changed between 2011 and 2017; which Autonomous Communities (Autonomous Communities) have a more efficient quantitative value; and, once the different business sizes are valued in the number of workers have been determined, which of them should approximate those benchmark firms that comprise the TFP values. The weighted weight of tourist infrastructures by the various analyzed Autonomous Communities is remarkable, as shown in table 5, which depicts the geographical distribution of tourism enterprises in Spain. According to the spatial analysis, Catalonia is the Autonomous Community with the biggest number of enterprises, accounting for 21.17 percent of the total. This is followed by Madrid, the Balearic Islands, the Canary Islands, and Andalusia. This statistic corresponds with the Autonomous Communities that attract the most domestic and foreign tourists (Teran, 2015; Tocan, 2012). In terms of international arrivals, Catalonia, with 23.42 percent of the total, is the most important Autonomous Community, followed by the Balearic Islands, the Canary Islands, Andalusia, and the Valencian Community (see Table 5).

Table 4. Main variables

Variable	Measures	Mean	S.D.	Skewness	Kurtosis	References
Output						
Added Value (AV)[1]	Euros	8.11	1.24	-1.27	10.72	Faggio et al. (2010) / Añón et al. (2017)
Independents						
Labour (NL)	Euros	7.61	1.18	-1.01	8.40	Fu and Moral-Benito (2018)
Capital Stock (CS)	Euros	8.84	1.98	-1.06	4.67	Fu and Moral-Benito (2018)
Intermediate Inputs (INTIN)	Euros	6.94	1.22	-0.98	7.32	Fu and Moral-Benito (2018)
Others						
R&D workers(R&DEMP)	Staff in R&D activities	0.37	3.13	1.75	3.92	Graetz y Michaels (2018)
ICT (ICT)	Euros	3.01	2.31	0.88	3.40	Díaz-Chao et al. (2010)
Frequency						
Variable	**Measures**	**Yes**	**No**	**Skewness**	**Kurtosis**	**Bibliography**
Web page (WEB)	(yes/no)	85.78	14.22	-2.05	5.19	Miró and Pereira (2018)

1. VA = Sales + Variation in stock + Other management costs - Purchase – External services.
Notes: The continuous variables have been considered on a logarithmic basis—data in real terms.

Table 5. Total tourism firms by CC. AA (the Year 2015) y tourist arrivals by CC. AA (the Year 2017)

	Number of firms				Tourist arrival	
CC.AA	**Ranking**	**Total**	**Freq.**	**Ranking**	**Total**	**Freq.**
Andalusia	4	49	8.43	5	11,024,038	14.17
Aragon	11	9	1.55	10	519,450	0.67
Asturias	15	11	1.89	9	281,256	0.36
Baleares	2	97	16.70	3	13,691,618	17.60
Canarias	3	95	16.35	4	12, 957,334	16.65
Cantabria	12	3	0.52	15	401,208	0.52
Castile and León	8	6	1.03	13	1,379,744	1.77
Castile-La Mancha	16	6	1.03	12	213,864	0.27
Catalonia	1	123	21.17	1	18,223,294	23.42
Ceuta and Melilla	18	n.d.	n.d.	-	8,398	0.01
Valencian Comm.	5	35	6.02	6	8,517,973	10.95
Extremadura	13	1	0.17	16	350,026	0.45
Galicia	9	13	2.24	8	1,209,696	1.55
La Rioja	17	n.d.	n.d.	-		112,658
Madrid	6	109	18.76	2	6,218,732	7,99
Murcia	10	6	1.03	11	930,592	1.20
Navarre	14	3	0.52	14	316,765	0.41
Basque Country	7	15	2.58	7	1,447,975	1.86
Total		581	100.00		77,804,621	100.00

NA data is not available

Table 6 below shows the descriptive statistics of the inputs and outputs. This allows us to overcome the first obstacle derived from estimating the TFP function. The resulting results display the arithmetic mean for each variable in complete and logarithmic form. When applying logarithms, it is found that the results on skewness and kurtosis show that the variables are regularly distributed (approximate threshold values of 2.58). The following results after estimating using the LP approach are summarized in Table 7: (note that the values are expressed in neperian logarithms). Therefore, we have approximated the TFP using the methods of (J. Levinsohn & Petrin, 2003), based on recent worldwide research (Uwamariya et al., 2015; Van Ark et al., 2009; Van Beveren, 2012). In this way, we respond to the set of hypotheses connected with hypothesis 1 regarding the divergence/convergence of the Spanish tourism sector. Except for the capital variable, which has a non-significant value, it should be highlighted that all the parameters are statistically significant (the degree of significance is enclosed in brackets). Nevertheless, each variable positively correlates with the dependent variable (value-added). The tests for compliance with the collinearity assumption revealed that multicollinearity was not an issue (for all variables and explanatory indicators, Tolerance > 0.10 and VIF 10; the correlation matrix is provided in Appendix A). We can observe that the model does not exhibit multicollinearity because the average of the VIF factors is less than 10, avoiding the problem that emerges when similar explanatory variables are added. One is irrelevant to the

proposed model (Wagaw & Mulugeta; Wooldridge, 2006; Yeşil, 2013).

Table 6. Descriptive analysis of the variables used

Variable	Average	Des.Est.	Coef. Var.	Skewness	Curtosis
Added value	6257.95	17600.31	2.81	12.89	22.34
Labour Cost	3528.02	9607.27	2.72	13.40	23.63
Capital	147556.41	33821.05	2.29	9.83	17.14
Purchases	1770.25	3609.02	2.04	7.68	83.46
Ln Variable	**Average**	**Des.Est.**	**Coef.Var.**	**Skewness**	**Curtosis**
Added value	8.11	1.24	0.15	-1.27	10.72
Labour Cost	7.61	1.18	0.15	-1.02	8.40
Capital	8.48	1.98	0.23	-0.98	4.57
Purchases	6.95	1.23	0.18	-1.06	7.33

The CC. AA of Ceuta and Melilla are excluded as due to lack of data

Table 8. Descriptive statistics of the TFP (2011-2017)

Added value	Coefficients
Labour Cost	0.59*** (0.008)
Purchases	0.802*** (0.027)
Capital	0.260***
Added value	(0.298)

Where, *** p < 0.01; ** p < 0.05; * p < 0.1.

The key TFP results by year are presented in Table 8, which summarizes the TFP growth process throughout the analysis.

Year	Average	Des. Est.	Coef. Var.	Skewness
2011	0.96	8.46	8.79	28.15
2012	0.89	5.90	6.64	26.55
2013	0.86	4.47	5.18	27.72
2014	0.92	4.79	5.22	24.06
2015	0.87	3.56	4.06	26.94
2016	0.88	3.60	4.08	26.06
2017	0.96	4.28	4.44	26.38
Total	**0.91**	**5.13**	**5.66**	**31.51**

This section examines the convergence-divergence trend between the 10 percent of firms with the highest average value (frontier firms) and the other 90 percent of firms (non-frontier enterprises) from 2011 to 2017. Regarding pre- and post-crisis TFP growth, we notice a balanced pattern: from 2011 to 2014, the average value of TFP decreased by 4 percent. In the post-crisis period, the average TFP has increased by almost 12 percent.

In the final two years of the sample (2015-2016), small and medium-sized enterprises (SMEs) exhibit a trend toward convergence, as illustrated in Figure 2. As per the pattern indicated by base 100 (the year 2011), the results for SMEs indicate a distinct decline in the average annual TFP in the last years of the sample, with a total average yearly rise of 20 percent from 2011 to 2017.

Nonetheless, a second hypothesis for large enterprises demonstrates, based on the data acquired and the TFP variable, that there is a clear convergence between 10% and 90% of frontier and non-frontier firms. In addition, it should be emphasized that between 2011 and 2012, 90 percent of non-frontier enterprises outperformed the average TFP, with aggregate values between 6 and 14 percent higher.

As for the pre-crisis time, there is a diminishing tendency for both gazelles and followers among SMEs. However, for the post-crisis period, there is an increase in TFP for followers, but not for leaders who exhibit stagnation. On the other hand, the trend is on the rise for both eras (pre- and post-crisis) for large firms, albeit with greater irregularity.

Once the estimation of the TFP has been carried out, the next step is determined by the average TFP by Autonomous Regions.

First, it is crucial to recall that this period is the residue of a global economic crisis, during which the industrial fabric of Spain and the tourism industry were profoundly affected (A. M. Sánchez & Roura, 2014).

In this instance, a rise in the TFP value may be noted from 2011 to 2017. Throughout the years analyzed, a consistent pattern emerges. In this regard, the growth from 2011 to 2017 corresponds to an increase of 0.002 percent. This figure does not indicate a significant increase in TFP during the past several years.

Table 9 below shows the average results and the structure of the descriptive statistics of the variable concerning the Autonomous Regions.

It can be seen that the Autonomous Regions with the most favorable behavior in terms of productivity are Catalonia, Madrid, and Castile-La Mancha, with positive growth in their average TFP with values of 1.45, 1.11, and 0.88, respectively. The firms that show the most unfavorable evolution in terms of their performance concerning their TFP from an evolutionary point of view are those of Cantabria, Navarre, and Murcia, in that order, with values of 0.40, 0.43 and 0.44 in the period analyzed. The case of the latter Autonomous Regions can be related to the total number of firms and tourist arrivals (see table 5), where they occupy the last place in the ranking.

The national average total TFP, shown in the last row, is the approximation to the average productivity of the sector based on the total number of firms analyzed for the total number of years of the sample under study, which, as indicated above, implies a clear increase of 55% over the period.

5.2 Analysis factor: the SEM method

An exploratory factor analysis (EFA) is employed to conduct the statistical investigation, considering that the sample contains more than 300 observations that match the criteria for this analysis, as indicated by previous authors (Torrent-Sellens et al., 2016; Trajtenberg, 2018; Trequattrini et al., 2016). It also allows us to group variables with high correlations and those with weaker connections to variables in other groupings. First, the variables to be examined were chosen because they are representative of the model's dimensions. The minimum essential indicators suggested by Schemelleh-Engel et al. are used to validate the robustness of the model.

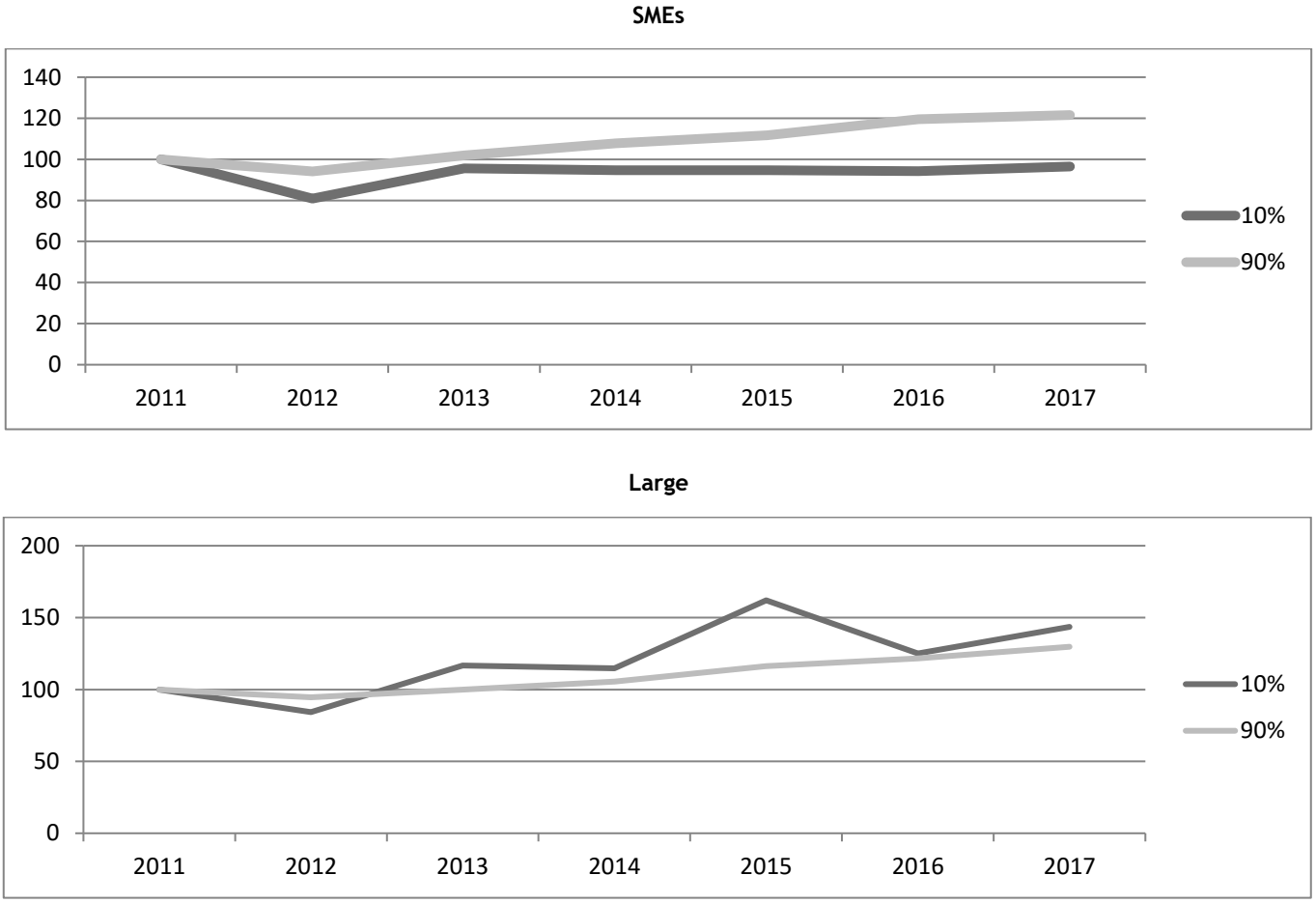


Figure 2. Average distribution of the TFP by SMEs and large firms (2011-2017)
(The base year 2011)

Table. 9. Descriptive statistics by TFP for CC. AA

CC.AA	Media	Des. Est.	Coef. Var.	Skewness	Ranking
Andalusia	0.62	0.50	0.79	5.33	9
Aragon	0.59	0.51	0.86	5.07	11
Asturias	0.48	0.37	0.77	1.14	13
Balearic Island	0.72	0.77	1.07	6.72	7
Canarias	0.62	0.79	1.27	13.62	10
Cantabria	0.40	0.13	0.31	0.71	17
Castile and León	0.74	0.89	1.19	2.51	6
Castile -La Mancha	0.88	0.87	0.99	1.16	3
Catalonia	1.45	10.16	6.99	16.78	1
Valencian Community	0.74	2.62	3.556	20.61	5
Extremadura	0.67	0.34	0.50	0.28	8
Galicia	0.50	0.33	0.66	1.84	12
La Rioja	0.48	0.20	0.42		14
Madrid	1.11	3.08	2.77	9.95	2
Murcia	0.44	0.44	0.99	3.94	15
Navarre	0.43	0.13	0.31	0.04	16
Basque Country	0.82	0.53	0.65	2.25	4
Total	**0.91**	**5.13**	**5.67**	**31.51**	

Table 10 displays the SEM estimation's key outcomes (standardized coefficients and standard errors) for Spanish tourism sector enterprises. The results demonstrate the causal association between ICT investment and TFP concerning H2. Although fewer empirical investigations test this theory Ciuriak et al. (2015); Díaz-Chao et al. (2016); Torrent Sellens and Díaz-Chao (2014), this association is supported by earlier research in other economic sectors (Bloom et al., 2017; Bloom et al., 2016; Bloom et al., 2012; Brida et al., 2008; Brynjolfsson & Hitt, 2003).

Similarly, H2 demonstrates a positive and statistically significant effect on using a website and enhancing TFP. This research indicates a good correlation between enterprises that utilize a website and TFP growth. Although the literature extensively discusses the use of the internet and, more specifically, the significance of having a website for the marketing of a service or product, there is no clear reference to the increase in productivity in terms of this hypothesis (Manero, García-González, García-Uceda, & Grijalba, 2012; Medina & Plaza, 2015; Miró & Pereira, 2017).

H3 concludes that there is a positive but non-significant correlation between the number of workers and the increase in TFP. This finding demonstrates a waste of resources when it comes to employing workers efficiently to achieve increased productivity (Abril et al., 2015).

Table 10. Explanatory factors of TFP for firms in the Spanish tourism sector

CC.AA	Variable	Standardised coefficients
H2	TIC	0.22* (0.058)
	Webpage	0.06 (0.462)
H3	Empidt	0.01* (0.097)
Benefits of adjustment indexes	**Value**	**Critical value**
RMSEA	0.000	<0.08
TLI	0.094	>0.95
CFI	0.090	>0.95

Note: Regression analysis: SEM with latent indicator and observable variables, and with error measures. Where, *** p < 0.01; ** p < 0.05; * p < 0.1.
RMSEA: Root Mean Square Error of Approximation; TLI: Tucker-Lewis Index; CFI: Comparative Fit Index.

Figure 3 below represents the statistical result of the hypothesis proposed in the model after the application of the methodology. In it, we find the estimation by the proposed model of the relationship between TFP and the variables that allow us to measure the reality of ICT and the rest of the variables analyzed.

The resulting standardized coefficients are significant at the 95% confidence level, and the values are consistent with the hypotheses. The main determinant of TFP to Spanish firms is ICT itself (H1: β = 0.022, p = 0.00). The second much weaker factor is using websites in the interaction with external customers (H2: β = -0.66, p = 0.02). Finally, the number of employees can be observed (H3: β = 0.11, p = 0.00).

Figure 3. Standardized solution of the causal model

Where, *** p < 0.01; ** p < 0.05; * p < 0.1.

To summarise the results, investment in ICT and having a website impact TFP, as the impact is higher (significant and positive) and is in line with the results obtained in the literature. As for the number of employees, the result is positive but not significant. Therefore, there is poor profitability concerning this variable and TFP.

6. Discussion of results

This research has reviewed the literature on two key concepts in the tourism sector: the discussion on the divergence or convergence between frontier firms (10 percent of firms with the highest value of production) and non-frontier firms (90 percent of the remaining firms) between 2011 and 2017, distinguishing between large firms and SMEs in a disaggregated manner. The association between TFP growth and ICT use has also been analyzed, along with the participation of R&D professionals and the use of the website.

The relevant study performed on the TFP variable has shown two quite distinct realities. The 10 percent of enterprises with the highest average TFP value outperform the remaining 90 percent in growth, according to the data obtained for major businesses. According to the literature Andrews et al. (2015); Arenas et al. (2019), this reality is supported by the long-term trends in TFP. In contrast, this reality is not connected with SME analysis. In this instance, the data indicate that non-frontier enterprises had a larger average growth rate than frontier firms, which is contrary to what the literature indicates (Corrado et al., 2009; Cuadrado et al., 2020).

The Autonomous Regions of Catalonia (21.17 percent), Madrid (18.76 percent), the Balearic Islands (17.60 percent), and the Canary Islands (16.65 percent) are those with the biggest number of enterprises that contribute to the structural landscape, according to the acquired statistics. Catalonia, the Balearic Islands, and the Canary Islands are the Autonomous Communities with the highest number of tourist arrivals. However, this is not the case for Madrid, which ranks in the middle of all Autonomous Communities analyzed. Catalonia, the Balearic Islands, and the Canary Islands are the principal Autonomous Communities with the biggest number of tourists (FRONTUR, 2014; (Ciuriak et al., 2015). Therefore, these results are not surprising.

In the tourism sector, however, it has been possible to demonstrate that they are highly productive in terms of the total factor productivity (TFP) of enterprises in the Spanish tourism sector throughout the time analyzed. Regarding TFP, the Autonomous Regions of Catalonia, Madrid, and Castilla-La Mancha exhibited the best performance. These regions have high productivity levels due to the more efficient utilization of their resources (Alberca & Parte, 2013). However, the TFP of Spain's tourism industry is mostly influenced by economic and service sector development levels (Díaz-Chao et al., 2016).

Thus, it has been possible to observe how, in the tourism sector, divergence (convergence) (Hypothesis 1) has been demonstrated that there is a tendency toward divergence among SMEs in terms of the follower firms' ability to improve their productive position over the years analyzed in this study. This result contradicts what the specialized literature indicates. Nevertheless, the studies analyzed to date demonstrate divergence concerning the industry as a whole (Castellani, 2002). Taking into account the analysis of the tourism sector, we can see that SMEs have a steeper learning curve and a greater capacity for association due to their flexibility and local social capital (Fernández & Narváez, 2011). This trend can be observed in leaders' and followers' productivity improvement margins.

This research, which analyzes the tourism industry, is based on new compendiums formed by the impact of globalization, which has systematized new work organization techniques based on functional autonomy and decentralized decision-making. Similarly, this interconnectedness has been accompanied by the revolution of the knowledge economy; in this case, the application of co-innovations (knowledge, ICT,

etc.) is visible (Díaz-Chao et al., 2016; Díaz-Chao & Torrent-Sellens, 2010; Quiroga-Parra & Torrent-Sellens, 2015).

Nonetheless, it appears that the Spanish tourism industry lacks ICT inclusion in its company structure (López García, Méndez Alonso, & Dones Tacero, 2009). Thus, according to (Miró & Pereira, 2017), "any economic sector that wishes to engage effectively in the international market and be competitive would need to make development in ICTs, as they promote a shift in the method of working, purchasing, conducting business, and communicating." Therefore, it is vital to analyze TFP alongside the significance of ICT use.

The influence of ICT on TFP growth has been established, suggesting that the return on investment in ICT is substantial (Bloom et al., 2016; Brynjolfsson & Hitt, 2003; A. M. Sánchez & Roura, 2014; C. P. Sánchez, de Llano Monelos, & López, 2016). Therefore, Hypothesis 2 is confirmed.

Notably, owning a website is associated with increasing TFP, a conclusion consistent with the literature (Manero et al., 2012; Miró & Pereira, 2017). Thus, product innovation and increased internet usage are believed to increase the TFP of the Spanish tourism industry. As suggested by Daz-Chao and Torrent-Sellens, enterprises should make a clear commitment to investing in ICT (co-innovation) because ICT can considerably and positively increase TFP.

Under this result's interpretation, the third hypothesis (Hypothesis 3) is supported by studies on the significance of workers' talents and organizational innovations (Bagger et al.; Hult et al., 2018).

7. Limitations and future lines of investigation

The study's limitations stem from considering a specific industry in Spain without comparison to other European nations. As a result, it is suggested that future studies corroborate the results by applying the same analysis in a new environment, either by industry or country. Moreover, various ICT-related viewpoints can be used to broaden our findings. One of the examined variables has significant restrictions, as the use of the website implies an outmoded technological development. This is evident in the current state of the art, in which the field of smart technologies (IoT, Big Data, Artificial Intelligence, etc.) is handled from a perspective that enhances the productivity of the sector under study. Torrent-Sellens (2019: 8) notes, however, that "the lack of data on other crucial 4.0 technologies such as big data, cloud computing, and IoT, as well as the absence of a time series of data, has precluded us from moving farther. Even so, to enhance and expand this study in line with the interaction of the firm with the customer, the management of social networks within the tourism sector can be considered a future line of research; since the bi-directionality and interaction of firms with their audiences are fundamental aspects that have allowed social networks to become an integral part of the management of communication of firms (Carvalho & Sarkar, 2014; González-Rodriguez et al., 2015; Graetz & Michaels, 2018).

Lastly, it is advised that future studies include a deeper knowledge of the relationship between various degrees of TFP growth and the competitive strategies of major and small Spanish companies. In addition to an update of the sample in terms of the time under consideration.

8. Policy implications

According to specialized literature, there is a correlation between technological advancement and economic expansion. In light of this, the Spanish government must continue to implement measures that have proven effective. Among them is the fact that the development of physical telecommunications networks throughout the national territory has increased its competitiveness. Nonetheless, public policies must intensify and enhance efforts in policies aimed at the digitalization of industry and business, particularly SMEs, in the fields of research and development, innovation, and digital training of the industrial fabric of the entire territory.

9. Conclusions

In recent decades, the production divergence between the frontier and non-frontier enterprises in the Spanish industrial fabric has increased, resulting in a wider gap between the two groups of major firms. While ten percent of enterprises with a higher average value have experienced a continuous increase in TFP from 2011 to 2017, the remaining ninety percent of firms have experienced stable growth. This scenario increases the dispersion of the sample. However, this is not the case for small and medium-sized enterprises (SMEs), where the trend diverges, as non-frontier firms exhibit greater average growth than frontier firms.

In this work, we have attempted to contribute to the literature by utilizing the SABI database to determine which technological variables have had the greatest effect on economic growth. TFP growth appears to be correlated with R&D spending, ICT use, and product innovation. This research concludes with a review of the role of policies that demonstrate stronger productivity growth, less TFP divergence with an inclination toward increased R&D investment, and enhanced coordination, among others.

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Appendix A

Table a.1. Correlation matrix

	Added Value	Intermediate Inputs	Labour Cost	Capital
Added Value	1			
Labour Cost	0.632***	1		
Capital	0.802***	0.642***	1	
Intermediate Inputs	0.531***	0.365***	0.441***	1

Where, *** p < 0.01; ** p < 0.05; * p < 0.1.

Table a.2. Multicollinearity test

Variable	**VIF**	**1/VIF**
Labour Cost	1.85	0.54
Capital	1.27	0.79
Intermediate Inputs	1.69	0.59
Average VIF	1.61	