Smart Innovation, Systems and Technologies 208

João Vidal de Carvalho
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Advances in Tourism, Technology and Systems

Selected Papers from ICOTTS20 , Volume 1

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Smart Innovation, Systems and Technologies

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Editorial

This book—Advances in Tourism, Technology and Systems Volume 1—from the SIST Series is composed of the best selected papers accepted for presentation and discussion at the 2020 International Conference on Tourism, Technology and Systems (ICOTTS'20). The ICOTTS is a multidisciplinary conference with a special focus on new technologies and systems in the tourism sector and was held between October 29 and 31, 2020. The ICOTTS'20 was supported by the University of Cartagena, in Cartagena de Indias, Colombia, by the School of Hospitality and Tourism, Polytechnic Institute of Porto, Portugal, and by AISTI (Iberian Association of Information Systems and Technologies).

The International Conference on Tourism, Technologies and Systems is an international forum for researchers and professionals in the tourism sector, which enables the discussion of the latest innovations, trends and concerns in several areas, in the tourism sector, associated with information technologies and systems. It is an event for professionals in the sector, in search of technology solutions, where academics, IT experts and business managers meet to discuss new ideas that help them maximize the potential of tourism business through technology.

The ICOTTS'20 Scientific Committee is composed of a multidisciplinary group of 137 experts who assessed some 190 papers from 28 countries, received for each of the main topics proposed for the conference: a) technology in tourism and tourism experience; b) smart destinations; c) digital marketing applied to tourism and travel; d) mobile technologies applied to sustainable tourism; e) research in the area of tourism to provide innovative solutions to social problems; f) tourism, well-being and hospitality; g) information technologies in tourism; h) digital transformation of tourism business; i) travel for health and well-being; j) information technologies in ecotourism and agrotourism; k) information technologies in food tourism; l) information technologies in education and educational tourism; m) e-tourism and tourism 2.0; n) big data and travel and tourism management; o) robotics in tourism; p) resilience and tourism; q) dark tourism; and r) military tourism.

The papers accepted for presentation and discussion at the conference are published by Springer and will be submitted for indexing by ISI, SCOPUS, EI-Compendex, Google Scholar and SpringerLink.

We thank all those who contributed to the ICOTTS'20 conference (authors, committees, workshop organizers and sponsors). We deeply appreciate your involvement and support, which were crucial to the success of the conference.

October 2020

João Vidal
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Contents

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João Vidal de Carvalho is Adjunct Professor at the Institute of Accounting and Administration of Porto, Polytechnic of Porto (Portugal). He completed postdoctorate in Technologies and Information Systems from the University of Coimbra (Portugal), PhD in Information Systems and Technology from the University of Santiago de Compostela (Spain), MSc in Information Technology Management from the University of Minho (Portugal), and Bachelor in Computer Science. He is an effective member of the CEOS.PP Research Center—Center for Organizational and Social Studies of the Polytechnic of Oporto—and member of LIACC Artificial Intelligence and Computer Science Laboratory—FEUP. He is a member of the Iberian Systems and Information Technology Association (AISTI) and Conference Chair of the ICOTTS 2019—the 2019 International Conference on Tourism, Technology and Systems. He published some books in computer science/database management. He is a scientific committee member of several conferences in the area of information systems and technologies.

Álvaro Rocha holds the title of Honorary Professor and holds a D.Sc. in information science, Ph.D. in information systems and technologies, M.Sc. in information management and BCS in computer science. He is Professor of Information Systems at the University of Lisbon, President of AISTI (the Iberian Association for Information Systems and Technologies), Chair of the IEEE Portugal Section Systems, Man, and Cybernetics Society Chapter, and Editor-in-Chief of both JISEM (Journal of Information Systems Engineering & Management) and RISTI (Iberian Journal of Information Systems and Technologies). Moreover, he has served as Vice-Chair of Experts for the European Commission's Horizon 2020 program and as Expert at the COST—intergovernmental framework for European Cooperation in Science and Technology, at the Government of Italy's Ministry of Education, Universities and Research, at the Government of Latvia's Ministry of Finance, at the Government of Mexico's National Council of Science and Technology, and at the Government of Polish's National Science Centre.

Pedro Liberato is Professor of tourism, specializing in tourism destinations management, tourism planning and tourism marketing, at the School of Hospitality and Tourism, Polytechnic of Porto. Currently, he coordinates the Tourism and Leisure Department and the master's degree in tourism management in the same school. His main research interests are tourism management, tourism planning, e-tourism, ICT in tourism and tourism marketing.

Alejandro Peña is part of the academic staff in EIA University in the areas of management, finance and computer science. He has a bachelor's degree in mechanical engineering, a master's degree in systems engineering, and a Ph.D. in engineering and is Postdoctoral Researcher focused on machine learning. Mr. Peña has developed several researches and publications in advanced topics related to computational intelligence and machine learning, in fields such as financial risk, decision management, precision agriculture and other areas related to computer science.

Drivers of Productivity in the Portuguese Nature Tourism Industry

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Abstract. Considering the importance of tourism to the world economy, productivity measurement has been raising increasing interest in academia and recognized as critically important for the understanding of the strengths and weaknesses of the tourism sector. Thus, this paper analyses the determinants of firm-level labor productivity of Portuguese nature tourism firms. A fixed effects model was used to analyze the impact of physical capital, human capital, firm size, innovation, competition and agglomeration economies on labor productivity of Portuguese nature tourism firms, for 2014–2017. The sample comprises 369 firms, representing 55% of firms operating in nature tourism in the mainland. Results show that labor productivity is driven by physical capital, suggesting that human resources in nature tourism are more productive when helped by machinery and equipment, for example information technology. By contrast, the negative impact of the number of employees on labor productivity may be triggered by inefficiencies, due to dysfunctions in tourism services with excess of personnel. Also, and in the case of Algarve, the presence of agglomeration economies may hinder labor productivity. Indeed, the existence of many tourism firms in the region and, therefore, several employment opportunities, might dampen the incentive to increase productivity on the part of employees in nature tourism firms. These results can be of significant use to further understand the various dimensions of tourism management.

Keywords: Productivity · Regional analysis · Tourism

1 Introduction

Tourism involves a growingly wide range of stakeholders, activities, and types of firms [1, 2]. The spatial agglomeration of tourism activities has an impact on regional growth [3]. However, even when conducted at a regional level, the spatial issues are very often ignored in tourism studies. The tourism sector is of critical importance in the national and regional economy of Portugal. According to Travel BI, the number of guests in tourist accommodation in 2019 reached 27 million and, according to Pordata, in 2018,

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the number of guests was nearly 25.3 million, of which 22.9 million in the mainland. Yet, the distribution of guests is uneven: Lisbon and North capture a share of 51% in 2018, followed by Algarve (19%) and the Centre (15%). Madeira and Alentejo attracted 6% of guests each, and Azores captured 3% of guests. Considering the importance of tourism to the world economy, productivity measurement has been raising increasing interest in academia and recognized as critically important, since it is an important indicator for understanding the strengths and weaknesses of the tourism sector [4]. Still, to make comparisons across industries, productivity has been measured by a raw tool of 'inputs and outputs' (e.g., hours worked and turnover). The tourism industry has different challenges regarding productivity, and it is often reported as having low productivity when compared to other industries [5]. Significant productivity differences between firms have been reported at regional level in Portugal [6]. On the other hand, empirical evidence on the regional performance of the Portuguese firms are scarce. The analysis of determinants of labor productivity at regional level is key to understand the relationship between tourism and economic development. This paper attempts to fill the existing gap by testing the impact of several determinants on the labor productivity of nature tourism firms across regions. The remainder of the paper is organized as follows. Section 2 presents the empirical literature on the drivers of productivity. Section 3 describes the data and methodology. Results are reported in Sect. 4; and Sect. 5 concludes.

2 Literature Review

Firm-specific characteristics (e.g. physical capital, human capital and size), industrial structure (e.g., innovation) and regional characteristics (e.g., competition and agglomeration economies) can explain, at least in part, firms' performance [7, 8].

Physical Capital - A study for Greece [9], in 1995–1999, found that that investments in physical capital are related with productivity growth. Moreover, another study [10] for 45 countries, in 1980–2005, found a positive and significant role of Information and Communications Technology (ICT) investment on labor productivity growth. A third study [11] for 74 countries, in 1950–2010, found that labor productivity is stagnant with physical capital stagnation. Other study [12] for South-Eastern European countries, in 2000–2017, confirmed that changes in productivity are explained by changes in gross fixed capital formation.

Human capital - Several studies, using firm-level data, found that training have a positive and significant impact on firms' productivity [13, 14]. On study [15] examining the Asia-Pacific region, in 1980–2014, found that human capital has a significant impact on labor productivity. Another study [16], using an autoregressive-distributed lag technique, found that education has a significant positive impact on labor productivity in Iranian firms, in 1974–2014.

Firm size - Efficiency advantages may arise in larger firms [17]. A study for 8 African countries [18] concluded that productivity is positively correlated with firm size. Another study [19], using data from Tunisian manufacturing firms, for the 1998–2004, found that small firms fail to achieve economies of scale. However, another study [20] found a U-shape relationship between firm size and efficiency.

Innovation – A study [21] suggests that regional innovation may prompt externalities that lead to agglomeration economies. A second study [20] for the hotel sector in Spain, in 1999–2007, showed that innovation impacts on the productivity, but the magnitude depends on the geographic location. Moreover, a third study [22] on Pakistani Small and Medium Enterprises (SMEs), in 1980–2013, found a causal relationship among innovation and firm growth.

Competition - The competitive environment plays a key role on productivity growth [23, 24], by boosting innovation rates, reducing costs and improving efficiency. Cross section regression analysis for the 35 NUTS-3 regions of Austria performed by a study [24] showed that regions with high-competitive pressure display above-average productivity levels. Another study [25] for the hospitality industry in Spain, in 1996–2004, suggested that increases in competition (measured by the touristic intensity) have a positive impact on labor productivity growth. However, using regional data for the period 1996–2004, another study [26] for Spanish hotels found that increases in the number of hotels affected negatively productivity growth.

Agglomeration Economies – A study [27] for Egypt, using 342 firms in 27 regions, showed that SMEs are more likely to benefit from agglomeration than large firms.

3 Methodology

3.1 Data

The initial research of nature tourism firms in National Tourism Registry delivered 1023 touristic agents. There was a need to collect financial data from the SABI database financial reports. However, since SABI does not provide financial reports of entrepreneurs, 343 tourism agents were withdrawn. As a result, 428 firm reports were obtained. Because Quadros do Pessoal do not provide information regarding the qualification level of employees for the Islands, 14 firms located in Madeira and Azores were withdrawn. After the data cleaning procedure, the sample comprises 369 nature-based firms. Thus, the sample represents 55% of total firms operating in nature tourism in the mainland, in 2014–2017. The sample size grants the reliability of conclusions at 95% level of confidence. All nominal variables are deflated by the respective price index, obtained in the PORDATA database. The sectors with no specific deflator (e.g., some services) are deflated by the consumer price index (CPI). Missing values in the sample were filled by multiple imputation on Stata 13.0. Table 1 resumes the proxies and the expected sign as well as data sources.

3.2 Model Specification

The labor productivity is directly derived from an aggregate Cobb-Douglas type production function, where both sides are divided by labor (L). Taking logarithms and adding the control variables, the model is

Table 1. Proxies and expected sign

Independent variable	Proxy	Expected sign	Data source
Physical capital (K)	Tangible assets - depreciation	+	SABI
Human capital (H)	Number of employees with at least a degree at sectoral level	+	Quadros do Pessoal
Firm size	Number of employees (B) and turnover (Y)	+	SABI
Innovation (INOV)	Share of firms with innovation activities at sectoral level	+	Community Innovation Survey (2014–2016)
Competition [touristic intensity (TI)]	overnight stays per 100 inhabitants at regional level	+	PORDATA
Agglomeration Economies	firm density (FD) for each region	+	PORDATA

Source: Authors' elaboration

$$ln(PROD_{ijrt}) = \beta_0 + \beta_1\, ln(K_{ijrt}) + \beta_2\, ln(H_{jrt}) + ({}_3ln(B_{ijrt}) + ({}_4ln(Y_{ijrt}) + \beta_5\, ln(INOV_{jrt}) + \beta_6 ln(TI_{rt}) + \beta_7 ln(FD_{rt}) + \varepsilon_{ijrt} \quad (1)$$

Where, i, j, r and t denote firm, sector, region and time. The independent variables are described in Table 1. The balanced panel data set includes 369 firms for the 4 years in a total of 1476 observations (see Table 5 in the appendix for basic statistics). The Hausman test was the criterion for choosing between fixed and random effects. Thus, the labor productivity was regressed on its drivers using the a fixed-effects model in Stata 13.0. The three-sigma rule of thumb method is applied to define outliers. Table 5 (in the appendix) shows that none of the variables log-transformed falls outside of 3 standard deviations. As the study employs panel data it is expected that the result will not be affected by multicollinearity, which was confirmed by the application of the Variance Inflation Factor.

4 Results and Discussion

Table 2 shows the regression results for models 1, 2, 3 and 4. For the full model, and as expected, the contribution of physical capital is statistically and positively related to firm productivity ($\approx$0.01, $p < 0.001$). Also, the sign of the impact of firm size on labor productivity is confirmed when measured by turnover ($\approx$1.00, $p < 0.001$). However, when firms size is measured by the number of employees, results report a negative impact (≈ -1.00, $p < 0.001$) on labor productivity, suggesting service inefficiencies when the number of employees increase in the nature tourism firms. Contrary to what was expected, models 2 and 4 suggest that agglomeration economies exert a negative (≈ -0.09, $p < 0.05$) and significant impact on labor productivity. The determinants

human capital, innovation and *competition* do not appear to exert a significant impact on labor productivity for 2014–2017.

Table 2. Regression results for the whole sample

	(1)	(2)	(3)	(4)
Ln(K)	0.0125***	0.0125***	0.0123***	0.0123***
	(4.24)	(4.26)	(4.20)	(4.22)
Ln(H)	0.00440	0.00428		
	(0.78)	(0.76)		
Ln(B)	−1.000***	−1.000***	−1.000***	−1.000***
	(−172.60)	(−172.71)	(−172.71)	(−172.82)
Ln(Y)	1.009***	1.009***	1.009***	1.009***
	(241.24)	(244.68)	(241.50)	(244.80)
Ln(INOV)	−0.0236	−0.0246	−0.0141	−0.0147
	(−0.33)	(−0.35)	(−0.20)	(−0.21)
Ln(TI)	−0.00371		−0.00164	
	(−0.17)		(−0.08)	
Ln(FD)	−0.0934	−0.101*	−0.0880	−0.0913*
	(−1.51)	(−2.29)	(−1.43)	(−2.17)
_cons	0.270	0.274	0.241	0.243
	(0.83)	(0.84)	(0.75)	(0.76)
N	1082	1082	1082	1082
adj.	0.986	0.986	0.986	0.986

Notes: Statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. k - physical capital, h - human capital, b and y - labor and turnover (proxies of firm size), INOV - innovation, ti - touristic intensity (as a proxy for competition), and fd - firm density (proxy for agglomeration economies. Source: Authors' calculations in Stata 13.0.

Table 3 show the regression results by region, for model 1. In model 1, the physical capital only affects significantly the productivity of nature tourism firms located in the North and Alentejo (respectively ≈0.009 and 0.076, $p < 0.01$). The sign and magnitudes of the impact of firm size on productivity follow the same pattern of the sample for the entire territory, both measured by turnover and number of employees. However, disaggregating by regions, results uncover a significant impact of regional competition (0.125, $p < 0.05$) and a negative and significant impact of agglomeration economies (−0.137, $p < 0.05$) in Algarve.

The results of model 2, by regions (Table 6 in the Appendix) show the same pattern of model 1, except for a non-significant impact of regional competition and agglomeration economies in all regions. Results of model 3, by regions (Table 7 in the Appendix) follow the same pattern of model 1, with a significant impact of regional competition (0.126, $p < 0.05$) and a negative and significant impact of agglomeration economies (−0.143, $p < 0.05$) in Algarve. Finally, the results of model 4 by regions

Table 3. Regression results of model 1 by NUTS II regions

	North	Centre	Lisbon	Alentejo	Algarve
Ln(K)	0.00933**	0.0139	0.00347	0.0763**	−0.00180
	(3.05)	(1.86)	(1.51)	(3.36)	(−0.95)
Ln(H)	−0.00240	0.0113	0.00651	0.0164	−0.00266
	(−0.39)	(0.57)	(1.60)	(0.41)	(−0.72)
Ln(B)	−0.986***	−0.993***	−1.000***	−1.044***	−0.988***
	(−189.05)	(−69.01)	(−198.71)	(−21.77)	(−260.00)
Ln(Y)	0.996***	1.001***	1.000***	1.037***	0.996***
	(226.10)	(104.57)	(278.50)	(42.76)	(312.86)
Ln(INOV)	−0.0133	0.0443	−0.0697	−0.0921	−0.0131
	(−0.21)	(0.29)	(−1.03)	(−0.20)	(−0.23)
Ln(TI)	−0.112	−0.101	−0.144	0.0450	0.125*
	(−0.95)	(−0.36)	(−0.47)	(0.20)	(2.21)
Ln(FD)	0.585	0.377	0.323	−0.329	−0.137*
Ln(K)	(0.91)	(0.21)	(0.45)	(−0.31)	(−2.11)
_cons	−1.063	−0.616	−0.433	−0.149	−0.600
	(−0.82)	(−0.23)	(−0.29)	(−0.08)	(−1.42)
N	230	191	271	125	265
adj. R-sq	0.997	0.986	0.997	0.953	0.998

Notes: Statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. k - physical capital, h - human capital, b and y - labor and turnover (proxies of firm size), INOV - innovation, ti - touristic intensity (as a proxy for competition), and fd - firm density (proxy for agglomeration economies. Source: Authors' calculations in Stata 13.0.

(Table 8 in the Appendix) are like those of model 2, with no influence of competition and agglomeration economies on the labor productivity of nature tourism firms in Algarve. According to a study [10], the divergence in regional productivity can be explained by resource endowment. Results show that labor productivity is driven by physical capital, suggesting that human resources in nature tourism are more productive when helped by machinery and equipment, for example information technology. By contrast the negative impact of the number of employees on labor productivity may be triggered by inefficiencies, due to dysfunctions in tourism services with excess of personnel. In Algarve, the agglomeration economies may hinder labor productivity. The existence of many tourism firms with many employment opportunities, might dampen the incentive to increase labor productivity, with implications for tourism management.

5 Conclusions and Policy Implications

Considering the importance of tourism to the world economy, productivity measurement has been raising increasing interest in academia and recognized as critically important, since it is an important indicator for understanding the strengths and weaknesses of the tourism sector. However, tourism industry has different challenges regarding productivity, and it is often reported as having low productivity when compared to other industries. The management and monitoring of productivity in the tourism sector is much more difficult than in other economic activities due to a lack of accuracy of the measurement of productivity, especially in the service sector. Indeed, substandard service productivity definition and errors in costs and price of the factors have been reported in the sector [28]. Consequently, measurement improvements can be helpful in this regard. This paper is an attempt to fill this gap, by testing the impact of physical capital, human capital, firm size, innovation, competition and agglomeration economies on labor productivity of nature tourism firms located in the mainland, for 2014–2017.

Results suggest that human resources in nature tourism are more productive when assisted, for example, by information technology. Thus, capital expansion is predominantly an extensive form of raising firms' productivity. On the other hand, labor productivity appears to be hindered in firms with excess of personnel. This result seems to corroborate the U-shaped relationship between firm size and efficiency suggested by [20]. In Algarve region, it appears that several employment opportunities, triggered by the presence of high firm density, may be dampening the incentive to increase labor productivity. Practical implications of these results, regarding tourism management, include the choice of firm location in areas under a certain level of firm density and human resources management in nature tourism firms. Indeed, in tourism, more than in other sectors, the location of the activities is crucial for firm performance and for firm internal resources and characteristics [29]. Yet, considerations on human resources management in tourism are of complex nature due to the nature of the rapidly changing business structures, evidenced in the form of partnerships, alliances and franchises, along with multi-employer sites [30]. Indeed, employment in tourism is regarded as being "low-skilled" and is often perceived as low status and limited career [30–32]. In this context, the coordination between the private and government is of key relevance for productivity growth. Government officials can co-operate to assist productivity increases, with specifically tailored measures for small firms. Hence, government officials should focus on promoting especially the acquisition of IT equipment and training for managers on organizational skills in order to avoid the inefficiencies, due to dysfunctions in tourism services with excess of personnel. This could be achieved by providing incentives for training and education, especially in hospitality industry where the lack of skilled personnel is especially notorious in Portugal. Considering the data limitations, we were only able to study the drivers of productivity in nature tourism in relation to mainland Portugal for the period 2014–2017, so it is suggested that in future investigations include the islands of Madeira and Azores in order to obtain a more complete study in the area under analysis. In turn, the fact that only a limited period of time for analysis (2014–2017) was considered does not allow us to draw conclusions in

terms of the evolution of productivity in nature tourism, suggesting, therefore, a longitudinal study. With analysis of different periods a historical perspective of the phenomenon is also possible. An additional limitation is underlying the non-inclusion of some factors in the study, such as, for example, data on the characteristics of the regions, local government support or heterogeneous tourist resources, which should also be incorporated in future research. An interesting issue to be studied in the future is related to the negative relationship verified between labor productivity and excess staff, which contradicts some of the published works that claim, including that productivity is an effect of the agglomeration of personnel. As such, this seems to be an interesting point that must be studied.

Appendix

Table 4. Firms by NUTS II region

Region	# firms	% Total
North	79	21
Centre	64	17
Lisbon	101	27
Alentejo	45	12
Algarve	80	22
Total	**369**	**100**

Source: Authors' elaboration

Table 5. Basic statistics (n = 1476)

Variable	Mean	St. Dev.	Min.	Max
Ln(PROD)	3.27	1.18	0	7.49
Ln(K)	2.83	2.06	0	9.64
Ln(H)	9.10	0.76	4.98	10.96
Ln(B)	0.78	0.90	0	4.66
Ln(Y)	3.89	1.84	0	10.61
Ln(INOV)	4.29	0.06	4.08	4.41
Ln(TI)	6.29	1.13	5.12	8.43
Ln(FD)	2.96	1.21	0.92	4.77

Prod – productivity, k - physical capital, h - human capital, b and y - labor and turnover (proxies of firm size), INOV - innovation, ti - touristic intensity (as a proxy for competition), and fd - firm density (proxy for agglomeration economies. Source: Authors' elaboration

Table 6. Regression results of model 2 by NUTS II regions

	North	Centre	Lisbon	Alentejo	Algarve
Ln(K)	0.00947**	0.0140	0.00366	0.0764**	−0.00186
	(3.10)	(1.88)	(1.61)	(3.39)	(−0.97)
Ln(H)	−0.00282	0.0108	0.00649	0.0178	−0.00272
	(−0.46)	(0.55)	(1.60)	(0.45)	(−0.73)
Ln(B)	−0.986***	−0.993***	−1.000***	−1.042***	−0.988***
	(−189.15)	(−69.37)	(−199.37)	(−22.15)	(−257.62)
Ln(Y)	0.996***	1.001***	1.000***	1.037***	0.996***
	(226.67)	(104.93)	(281.36)	(43.13)	(309.92)
Ln(INOV)	−0.0138	0.0342	−0.0697	−0.0942	−0.0235
	(−0.22)	(0.23)	(−1.03)	(−0.21)	(−0.40)
Ln(FD)	−0.0238	−0.274	−0.0136	−0.134	−0.00335
	(−0.35)	(−1.28)	(−0.38)	(−0.31)	(−0.14)
_cons	0.134	0.305	0.253	−0.0871	0.146
	(0.41)	(0.44)	(0.74)	(−0.05)	(0.57)
N	230	191	271	125	265
adj. R-sq	0.997	0.987	0.997	0.954	0.998

Notes: Statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. k - physical capital, h - human capital, b and y - labor and turnover (proxies of firm size), INOV - innovation, ti - touristic intensity (as a proxy for competition), and fd - firm density (proxy for agglomeration economies. Source: Authors' calculations in Stata 13.0.

Table 7. Regression results of model 3 by NUTS II regions

	North	Centre	Lisbon	Alentejo	Algarve
Ln(K)	0.00934**	0.0133	0.00326	0.0753**	−0.00170
	(3.06)	(1.80)	(1.41)	(3.35)	(−0.90)
Ln(B)	−0.986***	−0.991***	−0.999***	−1.046***	−0.988***
	(−189.59)	(−70.65)	(−198.68)	(−22.16)	(−260.41)
Ln(Y)	0.997***	1.001***	1.001***	1.037***	0.996***
	(230.68)	(104.85)	(278.19)	(43.02)	(315.94)
Ln(INOV)	−0.0138	0.0396	−0.0335	−0.0192	−0.0188
	(−0.22)	(0.26)	(−0.52)	(−0.05)	(−0.33)
Ln(TI)	−0.115	−0.0895	−0.138	0.0614	0.126*
	(−0.98)	(−0.32)	(−0.45)	(0.27)	(2.21)
Ln(FD)	0.591	0.352	0.326	−0.389	−0.143*
	(0.92)	(0.19)	(0.45)	(−0.37)	(−2.23)
_cons	−1.086	−0.501	−0.585	−0.341	−0.589
	(−0.84)	(−0.19)	(−0.39)	(−0.19)	(−1.39)
N	230	191	271	125	265
adj. R-sq	0.997	0.987	0.997	0.954	0.998

Notes: Statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. k - physical capital, h - human capital, b and y - labor and turnover (proxies of firm size), INOV - innovation, ti - touristic intensity (as a proxy for competition), and fd - firm density (proxy for agglomeration economies. Source: Authors' calculations in Stata 13.0.

Table 8. Regression results of model 4 by NUTS II regions

	North	Centre	Lisbon	Alentejo	Algarve
Ln(K)	0.00949**	0.0134	0.00343	0.0753**	−0.00176
	(3.11)	(1.82)	(1.51)	(3.37)	(−0.93)
Ln(B)	−0.986***	−0.991***	−0.999***	−1.045***	−0.988***
	(−189.66)	(−70.98)	(−199.35)	(−22.46)	(−258.03)
Ln(Y)	0.997***	1.001***	1.000***	1.038***	0.997***
	(231.05)	(105.22)	(281.11)	(43.41)	(312.98)
Ln(INOV)	−0.0144	0.0308	−0.0336	−0.0133	−0.0294
	(−0.23)	(0.21)	(−0.53)	(−0.03)	(−0.51)
Ln(FD)	−0.0372	−0.226	0.00359	−0.122	−0.00899
	(−0.60)	(−1.16)	(0.10)	(−0.29)	(−0.41)
_cons	0.149	0.315	0.0740	−0.278	0.160
	(0.46)	(0.46)	(0.23)	(−0.16)	(0.62)
N	230	191	271	125	265
adj. R-sq	0.997	0.987	0.997	0.954	0.998

Notes: Statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. k - physical capital, h - human capital, b and y - labor and turnover (proxies of firm size), INOV - innovation, ti - touristic intensity (as a proxy for competition), and fd - firm density (proxy for agglomeration economies. Source: Authors' calculations in Stata 13.0.

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Decentralized Application for the Classification of Hotels Based on IPFS and Blockchain

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Abstract. This paper presents the results of the construction of a prototype that provides a web platform to classify and recommend hotels, in an unstructured format, specifically using images. The application uses the information supplied by the image repository that communicates with the platform. Using technologies such as blockchain and the Interplanetary File System (IPFS), it is intended to provide a new approach that allows users to use the benefits of these technologies to provide security on the quality of stored information and on content access.

Keywords: Blockchain · IPFS · Image classification · Tourism · Data treatment

1 Introduction

Blockchain is a set of interlinked nodes or blocks where records and transactions are stored. These blocks, in addition to storing their own information, also store the information of all the nodes that make up the network [9]. Each block has a unique place within the chain, because inside the information it contains are the hash data (unique key) of the previous node and itself, so it also has an exact copy of the information of the entire network, the latter is what makes blockchain so secure in all areas.

To begin to understand the operation of blockchain we can see in the Fig. 1 the explanation of a transaccion. That image shows a banking transaction where the user A wants to send money to the user B. The first user send the movement data and the recipient. The transaction enter to the blockchain, how explained in the begin each one of the blocks has the total of the network information, in other words the validation of the newly entered transaction will be performed by all nodes and once these approved it, the transaction will begin to be a part of the network.

A smart contract [12] is an script that self-running over blockchain enforcing the terms outline in this, and also there are unchangeable. This ensures that it is fulfilled to the letter. With the help of the smart contracts the nodes of a blockchain can perform the validations over transactions.

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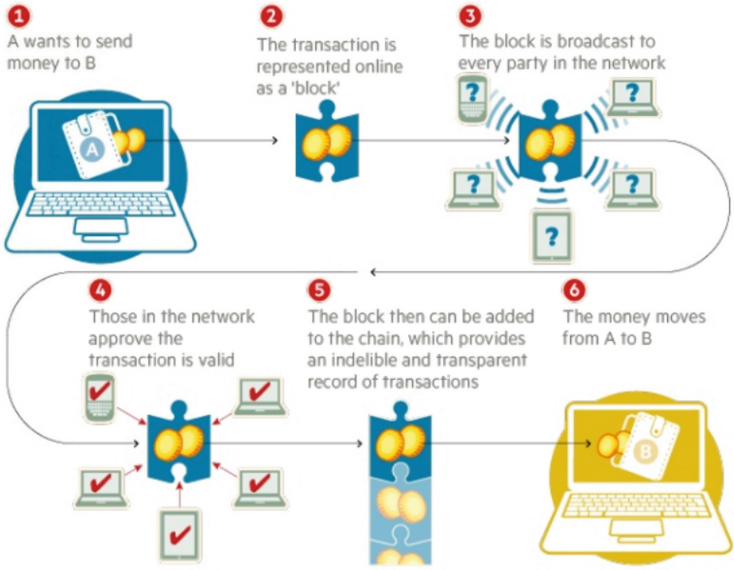

Fig. 1. Financial transaction using blockchain technology [5].

Ethereum is a global open source platform to decentralized applications. In Ethereum you can code that controls digital value, runs exactly as programmed, and is accessible from anywhere in the world [7]. Currently is one of the most used block-chain technology platform in the world for development of applications.

InterPlanetary File System (IPFS) is a distributed system of P2P files that has as aim connect all the informatic devices with the same files system and warranty the continuous availability of the files through multiple backups in the different network nodes [1]. For it redirect the communications based on the content, rather than name as is currently happening, providing a high-performance content-based block storage model, with addressable hyperlinks by content. Specifically an identifier IPFS uses an cryptographic hash of the content [13]. Through criptogrhapy that hash warranty that it always represents the content of that file, because if some modification was made the hash will be totally change. Simultaneously this protect the tampering and degradation of the files, also makes that objects will be unchangeable.

Based on the above it can be understood that the blockchain application is just for banking transaction, but it does not, we can apply it to almost everything, for example, in the health sector where the management of medical records has been somewhat tedious [10] because there are susceptible to loss or wrong information, blockchain would allow more security, control and easy access to these data from each medical entity.

So as to that the prototype to classify hotels based in IPFS and blockchain, each user will be a node and each interaction will be a transaction.

2 Theoretical Background

Tourism promotes economic growth such as can be seen in latin american countries where there is a directly proportional relationship between the growth of the economy and the growth of tourism per capita conditioned by macroeconomic variables from 1985 to 1998 [8]. Based in this behavior, the tourist industry strives to offer products and services to try to meet the preferences and needs of tourists. In Colombia between 2015 and 2018, the tourism industry contributed to the colombian PIB more than 125 billions of colombian pesos [3] (Fig. 2).

Fig. 2. Growth in the contribution of tourism to Colombia's GDP [3].

Big Data (BD) are considered by many an incredible opportunity for its supposed capacity to provide answers to practically any question that could be asked about people's behaviours, views and feelings. Big Data provide a wealth of valuable and unquestionable insights into many aspects of the modern life of individuals, organisations and markets [2].

Blockchain is another technology that can offer tourism solutions. Among the research topics, it is found that the biggest impact of blockchain on the travel industry will be an increasing level of disintermediation [11], added the impact of online travel agency, which have increased disintermediation since the beginning of the first decade of the 21st century. In that vein, there are already cases of countries like Malta [4] and United Arab Emirates [6] who are currently basing their tourism and general economy on blockchain based transactions.

3 Application Modules

The prototype has four modules: Log in and sign in, hotels load, hotels classification and hotels visualization.

For the log in and sign in module, in HTML environment with bootstrap design, the textFields for entering each user's password and security phrase are displayed, this with an option to enter to the platform, where the credentials of the client are verified through javascript to get the data. Ajax is used as a link to Python and the last one makes the respective validation with the database. For the sign in a link to create an account can be found on the login page, this redirect to a form where the password and the confirmation of this is requested, automatically the system create an account for the user in Ethereum and gives the customer a security phrase generated from markov chain in a text.

Once the user login into the account will find a navigation bar that allows the user to move between home and the other three modules. About the hotels load module, the user is given the option to upload an image of a hotel from their device, this through an input file type in HTML and a Python function that allows to save the image locally. The user will be able to enter the image's metadata if the user has this information. Otherwise the system generate it automatically to save it along with the image. Finally the image and its metadata will be charge into a repository IPFS and the transaction of each user will be register over blockchain.

About hotels classification module, the hotel images will be bring from the repository and present randomly with their respective descriptions to the user, who can classify them if it likes or dislikes them, those preferences will be save in the database MongoDB and will be use on the hotels visualizations. Finally the hotels visualizations module shows what the system recognizes such as hotel's image user likes based in their preferences, this through collaborative filter, which takes the user's preferences and compares them with others to find commonalities, so the user receives hotels recommended by people with similar likes.

4 Database Model

The Fig. 3 represents the used database documental model, in this case MongoDB. There is a collection users, which has the fields in its JSON structure: address, password, phrase, keystore, like_images y dislike_images. Each of these fields is described below:

- address: This is a "string" type. It store the string that describes the Ethereum account created for the user.
- password: This is a "string" type. It store the encrypted password of each user.
- phrase: This is a "string" type. It store the encrypted the security phrase generated for this user.
- keystore: This is a dictionary type. It store the encrypted the public key associated with the Ethereum account.

- like_images_ This is a array type. It store the hash of the hotel images that the user has classified as "like".
- dislike_images_ This is a array type. It store the hash of the hotel images that the user has classified as "dislike".

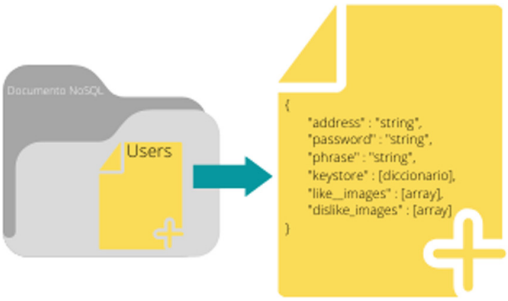

Fig. 3. Database documental model.

5 General System Requirements

The system must have the following features and functionalities (Table 1):

Table 1. Definition of general system requirements.

ID	Requirement	Description	Type
RF-001	User log in	Users registered in the application can access into their account using their password and security phrase	Functional
RF-002	User sign in	A user not registered in the application, can do the register process, where request a password and its confirmation. Additionally, a security phrase is presented	Functional
RF-003	Ethereum account creation	During the user registration process, the application creates an Ethereum account for that user	Functional
RF-004	Generation of security phrase	During the Ethereum account creation process, the application must be able to generate a security phrase for the user	Functional
RF-005	Uploading images	The user could select an hotel image, this will be upload into the application	Functional

(*continued*)