



# Digitalisation and rural tourism development in Europe

## Digitalización y desarrollo del turismo rural en Europa

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### Abstract

This work presents an analysis of the digitalisation of the tourism sector and evaluates the potential of this process for rural areas of the European Union (EU). To do this, we explore aspects of both the supply and demand of rural tourism, proposing a regression model that incorporates indicators that relate the advance of digitalisation with changes in the weight and characteristics of the sector in the regions with low population density included in the NUTS level 2. The research results indicate a positive relationship between the digitalisation of the sector and the supply of rural accommodation, as well as a positive impact on the demand for these facilities. In addition, the study has made it possible to address the potential competition between traditional accommodations and digital platforms, revealing that the greater use of digital platforms for reservations does not negatively affect hotel occupancy rates. The findings underline the importance of digitalisation in the development of rural tourism and suggest possible lines of political action for promoting digital platforms in rural areas.

**Keywords:** Digitalisation, Rural areas, NUTS classification, Tourism, depopulation, Digital Collaboration platforms, European Union, Regional statistics.

### Resumen

El trabajo plantea un análisis de la digitalización del sector del turismo y evalúa las potencialidades de este proceso para las zonas rurales de la Unión Europea (UE) a partir de factores tanto de oferta y de demanda del turismo rural, planteando un modelo de regresión que incorpora indicadores que relacionan el avance de la digitalización con cambios en el peso y las características del sector en las regiones de baja intensidad de población incluidas en el nivel NUTS 2. Los resultados que arroja la investigación indican una relación positiva entre la digitalización del sector y la oferta de alojamientos rurales, así como un impacto positivo en la demanda de dichas instalaciones. Además, se ha incluido la competencia potencial entre los alojamientos tradicionales y las plataformas digitales, revelando que el mayor uso de plataformas digitales para las reservas no afecta negativamente a las tasas de ocupación hotelera. Los hallazgos obtenidos subrayan la importancia de la digitalización en el desarrollo del turismo rural y sugieren posibles líneas de actuación política para la promoción de plataformas digitales en las zonas rurales.

**Palabras clave:** Digitalización, Áreas rurales, Clasificación NUTS, Turismo, Despoblación, Plataformas digitales colaborativas, Unión Europea, Estadísticas regionales.

## 1. Introduction

The trajectory of a good part of the economies that today make up the European Union reveals the importance of the tourism sector for their growth and development strategies, especially in those regions that have aspects to attract and maintain high flows of tourists over time (Capó & Valle, 2008; Vasanícova et al., 2022). Despite the high sensitivity of activities related to tourism to the ups and downs of the economy (as reflected by its increase in expansionary stages or its decrease when they are in periods of stagnation or economic recession), the truth is that this sector demonstrates a central role in those EU territories affected by the characteristics of rurality. The depopulation caused by scarce job and life opportunities, the relocation of business and industrial activities that explain the abandonment of these territories and other trends that generate serious problems in rural areas open the debate on possible responses that resolve this situation.

In this sense, European institutions, aware of the potential of tourism to boost growth and counteract the urgent challenges that affect the rural world, are betting on this sector. In recent years, increasing attention has been paid to the connection of rural tourism with economic development, given the greater dependence of these areas on tourism compared to urban areas (World Tourism Organization, 2020; European Commission, 2021). And this is reflected in the institutional agenda and in the European strategy for productive transformation to achieve sustained, sustainable, and digital growth in the member countries. We confirm that digitalisation has become a key catalyst in the development strategy of these European rural regions, as demonstrated by the initiatives developed by the European Commission in recent years. To drive a sustainable digital transformation in rural areas, promoting digital connectivity and the adoption of advanced technologies, and improving the development of digital skills, structural funds, ambitious community programs and numerous specific actions are being created to stimulate rural tourism. And many more efforts are expected in the near future.



It is demonstrated, therefore, that digitalisation has become an essential component in the development strategy of rural tourism in the EU. This is a strategy that has acquired even more relevance in the context after the health crisis, where it is confirmed that the advance of digitalisation has very positive effects on the revitalisation of activities, directly or indirectly, related to tourism and, by extension, on the economic growth of these regions. This European commitment to the sector's digitalisation forces us to evaluate its real effects on tourism supply and demand in rural areas and the results in boosting the sector and rural economies (OECD, 2020; Almeida-Santana et al., 2020; Tang et al., 2022; Guedes et al., 2023).

Therefore, this study focuses on analysing the relationship between digitalisation and tourism in rural areas of the EU based on a model that relates the variables of tourism supply and demand in those areas that, for different reasons, are considered within the rural category and in parallel, they explain better economic results depending on the level of digitalisation of the sector. The originality of our analysis with respect to previous literature is the use of European regions as the unit of analysis and the construction of the proposed model using variables for which information at that regional level is available in Eurostat. We find relationships between the level of digitalisation achieved in the tourism sector (from the perspective of educational and labour profiles and the use of digital tools for hiring) and other explanatory variables such as GDP per capita in rural areas and the tourist supply and demand for accommodation. The results demonstrate the positive relationship between digitalisation and the achievement of better results in the supply and demand of rural tourism, both in accommodation and traditional forms of contracting and in those more innovative and technological modalities. This indicates that digital advancement and tourism coexist in these areas, offering opportunities for economic development and diversification of the tourist offer, which are interesting to delve into for a better understanding.

## 2. Literature review of digitalisation and rural tourism

The tourism sector has proven to be key in the global economic drive, especially in those economies whose productive structures and growth models present high degrees of dependence on the activities located here and others directly related to it (Martí & Puertas, 2016; Rasool et al., 2021; Vasanicova et al., 2022). In this way, it is demonstrated that countries that, for different reasons, have a great tourist attraction see their national income increase, as well as the contribution of this sector to the GDP, benefiting at the same time from the chain effects generated by tourism in other economic branches of the country (Capó & Valle, 2008; Torres & Salá, 2008; Liu & Chenguang, 2019; Dreshaj et al., 2022).

However, we must not forget a risk that affects this sector, especially latent due to recent events (the Great Recession of 2008 or the subsequent health crisis), which compromises economies whose productive structures demonstrate a high dependence on tourism. As the literature points out, the high sensitivity of the sector (specifically, its demand) to the phenomena that mark economic drift seriously affects the evolution of tourism when periods of economic stagnation or recession occur (Apostolopoulos et al., 1996; Fiorello, 2010; Chica et al., 2021). In recent years, this high sensitivity explains the sharp variations in tourism records and has alerted international authorities: on a global scale, the contribution of the travel and tourism sector to the annual GDP was, in 2019, around 9.6 trillion dollars, a figure that was reduced by half with the health crisis and that, in recent years, has recovered moderately to reach 5.8 trillion in 2021 (according to data provided by the World Travel and Tourism Council). The possibilities of tourism supporting the growth of countries are therefore confirmed, but there are also risks that this entails for national models whose expectations depend mainly on activities linked to this sector.

From the European perspective, the relevance of the tourism sector is a reality in many economies that are now part of the EU. Specifically, its importance stands out in countries that have characteristics with which a higher level of tourist demand is related, such as better weather, lower average prices for stays, proximity to large urban centres, and cultural attractions or large coastal areas that are attractive for beach tourism (Martínez & Raya, 2008; Gemar et al., 2022; Guedes et al., 2023). Several attempts at regional analysis have been made based on regional data (NUTS) relating to point-of-sale electronic transactions in the tourism field (Marques et al., 2021; 2023).

Regarding the conditions that explain greater tourism flows, in recent years, new factors related to tourism potential have been pointed out by the literature, both on a national and local scale. Specifically, the following have been highlighted: the possibility of offering accommodation in quiet places far from cities, flexibility in the options for contracting the stay, access to the offer through intermediaries or digital platforms, the breadth of possibilities of cancellation or that there is an offer available for users of time-sharing systems (Hays & Buhalis, 2012; Fernández-Cavia et al., 2020; Caldevilla et al., 2021). Most of these factors describe a type of modernised tourism based on the benefits resulting from the commitment to the sector's digitalisation. Digitalisation and the green sustainability of the economy are the two strategic challenges guiding the EU's productive transformation (Troitiño, 2022; Matijová et al., 2023; Streimikiene, 2023).

Within the European strategy for green and digital transformation framework, tourism is clearly present due to the possibilities it allows for economies and, specifically, as a response to community rural regions' difficulties and problems. The characteristics of rural territories - such as their smaller territorial size, the small size of their economies and limited population volumes - cause a



strong relationship between prosperity and rural economic dynamism and the evolution of the records of this sector. A relationship that does not occur with the same intensity in the case of urban areas of those same countries. This has led tourism to be identified as the engine of economic reactivation in rural areas and, simultaneously, as a response to the problems shared by many of these territories. Such is the case of the disappearance of traditional activities located in these regions, the dismantling of small or medium-sized industries that have been moved to other places closer to large cities, the application of policies that promoted the concentration of investments in large cities or as a consequence of all of the above, the strong depopulation resulting from the lack of job opportunities for their inhabitants (Markey et al., 2008; López et al., 2021).

The rural world and the problems that currently affect it are among the main challenges for European institutions and require special attention from the economic plans and programs proposed at the community level (European Committee of the Regions, 2017). In this sense, many avenues of action, resources and strategies are implemented to reduce, stop, stabilise, or reverse depopulation and the movements of the affected population towards large cities, trying to resolve the social, economic, and environmental costs that cause these trends (Karcagi & Katona, 2012; Martínez et al., 2020). Tourism and the possibilities offered by the sector's digitalisation seem to be a possible way to address the worrying trends registered in rural regions in Europe, as demonstrated by recent economic literature.

We found relevant studies prepared by leading international organisations that show a direct correlation between investment in digitalisation and increased income and demand in the tourism sector. These studies present significant relationships with variables representative of economic progress, such as the case of the effects of digitalisation on the increase in GDP, the creation of new jobs in the technological sector or the improvements in tourism demand in the rural world (World Bank Group, 2018; OECD, 2020; European Commission, 2021). They point out that digital transformation and its application to attract greater flows related to tourism is part of the solution to solve the challenges faced by rural territories, in addition to advancing, at the same time, in achieving other objectives of international interest.

In parallel, several studies in this regard resort to a methodological proposal in line with that proposed in this work. For example, Hoonsawat's (2016) research analyses the effects of contracting through digital platforms that, resorting to the application of an extended gravity model to a set of data on international tourism flows from 1998 to 2012, evaluate the relationship between the level of Internet penetration and the effects on tourism. Guedes et al. (2023) used the traditional gravity model to explore the impact of both digital determinants and macroeconomic factors from origin countries on demand for international tourism to Southern European destinations. It is common to include variables such as per capita income or population in models of this type. These variables can play an important role in predicting international tourism flows, as they reflect purchasing power and population size, factors that can influence the capacity and propensity of residents of a country to travel to foreign tourist destinations.

Another approach is that of López-Córdova, J. (2020), who conducted a study using panel data analysis on tourist arrivals to countries in relation to various associated costs, cultural options and use of digital media, concluding that there are positive relationships linked to the adoption of digital platforms. In a very similar vein, the contribution of Goldfarb & Tucker (2019), who analyse how digital technologies reduce contracting costs in different sectors of the economy, or that of Tang et al. (2022) and his study about the significant relationships in regression models between the contracting of rural tourism establishments and the use of digital means of contracting. From another perspective, Almeida-Santana et al. (2020) uses a survey based on a representative sample of tourists from 19 European countries and applies a logistic regression (which includes personal and income characteristics, and different sources of contracting, conventional and digital platforms) that show positive and significant results with respect to new contracting methods (such as Expedia or Booking) and negative relationships concerning the most used social networks and traditional operators.

Based on this demonstrated capacity of the sector to generate income linked to digital tourism, we see the special attention paid to this issue by the academic world, but also present in political and territorial forums, as well as in the EU political agenda (Petrović et al., 2018; World Tourism Organization, 2020; European Commission, 2021; Vaishar & Šťastná, 2022). And specifically, with a special emphasis on rural regions. The binomial rurality and digital tourism has recently guided development strategies and plans in these regions, as demonstrated by the EU's community political agenda.

The European Commission (2021) has positioned itself in favour and has emphasised the importance of guaranteeing that rural areas and communities are at the centre of digitalisation, channelling European resources and promoting programs aimed at this objective. The "Rural Digital Futures" initiative is a clear example of this by proposing a set of integrated measures to promote a sustainable digital transformation in rural areas, aiming to make them more attractive as a destination for individuals and companies. Another focus of action for European institutions is developing digital capabilities through acquiring skills for digital transformation in rural areas, including access to a solid digital education system. These purposes are part of the strategic objectives of the Digital Education Action Plan 2021-2027, aimed at promoting digital skills and entrepreneurship so that all rural and urban



territories can benefit from the benefits of the digital transition. Additionally, the European Commission intends to evaluate progress in reducing the digital divide between urban and rural areas, reformulating current indicators, especially the Digital Economy and Society index, into an indicator of digitalisation in rural areas (European Commission et al., 2023).

Over a longer time, the objectives are more ambitious, at least those pursued by the Commission. This is demonstrated by its intention that, by 2030, the entire EU population will have full online access to democratic life and public services. According to the Digital Compass for 2030 (European Commission, 2021), the future objectives are expanded in several directions to respond: making essential public services fully available online for European citizens and businesses, ensuring that the entire population has access to their electronic medical records and that at least 80% use a digital identification solution by 2030. In parallel, it is worth highlighting that transportation also has a leading role and will be addressed in the new Mobility Framework EU Urban. In this regard, there is the intention to ensure that connections between urban and rural areas respond to rural needs.

To achieve the above, European financing, including European Regional Development Fund (ERDF), European Social Fund Plus (ESF+) and Connecting Europe Facility funds (CEF), together with national and private financing from countries, will collaborate to invest in the infrastructure, technology, and capacity development necessary to support the achievement of these goals. In addition to this financial support, the Commission undertakes to provide support to the responsible authorities to guarantee the extension of broadband Internet access, hoping that this will also contribute to greater digitalisation of the agricultural sector, which, on the other hand, it will be an objective to which other financial instruments traditionally operational in the EU will also be directed: such as the CAP, the cohesion policy or the Horizon 2020 strategy.

Another purpose of European policy is stimulating the rural economy and reducing disparities between urban and rural areas through rural tourism and digitalisation, an objective to which significant financing mechanisms have also been dedicated. In this sense, we locate the creation of structural funds and specific programs to promote rural tourism in less-developed regions, as well as the LEADER, PRODER, and INTERREG programs that have provided important incentives for the development of this tourism modality.

In parallel, this greater volume of resources has been combined with a greater role for digitalisation in rural areas after the health crisis, as demonstrated by the priorities in the plans that mark the rural agenda. In 2021, the European Commission presented to the European Parliament a long-term strategy for the development of rural areas in which the "Rural Digital Futures" digitalisation project was identified as a fundamental part of the regional development strategy. Likewise, the regular mention of these issues in the development plans promoted by the EU and where significant amounts of resources are being channelled in the coming years demonstrate the commitment to this type of strategy to address the problems that affect the rural world. Some examples can be found in the initiatives "Smart Rural and Agenda Spain 2025", which seeks to promote digital transformation in rural areas, "A Europe fit for the Digital Era", "2030 Digital Compass: The European path for the Digital Decade" or the priorities of the "Next Generation EU" funds that are oriented in one direction and with similar priorities for these regions.

All of the above demonstrates a digital commitment within the framework of the European economies that is reinforced by the "Digital Education Action Plan", which proposes moving towards societies and jobs in line with these digital priorities and is supported by plans such as the "European Skills Agenda", "the European Social Pillar Action Plan" and the "Digital Compass 2030: the European path for the Digital Decade". It is confirmed, therefore, that the digitalisation of the rural world and its application to tourism is a constant part of the EU's response plans and programs to the social, economic, and population problems of non-urban European regions.

### 3. Research Methodology

Building upon the discussion in the previous section, it is pertinent to examine the implications of this rural agenda, which focuses on promoting tourism through digitalisation, on the tourism sector. Additionally, it is important to evaluate the potential transformations that may alter the sector's traditional characteristics. In this research, we pose several questions underpinning our study's framework. Firstly, we aim to investigate whether digital rural tourism has enhanced both supply and demand in European territories and identify the key factors driving technological changes that have had the greatest impact on the tourism market. Another aspect involves analysing the shifts in the structure of supply and demand within this sector, pinpointing the regions that have potentially benefited by the increased levels of digitalisation in rural tourism.

The regional context upon which the working hypotheses will be formulated is the European Union. This section includes, firstly, a discussion on the statistical selection criteria necessary for studying rural establishments in the European context; secondly, based on these criteria, the formulation of research hypotheses; and finally, the selection of variables is elaborated upon to outline a model for contrasting the research hypotheses.



### 3.1. Territorial delimitation in the EU

Any analytical approach that wants to be made to the characteristics of rural areas and, specifically, tourism in these areas starts from the common nomenclature of territorial statistical units of the EU (Eurostat, 2022, pg 4-15 and 179-181), called "NUTS", with the legal basis of Regulation (EC) 1059/2003 of the European Parliament and modified on several occasions subsequently in response to the accession of new States to the EU, the current version of the NUTS Nomenclature is from 2021. The NUTS nomenclature is composed of three hierarchical levels, NUTS 1, NUTS 2 and NUTS 3, in which the second and third levels are subdivisions of the first and second levels, respectively. Each Member State can establish additional levels by subdividing the NUTS 3 level. It includes 92 NUTS level 1 regions, 242 NUTS level 2 regions and 1166 NUTS level 3 regions.

The NUTS level to which an administrative unit belongs is determined based on demographic thresholds, and if there is no administrative unit of sufficient size in a Member State for a given level of the nomenclature, this level will be established by adding an appropriate number of additional administrative units, small and contiguous (units thus added are called "non-administrative units").

- NUTS 1 between 3 and 7 million inhabitants, currently 92 regions in the EU.
- NUTS 2 between 800,000 and 3 million inhabitants, currently 242 regions in the EU.
- NUTS 3 between 150,000 and 800,000 inhabitants, currently 1166 regions in the EU.

The NUTS typology is fundamentally established according to the degree of urbanisation and defines urban areas with a minimum population density threshold of 300 inhabitants per km<sup>2</sup> and a minimum threshold of 5,000 inhabitants. The population living in rural areas is the population who live outside the urban areas identified through the method described above, and subsequently, the regions are classified into three categories: predominantly rural region when more than 50% of the population lives in rural municipalities; intermediate region when between 15% and 50% of the population lives in rural local units and predominantly urban region with less than 15% of the population lives in rural local units. However, there are other delimitations of rural regions, for example, the methodology of the Organisation for Economic Cooperation and Development (OECD) exclusively uses population density as a criterion to delimit rural areas and, from there, establishes that local units are defined as rural if its population density is less than 150 inhabitants per square kilometres.

### 3.2. Research Hypotheses and Variable Selection

The first working hypothesis (H1) is that the digitalisation of tourism can result in an increase in both hotel establishments in the areas under analysis (H1.1), as well as an increase in the demand for rural tourism establishments (H1.2). The second working hypothesis (H2) is whether the digital booking of vacation accommodations through platforms (largely offered by individuals) leads to an increase in both the total supply of tourist accommodations (H2.1) and bookings in the analysed areas (H2.2). In other words, it does not go against traditional forms of tourism booking in rural areas (hotel facilities).

To design a model with the stated hypotheses, the variables used are sourced from regional statistics classified by NUTS (Nomenclature of Territorial Units for Statistics) at the NUTS 2 disaggregation level, where digitisation proxy variables are available. In all cases, 2020 data has been excluded due to the COVID-19 pandemic causing disruptions in the data series, with numerous missing values and high variability. A sample of 181 NUTS that provided information for estimation was entered into the database. Research at the NUTS 3 level of disaggregation was not possible due to the unavailability of information regarding variables related to tourism and digitalisation. This implies that the database encompasses regions with very different dimensions, including autonomous communities of Spain alongside municipalities from other countries. For the sample, regions have been selected based on different criteria to maintain a degree of homogeneity: excluding from the database clearly non-rural areas (more than 300 inhabitants per square kilometre); the result of this selection process resulted in a database with 75% of the selected NUTS with less than 150 inhabitants per square kilometre.

To capture the tourism supply in the studied areas, statistics on capacity and utilisation in tourist accommodations from EUROSTAT were used, including "hotels and similar accommodation," "holiday and other short-stay accommodation," and "camping grounds, recreational vehicle parks, and trailer parks." The number of occupied beds was selected instead of establishments or rooms to capture tourism capacity more accurately. For demand, overnight stays in rural areas and the total net bed occupancy rate in the analysed areas were collected. 2019, 2021, and 2022 data were collected to calculate the averages for the following supply and demand variables. Specifically, the variables that have been studied:

RURTOT: Supply variable that includes the number of bed-places at tourist accommodation establishments ("hotels and similar accommodation", "holiday and other short-stay accommodation" and "camping grounds, recreational vehicle parks and trailer parks") in the rural areas within the NUTS2 classified by EUROSTAT.



NIGRURTOT: Demand variable that collects nights spent at tourist accommodation establishments (“hotels and similar accommodation”, “holiday and other short-stay accommodation” and “camping grounds, recreational vehicle parks and trailer parks”) in rural areas within the NUTS2 classified by EUROSTAT.

HBED: Offer variable that includes the number of bed-places in tourist hotels and similar accommodations (not holiday and other short-stay accommodation or camping grounds, recreational vehicle parks and trailer parks).

HOCUP: Net occupancy rate of bed-places in hotels and similar accommodations (not holiday and other short-stay accommodations, camping grounds, recreational vehicle parks, and trailer parks).

To study the effect of digitalisation on tourism demand and supply, the following variables were analysed, also in average of 2019, 2021 and 2022:

PLATF: Proxy for the digitisation of tourist accommodation. Its name in Eurostat is “Guest nights spent at short-stay accommodation offered via collaborative economy platforms”, which quantifies the contracting of accommodation through platforms without considering hotels and campsites, that is, it only considers holidays and other short-stay accommodation (houses and apartments). This is an experimental statistic based on the agreement reached by Eurostat with four international platforms (Airbnb, Booking.com, Expedia Group, Tripadvisor) in 2020. It collects the number of nights spent during a stay, considering the size of the group of guests. A trip, for example, a family of four staying three nights in an apartment represents one stay, three nights, and 12 nights of guests.

EMPTec: Business digitalisation proxy because it quantifies Human Resources in Science & Technology: Persons employed in science and technology in the percentage of the population in the labour force. The information allows us to distinguish human resources in Science and Technology aged 16 and over in the International Standard Classification of Occupations (ISCO). The data reflects the number of Science and Technology Resources occupied and their percentage concerning the active population of the ISCO 3 group: Technicians and associate professionals, which include, among others, the provision of information and communications technicians’ services.

Finally, it was decided to include in the research a set of control variables with economic and demographic content:

GDPPC: GDP euros per inhabitant at current market prices in average data from 2019, 2021 and 2022.

EDUCT: Percentage of people from 25 to 64 years with tertiary education (levels from non-university tertiary education to doctorate).

DEPOP: Depopulation (or rurality) dummy variable that takes the value 1 in the NUTS2 with a population density of less than 150 inhabitants per square kilometre.

MEDITERR: Dummy variable that delimits the NUTS that takes the value 1 in the NUTS2 with less than 300 inhabitants per square kilometre of Spain, Italy, Greece, and Portugal.

### 3.3. Model specification

The estimated Ordinary Least Squares (OLS) regression model, or multiple linear regression, follows the specification:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_p X_{pi} + \epsilon_i$$

$Y_i$  represents the dependent variable for unit  $i$  and  $X_{1i}, X_{2i}, \dots, X_{pi}$  represents the  $p$  explanatory variables defined for each unit within the EU regions specified in the following subsection. The error term  $\epsilon_i$  follows a standard normal distribution.

Several cross-section models have been proposed based on the NUTS level 2, which are those that would have the character of an intermediate or rural region, considering the following:

The first working hypothesis (H1) is based on the first focus of the analysis, which is to contrast whether the digitalisation of tourism is beneficial for rural tourism. To do this, in a first phase, we will study how it affects supply and, in a second phase, how the model changes by replacing the dependent variable with a demand variable. As has been highlighted in the previous section, the supply variable in rural areas is defined as tourist establishments in rural areas (RURTOT) and for demand the nights contracted in tourist establishments in rural areas (NIGRURTOT).

The independent variables of the model will have two variables linked to the digitalisation of the regions, firstly, a proxy for the digital development of regional tourism through the PLATF variable and, secondly, a proxy for the level of business digitalisation or digital specialisation of workers in the region analysed through the EMPTec variable. In addition, an economic level variable will be used with the GDP per capita with the GDPPC variable, another educational level variable (EDUCT) as a percentage of people who have tertiary education in the region and a proxy variable of depopulation (DEPOP).





Two models were developed using the set of independent variables. In the first model, the influence of these variables on the tourism offer is examined (H1.1). The dependent variable used is the number of beds in tourist accommodation establishments (RURTOT). In the second model, which analyses the effects on demand (H1.2), the dependent variable is the number of overnight stays in tourist accommodation establishments (NIGRURTOT).

To test the second hypothesis (H2), the bulk of the explanatory variables from the first model were included, along with an additional dummy variable to characterise regions of the Mediterranean area (MEDITERR). Hypotheses H2.1 and H2.2 will be tested. The dependent variables in these tests are the supply variable number of beds in tourist hotels and similar accommodations (HBED) and the net occupancy rate of beds in hotels and similar accommodations (HOCUP).

#### 4. Results

The first estimated model (H1.1.), whose estimation results can be seen in Table 1, shows us how the level of accommodation supply in rural areas has a direct relationship with the digitalisation variables and with the level of GDP per capita, while the relationship is negative with the educational level. Regions with low population density have a greater supply of rural accommodation, which suggests tourism's economic and social relevance in rural areas.

**Table 1: Results of model H1.1 with supply variable**

Dependent variable: RURTOT						
F(5, 176) = 70.68						
Prob > F = 0.0000						
R-squared = 0.7154						
Adjusted R-squared = 0.707						
Root MSE = 54694						
	Coefficient	Robust std.err.	t	P> t	95% confident Interval	
PLATF	.0167093	.0038259	4.37	0.000	.0091588	.0242599
EMPTEC	1249,062	682.1875	1.83	0.069	-97.25862	2595.382
GDPPC	.9908107	.3702283	2.68	0.008	.2601525	1.721469
EDUCT	-1934,627	655.2437	2.95	0.004	-3227,773	-641.4808
DEPOP	33565.76	11407.2	2.94	0.004	11053.25	56078.26

**Source:** own elaboration.

The probability associated with the F statistic implies that at least one of the independent variables is significant in the model. The model presents a high coefficient of determination (R-squared), which explains 71.54% of the variability in the dependent variable. Corrected for the number of independent variables used in the model relative to the sample size, the adjusted R-squared decreases slightly to 70.7%. The value of the F-test of overall significance indicates that our linear regression model provides a better fit to the data (rejecting the null hypothesis that all coefficients associated with the independent variables are zero). The model without constant had to be re-estimated as it was not significant. Additionally, the model had to be corrected for heteroskedasticity, using the White (1980) method to obtain robust standard residuals.

Regarding the coefficients associated with the independent variables, the estimated coefficient for the PLATF variable is positive and statistically significantly different from zero. It is a proxy variable of digitalisation used in contracting collaborative platforms on the Internet and is positively related to the tourist offer variable in rural areas.

The estimated coefficient for the GDPPC variable is approximately 0.9908. The associated p-value is 0.008, indicating statistical significance. The EMPTEC variable has a probability associated with the t-student value, the ratio between the coefficient value and its corrected standard errors, above the typical threshold of 5%. The parameter is not significant at 95%, and this positive relationship could be interpreted as taking a confidence level higher than 90%.

The estimated coefficient for the EDUCT variable has an associated p-value of 0.004, which indicates high statistical significance. The negative sign shows a negative relationship between the rural tourist occupation variable and the level of education proxy of the NUTs.

The DEPOP variable is significant at a 95% confidence level. This depopulation proxy seems to explain a significant part of the variability in the dependent variable, with an associated positive beta, confirming the economic background that there is a greater rural tourist offer in areas with lower population density.

The second estimated model (H 1.2) changes the dependent variable to a demand variable, NIGRURTOT, which collects overnight stays in rural tourist facilities. In this case, the coefficient of determination is somewhat lower than in the case of the supply model; the adjusted R-squared reflects a lower fit compared to the first estimated model, at 56.34%. However, the hypothesis that the variables introduced in the model result in a good fit is accepted based on the F-test. It also has a high value of the standard error



of the root of the residuals, a measure of how much the model's prediction errors vary, suggesting that the prediction errors are relatively large. In any case, it is a model that attempts to explore the relationships between a rural tourism use variable and the same group of variables that influence the supply variable.

Table 2 shows the results of the model regarding H1.2 hypothesis. In this case, the constant also had to be eliminated from the estimation. Besides, considering the significance level of the estimated coefficients, PLATF, EMPTEC and EDUCT would be part of the group of interpretable variables (the latter with a p-value somewhat above 5%), and the rest of the variables would be non-significant. The signs are identical to those obtained with the supply relationship: positive for the digitalisation proxy and the human capital proxy with technological specialisation and negative with the education variable.

**Table2: Results of model H1.2 with demand variable**

Dependent variable: NIGRURTOT						
F(5, 176) = 44.33						
Prob > F = 0.0000						
R-squared = 0.5759						
Adjusted R-squared = 0.5634						
Root MSE = 2.7e+06						
	Coefficient	Robust std. err.	t	P> t	95% Confidence Interval	
PLATF	.4163678	.1302441	3.20	0.002	.1593265	.673409
GDPPC	28.86839	16.81475	1.72	0.088	-4.316095	62.05288
EMPTC	92357.74	32496.31	2.84	0.005	28225.16	156490.3
EDUCT	-65569.92	33635.27	1.95	0.053	-131950.3	810.4382
DEPOP	302728.8	548374.9	0.55	0.582	-779507.9	1384965

Source: own elaboration.

The lower significance of the GDPPC variable in relation to the level of overnight stays makes economic sense, as the attraction of visitors to a rural area will depend more on the income level of the region of origin. Similarly, the depopulation proxy follows the same logic, as the relevant factor here is the total number of potential visitors, not just the possibilities of domestic tourism.

The second working hypothesis (H2), reflected in the second group of estimated models, is based on the attempt to contrast whether digitalisation channelled through the contracting of vacation accommodation through platforms (largely offered by individuals) harms hotels in each of the selected areas. In this case, the rural component is not exclusive since the database has eliminated regional areas that are clearly not rural (those with more than 300 inhabitants per square kilometre), but rather, the aim is to examine whether the variables of the database used for the rurality model have explanatory capacity on hotel supply and demand in the NUTS.

The supply model of this second hypothesis (H2.1.), whose results are shown in Table 3, explains a very significant part of the variability of the dependent variable, with an Adjusted R-squared of 73.75%. It also had to be estimated, neglecting the constant, since it was not significant. The proxy variables of digitalisation in PLATF contracting and per capita income of the NUTS (GDPPC) are significant. In addition, a variable has been introduced that contributed to the explanation of the regression model, related to the regional variable, specifically the DUMMY of Mediterranean countries (MEDITERR), which is clearly related to the level of beds offered, which confirms the hypothesis of greater installed capacity in Mediterranean countries, with a strong tourist tradition. This model does not confirm that contracting on platforms and tourism supply move in opposite directions.

**Table 3: Results of model H2.1 with supply variable**

Dependent variable: HBED						
F(5, 176) = 69.01						
Prob > F = 0.0000						
R-squared = 0.7425						
Adjusted R-squared = 0.7375						
Root MSE = 40339						
	Coefficient	std.err.Robust	t	P> t	95%conf.interval	
PLATF	.0113226	.0017802	6.36	0.000	.0078093	.0148359
GDPPC	.6899191	.2501727	2.76	0.006	.1961947	1.183643
EDUCT	-874.1962	486.0348	-1.80	0.074	-1833.403	85.01012
EMPTC	770.5873	493.7967	1.56	0.120	-203.9374	1745.112
MEDITERR	40677.72	8926.292	4.56	0.000	23061.38	58294.06

Source: own elaboration.





The last estimated model (H2.2.), whose results are shown in Table 4, changes the dependent variable for a demand variable, HOCUP, which reflects the tourist occupation in the NUTS areas. It has also not been observed that hiring on digital platforms in the NUTS negatively impacts hotel occupancy. The model has a clearly worse fit than the supply model with a coefficient of determination of 36.36%, adjusted R-squared 34.74%, largely because only two of the variables that were used in the case of the supply model are significant. However, the F-test confirms the existence of significant relationships between the predictors and the dependent variable. The use of digital platforms is an explanation of tourist occupancy. The MEDITERR variable is statistically significant and has a positive coefficient, which has an economic interpretation in that occupancy is also higher in the NUTS zones of Mediterranean countries than in other European regions.

**Table 4: Results of model H2.2 with demand variable**

Dependent variable: HOCUP						
F(5, 175) = 16.50						
Prob > F = 0.0000						
R-squared = 0.3636						
Adjusted R-squared = 0.34735						
Root MSE = 6.2302						
	Coefficient	std.err.Robust	t	P> t	95%conf.interval	
PLATF	1.06e-06	1.43e-07	7.40	0.000	7.75e-07	1.34e-06
GDPPC	.0000374	.0000523	0.72	0.475	-.0000657	.0001406
EDUCT	.0019468	.0731262	0.03	0.979	-.1423759	.1462695
EMPTTEC	.0993536	.1286286	0.77	0.441	-.1545094	.3532165
MEDITERR	5.163468	1.346292	3.84	0.000	2.50641	7.820527
_cons	29.72183	2.929519	10.15	0.000	23.9401	35.50357

Source: own elaboration.

## 5. Discussion

This work explores the correlation between digitalisation, tourism, and other factors in rural areas of the European Union. Although the initial relationship may seem clear due to the potential for economic and social development that digitalisation offers in a broad sense, it is limited by the scarcity of statistical information on rural areas and the complexity of "digitalisation" as a variable to quantify. The degree of digitalisation of companies, individuals, the public sector, etc. However, an effort has been made to address these challenges by defining variables that encapsulate the dimension of digitalisation and using the available information, together with the delimitation of rural areas using the EU NUTS Nomenclature. This type of analysis based on NUTS is in line with that carried out by other studies, such as that of Guedes et al. (2021; 2023).

In this sense, the article defines two types of models to analyse the aforementioned phenomenon: one to examine the supply and another to assess the demand for tourism in rural areas. These models incorporate independent variables such as digitalisation (measured using data from collaborative platforms), GDP per capita, education, employment in the technology sector, and depopulation to elucidate both the supply (quantified by the number of beds in tourist accommodation) and the demand (represented by overnight stays in tourist accommodation). The study has confirmed that digitalisation, as measured by the use of digital platforms, positively influences the tourist offer in rural areas without affecting hotel occupancy adversely. Correlations with variables such as GDP per capita, education, and depopulation are also evident.

The results derived from models based on the first Working hypothesis, H1.1 and H1.2, employing variables pertaining to tourist supply and demand, also underscore the significance of digitalisation in rural tourism development, aligning with assertions made by Troitiño, 2022, Matijová et al., 2023, and Streimikiene, 2023, regarding digitalisation as a pivotal aspect of productive transformation. Additionally, they posit that regions characterised by low population density exhibit a heightened provision of rural accommodation, thereby underscoring the economic and social importance of tourism in rural locales, as corroborated by Martí & Puertas, 2016, Rasool et al., 2021, and Vasanicova et al., 2022.

In our assessment, models formulated under this initial hypothesis furnish promising insights. However, the implications of the outcomes obtained therein should be juxtaposed with models constructed using data featuring a more refined regional breakdown.

On the other hand, the second Working hypothesis (H2) endeavours to ascertain whether digitalisation, facilitated through the procurement of holiday lodgings via platforms (largely facilitated by private entities), adversely affects the hotels situated within each of the designated zones. In this scenario, the rural element is not exclusive; rather, it involves an examination of whether the variables within the database employed for the rural model possess explanatory capacity regarding both hotel supply and demand within the NUTS.



In summary, we contend that this study furnishes valuable insights into the nexus between digitalisation and rural tourism, thereby paving the way for future research endeavours within this domain. Nevertheless, it is imperative to underscore the necessity for supplementary analyses and the consideration of other potential factors that could influence rural tourism.

## 6. Conclusions and Implications

Through the analysis presented in this article, focused on NUTS regions, we can conclude that digitalisation boosts tourism in terms of supply and demand. It is particularly compelling to assess their potential contribution to the economic growth of these regions. One aspect we observe is how the extent to which tourists stay or supply capacity correlates with the greater digitalisation in rural areas. Furthermore, beyond affirming the correlation between the advance of digitalisation and the increase in tourism demand and the consequent increase in income, it is conceivable to evaluate the change in the nature of the flows that drive a more intensive use of the platforms. Determining whether these changes reduce the sector's vulnerability is also possible.

### 6.1 Theoretical Implications

As we have been able to analyse, different studies evaluate the relationship between tourism demand or supply and variables linked to digitalisation. From a theoretical point of view, there is a common link between the different studies since the facilities provided by digital platforms for hiring accommodation and meals in tourist areas are significantly related to the greater demand or supply of tourism. In our case under study, we present an analysis based on a regional database, adopting a delimitation of NUTS regions to avoid clearly studying non-rural areas. This filtering of data in the Eurostat database is different from that proposed in previous studies, such as that of Guedes et al. (2023) or López-Cordova (2020), who make use of other databases such as Google Trends or the reports of the Bilateral tourism flows come from the United Nations World Tourism Organization (UNWTO). Although data from different statistical sources are analysed, there are common elements because digital contracting through the main platforms such as Expedia, Booking or Tripadvisor is present in our study and in the economic literature.

### 6.2 Practical Implications

From a practical perspective, one implication of the study is related to the problems of accessing relevant statistical information in rural areas. In our analysis, we recognise the limitation in the use of statistics available for the entire NUTS, which has made including new variables difficult. A future extension of this research is further to refine the delimitation of the rural areas under study; in this sense, the database of digitalisation and rurality variables has been requested from EUROSTAT, counting on the NUTS 3 level. Furthermore, it would be worth considering future research in areas directly related to this study, such as the impact of COVID-19 on rural tourism. This analysis could be relevant for the formulation of policies and strategies in the tourism and rural sectors. For example, if digitalisation positively impacts tourism offerings, there could be incentives to encourage the use of digital platforms in rural areas. These findings could offer valuable guidance for decisions and resource allocation in promoting tourism in these regions.

Another practical implication of the results is to explore how increasing the use of platforms for booking tourist stays can affect job stability in companies linked to tourist reservations with a more physical or virtual component. This leads us to consider the reasons for this competition between workers in the same sector since it is possible to investigate the feedback of both ways of accessing stays in the same destination, regardless of the diversity of types of accommodation or reservation methods. Additionally, this opens avenues to explore emerging opportunities in this area, which multiply with the arrival and proliferation of new developments facilitated by the digital field and artificial intelligence.

Finally, a practical aspect of the analysis that is different from those exposed before is identifying distinctive features that characterise areas where tourism has experienced conventional growth or depends on new trends. This could allow us to evaluate whether digitalisation can help mitigate the risks derived from a high dependence on tourism in the economic structure of countries and risks related to the sector's susceptibility to various phenomena (crisis, climate fluctuations, seasonality, inflation, etc.).

### Credit author statement

All authors have contributed equally. All authors have read and agreed to the published version of the manuscript.

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