

UNIVERSIDAD COMPLUTENSE DE MADRID  
FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES



**TESIS DOCTORAL**

The contribution of digital platforms to the transformation of the travel industry:  
Evidence on growth, resilience, and sustainability

La contribución de las plataformas digitales a la transformación de la industria  
turística: Evidencia en crecimiento, resiliencia y sostenibilidad

MEMORIA PARA OPTAR AL GRADO DE DOCTOR

PRESENTADA POR

Tomás Agustín Saralegui Escribal

DIRECTOR

Rafael Myro Sánchez

**UNIVERSIDAD COMPLUTENSE DE MADRID**  
FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES  
DOCTORADO EN ECONOMÍA



**TESIS DOCTORAL**

The contribution of digital platforms to the transformation of the travel industry:  
Evidence on growth, resilience, and sustainability

La contribución de las plataformas digitales a la transformación de la industria turística:  
Evidencia en crecimiento, resiliencia y sostenibilidad

MEMORIA PARA OPTAR AL GRADO DE DOCTOR

PRESENTADA POR

Tomás Agustín Saralegui Escribal

DIRECTOR

Rafael Myro Sánchez

*A mi familia*

Me siento inmensamente agradecido por la oportunidad de haber podido realizar este doctorado en Economía, investigando el sector que me apasiona, el turismo.

Agradezco especialmente a Rafael Myro Sánchez, mi director y tutor, quien sembró en mí la idea de este desafío y me motivó en todo momento a superarme. Sin su apoyo esto no habría sido posible.

Agradezco también a todo el cuerpo docente del programa de Economía, en particular a su comisión académica, así como al profesorado del Máster en Economía y Gestión de la Innovación de la Universidad Complutense de Madrid, Universidad Autónoma de Madrid y Universidad Politécnica de Madrid, y al del Máster en Economía y Gestión del Turismo de la Universidad de Buenos Aires.

Asimismo, quiero agradecer el feedback recibido en estos años de investigación por parte de las y los revisores de las revistas y congresos donde se han presentado resultados parciales de esta investigación.

Por último, quiero agradecer a mi familia que me ha apoyado en todo este proceso.

# Index

Index	4
Resumen	11
Abstract	12
<b>1. Introduction</b>	<b>13</b>
1.1 Two-sided markets and the platform economy	14
1.2 Travel industry: recovery and transformation	19
1.3 Research objectives	21
1.4 Methodology, delimitation, and resources	22
1.5 Thesis structure	23
1.6 References	26
<b>2. The impact of P2P accommodation on tourism demand: Do we observe more tourist arrivals because of Airbnb's innovation?</b>	<b>31</b>
Abstract	32
2.1 Introduction	33
2.2 Background & Literature Review	35
2.2.1 Sharing Economy & Peer-to-Peer accommodation	35
2.2.2 Tourism Demand	38
2.3 Methodology	40
2.3.1 Framework	42
2.3.2 Model	42
2.3.3 Data	45
2.4 Results & Discussion	50
2.5 Conclusions	57
2.6 References	59
<b>3. eWOM platforms as productivity catalyzers in the travel industry: a two-stage double bootstrap data envelopment analysis</b>	<b>70</b>
Abstract	71

3.1 Introduction	72
3.2 Background & Literature Review	74
3.2.1 Electronic Word of Mouth	74
3.2.2 Productivity & efficiency	79
3.3 Methodology	80
3.3.1 Framework	80
3.3.2 Data	84
3.4 Results & Discussion	87
3.5 Conclusion	94
3.6 References	97
<b>4. Filling up empty seats in cars as a responsible transportation production practice: exploring the effect of carpooling on aggregate road transport demand</b>	<b>104</b>
Abstract	105
4.1 Introduction	106
4.2 Background & Literature Review	110
4.2.1 Transport	110
4.2.2 Carpooling	113
4.2.3 Blablacar	116
4.3 Methodology	122
4.3.1 Framework	122
4.3.2 Model	124
4.3.3 Data	126
4.4 Results & Discussion	127
4.5 Conclusion	132
4.6 References	136
<b>5. Conclusions</b>	<b>147</b>
5.1 Policy implications	150
5.1 Academic Contributions & Limitations	151
5.3 Lines for future research	152

Annexes	154
Annex 1: Partial Autocorrelation analysis	154
Annex 2: Web Scraper information and code	157

# List of tables

Table 1: Two-sided platforms examples	15
Table 2: Thesis structure	24
Table 3: Reviewed literature modeling tourism demand	43
Table 4: Variables description	50
Table 5: Descriptive statistics	51
Table 6: Results for Structural Break	52
Table 7: Results for Interest in P2P Accommodation	53
Table 8: Coefficient interpretation for cebreak	55
Table 9: Coefficient interpretation for xlnctrend	55
Table 10: Causality test for international tourist arrivals and interest in the P2P innovation	56
Table 11: Reviewed literature employing the two-stage double bootstrap DEA	82
Table 12: Variables description	87
Table 13: Descriptive statistics	88
Table 14: DEA results	89
Table 15: Descriptive statistics of technical efficiency	89
Table 16: Simar & Wilson results	90
Table 17: Simar & Wilson results - continued	91
Table 18: Hypotheses' confirmation summary	94
Table 19: Reviewed literature modeling road transport demand	124
Table 20: Variables description	128
Table 21: Descriptive statistics - Monthly time series	128
Table 22: Descriptive statistics - Yearly time series	128
Table 23: Results - Monthly time series	129

Table 24: Results - Yearly time series	130
Table 25: Causality test for road transport demand model	131

# List of figures

Figure 1: Interest in Spain toward hospitality brands over time	37
Figure 2: Spanish Inbound Tourism Markets from 2005 to 2015	41
Figure 3: International Tourist Arrivals - Gross terms	46
Figure 4: International Tourist Arrivals - Quarterly interannual change rate	47
Figure 5: eWOM as a research topic	75
Figure 6: eWOM Management in the Travel Industry	78
Figure 7: Research framework	83
Figure 8: Data scraped from Trustpilot	86
Figure 9: Carpooling advertisement in a Spanish paper from 1791.	108
Figure 10: Global average CO2 emissions in kilograms per passenger kilometer (PKM)	112
Figure 11: Passenger vehicle occupancy rate and ownership index in Europe	113
Figure 12: BlaBlaCar platform	117
Figure 13: Year-over-Year growth of BlaBlaCar users in Spain	118
Figure 14: Preferred transport means alternatives for carpooling drivers	120
Figure 15: Preferred transport means alternatives for carpooling passengers	121
Figure 16: Partial autocorrelation analysis per country	156

## List of acronyms

- CRS: Constant returns of scale
- DEA: Data envelopment analysis
- DMU: Decision-making units
- EMU: European Monetary Union
- eWOM: Electronic word of mouth
- GDP: Gross domestic product
- GLS: Generalized least squares
- INE: Spanish National Statistics Institute (Instituto Nacional de Estadística)
- LLC: Low-cost carriers
- OECD: Organisation for Economic Cooperation and Development
- OLS: Ordinary least squares
- P2P: Peer-to-Peer
- SA: Sharing economy
- SDG: Sustainable development goal
- TFP: Total factor productivity
- UGC: User-generated content
- UNWTO: United Nations World Tourism Organization
- VKM: Vehicles per kilometer
- VRS: Variable returns of scale
- WOM: Word of mouth

# Resumen

El auge de la digitalización está transformando diferentes industrias a escala global. En el contexto en que los consumidores están expuestos a grandes niveles de sobreinformación, las plataformas digitales están ganando adopción al simplificar el acceso a la información. Las plataformas digitales conectan diferentes lados de un mercado, habilitando nuevas interacciones entre diversos actores y generando nuevas oportunidades de creación de valor. Estas plataformas están transformando la industria turística. Esta investigación analiza cómo las plataformas digitales están contribuyendo a la transformación de la industria turística. El estudio se centra en tres desafíos que está afrontando el sector turístico: recuperar el crecimiento, construir resiliencia y transitar a prácticas más sostenibles. Cada capítulo analiza cómo algunas innovaciones, promovidas por plataformas digitales como Airbnb, Tripadvisor o BlaBlaCar, están contribuyendo a afrontar estos desafíos. La primera investigación analiza el efecto de la innovación de alojamiento entre pares (P2P) en los flujos internacionales de turistas. Aplicando diferentes modelos de paneles de datos dinámicos y GLS, este estudio analiza el efecto de la innovación de Airbnb en la demanda turística. Los resultados revelan que esta innovación ha tenido un impacto positivo y significativo en la demanda turística internacional. La segunda investigación analiza cómo el boca a boca digital, promovido por plataformas como Trustpilot, puede ayudar a las agencias de viaje a incrementar su productividad. La eficiencia de las agencias de viaje se analiza a través de un análisis envolvente de datos de dos etapas. Los resultados permiten afirmar que las empresas que gestionan el boca a boca digital se encuentran más cerca de la frontera de la productividad, y que gestionarlo proactivamente tiene una correlación positiva con la eficiencia productiva. Por último, el tercer estudio analiza cómo la innovación del carpooling de larga distancia, impulsado por plataformas como BlaBlaCar, puede promover la producción y consumo más responsable de transporte por carretera. Esta investigación analiza en una serie temporal el efecto de la adopción del carpooling de larga distancia en un modelo de demanda agregada de transporte por carretera. Los resultados sugieren que esta innovación puede tener un impacto negativo y significativo en la demanda de transporte. Este trabajo concluye que las plataformas digitales están contribuyendo a la transformación de este sector, y presenta recomendaciones de políticas públicas que permiten promover la difusión de estas plataformas, capitalizando sus externalidades positivas y mitigando sus impactos negativos.

# Abstract

The rise of digitalization is transforming several industries worldwide. In times when consumers are exposed to unprecedented amounts of information, digital platforms are gaining value and seeing increased adoption. These platforms connect two sides of a market, enabling interactions and creating value in new ways. In the travel industry, these platforms are reshaping the future of the sector. This research has set out to analyze how two-sided digital platforms contribute to the transformation of the travel industry. This work focuses on three specific challenges that the travel industry is facing: revitalizing growth, enhancing resilience, and transitioning into more sustainable formats. Each chapter analyzes how specific innovations put forward by two-sided platforms like Airbnb, Tripadvisor, or BlaBlaCar contribute to facing these challenges. The first study analyzes the effect of the peer-to-peer (P2P) accommodation innovation on international tourist flows. By means of different dynamic data-panel and random effects GLS panel models, this research analyzes the effect of Airbnb's innovation on international tourism demand. Results reveal a significant and positive impact of the P2P accommodation innovation on international tourist flows. The second study analyzes how electronic Word of Mouth (eWOM) platforms like Trustpilot can help travel agencies improve their productivity. The efficiency of travel agencies is assessed by means of a two-stage double bootstrap data envelopment analysis. Results show that firms that proactively manage eWOM are closer to the efficiency frontier and that doing so positively correlates with higher levels of productive efficiency. Lastly, the third study assesses how the long-distance carpooling innovation put forward by platforms like BlaBlaCar can promote more responsible production and consumption road transportation practices. This research analyzes the effect of the adoption of long-distance carpooling on the aggregate road transport demand. Findings show that this innovation can have a negative and significant impact on aggregate road transport demand. This work concludes that two-sided platforms are indeed reshaping the travel industry and presents policy implications that may foster the diffusion of two-sided platforms, leveraging these innovations' positive externalities while mitigating their negative impacts.

## 1. Introduction

# 1. Introduction

The travel industry, as many other sectors, is being reshaped by digitalization. Consumers are exposed to an overwhelming volume of information, which at the same time, causes the need to systematize, organize, and corroborate all this knowledge. In this context, digital platforms are becoming more valuable and widely embraced than ever. These platforms act as intermediaries, providing the environment to access relevant information, facilitating interactions, and in doing so, generating innovative forms of value. In the travel industry, these platforms are transforming the sector's future. Since tourism is a key contributor to many worldwide economies and has significant social and environmental externalities, there is a pressing need to assess how these new technologies are transforming this sector. This work addresses this need and seeks to assess the transformational potential of the platform economy in the tourism industry.

## 1.1 Two-sided markets and the platform economy

There is little question that digitalization has transformed how people interact with their surroundings. Thanks to information and communication technologies, people have access to more information than ever. Some decades ago, consumers depended mostly on proximity to firms to acquire products or services. As these technologies developed, consumers reached an unprecedented amount of information available online and no longer necessarily depend on nearby commerce. Such paramount information made imperative the need to structure access to information, and most importantly, to coordinate how different groups of people or firms communicate and interact.

Many of today's most prominent, highest-valued, and fastest-growing companies and startups have one thing in common. They provide a platform that connects two or more distinct groups of users or firms, allowing them to interact in a structured and organized way. Visa connects cardholders with merchants. Uber connects travelers with drivers. Amazon connects buyers with vendors. PlayStation connects gamers with game developers. Examples can be found across most industries, ranging from education to healthcare, and from travel to consumer goods.

Side A	Platform	Side B
Cardholders	Debit and credit cards (ie: Visa, Mastercard, American Express)	Merchants
Gamers	Video game platform (ie: PlayStation, Xbox)	Game developers
Users	Operating system (ie: Windows, MacOS, Android)	Application developers
Readers/Viewers	Media platforms (ie: Netflix, Vogue, YouTube)	Advertisers
Job seekers	Online recruiting platforms (ie: Monster, Indeed, Recrutee)	Employers
Travelers	P2P accommodation platforms (ie: Airbnb, Vrbo)	Homeowners
Passengers	Carpooling and Ridesharing platforms (ie: Uber, Cabify, BlaBlaCar)	Drivers
Consumers	eWOM platforms (ie: Trustpilot, Tripadvisor)	Brands

Table 1: Two-sided platforms examples

Platform business models are attracting a lot of attention due to the spike in prominent firms operating under this structure. However, platforms are far from being a new phenomenon. From bankers and marketplaces in Ancient Greece to the first newspaper advertisements, two-sided markets are long-standing (Evans & Schmalensee, 2016). Nonetheless, digital technologies are enabling new interactions in diverse sectors, making this business model more attractive and scalable than ever.

Industrial economic theory has long observed a phenomenon in which the value for a user of a product or service increases as the number of users who have already adopted it grows. Phone lines were increasingly valuable for users as more people installed phone lines. The theory of network effects (Rohlf, 1974), also called network externalities (Tirole, 1988), laid the foundations to understand today's digital platforms. Surely Facebook was only as valuable for its users as long as their friends had also adopted it. However, economists observed that

there was another side to the coin in these prominent firms' business models. Facebook was also more valuable for advertisers the more users they could reach through the platform. Rochet and Tirole (2003) observed that most markets with positive network externalities were characterized by two or more sides of the market creating value from their interactions.

Two-sided markets (Rochet & Tirole, 2003; Evans & Schmalensee, 2016; Parker et al, 2016; Tirole, 2017) exist when an intermediary enables two or more distinct groups (normally but not necessarily buyers and sellers) to interact. The intermediary party provides a platform, either digital or physical, that brings both “sides” of the market together. The main difference between traditional firms, either retailers or manufacturers, and two-sided platforms is that the first employ a pipeline process to create value. These firms acquire their supply, sometimes transforming them into final products, and sell them on profitable terms to their customers. On the other hand, two-sided platforms generate value by enabling interactions between different sides of the market. In the traditional value chain, value flows from left to right. On the left are the company's costs, and on the right are the company's profits. In two-sided platforms, value is allocated on both sides.

Two-sided platforms are disrupting traditional industries. These firms don't only act as a distribution channel but also create a new infrastructure and coordination mechanism. Platforms not only act as matchmakers between different groups but also provide convenient information about the products or services being offered. Sometimes these platforms even leverage the users themselves to create and share content, such as with the implementation of reputational systems. Furthermore, on top of operating as matchmaking agents between different parties that do not know each other, platforms might even connect two parties that are familiar. In this case, platforms facilitate the interaction and provide an environment where these exchanges can happen as smoothly as possible. Lastly, platforms also act as regulators themselves (Tirole, 2017). They can incentivize competition among sellers, regulate prices, monitor quality, provide information, and verify the parties to provide enhanced security in transactions.

The economic model in two-sided platforms depends on two main concepts (Tirole, 2017). First, on the elasticity of demand, and second, on the externalities between both sides of the market. The first refers to the number of users the platform will gain or lose by altering the price of the service. In scenarios with high elasticity, price moderation is recommended, as

alterations in prices will significantly affect its customer base. However, in scenarios with low elasticity, price increases are better tolerated. As two-sided platforms need to attract the largest possible base of customers to provide value to the other side, this balance is of significant relevance. Second, these platforms also need to deal with the cross-externalities between and within both sides of the market. If one side of the market benefits from the other side, this profiting side is much more likely to provide a more robust source of revenue for the platform than the other. The platform provider must therefore understand which market segment has the lowest demand elasticity, and which segment adds the most value to the other segment. This way, platforms can not only create value by economies of scale, or by learning-by-doing, but also by seizing network externalities to its favor (Varian, 2017). There are four types of network externalities (Parker et al, 2016). Network externalities occur within individuals on the same side of the market or across sides. Users having influence over other users, or over producers. These refer to same-side or cross-side externalities. But also, network externalities might also be positive or negative depending on the effect they have on the value creation system.

Two-sided platforms face unique challenges. First, since platforms need to ensure that both sides of the market join their networks, they face a chicken-and-egg problem. They need a large enough base of customers to attract sellers, and a large enough base of sellers to attract customers. This problem requires the development of viable economic models that ensure both parties' participation. Platforms not only need to decide on their price levels but also their pricing structure. In order to acquire both sides of the market, platforms might structure their revenue streams by profiting on one side, and operating at a loss or being financially neutral on the other side. Pricing structure normally depends on the cross-externalities between both sides, on the capability to charge fixed or per-transaction fees, and on whether users will need to exclusively use one platform, or if they'll be able to use different platforms simultaneously for the same service (Armstrong, 2006). Regarding competition, two-sided platforms face the single or multi-homing challenge. Users might be able to adopt different platforms for the same service. Some platforms might develop a single-homing environment, requiring the users to adopt their platform exclusively or be open to competition, enabling the users to multi-home and use different platforms simultaneously (Eisenmann et al, 2006). Furthermore, platforms need to avoid envelopment. Different platforms might have overlapping user bases, which represent an opportunity for platforms to envelop other platforms' services within their own. Lastly, two-sided markets also need to deal with

struggles typical of innovations with network externalities. Uncoordinated demand might lead to inertia, with users waiting to see if other users will adopt the innovation and therefore provide them with the best value, or with inefficiencies, with users rushing into the adoption of new technologies without certainty that it will provide the best value (Farrell & Saloner, 1985).

In contrast to these unique challenges, two-sided platforms also have unique opportunities. Particularly, platforms have the advantage of marginal economics of production and distribution. Compared to linear production companies, expansion opportunities come at a significantly lower cost for platforms. Since they create value using assets that they do not own or control, two-sided platforms can grow considerably more quickly than conventional businesses. When a hotel chain company wants to expand, they need to acquire new real estate, build or refurbish buildings, hire and train a significant number of staff. Whereas a two-sided platform like Airbnb needs only to get more home-owner users onboard the platform. Furthermore, when these platforms expand on one side of the market, the network externalities normally operate in their favor, and contribute to expanding the other side of the market as well, creating a virtuous cycle.

Two-sided platforms are constantly evolving, and the fact that they might have developed a matchmaking business model doesn't mean other strategies are unfeasible. Rather, firms operating in multisided markets might go back and forth and apply different business models. For example, Amazon started as a vertically integrated firm, owning its stock of products, but opened to the two-sided market by allowing external sellers to offer their products to Amazon's customers. On the other hand, Netflix started operating with a matchmaking strategy, connecting film producers to viewers, but later started developing its own content. Furthermore, platforms might even decide to vertically integrate one side of their markets. For instance, whereas Microsoft operates a three-sided market, offering an operating system platform that enables interactions between consumers, software developers, and hardware producers, Apple has decided to vertically integrate the hardware line and offer it within its own platform (Hagiu & Wright, 2015).

By connecting two previously uncoupled sides of a market, platforms are sparking innovation across different industries (Gawer & Cusumano, 2013). One of the industries that has seen prominent growth on two-sided platforms is the travel industry. Because of its peculiarities,

this sector had long needed intermediaries to connect prospective travelers in their countries of origin with travel service providers in their future destinations. Airlines developed global distribution systems to cater their products to travel agents and travelers worldwide even before the advent of the Internet. It is no surprise, therefore, that digitalization provided a whole new set of opportunities for this sector (Raad et al, 2023).

Several online travel agencies, such as Booking.com or Expedia, employ a two-sided platform business model and have become the go-to channels for travelers to plan and book their vacations. But by transforming the rules of interaction inside the markets, the platform economy has also set the ground to the advent of new types of relationships. New trends in consumption and an increased awareness on sustainability have led individuals to employ platforms to interact and engage in collaborative consumption (Botsman & Rogers, 2010). As usefulness is prioritized over ownership, and the sense of community over selfishness, new business models have emerged, leading to innovations such as P2P accommodation, the diffusion of electronic word of mouth, or organized carpooling. Firms like Airbnb, Tripadvisor, and BlaBlaCar are reshaping the travel industry. This research intends to provide insight into how the innovations promoted by the aforementioned two-sided platforms are contributing to the transformation of the travel industry.

## 1.2 Travel industry: recovery and transformation

The tourism industry stands as a vital cornerstone in the global economy. This sector is increasingly being recognized as a key contributor to economic development. The travel industry plays an integral role in job creation, foreign exchange earnings, infrastructure development, and overall economic growth. However, the industry has faced unprecedented challenges as a result of the COVID-19 pandemic, and addressing these challenges has become imperative to secure its future as a contributor to economic prosperity.

The travel sector is a thriving contributor to the global economy. Including its direct and indirect contributions, tourism represented 10.2% of global pre-pandemic GDP and about 1 in 10 jobs in the world (Petcu & Cismasu, 2019; World Travel and Tourism Council & Oxford Economics, 2022; OECD, 2023). Tourism can certainly contribute to sustainable

development by stimulating economic growth and employment creation (Peña-Sánchez et al, 2020; World Tourism Organization, 2006), and has the potential to alleviate poverty (Llorca-Rodríguez et al, 2018) and reduce inequalities (Ofori et al, 2023; Seetanah et al, 2023). Moreover, tourism facilitates international trade (Santana-Gallego et al, 2016; Suresh & Tiwari, 2017), stimulates the growth of infrastructure projects (Giannoni & Maupertuis, 2007; Lim et al, 2018), and supports small and medium-sized enterprises (Mshenga et al, 2010; Deyshappriya & Nawarathna, 2020).

For the least developed nations in the world, tourism is the main source of foreign income, representing the main export for over 80% of the world's developing nations, and making up more than 25% of the GDP in some regions (Narayan et al, 2010; World Tourism Organization & Netherlands Development Organization, 2010). But for developed economies, tourism can also represent a significant powerhouse. In fact, the top 10 destinations receive 40% of worldwide international tourist arrivals, with France being the leading international touristic economy accounting for 89 million international visitors yearly, followed by Spain with 83 million, and the USA with 80 million (World Tourism Organization, 2019). Accounting for domestic tourists as well, these numbers increase. Measured in overnight visitors, the domestic travel market is six times larger than the international travel market (World Tourism Organization, 2020). In Spain, tourism represented 12.6% of the GDP in 2019 prior to the COVID-19 pandemic, rebounding to 8% by 2022, and it represents 12.2% of the total employment in the country (Instituto Nacional de Estadística, 2022; Turespaña, 2023).

The COVID-19 pandemic, however, revealed the vulnerability of the tourism industry to external shocks. The sudden halt in travel brought the sector to a standstill, resulting in economic repercussions that are still being accounted for. As the industry navigates its recovery, several key challenges have come to the forefront.

First, the challenge of regaining growth and restoring the industry to its pre-pandemic levels is of paramount importance. The tourism sector's contribution to the global economy drastically stopped during the pandemic, resulting in economic losses that have impacted the entire value chain (Škare et al, 2020; Harchandani & Shome, 2021; Allan et al, 2022). As countries endeavor to reach pre-pandemic levels for this sector, this recovery is heterogeneous across different countries and regions (Okafor et al, 2022). This makes the

recovery of the sector of vital importance, particularly for developing countries that are highly dependent on this industry, as lagging behind could have severe effects on their economies (Mensah & Boakye, 2021; Chiawo et al, 2023).

Second, the need for building resilience has emerged as a vital lesson from the pandemic (Prayag, 2020). The tourism industry must better prepare itself to withstand future crises by developing adaptive strategies that can enhance operational efficiency and resource optimization of travel firms (Rastegar et al, 2023). This improved efficiency not only increases the ability to withstand external shocks but also facilitates flexibility and innovation, enabling the introduction of new products and services aligned with evolving customer preferences.

Third, the pandemic offered a unique opportunity to reflect on the environmental impact of travel, particularly in terms of transportation. Tourism represents around 8% of global greenhouse gas emissions (Lenzen et al, 2018). The rate at which global tourism is growing is outpacing the technological advancements to decarbonize the industry. The sector must transition toward more responsible consumption and production practices, with a focus on reducing carbon emissions and profiting from more efficient use of resources (Prideaux et al, 2020).

Addressing these challenges demands innovation and adaptation, and digital platforms are emerging as instrumental tools in this transformation. Adopting new technologies in the travel industry can help the sector overcome these challenges and transition into more sustainable formats (Ali et al, 2020). In particular, several new business models have arisen in the last years allowing interactions between different actors. Digital platforms enabling peer-to-peer (P2P) relationships allow for the exchange of information, sharing of underutilized assets, or promoting entrepreneurship. The innovation put forward by these platforms is offering tools to revitalize growth, enhance resilience, and promote sustainability, and have therefore been considered to have the transformational power to overcome several of the challenges faced by the tourism sector (Gössling & Hall, 2019).

## 1.3 Research objectives

The general objective of this thesis is to explore the contribution of two-sided digital platforms to the transformation the travel industry, and enhance our understanding of their role in driving growth, building resilience, and fostering sustainable practices.

In order to achieve this general objective, three different innovations, promoted by different two-sided platforms have been identified, leading to the following specific objectives:

- Analyze the impact of the P2P accommodation innovation on international tourist flows.
- Identify the effects of the proactive management of eWOM on travel agencies' productivity.
- Assess the contribution of carpooling on transitioning to more responsible production and consumption mobility practices.

These specific objectives delimit the innovations and platforms studied, as well as the particular studied areas where digital platforms are enabling change in the travel industry. Each of the aforementioned specific objectives is analyzed in each of the three chapters presented in this document.

## 1.4 Methodology, delimitation, and resources

This research employs an econometrical approach to analyze the effects of diverse innovations spawned by two-sided platforms on the travel industry. Each chapter employs a different methodology, including both demand and production equations, analyzed by means of diverse time series, data panel, and data envelopment analysis techniques. This methodology is nurtured by literature reviews that provide the necessary and relevant background on the studied topic.

This research observes the effect of two-sided platforms in the travel industry taking under scrutiny the Spanish economy. Spain has been chosen to focus this study for different reasons. On one side, this research is conducted within the Ph.D. in Economics from the Complutense University of Madrid. Therefore, the personal interests of the researcher and the

context of the institution affect the choice of the country under study. Furthermore, Spain represents a robust case study to focus an analysis on the effect of two-sided platforms in the travel industry. Spain is the second-largest worldwide tourism economy, and the travel industry represented 12.6% of its gross domestic product in 2019 (INE, 2022).

Last, different further delimitations have been applied due to specific methodological needs, such as the time periods or populations analyzed. Each of these methodological delimitations are discussed in each chapter.

Several different resources have been employed to develop the present study. Most resources were made available by the Complutense University of Madrid. Web of Science, Google Scholar, and the United Nations World Tourism Organization e-Library were employed as the main sources of bibliographical information. As data sources, different platforms were employed. Each chapter provides detailed information regarding the data sources for each analysis. The most popular sources employed in the study were the datasets made available by ORBIS, Eurostat, OECD, the International Monetary Fund, and the World Bank. Further tools employed as sources of information were Google Trends, Ahrefs, and Statista. Last, web scrapping techniques were also employed as sources of information for the research. Regarding the econometric analyses, the main tool employed was the Stata package. The research was conducted using various tools provided by Google Workspace, such as Google Docs, Google Sheets, and Google Slides.

## 1.5 Thesis structure

This thesis is structured as follows. First, this introduction seeks to contextualize the emergence and relevancy of two-sided markets and how digital platforms are disrupting several industries. Furthermore, it presents the specific case of the travel industry and the challenges this sector is facing. As a result of this contextualization, this introduction presented the general and specific objectives, that help delimit the study. Last, the general methodology applied in this research is explained, together with an enumeration of the resources employed for the study.

Next, three chapters go into detail on the specific objectives. Each chapter analyzes a remarkable innovation that impacted the travel industry in recent years, that was fostered by particular two-sided digital platforms, and its contribution to tackling a specific challenge faced by the travel industry.

	Chapter 2	Chapter 3	Chapter 4
Innovation	P2P Accommodation	eWOM	Carpooling
Two-sided platform	Airbnb Vrbo	Tripadvisor Trustpilot	BlaBlaCar Amovens
Challenge	Growth	Resilience	Sustainability

Table 2: Thesis structure

Chapter 2 presents an analysis of how the P2P accommodation innovation, namely, people sharing idle space in their homes with travelers, promoted by two-sided platforms such as Airbnb or Vrbo, is contributing to fostering international tourist flows and thus supporting economic growth. This research offers an econometric analysis that utilizes panel data to examine the international tourism demand in Spain and how Airbnb's innovation influenced tourism flows.

Chapter 3, unlike the analysis of the demand equation in chapter 2, presents an analysis of the production equation. Specifically, this chapter examines the relationship between managing eWOM (electronic word of mouth) and online reviews through two-sided platforms and the productive efficiency of travel agencies. This research employs a two-stage double bootstrap data envelopment analysis to delve into the impact of eWOM and how firms manage eWOM on travel agencies' productivity.

Chapter 4 introduces an exploratory analysis of the impact of the carpooling innovation, promoted by two-sided platforms like BlaBlaCar or Amovens, on long-distance road transport demand. Given that most drivers undertake journeys with empty seats in their

vehicles, this chapter examines how these platforms contribute to utilizing those vacant seats and encouraging more sustainable transportation production and consumption practices. This analysis is conducted using an aggregated road transport demand model.

Lastly, the research's overall conclusions are presented in Chapter 5, which also outlines the study's limitations and highlights lines for future research. This section presents public policy and managerial implications and recommendations.

## 1.6 References

- Ali, A., Rasoolimanesh, S. M., & Cobanoglu, C. (2020). Technology in tourism and hospitality to achieve Sustainable Development Goals (SDGs). *Journal of Hospitality and Tourism Technology*, 11(2), 177-181
- Allan, G., Connolly, K., Figus, G., & Maurya, A. (2022). Economic impacts of COVID-19 on inbound and domestic tourism. *Annals of Tourism Research Empirical Insights*, 3(2), 100075.
- Armstrong, M. (2006). Competition in two-sided markets. *The RAND Journal of Economics*, 37(3), 668–691.
- Botsman, R., & Rogers, R. (2010). *What's mine is yours: The rise of collaborative consumption*. Harper Business. ISBN-13: 978-0061963544.
- Chakravorti, S., & Roson, R. (2004). Platform Competition in Two-Sided Markets: The Case of Payment Networks. *SSRN Electronic Journal*.
- Chiawo, D., Haggai, C., Muniu, V., Njuguna, R., & Ngila, P. (2023). Tourism Recovery and Sustainability Post Pandemic: An Integrated Approach for Kenya's Tourism Hotspots. *Sustainability*, 15(9), 7291.
- Deyshappriya, N. & Nawarathna, A. (2020). Tourism and SME development: Performance of tourism SMEs in coastal tourist destinations in southern Sri Lanka, ADBI Working Paper Series, No. 1164, Asian Development Bank Institute (ADBI), Tokyo
- Eisenmann, T., Parker, G., & Van Alstyne, M. W. (2006). Strategies for two-sided markets. *Harvard Business Review*, 84(10), 92-101
- Evans, D. S., & Schmalensee, R. (2016). *Matchmakers: The new economics of multisided platforms*. Harvard Business Review Press.

Farrell, J., & Saloner, G. (1985). Standardization, Compatibility, and Innovation. *The RAND Journal of Economics*, 16(1), 70.

Gawer, A., & Cusumano, M. A. (2013). Industry Platforms and Ecosystem Innovation. *Journal of Product Innovation Management*, 31(3), 417–433.

Giannoni, S., & Maupertuis, M.-A. (2007). Environmental Quality and Optimal Investment in Tourism Infrastructures: A Small Island Perspective. *Tourism Economics*, 13(4), 499–513.

Gössling, S., & Michael Hall, C. (2019). Sharing versus collaborative economy: how to align ICT developments and the SDGs in tourism? *Journal of Sustainable Tourism*, 1–23.

Hagiu, A., & Hałaburda, H. (2014). Information and two-sided platform profits. *International Journal of Industrial Organization*, 34, 25–35.

Hagiu, A., & Wright, J. (2015). Multi-sided platforms. *International Journal of Industrial Organization*, 43, 162–174.

Harchandani, P. & Shome, S. (2021). Global Tourism and COVID-19: An Impact Assessment. *Tourism*. 69. 262-280

Instituto Nacional de Estadística (2022). Cuenta Satélite del Turismo de España. Accessed online on May 9th 2023, on [https://www.ine.es/prensa/cst\\_2021.pdf](https://www.ine.es/prensa/cst_2021.pdf)

Lenzen, M., Sun, Y.-Y., Faturay, F., Ting, Y.-P., Geschke, A., & Malik, A. (2018). The carbon footprint of global tourism. *Nature Climate Change*, 8(6), 522–528.

Lim, C., Zhu, L., & Koo, T. T. R. (2018). Urban redevelopment and tourism growth: Relationship between tourism infrastructure and international visitor flows. *International Journal of Tourism Research*.

Lladós-Masllorens, J., Meseguer-Artola, A., & Rodríguez-Ardura, I. (2020). Understanding Peer-to-Peer, Two-Sided Digital Marketplaces: Pricing Lessons from Airbnb in Barcelona. *Sustainability*, 12(13), 5229.

Llorca-Rodríguez, C. M., García-Fernández, R. M., & Casas-Jurado, A. C. (2018). Domestic versus inbound tourism in poverty reduction: evidence from panel data. *Current Issues in Tourism*, 1–20.

Mensah, E. A., & Boakye, K. A. (2021). Conceptualizing Post-COVID 19 Tourism Recovery: A Three-Step Framework. *Tourism Planning & Development*, 1–25.

Mshenga, P. M., Richardson, R. B., Njehia, B. K., & Birachi, E. A. (2010). The Contribution of Tourism to Micro and Small Enterprise Growth. *Tourism Economics*, 16(4), 953–964.

Narayan, P. K., Narayan, S., Prasad, A., & Prasad, B. C. (2010). Tourism and Economic Growth: A Panel Data Analysis for Pacific Island Countries. *Tourism Economics*, 16(1), 169–183.

OECD (2023). Tourism GDP (indicator). Accessed online on May 9th 2023, at <https://doi.org/10.1787/b472589a-en>

Ofori, I.K., Dossou, T.A.M., & Saint Akadiri, S. (2023). Towards the quest to reduce income inequality in Africa: is there a synergy between tourism development and governance?, *Current Issues in Tourism*, 26:3, 429-449.

Okafor, L., Khalid, U., & Gopalan, S. (2022). COVID-19 economic policy response, resilience and tourism recovery. *Annals of Tourism Research Empirical Insights*, 3(2), 100073

Parker, G., Van Alstyne, M., & Choudary, S. P. (2016). *Platform revolution: How networked markets are transforming the economy and how to make them work for you*. WW Norton & Company.

Peña-Sánchez, A. R., Ruiz-Chico, J., Jiménez-García, M., & López-Sánchez, J. A. (2020). Tourism and the SDGs: An Analysis of Economic Growth, Decent Employment, and Gender Equality in the European Union (2009–2018). *Sustainability*, 12(13), 5480.

Petcu, M.A. & Cismasu, I.D. (2019). Tourism: A contribution to the sustainable economic growth. *Quality-access to success* (20), pp. 460-466.

Prayag, G. (2020). Time for Reset? Covid-19 and Tourism Resilience. *Tourism Review International*, 24(2), 179–184.

Prideaux, B., Thompson, M., & Pabel, A. (2020). Lessons from COVID-19 can prepare global tourism for the economic transformation needed to combat climate change. *Tourism Geographies*, 1–12.

Raad, J., Sharma, A. & Nicolau, J.L. (2023). Performance effects of innovation in two-sided markets: The paradigmatic case of OTAs. *Tourism Management* 94 (2023) 104637

Rastegar, R., Seyfi, S. & Shahi, T. (2023). Tourism SMEs' resilience strategies amidst the COVID-19 crisis: the story of survival, *Tourism Recreation Research*

Rochet, J. C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association*, 1(4), 990-1029.

Rohlfs, J. (1974). A theory of interdependent demand for a communications service. *The Bell Journal of Economics and Management Science*, 5(1), 16-37.

Santana-Gallego, M., Ledesma-Rodríguez, F. J., & Pérez-Rodríguez, J. V. (2016). International trade and tourism flows: An extension of the gravity model. *Economic Modelling*, 52, 1026–1033.

Seetanah, B., Gopy-Ramdhany, N. and Bhattu-Babajee, R. (2023), Can tourism curb income inequality? *Tourism Agenda 2030, Tourism Review*, Vol. 78 No. 2, pp. 646-664.

Škare, M., Soriano, D. R., & Porada-Rochoń, M. (2020). Impact of COVID-19 on the Travel and Tourism Industry. *Technological Forecasting and Social Change*, 120469

Suresh, K. G., & Tiwari, A. K. (2017). Does international tourism affect international trade and economic growth? The Indian experience. *Empirical Economics*, 54(3), 945–957.

Tirole, J. (1988). The theory of industrial organization. MIT Press.

Tirole, J. (2017). Economics for the common good. Princeton University Press.

Turespaña (2023). Empleo en turismo. Accessed online on May 9th 2023, on <https://www.tourspain.es/es-es/ConocimientoTuristico/AfiliacionSS/notaAfiliacionALaSS0223.pdf>

Varian, H. R. (2017). Use and Abuse of Network Effects. SSRN Electronic Journal .

World Tourism Organization (2006), Tourism and Poverty Alleviation, UNWTO, Madrid

World Tourism Organization (2019), International Tourism Highlights, 2019 Edition, UNWTO, Madrid

World Tourism Organization (2020), UNWTO Briefing Note – Tourism and COVID-19, Issue 3. Understanding Domestic Tourism and Seizing its Opportunities, UNWTO, Madrid

World Tourism Organization and the Netherlands Development Organization (2010), Manual on Tourism and Poverty Alleviation – Practical Steps for Destinations, UNWTO, Madrid

World Travel and Tourism Council and Oxford Economics (2022). Economic impact 2022. Accessed on May 9th 2023 at <https://wtcc.org/Portals/0/Documents/EIR/EIR2022%20Global%20Infographics%20Page%201.pdf?ver=2022-04-25-102003-887>.

2. The impact of P2P accommodation on tourism demand: Do we observe more tourist arrivals because of Airbnb's innovation?

## Abstract

The sharing economy (SE) has emerged as a disruptive innovation. It has transversally impacted several industries, finding particular fertile soil in the tourism industry in the form of peer-to-peer (P2P) accommodation. There is extensive evidence of the negative impact that the P2P accommodation has had on the hotel industry. However, recent research has identified positive spillover effects of the SE in the hosting ecosystems that suggest the SE might have in fact contributed to more tourist arrivals. The objective of this research is, therefore, to examine whether the P2P accommodation innovation has contributed to fostering international tourism. This research applies an econometric approach to analyse the international tourism demand in Spain over the period 2006Q1-2019Q4. This is executed by the means of different dynamic data-panel and random effects GLS panel models. The results reveal a significant and positive impact of the SE on tourist flows. It is concluded that, despite the adverse effects on the hotel industry, the SE has nurtured growth in tourism demand.

**Keywords:** Sharing economy; collaborative consumption; peer-to-peer accommodation; Airbnb; tourism demand; panel data model.

## 2.1 Introduction

The sharing economy (SE) has experienced a singular rise in the last decade, disrupting many industries, particularly the tourism industry. Although defining the SE has proven to be a challenge by itself, as explained in the following section, for the purpose of this research, a broad definition is considered. Under this definition, the SE is understood as the business models where activities are facilitated by collaborative platforms that create an open marketplace for the temporary usage of goods or services, often provided by private individuals (European Commission, 2016). In the hospitality sector, the SE has been most disruptive in the form of peer-to-peer (P2P) accommodation, an innovation that allows a non-commercial party (host) to sell short-term accommodation to an end user (guest) in direct interaction (Dolnicar, 2020).

Current discussions on this topic, both in academic literature and in industry debates, frequently focus on the negative impact the SE has had on the hotel industry (Falk and Yang, 2020; Guttentag and Smith, 2017; Zervas et al, 2017). However, other perspectives on this phenomenon suggest that due to the positive spillover effects of the SE in the hosting ecosystems, such as labor creation (Fang et al, 2016) and local restaurant revenue (Basuroy et al, 2020), the SE might have actually fostered tourism demand.

The objective of this research is to examine whether the SE, in the form of P2P accommodation, has contributed to fostering international tourism. The main hypothesis is that the emergence of P2P accommodation platforms has contributed to increasing tourism flows. This hypothesis is based on three observations. First, in their participation in the SE, local communities are directly extending the receptive capacity of destinations globally (Ferreira et al, 2020). Second, they are lowering costs for travel services (Sthapit et al, 2019), both by offering a lower price than hotels and by increasing competition (Önder et al, 2018). Lastly, these local SE communities are seizing the consumers' changing tastes, offering an authentic local experience and interaction travelers hardly had access to before (Guttentag et al, 2018; Paulauskaite et al, 2017; Tussyadiah and Pesonen, 2016). To test this hypothesis, a demand model for incoming tourism to Spain was built and analyzed by different panel-data estimations.

Understanding the impact of the SE on the tourism industry has significant relevance to the industry's stakeholders, policymakers, local communities, and entrepreneurs. The SE has as many positive externalities as it has negatives, such as its impact on the environment, employment, and touristification, among others. However, unveiling whether these innovative business models, specifically in the accommodation sector, have only acted as alternatives for traditional lodging products or have also fostered international tourist flows will help create a broader understanding of this growing phenomenon.

This research intends to contribute to academic literature in the following ways. First, to better understand the impacts of the sharing economy innovation on economic growth and, particularly, on the development of the tourism industry. Second, to provide further evidence on how the creative destruction caused by innovation may foster growth. Lastly, this paper aims to contribute to the understanding of the changing factors affecting tourism demand.

The chapter will be structured as follows. First, a background will be presented in the following section, aiming to offer contextualization of the sharing economy. This section will also cover a review of the discussions in academic literature over the topics of the sharing economy, its place in innovation, and the economic growth that it could represent, giving voice both to its promoters and its detractors. This section will also review academic literature on the topic of tourism demand, and in particular, on literature that has delved into a similar research question as the one discussed here to assess the methodology employed therein. The following section offers a methodological approach to explain the impact of the sharing economy on tourism. Here, the details of the framework and econometric model will be presented, as well as an explanation of the data and data sources that inform the analysis. The next section presents the results of the analysis, complemented by a discussion of those results. Finally, the main conclusions of the study are presented, followed by the references for this research.

## 2.2 Background & Literature Review

### 2.2.1 Sharing Economy & Peer-to-Peer accommodation

Recent developments in the literature in the field of economics and innovation reveal a new globalization process that brings faster and more disruptive changes that mostly affect the services sector (Baldwin, 2016). This new wave of innovation is already altering the regimes that established the rules of certain industries, transforming the balance between consumers and suppliers in the knowledge society (Trimi and Berbegal-Mirabent, 2012) and leading to a servitization of society (Toivonen and Tuominen, 2009; Botsman & Rogers, 2010). The SE is indubitably part of this phenomenon, where a handful of players are transforming different sectors. In the travel industry, accommodation is one of them.

The SE is still emerging as a field of research and, as a result of its novelty and peculiarities, has become a difficult concept to delimit, define, and reach a consensus on (Acquier et al, 2019). A comprehensive study of the different available definitions of the SE has identified its main features, namely (i) granting temporary access without transferring ownership; (ii) employing online platforms; (iii) promoting a more collaborative form of consumption; (iv) it's based on using idle capacity; and (v) it acts as an intermediary between different actors in peer-to-peer networks (Ranjbari et al, 2018). To the effect of this research, a broad definition is considered, understanding the SE as the business models where, by means of a collaborative platform, consumers gain temporary access to goods or services often provided by individuals (European Commission, 2016). The SE may be found in the literature under many names, such as collaborative economy, sharing economy, gig economy, peer-to-peer economy, access economy, and collaborative consumption, among others. Although the variety of names could be due to a lack of consensus product of its novelty, all these concepts vary slightly in their definitions, each including or excluding a certain type of activity (Acquier et al, 2019). In the particularity of the accommodation sector, the SE takes the form of peer-to-peer (P2P) accommodation (Dolnicar, 2020).

The study of the sharing economy is particularly interesting since it operates under both market and non-market logics. Within it, it is possible to find both economic transactions for the provision of services as well as the same services being delivered with no economic

retribution, representing no gain for the service provider other than the opportunity to be of help (Acquier et al, 2016). The sharing economy supposes a potential transformation of consumption and production as we know it, contributing to avoiding superfluous overproductions and, therefore, gaining a place as a promising format for the green revolution. In addition, sharing economy platforms can also become players with a social orientation, as they foster value co-creation and sharing opportunities inside and amid societies.

A comprehensive understanding of this phenomenon is of great importance, primarily due to the diverse externalities that the SE has on different levels. The SE is seen by many authors as a resource optimization opportunity (Szetela and Mentel, 2016; Demailly and Novel, 2014), and as a sustainable tool to move toward an ecological transition (Gansky, 2010; Leismann et al, 2013; Voytenko Palgan et al, 2017). However, other research indicates that these ecological benefits are being overestimated (Böcker and Meelen, 2017), and furthermore, that the SE is worryingly liberalizing previously regulated markets, such as labor (Slee, 2015; Murillo et al, 2017), with only a few monopolistic digital platform companies controlling and profiting from most transactions (Gössling and Hall, 2018). One of the main concerns regarding the SE rests on the hospitality platforms, which are causing housing rental prices to increase and therefore inducing touristification, displacing neighbors in favor of higher-paying tourists (Paccoud, 2016; Haar, 2018; Cocola-Gant and Gago, 2019; Rodríguez-Pérez de Arenaza et al, 2019; Morales-Alonso & Núñez, 2022), and which calls for specific regulations to help contain these negative externalities, as well as overtourism (Benítez-Aurioles, 2020).

In the travel and tourism industry, the sharing economy has found fertile ground for its expansion and popularization. In recent years, this phenomenon has gained popularity among locals and travelers alike. From the local community perspective, the chance to generate extra household income by sharing one's home or second residence was seized. For travelers, this was perceived as an opportunity to travel more authentically by staying in a real home instead of a hotel room, and many argue, more budget-friendly. The rise in interest in P2P accommodation is notable:

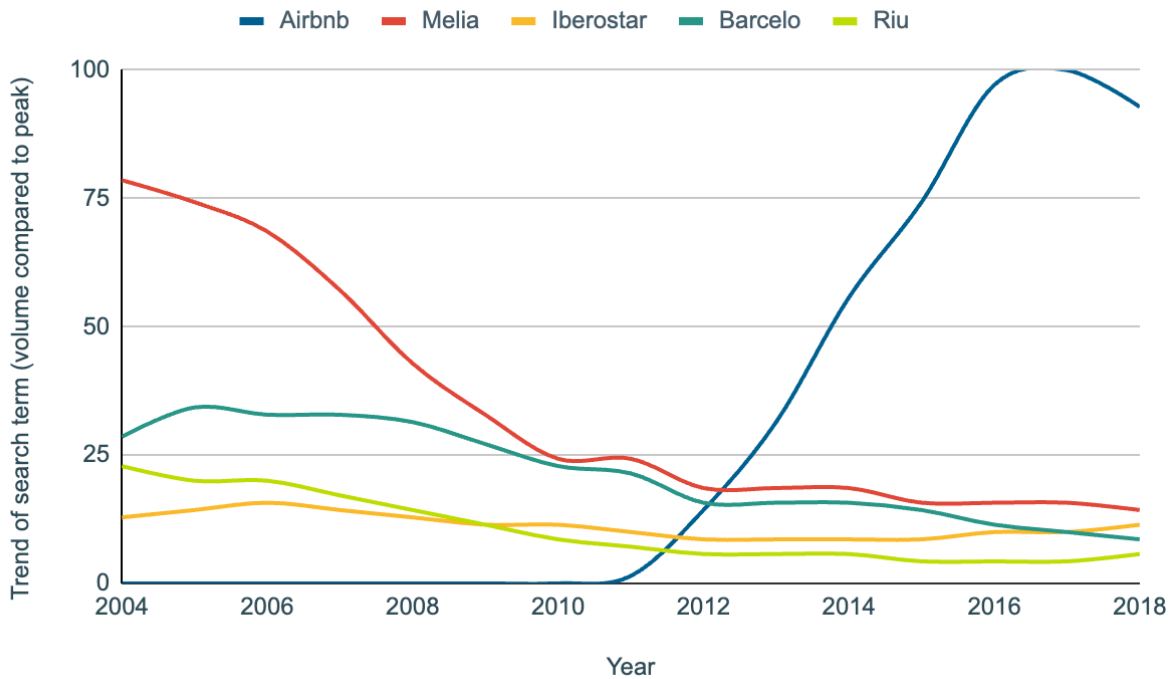


Figure 1: Interest in Spain toward hospitality brands over time

Source: Own elaboration with data from Google Trends

Although Airbnb is undoubtedly the most widespread P2P accommodation platform in the tourism industry and frequently merited the innovation, it is not alone in changing the rules of this traditional industry. Other companies such as Vrbo, Couchsurfing, FlipKey, Onefinesay, or WarmShowers also operate under this market logic, either competing with the leader in the same market segment or offering a different concept within the sharing economy. Nonetheless, leading the P2P accommodation platform, Airbnb is often referred to as the most representative company for understanding the implications of this phenomenon and is, for this reason, considered the parameter of reference for analyzing the effects this sector has had on the tourism industry.

There is conflicting evidence regarding the effect that the sharing economy has had on the tourism industry, but it is clear that it has redefined the hospitality sector (Farmaki et al, 2020). Evidence in favor of the SE suggests that it does not compete with the hotel industry, basing this conclusion on the finding that they aim at different market segments (Mody et al, 2017). This view is reinforced by an analysis conducted by the firm STR (2017) that has provided evidence that the hotel industry's business has continued its growth unaffected after the emergence of these disruptive players in the market. Furthermore, the SE has contributed

to employment creation in destinations globally by reducing accommodation prices (Fang et al, 2016). On the other hand, one of the most influential publications on the impacts of the SE estimates the profit loss of the hotel industry around 8% to 10% as a result of this innovation (Zervas et al, 2017). Still, although the SE may have indeed had a negative impact on the hotel business, it has had a positive and significant impact on the revenue of restaurants close to SE dwellings, especially those that are independent and not part of a chain, contributing to those businesses that need it the most (Basuroy et al, 2020). Both the creation of employment and the increase of local restaurant revenue suggest that, besides competing with traditional accommodation services, the SE has created new demand.

### 2.2.2 Tourism Demand

Tourism demand, frequently measured in tourist arrivals and tourist expenditure, has been one of the most popular topics in tourism research. International tourism demand is normally explained by the income and population of the country of origin, the destination country's travel services' own price as well as substitute countries' prices, but also on marketing efforts and stable behavior patterns (Song et al, 2009). Regarding price, because of the informality and limited cost structure of the activity compared to those of hotels, the SE is frequently able to offer more economical lodging alternatives than hotels, and as such, this functional benefit is one of the main perceived benefits of these digital platforms (Sthapit et al, 2019). However, the price reduction of accommodation services is not only limited to those participants in the SE but also affects traditional services by increasing supply and competition (Önder et al, 2018). Tourism demand elasticity for price variation is a complex factor, but is expected to positively impact tourist flows (Maloney and Montes Rojas, 2005; Álvarez-Díaz et al, 2015).

The P2P accommodation innovation has also had an impact on tourism demand at a behavioral level. Previous research on this topic (Tussyadiah and Pesonen, 2016) has identified an increase in travel frequency and length of stays as a result of the price reduction in hospitality services. It was also identified that travelers are searching for a more authentic experience, and staying in real apartments as locals do greatly contributes to the authenticity of the trip. Additionally, contact with local hosts enhances this experience and provides opportunities for more authentic interactions. Lastly, this research also highlights that cost

reduction allows travelers to reach destinations that were previously cost-prohibitive. This study is complemented by the survey conducted with 800 tourists who had used Airbnb in the past year, which concluded that travelers were motivated by practical benefits more than the experiential characteristics of the sharing economy, such as money-saving and home benefits like access to a kitchen, location in non-hotel covered areas, or a private setting (Guttentag et al, 2018). This evidence suggests that tourism demand should have been positively affected by the P2P accommodation innovation.

Tourism demand has proven elastic towards other innovations, such as the creation of the eurozone and the emergence of low-cost carriers in the aviation industry, providing a relevant background for this research. First, Gil, Llorca, and Martínez (2006) have provided evidence of the effect that the European Monetary Union has had on tourist flows. Through an econometric analysis applying a gravity model covering the period from 1995 to 2002, their research shows that the adoption of the euro represented an increase of 6.3% in incoming tourist flows to eurozone countries. The authors employed four panel-data models to test their hypothesis, including a dichotomous variable to represent the adoption of the euro as a national currency in each country. Regarding the second innovation mentioned, Rey, Myro, and Galera (2010) analyzed the impact of the emergence of low-cost carriers resulting from the deregulation of the airline markets. Employing a dynamic panel data model and focusing their study on Spain while analyzing the effect in each Autonomous Community, their findings reveal that this innovation has had significant and positive direct and indirect effects on tourism demand in Spain. These authors also emphasize the robustness of their model by presenting six different estimations employing alternative estimators, such as the fixed-effects Arellano-Bond estimator, a random-effects generalized least squares estimator, and the Balestra model, including some additional instruments.

Given the background of previous innovations that have fostered tourism demand and the aforementioned observations from the SE, such as the extension of the receptive capacity of destinations, the reduction of travel prices, and the change in demand behavior, the main hypothesis of this research is that the P2P accommodation innovation has indeed contributed to boosting tourism demand. As a result of the behavioral change in demand, seeking more authentic experiences and being willing to travel more frequently, along with the extension of the receptive capacity of destinations and the reduction in travel costs promoted by P2P

accommodation, this innovation in services could have led to an increase in international traveler flows, resulting in sustained growth for global economies.

This research, therefore, aims to contribute to academic literature by enhancing our understanding of this phenomenon and identifying the impact that the sharing economy has had on the tourism industry as a whole. Additionally, it seeks to shed light on the role that the sharing economy can play in reshaping the travel sector. The following section aims to provide a framework for this analysis and design a model for travel demand that can estimate the impact of the sharing economy on tourism.

## 2.3 Methodology

Aiming to assess whether the emergence of the SE in tourism, as a disruptive business model innovation alternative to the traditional lodging industry, indeed fosters incoming international tourist flows and thereby contributes to the economic growth of countries (Gahli, 1976; Pablo-Romero and Molina, 2013; Brida et al, 2014), this research applies a statistical inference methodology.

To address the research question, a tourism demand model has been built and analyzed using panel data. The particularity of this panel data is that it involves different countries, but focuses on their tourist outflows toward a specific economy. As a result, the cross-sectional feature is provided by the countries of origin of the tourist flows, and the time series component ranges from 2006Q1, previously to the emergence of the SE, up to 2019Q4. In this model the series are stationary. Dickey-Fuller tests for the root unit have been conducted individually for each country and results indicate that it is possible to accept the hypothesis that the series is stationary.

To reduce the inherent autocorrelation in the model, different adjustments have been made. First, the data has been transformed from gross values to quarterly interannual change rates. Additionally, this bias is addressed by using lags of the dependent variable as instruments for the lagged dependent variable. The models are presented with 1 lag. The rationale for choosing this particular lag is based on a partial autocorrelation analysis, which indicated that

the first lag consistently falls outside the confidence interval and is significantly different from zero. This research presents four different models. On one hand, there are two dynamic panel-data estimations, and on the other hand, there are two random-effects generalized least squares regressions. Each of these two models is estimated twice: first, to test for a structural break, and secondly, by including a variable specific to the SE.

To delimit the study and specify the country for analysis, Spain was the initial choice. This country is commonly used as a reference for tourism analysis due to its global prominent position in incoming tourism, ranking second only to France (UNWTO, 2020), and the significant contribution that tourism has had to the industrialization and economic growth of the country (Liu and Wu, 2019; Alvarez-Diaz et al., 2020). To facilitate the analysis and determine the countries to be included in the research, it is essential to consider the markets of inbound tourism to Spain:

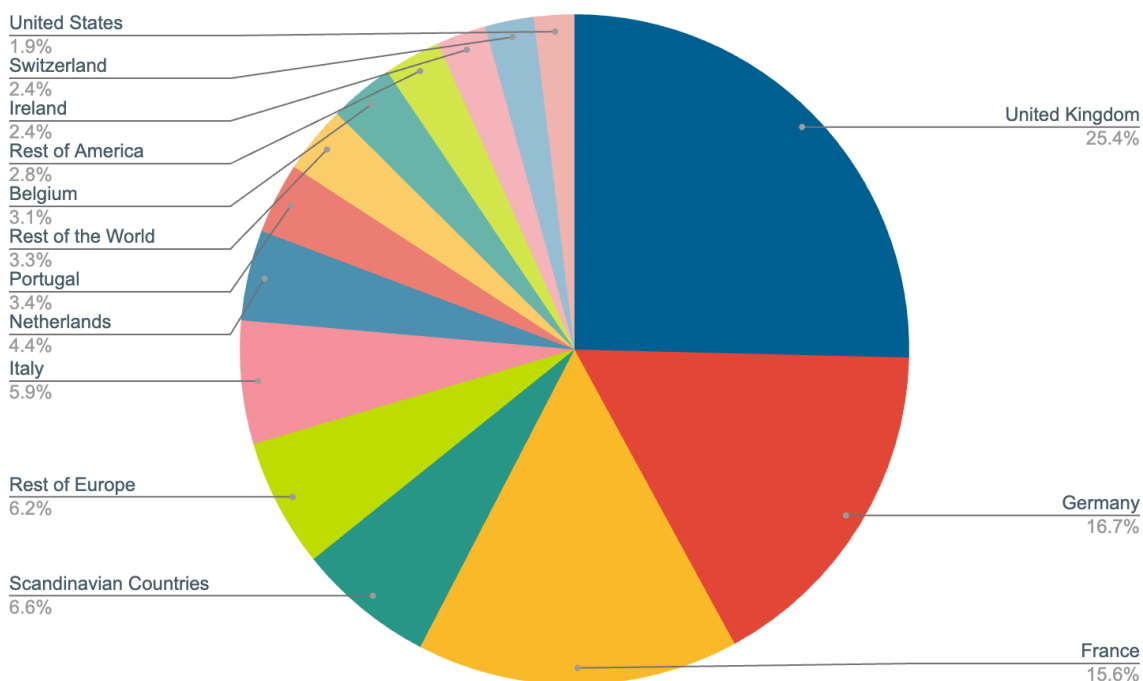


Figure 2: Spanish Inbound Tourism Markets from 2005 to 2015

Source: Own elaboration with data from Frontur

As can be observed from the preceding figure, the United Kingdom, Germany, and France are the main inbound tourism markets for Spain. Along with the following 7 countries – Italy, Netherlands, Portugal, Belgium, Ireland, Switzerland, and the United States – these top 10

countries represent 81.1% of the total incoming tourists to Spain. For this reason, these countries are considered to sufficiently explain the tourism demand for Spain.

### 2.3.1 Framework

In explaining international tourism flows, the most widespread framework are tourism demand models (Song et al, 2009). The demand function of tourism in destination  $i$  by residents of country  $j$  is given by:

$$Q_{ij} = f(Y_j; R_{ij}; P_j; D_{ij}; \varepsilon_{ij})$$

Here,  $Q$  is the quantity of tourism demand, measurable by incoming tourists to the destination  $i$  originating from country  $j$ .  $Y$  represents the size of the economy of country  $j$ .  $R$  is the real exchange rate between country  $i$  and country  $j$ .  $P$  is the population of origin country  $j$ .  $D$  is the distance between country  $i$  and country  $j$ . Last,  $\varepsilon$  is the disturbance term that captures all other factors that may affect the tourist flows from country  $j$  to country  $i$ .

### 2.3.2 Model

In order to develop the model for tourism demand, the following body of empirical literature has been reviewed, and the key drivers of tourism demand have been identified.

Article	Dependent variable	Lag of dependent variable		Income	Price	Population	Distance / Price of travel	Common Border	Common Currency	Common Language	Detractors of demand	Bilateral Commerce	Tourism infrastructure	Free-trade agreement	Island Region	Price of fuel	Days of sun	Research-specific variable	Others
Choong-Ki et al, 1996	Tourism expenditure			X	X						X								
Song et al, 2000	Tourist arrivals			X	X	X					X								
Garín-Muñoz & Amaral, 2000	Tourist arrivals			X	X	X					X								
Divisekera, 2003	Tourist arrivals			X	X		X												
Lim, 2004	Tourist arrivals			X	X														
Croes & Vanegas, 2005	Tourist arrivals			X	X	X	X				X								
Gardella et al, 2005	Tourist arrivals			X	X	X													
Garín-Muñoz, 2005	Tourist arrivals			X	X	X	X	X			X								
Gil-Pareja et al, 2007	Tourist arrivals			X	X	X	X	X	X	X	X			X	X			X	X
Moore, 2010	Tourist arrivals			X	X	X	X												
Song et al, 2010	Tourist arrivals & expenditure			X	X	X													
Rey et al, 2010	Tourist arrivals			X	X	X	X											X	X
Lee, 2011	Tourist arrivals			X	X	X					X	X							X
Lee, 2011	Tourist arrivals			X	X	X					X	X							X
Barman & Nath, 2011	Tourist arrivals			X	X	X							X						X
Onafowora & Owoye, 2012	Tourist arrivals			X	X	X	X				X					X			X
Kusni et al, 2013	Tourist arrivals			X	X						X								
Serra et al, 2014	Room nights			X	X													X	X
Zhou-Grundy & Turner, 2014	Tourist arrivals			X	X						X	X		X					X
Bento, 2014	Tourist arrivals			X	X	X	X											X	X
Santeramo & Morelli, 2015	Tourist arrivals			X	X	X	X	X					X	X					X
Álvarez-Díaz et al, 2015	Tourist arrivals			X	X	X					X								
Tavares & Leitão, 2016	Tourist arrivals			X	X		X	X		X									
Saayman et al, 2016	Tourist arrivals			X	X	X	X	X	X	X		X							X
Álvarez-Díaz et al, 2016	Tourist arrivals			X	X	X					X							X	X
Martins et al, 2016	Tourist arrivals			X	X	X													
Kozić et al, 2018	Tourist arrivals			X	X	X													
Takahashi, K, 2019	Tourist arrivals			X	X	X	X			X								X	X
Yerdelen Tatoglu & Gul, 2019	Tourist arrivals			X	X	X	X	X		X	X	X		X	X		X		X
Lin, 2019	Tourist arrivals			X	X													X	X

Table 3: Reviewed literature modeling tourism demand

As presented in the present table, the literature identifies income, price, population, and distance as the main determinants of tourism demand. Following this body of literature, and in particular Garín-Muñoz (2004, 2005, 2006), Rey et al (2010), and Gil-Pareja et al (2007), the model considers the key explanatory variables of tourism demand (Song et al, 2009), and incorporates the variables to explain the effect of the sharing economy in tourism demand flows:

$$ITA_{ij,t} = \alpha GDPpc_{j,t}^{\beta_1} POP_{j,t}^{\beta_2} RER_{j,t}^{\beta_3} DIS_j^{\beta_4} CEbreak_{i,t}^{\beta_5} CEtrend_{j,t}^{\beta_6} \mu_{ij} \varepsilon_{ij,t}$$

Here,  $i$ ,  $j$  and  $t$  represent the cross-section and time-series observations. ITA is the number of international tourist arrivals from country  $j$  to country  $i$ . GDP is the real GDP per capita in country  $j$ . POP is the population of country  $j$ . RER is the real exchange rate in country  $j$  towards that of country  $i$ . DIS is the distance between country  $i$  and country  $j$ , measured in kilometers. CEbreak is the dummy variable for the emergence of the sharing economy in country  $i$  which signifies the structural break in the model. CETrend is the variable denoting the interest in the sharing economy in countries of origin  $j$ . Additionally,  $\mu$  is month fixed term to capture the effect of external factors that affect the dependant variable. Lastly,  $\varepsilon$  is the error term.

As is often the case in tourism analysis, the aforementioned variables have a circular relationship, as the international tourism flows impact GDP, and this impact also affects the use of the sharing economy, and vice versa. This issue is present in most tourism demand analyses and explains why much of the literature presented in table 3 includes a lag of the dependent variable as a determinant of tourism demand. This calls for the instrumentalization of the Arellano-Bond estimator that avoids circularity by explaining the dependent variable also by its past data. The Arellano-Bond estimator is commonly employed in dynamic panel data models like the dynamic panel data regression model with endogenous variables and autocorrelation. It is especially well-suited for dealing with endogeneity and autocorrelation difficulties that are typical in panel data situations. Since the Arellano-Bond estimator is a fixed-effects model, the variables that are constant in time cannot be included. Therefore, and since its effect is already captured in the fixed effect term, the distance variable shall be omitted from these models. In the random effects regressions, the aforementioned lags shall be considered to reduce autocorrelation. Furthermore, in order to validate the causality direction between the P2P accommodation innovation variable and the international tourist flows, this research also conducts a panel data Granger-causality test, as developed by Dumitrescu and Hurlin (2012). This test is increasingly being employed in tourism demand panel data analysis (Shafiullah et al 2018; Akadiri & Akadiri, 2019; Koçak et al, 2020; Kyara et al, 2021; Tsui et al, 2021; Wang et al, 2021).

After the logarithmic transformation, the final form of the estimation model is:

$$\ln ITA_{ij,t} = \alpha + \beta_1 \ln GDPpc_{j,t} + \beta_2 \ln POP_{j,t} + \beta_3 \ln RER_{j,t} + \beta_4 \ln DIS_j \\ + \beta_5 CEbreak_{i,t} + \beta_6 \ln CEtrend_{j,t} + \mu_{ij} + \varepsilon_{ij,t}$$

The parameters of interest to the effect of this research are  $\beta_5$  and  $\beta_6$ . If the sharing economy indeed stimulates the international tourism flows, the coefficients  $\beta_5$  and  $\beta_6$  should be positive and of statistical significance.

### 2.3.3 Data

In order to build the model that explains the research question, many sources of data were analyzed for each variable. The following are the most relevant clarifications regarding the data and the selected data sources:

#### Dependent Variable: international tourist arrivals

International tourism demand is typically measured either in terms of tourist flows or in matters of international tourists' expenditure. This last measurement could be problematic in terms of this research since the income generated by the tourist consumers of P2P accommodation dwellings is hardly accounted for in statistics. This is due to the fact that the payment made by the tourist is collected by foreign digital platforms (such as Airbnb, Vrbo, etc.) and directly transferred to the host shortly after the tourist's arrival. For this reason, and although it would certainly be interesting to have insight into the effect of the sharing economy on tourists' expenditure and its direct spillover to the hosting ecosystem, the dependent variable considered by this research is that of international tourist arrivals. This data is provided by Spain's National Institute of Statistics (Instituto Nacional de Estadísticas) and the Ministry of Industry, Commerce, and Tourism (Ministerio de Industria, Comercio y Turismo) through the Frontur analysis, which captures the movement of tourists at the Spanish international borders.

In gross terms, the variable for international tourist arrivals, as depicted below, exhibits an autocorrelation pattern that needs to be addressed:

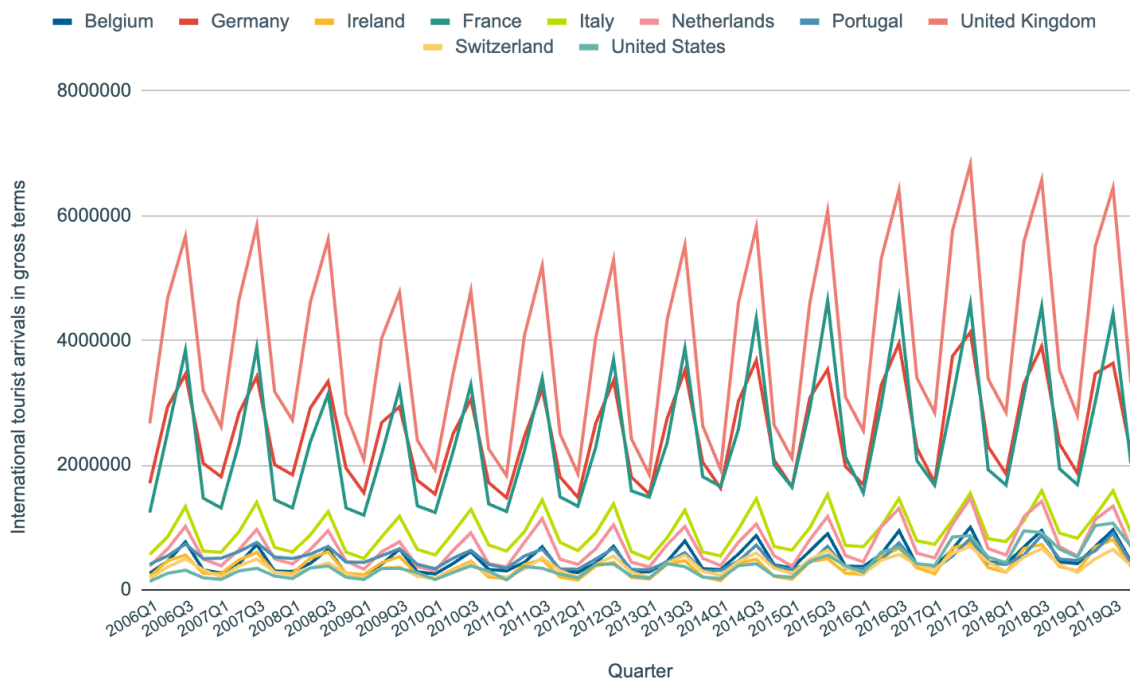


Figure 3: International Tourist Arrivals - Gross terms

Source: Own elaboration with data from Frontur

For this reason, the dependent variable used in this analysis is the difference of the logarithms between the observed quarter and the corresponding quarter in the previous year. Therefore, the analyzed dependent variable is the quarterly interannual change rate.

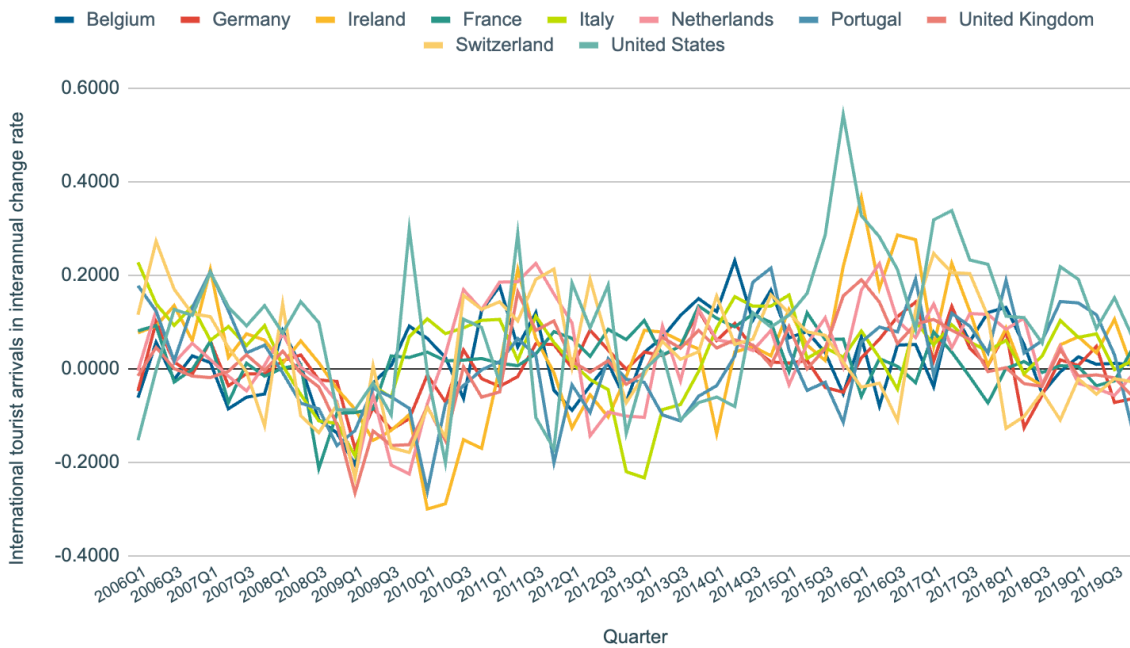


Figure 4: International Tourist Arrivals - Quarterly interannual change rate

Source: Own elaboration with data from Frontur

The dependent variable in the quarterly interannual change rate, as shown, does not exhibit the autocorrelation issues observed in the gross variable.

In order to analyze the changes in tourism demand and comprehend the impact of the sharing economy on it, the following explanatory variables will be taken into account:

### Income

The income of the country of origin is often considered the key explanatory variable in tourism demand models. This can be considered in two forms. If only leisure tourism is considered, then personal disposable income is recommended to be employed. However, since the P2P accommodations also serve business travel, the more general income variable of GDP is a better variable to be employed. This variable was constructed using OECD Quarterly National Accounts data, specifically the Gross Domestic Product per capita, in 2015 United States dollars at constant prices in Purchasing Power Parity.

## Population

*Ceteris paribus*, the greater the population of a country, the greater the amount it's of tourists. Therefore, this variable could not be obviated and is included in many tourism econometric analyses. The population for the selected countries was obtained through the OECD demographic database, which registers quarterly data for this indicator.

## Real Exchange Rate

The real exchange rate between the country of origin ( $j$ ) and the destination country, Spain ( $i$ ) is also a variable that affects the tourism flows. The real exchange rate was obtained by the following procedure:

$$RER = \frac{ER_j}{ER_i} \div \frac{CPI_j}{CPI_i}$$

Both the exchange rate and the consumer price index were obtained from the Eurostat's database. While the exchange rate is considered as the average of the quarter, the consumer price index employed was quarterly provided, harmonized base 100 in 2015.

## Distance

The distance between the country of origin ( $j$ ) and Spain, the destination country ( $i$ ), is one of the key determinants of tourism demand. The data on the distance between countries is obtained through the European Commission Distance Calculator. The air distance data is provided in kilometers and considered from capital city to capital city.

## Sharing Economy

As previously stated, although sharing economy platforms have long existed and, furthermore, travelers have always had the possibility to stay in private dwellings while visiting destinations in which they had family or friends, this lodging alternative had always been marginal, until the business model innovation developed by Airbnb in early 2008. For the first years of operation, the platform and its imitators had a small niche in the market, but

since 2012, its market has grown consistently, outgrowing that of traditional industry players like Meliá Hotels, Barceló Hotel Group, Riu Hotels & Resorts, and Iberostar Hotels & Resorts (as displayed in Figure 1). For this reason, the sharing economy's significant emergence shall be considered with a dichotomous variable represented by 0s until the fourth quarter of 2011, and 1s from 2012 onwards. However, since the sharing economy emergence occurred in the same period of time as the economic crisis recovery, this variable might not be as representative as intended of the phenomenon. For this reason, a second explanatory variable is included.

The second explanatory variable for the purpose of this topic is the interest in P2P accommodation in the countries of origin. This is obtained through the Google Trends tool, which provides insights into the interest of a specific market in the platform. This data source is increasingly being employed in economic analysis (Jun et al, 2018) and as such, some concerns have been raised regarding the quality of the data (Cebrián & Domenech, 2023). However, the Google Trends tool has been increasingly being employed in the context of tourism and hospitality research (Dinis et al, 2019), with a significant body of literature confirming that it can help improve the accuracy of tourism demand analysis and serve as an accurate approximation of the reality of the travel phenomenon (Jackman & Naitram, 2015; Önder & Gunter, 2015; Önder, 2017; Höpken et al, 2018; Siliverstovs & Wochner, 2018; Bokelmann & Lessmann, 2019; Emili et al, 2019; Feng et al, 2019; Hu & Song, 2019; Huarng & Yu, 2019; Volchek et al, 2019; Emili et al, 2020; Hu & Wu, 2022). This tool assigns a value of 100 to the month in which the search term was most popular, and the respective percentages to the other months in comparison with the former. This tracks the interest in P2P accommodation in the countries of origin, allowing over time to corroborate the existence of a correlation between the interest in the sharing economy and the tourist flows to the destination country. As elaborated earlier on this paper, since Airbnb is the undisputed leader of the sharing economy in the hospitality industry, this company will be considered as the reference for the interest in the sharing economy by residents of the country of origin. This variable is particularly advantageous for the purpose of this research, as the interest in the sharing economy in the countries of origin is less prone to circularity problems that often arise in tourism demand models. Additionally, the interest in the sharing economy does not necessarily imply that the tourist indeed used collaborative platforms, since price reductions in hospitality services as a result of the higher competition in the market could result in the tourist traveling to the destination but staying in a traditional hospitality product

instead. The final data on where the tourist ultimately stayed is less relevant for this research, as the focus is on explaining international tourist arrivals, regardless of whether they stayed in a hotel or a P2P accommodation dwelling.

It should be noted that a third explanatory variable was initially considered to represent the sharing economy phenomenon, which was the officially collected data on the use of apartments by tourists visiting Spain. This data is available in the Frontur survey published by Spain's National Institute of Statistics (Instituto Nacional de Estadísticas) and the Ministry of Industry, Commerce, and Tourism (Ministerio de Industria, Comercio y Turismo). However, this variable was ultimately excluded for several reasons. First, a methodological change occurred in 2015 that directly impacted the information required for this analysis. Second, the use of apartments as a form of hospitality service is not exclusive to P2P accommodation services and could thus lead to potential misunderstandings. Third, since the information provided by the Frontur survey pertains to the use of hospitality services, analyzing it in relation to international tourist flows would have introduced significant circularity issues.

## 2.4 Results & Discussion

The following variables are included in the analysis, each in quarterly interannual change rate, except for the distance variable, which is naturally constant, and the dichotomous variable for the structural break:

Variable	Mean
xlnita	Quarterly interannual change rate for international tourist arrivals from origin countries to Spain
xlngdppc	Quarterly interannual change rate for GDP per capita of origin countries
xlnrer	Quarterly interannual change rate for the real exchange rate for origin countries to Spain
xlnpop	Quarterly interannual change rate for the population of origin countries
lndis	Logarithm for the distance between origin countries and Spain
cebreak	Structural break dummy
xlnctrend	Quarterly interannual change rate for CE trend in origin countries

Table 4: Variables description

Variable	Mean	Standard Deviation	Observations
xlnita	0.030	0.106	560
xlngdppc	0.010	0.030	560
xlnrer	-0.003	0.047	560
xlnpop	0.005	0.005	560
lndis	7.256	0.584	560
cebreak	0.571	0.495	560
xlnctrend	0.302	0.359	560

Table 5: Descriptive statistics

Below are the results for the estimation of the two dynamic panel-data models, and the two random-effects GLS regressions. Table 6 provides the results for the four models including the variable for the structural break. Table 7 depicts the results replacing this dichotomous variable with the more accurate variable for the interest in P2P accommodation in countries of origin.

Variable	(1)	(2)	(3)	(4)
L1	0.484 (0.000)	0.431 (0.000)	0.501 (0.000)	0.443 (0.000)
L2		0.127 (0.002)		0.134 (0.002)
L3		0.139 (0.010)		0.148 (0.010)
L4		-0.246 (0.000)		-0.237 (0.000)
xgdppc	0.630 (0.006)	0.531 (0.010)	0.572 (0.013)	0.438 (0.022)
xrer	-0.164 (0.056)	-0.158 (0.025)	-0.160 (0.036)	-0.179 (0.009)
xpop	1.868 (0.000)	2.156 (0.000)	0.551 (0.316)	0.729 (0.146)
lndis		0.016 (0.012)	0.015 (0.005)	
break	0.019 (0.007)	0.024 (0.000)	0.013 (0.034)	0.020 (0.000)
_cons	-0.013 (0.017)	0.017 (0.011)	-0.120 (0.011)	-0.119 (0.002)
Wald Test	2973.710 (0.000)	6304.930 (0.000)	13271.720 (0.000)	352022.140 (0.000)
Observations	540	510	550	520
Groups	10	10	10	10
Obs. per group	54	51	55	52

(1) Arellano-Bond dynamic panel-data estimation - 1 lag

(2) Arellano-Bond dynamic panel-data estimation - 4 lags.

(3) Random-effects GLS regression - 1 lag

(4) Random-effects GLS regression - 4 lags

Notes: Coefficient for each value is provided, together with its p-value between parenthesis. The dependant variable is International Tourist Arrival quarterly interannual change rate. The regressions include GDP per capita, real exchange rate and population all in quarterly interannual change rate product of the difference between the logarithm with the same quarter in the previous year, as well as distance and a dummy for the emergence of the Sharing Economy. The distance variable is excluded from (1) and (2) regressions since its effect is already captured in the countries fixed-effect term and its inclusion would cause perfect collinearity.

Table 6: Results for Structural Break

Variable	(1)	(2)	(3)	(4)
L1	0.490 (0.000)	0.433 (0.000)	0.504 (0.000)	0.445 (0.000)
L2		0.131 (0.000)		0.137 (0.000)
L3		0.147 (0.010)		0.154 (0.010)
L4		-0.226 (0.000)		-0.221 (0.000)
xgdppc	0.669 (0.006)	0.577 (0.007)	0.598 (0.013)	0.482 (0.016)
xrer	-0.152 (0.010)	-0.164 (0.001)	-0.146 (0.005)	-0.180 (0.001)
xpop	1.679 (0.015)	1.654 (0.039)	0.482 (0.449)	0.497 (0.462)
lndis			0.016 (0.017)	0.015 (0.007)
xlnctrend	0.025 (0.011)	0.024 (0.022)	0.020 (0.056)	0.021 (0.044)
_cons	-0.009 (0.302)	-0.009 (0.336)	-0.117 (0.010)	-0.108 (0.002)
Wald Test	815.16 (0.000)	85277.72 (0.000)	1816.70 (0.000)	5.84e+06 (0.000)
Observations	540	510	550	520
Groups	10	10	10	10
Obs. per group	54	51	55	52

(1) Arellano-Bond dynamic panel-data estimation - 1 lag

(2) Arellano-Bond dynamic panel-data estimation - 4 lags.

(3) Random-effects GLS regression - 1 lag

(4) Random-effects GLS regression - 4 lags

Notes: Coefficient for each value is provided, together with its p-value between parenthesis. The dependant variable is International Tourist Arrival quarterly interannual change rate. The regressions include GDP per capita, real exchange rate and population all in quarterly interannual change rate product of the difference between the logarithm with the same quarter in the previous year, as well as distance and the quarterly interannual change rate for the interest in the Sharing Economy. The distance variable is excluded from (1) and (2) regressions since its effect is already captured in the countries fixed-effect term and its inclusion would cause perfect collinearity.

Table 7: Results for Interest in P2P Accommodation

As can be interpreted from the preceding results, all variables are significant and exhibit the expected signs. The Wald test indicates that all eight models feature significant explanatory variables. In all eight models estimated, as anticipated, the GDP per capita of the countries of origin serves as the primary explanatory variable for international tourist arrivals to Spain. The larger the growth of the GDP per capita in the countries of origin, the greater the number of outgoing tourists they contribute. While the first models, the Arellano-Bond dynamic panel-data estimations, exhibit the highest coefficient for this variable, all estimations present positive and significant estimates for this variable. The coefficient of the real exchange rate variable indicates that when Spain becomes a more expensive destination and the real

exchange rates increase, tourism to the country tends to decrease, although its impact is notably smaller than that of the GDP per capita. The expected result was a negative sign, and all estimations yield this result, with a negative and significant coefficient ranging from -0.146 to -0.179. Concerning the population in the country of origin, the results are as expected, with positive outcomes. Except for the third estimation, the random-effects GLS regression with 1 lag, all estimations provide a significant value for the coefficient of this variable. The distance variable, which remains invariant in the time series, was deliberately excluded from the dynamic data-panel models as its effect was already accounted for in the fixed-effect term, and its inclusion would lead to perfect collinearity. The random-effect regressions allow the inclusion of this variable, which is essential as described earlier in demand models. Its estimation is positive and statistically significant. However, for the focus of this research, the most relevant variables are those related to the P2P accommodation innovation. This was analyzed using two different variables. Firstly, a dichotomous variable for the innovation of the sharing economy. As evident in the results across all four different models, ranging from dynamic data-panel models to random effects estimations, both with one and four lags, the coefficient for the structural break variable for the sharing economy is positive and statistically significant. This provides evidence of a structural change in the tourism demand model in Spain as a result of the innovation brought about by the sharing economy in the hospitality sector. Nonetheless, since the emergence of the Sharing Economy coincided with the economic crisis recovery, and although this effect is partially accounted for in the GDP per capita variable, the dichotomous variable might not fully capture the sharing economy phenomenon as comprehensively as needed. Hence, a much more specific second variable for the sharing economy is included, representing the interest in this sector in the countries of origin. In this case, all coefficients are once again positive and statistically significant, confirming that the innovation of P2P accommodation has indeed exerted a positive effect on international tourist arrivals to Spain.

To further interpret the result, since the dependant variable had undergone a logarithmic transformation, the coefficients for the sharing economy structural break and trend require the application of exponentials to obtain the estimated impact of this variable in the international tourist arrivals. In this way, the original dependant variable  $x_{lnita}$  was the product of:

$$\ln (ITA_t) - \ln (ITA_{t-4}) = \ln \left( \frac{ITA_t}{ITA_{t-4}} \right)$$

To eliminate the neperian logarithm and purely obtain the ratio of change that the sharing economy has had over the international tourist arrivals, the exponential of the coefficient is in place:

cebreak	Coefficient	Exponential
(1)	0.019	1.0189
(2)	0.024	1.0246
(3)	0.013	1.0130
(4)	0.020	1.0204

Table 8: Coefficient interpretation for cbreak

xlnctrend	Coefficient	Exponential
(1)	0.025	1.0257
(2)	0.024	1.0242
(3)	0.020	1.0204
(4)	0.021	1.0213

Table 9: Coefficient interpretation for xlnctrend

This way, the coefficient exponentials explain the growth rate of the quarter t over quarter t-4 (quarterly interannual change) that the introduction of the P2P accommodation innovation has had on the dependant variable, the international tourist arrivals. This growth rate varies over the different models but is expected to be in the range from a significant 1.30% to 2.56%.

As a post-estimator, this research presents a panel data Granger-causality test, as developed by Dumitrescu and Hurlin (2012). This test allows the detection of possible bi-directional casualties between variables. In this case, one can presume that a circular relationship might exist between international tourist arrivals and the interest on the P2P accommodation innovation on the countries of origin of the tourists. Table 10 presents the causality test:

Null hypothesis	W-stat.	p-value	Decision
xlnctrend does not Granger-cause xlnita	2.874	0.000	xlnctrend → xlnita (unidirectional causality)
xlnita does not Granger-cause xlnctrend	0.515	0.278	

Table 10: Causality test for international tourist arrivals and interest in the P2P innovation

As presented in the precedent table, the causality test confirms that the interest in P2P accommodation Granger-causes international tourist arrivals, therefore validating the causality direction of the model.

This work naturally has different limitations that could be addressed in future research. First, although the results are robust, there might be other unobserved factors that could affect the dependent variable. Additionally, despite its clarity, the structural break dichotomous variable does have limitations that the interest variable is intended to address, but officially collected specific data for the demand or interest in P2P accommodation could contribute significantly to the analysis. On another note, a portion of the dwellings on sharing economy platforms are purely buy-to-let investments and should therefore not be regarded as part of the sharing economy (Ranjbari et al, 2018). However, by analyzing the business model innovation, its impact on international tourist flows is still captured by this study. Furthermore, the effect of the P2P accommodation innovation may not be uniform across different destinations within Spain. It is expected that different characteristics of the destination, such as the type of tourism it offers, natural or geographical attributes, or the traditional accommodation options it provides, might cause this innovation to have a varied impact on the tourism flows at a destination-specific level. Nonetheless, analyzing tourism demand on a national aggregated level provides an overview of the phenomenon's impact. Lastly, this research is limited to the international tourism demand for Spain, and these findings might not necessarily be extrapolated to different countries. Other characteristics such as the size of the economy, geographical proximity to the main travel markets, and tourism infrastructure could affect the elasticity of travel demand in response to the P2P accommodation innovation. Therefore, repeating this study in other contexts would be necessary to account for these variations.

The results obtained by the means of the eight different econometric models show robust evidence that the sharing economy has had a positive and significant impact on international tourist arrivals in the range of 1.30% to 2.56%.

## 2.5 Conclusions

The SE emergence has indubitably, although to different extents, disrupted the course of many industries globally. It has also presented an alternative for individuals to generate a complimentary household income, while at the same time co-creating value in their communities and promoting more conscious production and consumption practices. Nonetheless, it is not exempt from negative externalities, such as market deregulation, labour precariousness and touristification.

Different contributions to academic literature have deepened on the SE impact on the hotel industry, providing conflicting statements on the matter. However, limited evidence on the impact of the SE on tourist flows has been found. This research intends to fill this gap by providing insight into the change in the tourism demand equation produced by the innovation spawned by the SE. Although the SE might have had a negative impact on the hotel industry, it seemed likely that, because of the price reduction on hospitality services, both by offering a more economical lodging product than hotels and by increasing competition, as well as by increasing the receptive capacities of destinations and by seizing the changing tastes of the demand, the SE might have, in reality, fostered the international tourist flows and cherished economic growth. To test this hypothesis, a demand model has been built and analyzed through several data-panel models. By contrasting different estimators and models, ranging from fixed-effects dynamic data-panel models to generalized least squares data panels, the effect of the SE in the tourism industry has been analyzed.

The results for such estimations in all four models provide a significant and positive coefficient for the impact of the SE variables. The interpretation of the results is that the SE is responsible for the growth rate of international tourist arrivals to Spain in the range of a significant 1.39% to 2.58%. Such a growth rate is far from negligible, especially in an economy like Spain's, where the tourism industry is a crucial component of the economic machinery. This is particularly relevant in times of significant economic uncertainty, during which the earnings from the SE and its immediate impact on household incomes undoubtedly offer much-needed relief to society.

These results indicate that the SE phenomenon must be embraced since it positively contributes to tourism flows and therefore promotes economic growth, especially for small independent businesses as well as to employment creation as previously highlighted in this paper. Furthermore, policymakers should encourage the collaboration of local authorities and communities with SE platforms to co-create the still immature normative system. Customer and employment protection should be prioritized while also enhancing the entrepreneurial and job-creating potential of the SE. This policy must be complemented with a harmonization of the divergent normative system that may be found in a local scale, hopefully to a transnational level, that may generate the necessary confidence in the SE that both customers, communities, and entrepreneurs require. Complimentary, it is necessary that the SE regulatory system prevents it from becoming a submerged economy and contributes to capitalizing its positive externalities. Last, since the SE has a positive effect on tourism flows, the regulatory system must bear the possibility to contain this effect in destinations that are experiencing over-tourism.

This research intends to contribute to the academic literature by deepening into the ongoing discussion on the SE and particularly, providing evidence on the impact of the SE on tourism flows as well as contributing to the understanding of the changing tourism demand factors. Further research could complement this paper by offering a deeper understanding of the SE phenomenon. Firstly, investigating the impact of the SE on other countries in diverse regions could significantly contribute to validating the findings of this study. Moreover, analyzing the impact of SE user expenditures and their spillover effects on the hosting ecosystem.

## 2.6 References

Acquier, A., Carbone V., & Massé, D. (2016). Les mondes de l'économie collaborative: une approche par les modèles économiques. IDDRI Research Papers – Projet PICO.

Acquier, A., Carbone, V. & Massé, D. (2019). How to Create Value(s) in the Sharing Economy: Business Models, Scalability and Sustainability, *Technology Innovation Management Review*, 9(2), 5-24. DOI: 10.22215/timreview/1215

Akadiri, S. S., & Akadiri, A. C. (2019). Examining The Causal Relationship Between Tourism, Exchange Rate, And Economic Growth In Tourism Island States: Evidence From Second-Generation Panel. *International Journal of Hospitality & Tourism Administration*, 22(3), 235–250. DOI: 10.1080/15256480.2019.1598912

Álvarez-Díaz, M., & González-Gómez, M., Otero-Giráldez, M.S. & Trigo-Iglesias, A.B. (2015). La demanda de turistas británicos a España. *Revista de Economía Aplicada*, XXIII(69),51-59.

Álvarez-Díaz, M., González-Gómez, M. & Otero-Giráldez, M. S. (2015). Estimating Price and Income Demand Elasticities for Spain Separately by the Major Source Markets, *Tourism Economics*, 21(5), 1103–1110. DOI: 10.5367/te.2014.0396

Álvarez-Díaz, M., González-Gómez, M., & Otero-Giráldez, M. S. (2016). La modelización de la demanda de turismo de economías emergentes: el caso de la llegada de turistas rusos a España. *Cuadernos de Economía*, 39(110), 112–125.

Alvarez-Díaz, M., D'Hombres, B., Ghisetti, C., & Pontarollo, N. (2020). Analysing domestic tourism flows at the provincial level in Spain by using spatial gravity models, *International Journal of Tourism Research*, 22(4), 403-415. DOI: 10.1002/jtr.2344

Ardura Urquiaga, A., Lorente-Riverola, I., Mohino, I., & Ruiz Sanchez, J. (2019). “No estamos tan mal como Barcelona”: análisis de la proliferación y regulación de las viviendas

de uso turístico en Madrid y Barcelona. *Boletín de la Asociación de Geógrafos Españoles*, 83, 2828, 1–47. DOI: 10.21138/bage.2828

Avdimiotis, S., & Poulaki, I. (2019). Airbnb impact and regulation issues through destination life cycle concept. *International Journal of Culture, Tourism and Hospitality Research*, 13(4), 458–472. DOI: 10.1108/ijcthr-03-2019-0044

Baldwin, R. (2016). *The Great Convergence: Information Technology and the New Globalization*. Harvard University Press.

Barman, H., & Nath, H. K. (2018). What determines international tourist arrivals in India? *Asia Pacific Journal of Tourism Research*, 1–11.

Basuroy, S., Kim, Y. & Proserpio, D. (2020). Estimating the impact of Airbnb on the local economy: Evidence from the restaurant industry. Advance online publication. DOI: 10.2139/ssrn.3516983

Bento, J. P. C. (2014). The Determinants of International Academic Tourism Demand in Europe. *Tourism Economics*, 20(3), 611–628.

Böcker, L. & Meelen, T. (2017). Sharing for People, Planet or Profit? Analysing Motivations for Intended Sharing Economy Participation, Environmental Innovation and Societal Transitions, 23, 28–39. DOI: 10.1016/j.eist.2016.09.004

Bokelmann, B., & Lessmann, S. (2019). Spurious patterns in Google Trends data - An analysis of the effects on tourism demand forecasting in Germany. *Tourism Management*, 75, 1–12.

Botsman, R., & Rogers, R. (2010). *What's mine is yours: The rise of collaborative consumption*. Harper Business. ISBN-13: 978-0061963544.

Cebrián, E. & Domenech, J. (2023). Is Google Trends a quality data source?, *Applied Economics Letters*, Vol. 30(6), pp: 811-815

Cerdá Mansilla, E., García Henche, B. & Such Devesa, M. J. (2021). Análisis de la economía colaborativa en el turismo urbano. Estudio de la implantación de Airbnb en Madrid y Barcelona. *Cuadernos de Turismo* (47), 383-412. DOI: 10.6018/turismo.474481

Choong-Ki, L., Var, T., & Blaine, T. W. (1996). Determinants of Inbound Tourist Expenditures. *Annals of Tourism Research*, 23(3), 527–542.

Cocola-Gant, A. & Gago, A. (2019). Airbnb, buy-to-let investment and tourism-driven displacement: A case study in Lisbon, *Environment and Planning A: Economy and Space*, 1–18. DOI: 10.1177/0308518X19869012

Croes, R. R., & Vanegas Sr., M. (2005). An econometric study of tourist arrivals in Aruba and its implications. *Tourism Management*, 26(6), 879–890.

Demailly, D. & Novel, A. S. (2014). The Sharing Economy: Make It Sustainable, *Iddri Studies*, 03/14.

Dinis, G., Breda, Z., Costa, C., & Pacheco, O. (2019). Google Trends in tourism and hospitality research: a systematic literature review. *Journal of Hospitality and Tourism Technology*, 10(4), 747–763.

Divisekera, S. (2003). A model of demand for international tourism. *Annals of Tourism Research*, 30(1), 31–49.

Dolnicar, S. (2020). Sharing economy and peer-to-peer accommodation – a perspective paper, *Tourism Review*. Advance online publication. DOI: 10.1108/TR-05-2019-0197

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, 29(4), 1450–1460. DOI 10.1016/j.econmod.2012.02.014

Emili, S., Figini, P., & Guizzardi, A. (2019). Modelling international monthly tourism demand at the micro destination level with climate indicators and web-traffic data. *Tourism Economics*, 135481661986780.

Emili, S., Gardini, A., & Foscolo, E. (2020). High spatial and temporal detail in timely prediction of tourism demand. *International Journal of Tourism Research*.

European Commission (2016). A European agenda for the collaborative economy. Available at: <https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-356-EN-F1-1.PDF> [Accessed June 20th, 2020]

Falk, M. T. & Yang, Y. (2020). Hotels benefit from stricter regulations on short-term rentals in European cities, *Tourism Economics*. Advance online publication. DOI: 10.1177/1354816620918769.

Fang, B., Ye, Q. & Law, R. (2016). Effect of sharing economy on tourism industry employment, *Annals of Tourism Research*, (57), 264–267. DOI: 10.1016/j.annals.2015.11.018

Feng, Y., Li, G., Sun, X., & Li, J. (2019). Forecasting the number of inbound tourists with Google Trends. *Procedia Computer Science*, 162, 628–633.

Ferreira, J. P., Ramos, P. N. & Lahr, M. L. (2020). The rise of the sharing economy: Guesthouse boom and the crowding-out effects of tourism in Lisbon, *Tourism Economics*, 26(3), 389–403. DOI: 10.1177/1354816619839849.

Gansky, L. (2010). *The mesh: Why the future of business is sharing*, Penguin Books, New York, NY.

Gardella, R., Lupo, F. & Aguayo, E. (2005). Mercado turístico argentino: análisis de su demanda internacional. *Estudios y Perspectivas en Turismo*, 14(2)

Garin-Munoz, T., & Amaral, T. P. (2000). An econometric model for international tourism flows to Spain. *Applied Economics Letters*, 7(8), 525–529.

Garín-Muñoz, T. (2005). German demand for tourism in Spain. *Tourism Management* Vol. 28: 12–22

Garín-Muñoz, T. (2006). Inbound international tourism to Canary Islands: a dynamic panel data model, *Tourism Management*, (27), 281–291. DOI: 10.1016/j.tourman.2004.10.002

Gil Pareja, S., Llorca Vivero, R., & Martínez Serrano, J. A. (2007). The Effect of EMU on Tourism. *Review of International Economics*, 15(2), 302–312.

Guttentag, D. & Smith, S.L.J. (2017). Assessing Airbnb as a disruptive innovation relative to hotels: Substitution and comparative performance expectations, *International Journal of Hospitality Management*, 64), 1–10. DOI: 10.1016/j.ijhm.2017.02.003

Guttentag, D., Smith, S., Potwarka, L. & Havitz, M. (2018). Why Tourists Choose Airbnb: A Motivation-Based Segmentation Study, *Journal of Travel Research*, 57(3), 342–359. DOI: 10.1177/0047287517696980

Haar, K. (2018). UnFairBnb: How online rental platforms use the EU to defeat cities affordable housing measures, *Corporate Europe Observatory*. Available at: <https://corporateeurope.org/sites/default/files/unfairbnb.pdf> [Accessed June 15th, 2020]

Höpken, W., Eberle, T., Fuchs, M., & Lexhagen, M. (2018). Google Trends data for analysing tourists' online search behaviour and improving demand forecasting: the case of Åre, Sweden. *Information Technology & Tourism*.

Hu, M., & Song, H. (2019). Data source combination for tourism demand forecasting. *Tourism Economics*, 26(7), 1248–1265.

Hu, Y.C. & Wu, G. (2022), The impact of Google Trends index and encompassing tests on forecast combinations in tourism, *Tourism Review*, Vol. 77(5), pp. 1276-1298

Huang, K.H. & Yu, T.H.K. (2019). Application of Google Trends to Forecast Tourism Demand. *Journal of Internet Technology*. Vol 20(4), pp 1273-1280.

Inside Airbnb. (2022). Barcelona insights. Available at <http://insideairbnb.com/barcelona/> [Accessed August 2nd, 2022].

Jackman, M., & Naitram, S. (2015). Research Note: Nowcasting Tourist Arrivals in Barbados – Just Google it! *Tourism Economics*, 21(6), 1309–1313.

Jun, S. P., Yoo, H.S. & Choi, S. (2018). Ten years of research change using Google Trends: From the perspective of big data utilizations and applications, *Technological Forecasting and Social Change*, 130), 69–87. DOI: 10.1016/j.techfore.2017.11.009

Koçak, E., Ulucak, R., & Ulucak, Z. Ş. (2020). The impact of tourism developments on CO2 emissions: An advanced panel data estimation. *Tourism Management Perspectives*, 33, 100611. DOI: 10.1016/j.tmp.2019.100611

Koh, E., & King, B. (2017). Accommodating the sharing revolution: a qualitative evaluation of the impact of Airbnb on Singapore's budget hotels. *Tourism Recreation Research*, 42(4), 409–421. DOI: 10.1080/02508281.2017.1314413

Kozić, I., Sorić, P., & Sever, I. (2018). Interdependence of international tourism demand for Mediterranean countries: Impact of demand shocks. *International Journal of Tourism Research*.

Kusni, A., Kadir, N., & Nayan, S. (2013). International Tourism Demand in Malaysia by Tourists from OECD Countries: A Panel Data Econometric Analysis. *Procedia Economics and Finance*, 7, 28–34.

Kyara, V. C., Rahman, M. M., & Khanam, R. (2021). Tourism expansion and economic growth in Tanzania: A causality analysis. *Heliyon*, 7(5), e06966. DOI: 10.1016/j.heliyon.2021.e06966

Lee, K. N. (2011). Forecasting long-haul tourism demand for Hong Kong using error correction models. *Applied Economics*, 43(5), 527–549.

Lee, K. N. (2011). Estimating demand elasticities for intra-regional tourist arrivals to Hong Kong – the “bounds” testing approach. *Applied Economics Letters*, 18(17), 1645–1654.

Leismann, K., Schmitt, M., Rohn, H. & Baedeker, C. (2013). Collaborative Consumption: Towards a Resource-Saving Consumption Culture, *Resources*, 2(3), 184–203. DOI: 10.3390/resources2030184

Lim, C. (2004). The major determinants of Korean outbound travel to Australia. *Mathematics and Computers in Simulation*, 64(3-4), 477–485.

Lin, L.F. (2019). The factors influencing taiwanese demand to travel abroad. *Tourism and hospitality management - Croatia*, 25(2).

Liu, A. & Wu, D. C. (2019). Tourism productivity and economic growth, *Annals of Tourism Research*, 76), 253–265. DOI: 10.1016/j.annals.2019.04.005

Lu, L., & Tabari, S. (2019). Impact of Airbnb on Customers' Behavior In the UK Hotel Industry. *Tourism Analysis*, 24(1), 13–26. DOI: 10.3727/108354219x15458295631891

Maloney, W. F. & Montes Rojas, G. V. (2005). How elastic are sea, sand and sun? Dynamic panel estimates of the demand for tourism, *Applied Economics Letters*, 12(5), 277–280. DOI: 10.1080/1350485042000338626

Martins, L. F., Gan, Y., & Ferreira-Lopes, A. (2017). An empirical analysis of the influence of macroeconomic determinants on World tourism demand. *Tourism Management*, 61, 248–260.

Mody, M., Suess, T. & Dogru, T. (2017). Comparing apples and oranges? Examining the impact of Airbnb on hotel performance in Boston, *Boston Hospitality Review*, 5(2).

Moore, W. R. (2010). The impact of climate change on Caribbean tourism demand. *Current Issues in Tourism*, 13(5), 495–505.

Morales-Alonso, G., & Núñez, Y. M. (2022). Dragging on multilisting: The reason why home-sharing platforms make long-term rental prices increase and how to fix it. *Technological Forecasting and Social Change*, 174, 121297.

Murillo, D., Buckland, H. & Val. E. (2017). When the sharing economy becomes neoliberalism on steroids: Unravelling the controversies, *Technological Forecasting and Social Change*, 125), 66–76. DOI: 10.1016/j.techfore.2017.05.024

Onafowora, O. A., & Owoye, O. (2012). Modelling International Tourism Demand for the Caribbean. *Tourism Economics*, 18(1), 159–180.

Önder, I. (2017). Forecasting tourism demand with Google trends: Accuracy comparison of countries versus cities. *International Journal of Tourism Research*, 19(6), 648–660.

Önder, I. & Gunter, U. (2015). Forecasting Tourism Demand with Google Trends For a Major European City Destination. *Tourism Analysis*. 21. 203-220.

Önder, I., Weismayer, C. & Gunter, U. (2018). Spatial price dependencies between the traditional accommodation sector and the sharing economy, *Tourism Economics*, 25(8), 1150–1166. DOI: 10.1177/1354816618805860

Paccoud, A. (2016). Buy-to-let gentrification: extending social change through tenure shifts, *Environment and Planning A: Economy and Space*, 49(4), 839-856. DOI: 10.1177/0308518X16679406

Paulauskaite, D., Powell, R., Coca-Stefaniak, J. A. & Morrison, A. M. (2017). Living like a local: Authentic tourism experiences and the sharing economy, *International Journal of Tourism Research*, 19(6), 619–628. DOI: 10.1002/jtr.2134

Ranjbari, M., Morales-Alonso, G., & Carrasco-Gallego, R. (2018). Conceptualizing the Sharing Economy through Presenting a Comprehensive Framework. *Sustainability*, 10(7), 2336. DOI: 10.3390/su10072336

Rey, B., Myro, R. & Galera, A. (2011). Effect of low-cost airlines on tourism in Spain. A dynamic panel data model, *Journal of Air Transport Management*, 17(3), 163–167. DOI: 10.1016/j.jairtraman.2010.12.004

Rodríguez-Pérez de Arenaza, D., Hierro, L. Á. & Patiño, D. (2019). Airbnb, sun-and-beach tourism and residential rental prices. The case of the coast of Andalusia (Spain) , *Current Issues in Tourism*. Advance online publication. DOI: 10.1080/13683500.2019.1705768

Saayman, A., Figini, P., & Cassella, S. (2016). The influence of formal trade agreements and informal economic cooperation on international tourism flows. *Tourism Economics*, 22(6), 1274–1300.

Santeramo, F. G., & Morelli, M. (2015). Modelling tourism flows through gravity models: a quantile regression approach. *Current Issues in Tourism*, 19(11), 1077–1083.

Serra, J., Correia, A., & Rodrigues, P. M. M. (2014). A comparative analysis of tourism destination demand in Portugal. *Journal of Destination Marketing & Management*, 2(4), 221–227.

Shafiullah, M., Okafor, L. E., & Khalid, U. (2018). Determinants of international tourism demand. *Tourism Economics*, 135481661880064. DOI: 10.1177/1354816618800642

Silverstovs, B., & Wochner, D. S. (2018). Google Trends and reality: Do the proportions match? *Journal of Economic Behavior & Organization*, 145, 1–23.

Slee, T. (2015) *What's Yours Is Mine: Against the Sharing Economy*, OR Books, New York, NY.

Song, H., Li, G., Witt, S. F., & Fei, B. (2010). Tourism Demand Modelling and Forecasting: How Should Demand Be Measured? *Tourism Economics*, 16(1), 63–81.

Song, H., Romilly, P., & Liu, X. (2000). An empirical study of outbound tourism demand in the UK. *Applied Economics*, 32(5), 611–624.

Song, H., Witt, S. & Li, G. (2009). *The advanced econometrics of tourism demand*. Routledge, New York, NY.

Sthapit, E., Del Chiappa, G., Coudounaris, D. N. & Bjork, P. (2019). Determinants of the continuance intention of Airbnb users: consumption values, co-creation, information overload and satisfaction, *Tourism Review*, 75(3), 511-531. DOI: 10.1108/TR-03-2019-0111

STR (2017). Airbnb and Hotel Performance: An analysis of proprietary data in 13 global markets, Available at: <https://str.com/sites/default/files/2019-07/Airbnb-and-Hotel-Performance.pdf> [Accessed June 14th, 2020]

Szetela, B. & Mentel, G. (2016). May the sharing economy create a new wave of globalization?, *Economic Annals-XXI*, 161(9-10), 31-34. DOI: 10.21003/ea.V161-07

Takahashi, K. (2019). Tourism demand and migration nexus in Small Island Developing States (SIDS): applying the tourism demand model in the Pacific region. *Island Studies Journal*, 14(1), 163,174.

Tavares, J. M., & Leitão, N. C. (2016). The determinants of international tourism demand for Brazil. *Tourism Economics*, 23(4), 834–845.

Toivonen, M. & Tuominen, T. (2009). Emergence of innovations in services, *The Service Industries Journal*, 29(7), 887–902. DOI: 10.1080/02642060902749492

Trimi, S. & Berbegal-Mirabent, J. (2012). Business model innovation in entrepreneurship, *International Entrepreneurship and Management Journal*, 8(4), 449–465. DOI: 10.1007/s11365-012-0234-3

Tsui, W. H. K., Fu, X., Yin, C., & Zhang, H. (2021). Hong Kong's aviation and tourism growth - An empirical investigation. *Journal of Air Transport Management*, 93, 102036. DOI: 10.1016/j.jairtraman.2021.102036

Tussyadiah, I. P. & Pesonen, J. (2016). Impacts of Peer-to-Peer Accommodation Use on Travel Patterns, *Journal of Travel Research*, 55(8), 1022–1040. DOI: 10.1177/0047287515608505

UNWTO (2020). Country profile - inbound tourism. Available at: <https://www.unwto.org/country-profile-inbound-tourism> [Accessed July 20th, 2020]

Volchek, K., Liu, A., Song, H. & Buhalis, D. (2019). Forecasting tourist arrivals at attractions: Search engine empowered methodologies, *Tourism Economics*, 25(3), 425–447. DOI: 10.1177/1354816618811558.

Volgger, M., Pforr, C., Stawinoga, A. E., Taplin, R., & Matthews, S. (2018). Who adopts the Airbnb innovation? An analysis of international visitors to Western Australia. *Tourism Recreation Research*, 43(3), 305–320. DOI: 10.1080/02508281.2018.1443052

Voytenko Palgan, Y., Zvolnska, L. & Mont, O. (2017). Sustainability framings of accommodation sharing, *Environmental Innovation and Societal Transitions*, 23), 70–83. DOI: 10.1016/j.eist.2016.12.002

Wang, Y., Wang, L., Liu, H., & Wang, Y. (2021). The Robust Causal Relationships Among Domestic Tourism Demand, Carbon Emissions, and Economic Growth in China. *SAGE Open*, 11(4). DOI: 10.1177/21582440211054478

Yerdelen Tatoglu, F. & Gul, H. (2019), Analysis of tourism demand using a multi-dimensional panel gravity model, *Tourism Review*, 75 (2), 433-447

Zervas, G., Proserpio, D. & Byers, J. W. (2017). The Rise of the Sharing Economy: Estimating the Impact of Airbnb on the Hotel Industry, *Journal of Marketing Research*, 54(5), 687–705. DOI: 10.1509/jmr.15.0204

Zhou-Grundy, Y., & Turner, L. W. (2014). The Challenge of Regional Tourism Demand Forecasting. *Journal of Travel Research*, 53(6), 747–759.

3. eWOM platforms as productivity catalyzers in the travel industry: a two-stage double bootstrap data envelopment analysis

## Abstract

The travel industry, and in particular travel agencies, face a severe challenge to increase productivity. In a fast-paced digitalization context, embracing digital platforms to tackle this challenge is more pressing than ever. Electronic word of mouth (eWOM) could allow better learning processes, improve communication with customers, and serve as a remarkable diffusion channel. However, this channel is not yet fully embraced by the sector, and there is a belief that eWOM platforms are not trustworthy. This research, delimited to Spanish travel agencies in the period 2012-2019, applies a two-stage double bootstrap data envelopment analysis to assess whether eWOM and how firms manage eWOM contribute to achieving higher levels of efficiency. Results show that firms with higher valence and volume of eWOM tend to be closer to the efficiency frontier. Moreover, results show that proactively managing eWOM, by asking customers for their online reviews, answering negative reviews, doing so promptly, as well as investing in eWOM, positively and significantly correlates with achieving higher levels of efficiency.

**Keywords:** eWOM, UGC, efficiency, productivity, travel agencies.

### 3.1 Introduction

Increasing outputs while maintaining the same level of inputs is not a utopia; it's productivity. This key concept has naturally been a priority for economists, policymakers, and managers for decades, as it is essential for long-lasting economic growth. Raising productivity levels is crucial for achieving sustainable development among countries and firms, especially in the context building resilience. In the travel industry, the need to address the productivity challenge is even more urgent. This urgency stems not only from being a sector severely affected by the pandemic crisis, which has evidenced the need for this sector to be better prepared to faces crises, but also from its nature as a high-intensity labor industry with traditionally low labor productivity. Consequently, the United Nations World Tourism Organization identifies productivity and resource efficiency as one of the pillars for achieving economic growth through the sustainable development of the industry (World Tourism Organization, 2018).

Back in 1995, Amazon began allowing its users to post reviews of their purchases online, which soon became one of the flagship features of the e-commerce titan. The significance of electronic word of mouth (eWOM) and user-generated content (UGC) is beyond question. In fact, 78% of United States e-commerce customers stated that online product reviews played a major role in their purchasing decisions (Hong & Pittman, 2020). It's no surprise, then, that various companies have either integrated this functionality, such as Google Reviews and Booking.com, or have even built their entire business models around it, like Tripadvisor or TrustPilot. From a consumer perspective, learning about the opinions of others regarding a product, service, or company is extremely valuable in the decision-making process. Online recommendations strongly influence consumers (Senecal & Nantel, 2004). However, from a business perspective, understanding customer preferences, needs, and opinions is equally valuable. Furthermore, receiving feedback on products, services, or operations is essential for companies in enhancing customer satisfaction, improving processes, and ultimately achieving higher levels of productivity.

The objective of this research is to examine the extent to which eWOM contributes to increasing the productivity of companies, particularly in the travel and tourism industry. The main hypothesis is that eWOM contributes to increasing the productivity of firms in two

ways. First, by increasing consumer trust in specific products, services, and/or companies. Second, by providing firms with the opportunity to proactively manage eWOM, both by identifying improvement opportunities and by engaging in a deeper relationship with their customers. To achieve this objective, this research employs an econometric approach that assesses the efficiency of travel agencies at the firm level using a two-stage double bootstrap data envelopment analysis. Information on individual firms was obtained through the Orbis database. This dataset was complemented by data scraped from the eWOM digital platform Trustpilot, which includes online reviews of each firm as well as information on how those companies manage user-generated content (UGC).

Researching this topic is relevant for several reasons. First, there is an ongoing debate in the industry regarding the necessity for companies to actively manage eWOM. On one hand, some managers believe in the relevance that these platforms have in communicating with their clients, detecting opportunities for improvement, and increasing buzz on their products. However, others argue that because of the spread of fake reviews on the internet, eWOM platforms are not trustworthy. Additionally, from an academic contribution perspective, most previous research about eWOM in the travel industry has focused on the customer behavior aspect, and less on the business productivity topic. Of the latter, almost all research in the travel and tourism industry has focused on the hospitality sector, overlooking the effect of eWOM on the productivity of businesses in the tour operation, attractions, and transport sectors.

This paper is structured into sections. Following the introduction to the research topic, the next section provides the relevant background on the topics of UGC and eWOM. These are covered both in terms of theoretical background by presenting a literature review on the discussions in academic research, as well as a description of the state of the art in eWOM and eWOM management. This section also includes a review of the literature on productivity and efficiency in the travel and tourism industry, as well as the effects of these digital platforms on the productivity of firms. Following that, section 3 presents the methodology applied in this research, detailing the most relevant aspects of the techniques and data sources employed. Next, section 4 presents the estimation results and the subsequent discussion. Section 5 presents the main conclusions of the research. Finally, section 6 presents the references of this paper.

## 3.2 Background & Literature Review

### 3.2.1 Electronic Word of Mouth

Word of mouth (WOM), as a medium for sharing opinions on products and services, is as old as time. It is often considered to have a more significant impact on customers than any other communication channel (Godes & Mayzlin, 2004) and to be the most effective means of influencing customer behavior due to the high reliability and credibility that customers place on the opinion-sharing party (Huete-Alcocer, 2017). WOM itself has been considered a key diffusion channel in marketing, but when including the internet reach to the equation, this medium has expanded to new horizons. Every day, new user-generated content (UGC) is posted online. Some of this content consists of opinions on products and services and is therefore considered Electronic Word of Mouth (eWOM). This concept is defined as pronouncements, whether positive, neutral, or negative, about a product or service posted online by an individual and shared with other potential customers (Hennig-Thurau et al, 2004). The most structured channel through which eWOM actually takes form is online reviews (ORs).

Several characteristics differentiate eWOM from offline or traditional WOM (King et al, 2014) and are essential to understanding its relevance. First is the enhanced (a) volume. The online conversations of eWOM happen asynchronously on platforms that have an extensive reach, causing unprecedented awareness. Second, its (b) dispersion. As didn't happen with WOM, potential consumers worldwide could be influenced by eWOM. Next, since comments and reviews made online normally stay online, they are characterized by (c) persistence and observability that traditional WOM lacks. On the same aspect, eWOM normally benefits from the (d) salience of valence. This key concept refers to the numerical rating online reviews have. In traditional WOM, the valence of the message was the result of the communication and therefore subject to the interpretation of the receiver. In eWOM, the numerical valence makes it easy and fast to communicate the overall experience with the product. Next, eWOM is supported by platforms that create a (e) sense of community. This allows participants to engage in conversations, motivates them to generate new content, and

further increases the reach of their opinions. However, one last characteristic of eWOM is that the internet also allows for (f) anonymity and deception. This characteristic brings a certain level of uncertainty both to consumers and businesses that might not entirely trust online opinions. UGC in this way represents a dilemma. It could be trusted because it represents the opinions of the real experiences of real people independent of the company, but at the same time, isn't trustworthy because it is information easily faked (Burgess et al, 2009; Cox et al, 2009).

From a customer perspective, eWOM is primarily targeted at helping other users. This could either be for enjoyment, self-enhancement, or altruism (Herrero et al, 2017; Hu & Kim, 2018). However, there are many uses firms can do of UGC: learning from their customers (Lee & Yang, 2015), promoting their products through engaged clients (Schuckert et al, 2015), and engaging in a deeper relationship with their customers (Park & Allen, 2012).

Due to the key relevance eWOM has, both for customers and for firms, it has become an increasingly popular topic of academic research in the last few years (Bore et al, 2017), especially in the travel and tourism industry research (Yang et al, 2015; Muritala et al, 2020; Reyes-Menendez et al, 2020).

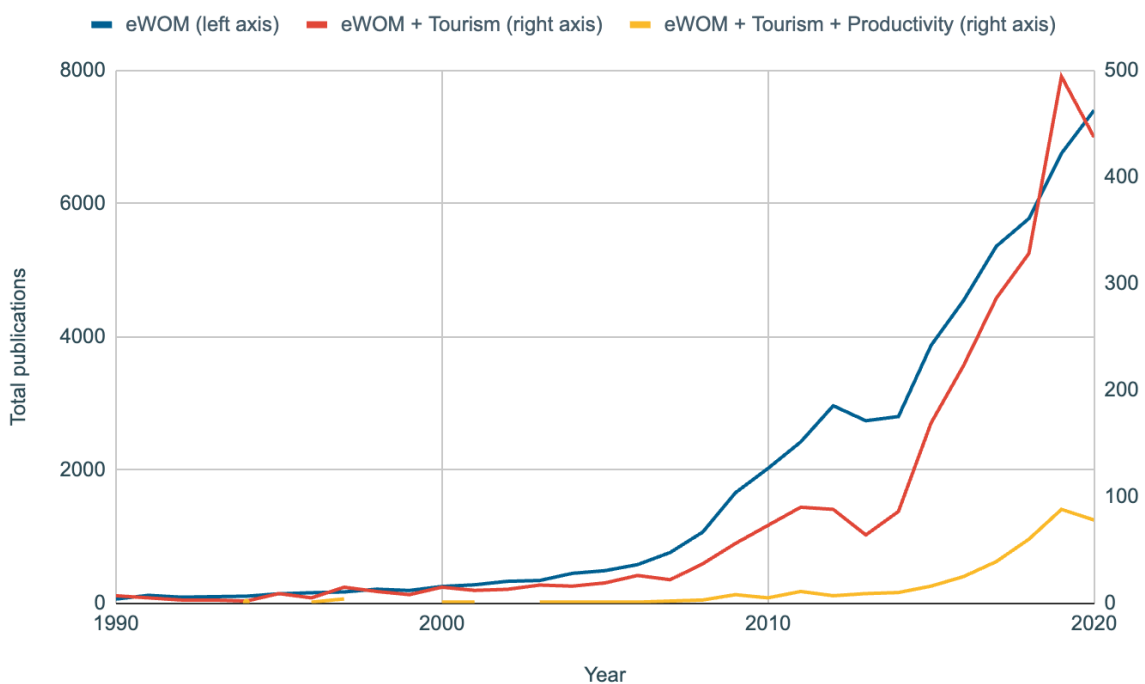


Figure 5: eWOM as a research topic

Source: Own elaboration with data from the Web of Science

To this day, most studies have focused on the behavioral aspect of eWOM. More precisely, studies have focused on how UGC and eWOM influence tourist decision-making processes (Hernández-Ortega et al, 2020). On the other hand, fewer studies have analyzed the impact of eWOM on businesses' performance (Schuckert et al, 2015; Phillips et al, 2016). Furthermore, most research on UGC and eWOM in the travel industry has focused on the hospitality sector, overlooking, to a certain degree, the importance these channels have for the rest of the travel industry players (Sann et al, 2020b).

UGC, and in particular eWOM, has the ability to influence consumers' decisions in different ways (Sann et al, 2020a). Every day, users support companies' communications by sharing their opinions online, but may very well affect firms' reputations equally easily (García de los Salmones et al, 2020). Regarding the hospitality industry, which concentrates most of the eWOM research, this channel has been identified to have a direct impact on firms' market share (Duverger, 2013). The restaurant sector doesn't remain unaffected by it either. A positive impact of eWOM on corporate performance at a financial level has been detected in this sector (Fernández-Miguélez et al, 2020).

In regards to the impact of eWOM on sales, previous research has confirmed that this is heavily dependent on the category of the product or service (Lee et al, 2011). When focusing on services, eWOM is even more relevant. This is due to the intangible and experiential characteristics of services, which makes first-hand experiences from previous customers essential for customers to assess the service's value (Papathanassis & Knolle, 2011). Since customers have fewer ways of pre-assessing the service, they find increased value in using these communication channels to reduce pre-purchase doubts (Litvin et al, 2008), all along the decision-making process, from preliminary scouting up to a detailed assessment of the service (Pourfakhimi et al., 2020). In particular, the existing literature on eWOM has identified that valence (the rating of reviews), variance (the dispersion of reviews according to the rating), and volume (the number of reviews) have a direct impact on customers' decision-making processes, and ultimately, on firm productivity or performance (Magnani, 2020; Mariani & Borghi, 2020). Given the background of these previous findings, the following hypotheses are developed regarding the expected impact of eWOM on travel industry firms' productivity:

**H1.** A higher volume of reviews has a positive correlation with firms' productivity.

**H2.** A higher valence of reviews has a positive correlation with firms' productivity.

**H3.** A variance of reviews concentrated in 5 and 4-star reviews has a positive correlation with firms' productivity, whereas concentration on 2 and 1-star reviews has a negative correlation with firms' productivity.

There is an increasing number of companies that are realizing the need to join the conversation on their products and to proactively manage eWOM. The managers of UGC and eWOM platforms, such as Trustpilot, TripAdvisor, or Google Reviews, have heard firms' claims and included functionalities for companies to respond to reviews on their products or services. This has led to a new dilemma on eWOM strategy for companies. While some companies perceive responding to eWOM better to be done as discreetly and privately as possible to avoid exposing their faults openly, other companies choose to answer publicly to engage in a deeper relationship with clients (Park & Allen, 2012). Furthermore, some managers even choose not to engage in eWOM communications with their customers because of a mistaken belief that fraudulent reviews are popular on these platforms (Levy et al, 2012). In any case, management responses to online reviews tackle one of the most predominant weaknesses of eWOM: untrustworthiness. Previous research has identified that the presence of management responses increases reviews' helpfulness (Cox et al, 2009) and has a positive impact on the volume of subsequent content (Chen et al, 2019). What is more, it was identified that management responses tend to positively impact the firms' performance (Xie et al, 2014). However, contradictory evidence shows that the presence of management responses has a negative impact on customers' purchasing intentions (Mauri & Minazzi, 2013). Therefore, the following hypotheses are developed concerning the impact of the proactive management of eWOM on firms' performance:

**H4.** Asking clients for their reviews has a positive correlation with firms' productivity.

**H5.** Replying to negative reviews and engaging in conversation with unsatisfied clients has a positive correlation with firms' productivity.

**H6.** Replying fast to negative feedback has a positive correlation with firms' productivity.

**H7.** Increasing efforts and investment in eWOM management has a positive correlation with firms' productivity.

Although most literature recommends companies to include eWOM as a business strategy (Cox et al, 2009; Herrero et al, 2015; Zhang et al, 2020), these recommendations seem to drift from the actual use of eWOM by travel businesses:

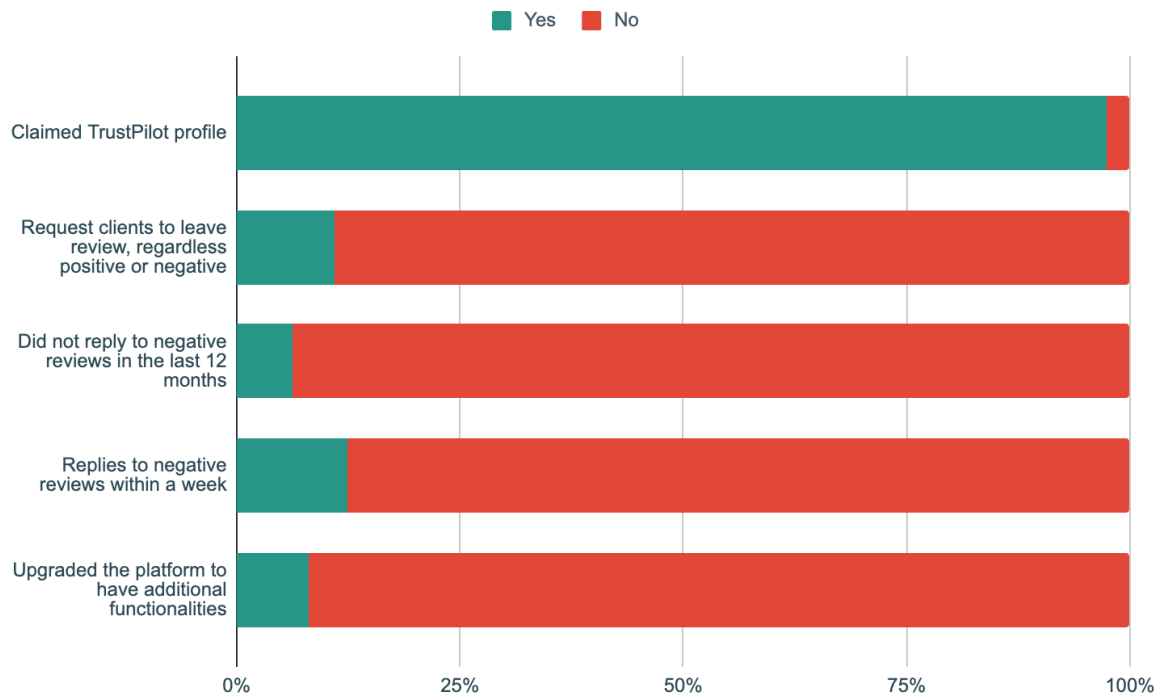


Figure 6: eWOM Management in the Travel Industry

Source: Own elaboration with data scraped from the 380 Spanish travel companies in Trustpilot

In Trustpilot, one of the leading online review platforms in the world, 380 Spanish businesses are tagged as part of the travel industry. Of those, although 97.37% of the businesses have claimed their profiles after the initial eWOM from a customer, most of the companies do not seem to proactively manage this tool. Only 11.05% of companies request their customers to share their experiences with other potential customers, and a worryingly 12.37% of firms reply to customers who have shared a negative experience.

These concerning statistics, given the aforementioned apparent benefits of managing eWOM, as well as the fact that previous research has overlooked the non-hospitality travel sector, evidence the need for research that may reveal how eWOM can contribute to increasing the productivity of travel industry firms.

### 3.2.2 Productivity & efficiency

Productivity is a key concept in explaining economic growth. In essence, an increase in productivity leads to an increase in outputs without requiring additional inputs (Liu & Wu, 2019). Being such a relevant concept, productivity, in all its forms, has been at the core of economic analysis. It has been regarded as a key instrument in achieving the sustainable development goals of the United Nations' Agenda 2030, particularly on sustainable economic growth. When dealing with limited resources, enhancing productivity is essential to ensure the long-term health of the productive systems (Pham, 2019). In the travel industry in particular, historically characterized by being a low (labor) productivity sector, there is an urgent need to tackle the productivity challenge (Kim et al, 2021). The COVID-19 pandemic has evidenced the need for this sector to build resilience. In this context, increasing productivity can help travel firms build resilience and better prepared to withstand future crises (Brown et al, 2022; Toubes et al, 2023).

Different types of productivity exist. In broad terms, inputs can be differentiated into two categories: labor and capital. Therefore, productivity can also be differentiated accordingly. The change in output growth per unit of labor input is defined as labor productivity, whereas the change in output growth per unit of capital input is defined as capital productivity. Changes in productivity are mostly caused by changes in technology or efficiency. The complexity of these measures has given rise to a comprehensive conception of productivity called total factor productivity (TFP). Firstly put forward by Solow and therefore also called the Solow Residual, TFP explains the increase in outputs that are not explained by labor nor capital increases, or in other words, the residual after considering inputs' contribution to growth (Solow, 1957).

Previous research in the travel industry has identified the key drivers of productivity as labor (by units, hours, or cost), capital, ownership type, the number of years of schooling of employees, age of the business, and customer satisfaction (Pham, 2019), as well as physical capital, the competitive environment, human capital, technology, and innovation (Kim, 2019). When measuring productivity, the most popular outputs in research are total revenue, sales, or in hospitality-specific analysis, revenue per available room or occupancy rate (Pham, 2019). Given the wide array of inputs and outputs, and the consequent complexity of measurement,

tourism productivity literature has evolved around two main methodologies of analysis: Data Envelopment Analysis, and Stochastic Frontier Analysis (Inchausti-Sintes et al, 2020). These methods present an opportunity to comprehensively understand the best practices that underperforming firms may follow to increase their efficiency. In travel and hospitality, efficiency is understood as how firms process inputs to achieve their outputs compared to their maximum potential, or production possibility frontier (De Jorge & Suárez, 2013).

Out of all inputs, innovation has the most significant positive impact on the productivity of tourism businesses (Blake et al., 2006). However, since most travel businesses are small and medium-sized companies, large investments in innovation, as well as strongly structured learning processes, are frequently scarce. What is more, since tourists receive the service at their destinations, these learning processes are even more complex, requiring an extra layer of codification (Romão & Nijkamp, 2017). In this regard, information technologies, and in particular eWOM, represent an outstanding chance for companies to learn from their customers and improve their processes (Melián-González & Bulchand-Gidumal, 2016), giving rise to efficiency increase opportunities.

### 3.3 Methodology

As previously stated, this work intends to explore whether eWOM platforms may help travel companies increase their productivity in two ways. First, by employing eWOM as a peer-trusted diffusion channel. Second, by allowing companies to proactively manage eWOM to improve their processes.

#### 3.3.1 Framework

This research applies Data Envelopment Analysis (DEA) to assess travel agencies' efficiency and to analyze the contribution of eWOM and eWOM management to achieving higher levels of efficiency. DEA was first introduced by Charnes et al (1978) and is still one of the most popular techniques to evaluate technical efficiency. In the specific area of study in this research, this methodology was previously applied to assess the efficiency of Spanish travel

agencies (Fuentes, 2011). DEA consists of a linear programming technique that converts different inputs and outputs to compare the efficiency of decision-making units (DMUs) by building an efficiency frontier envelope. DMUs can be efficient by maximizing outputs while keeping inputs constant, by minimizing inputs while keeping outputs constant, or by doing both alternatives at the same time. This analysis provides a single value per DMU, called an efficiency score, that ranges from 0 for non-efficient DMUs to 1 for those at the efficiency frontier.

The Data Envelopment Analysis, although functional, has been criticized for being a deterministic technique, as it doesn't provide a random error term when estimating efficiency. In this way, it doesn't allow for assessing the determinants of efficiency. Complementing the DEA, and for this purpose, Simar and Wilson (2007) have proposed a solution to double bootstrap DEA scores in a truncated regression, which allows for incorporating explanatory variables into the analysis of efficiency scores. This two-stage technique has been gaining popularity in efficiency studies in recent years. Some studies employing this two-stage double bootstrap Data Envelopment Analysis can be found in table 11:

Authors	Year	Tourism	Sector	Journal
Latruffe et al	2007	No	Agriculture	Journal of Productivity Analysis
Pestana Barros & Dieke	2008	Yes	Hotel	International Journal of Hospitality Management
Pestana Barros & Dieke	2008	Yes	Airports	Transportation Research Part E
Latruffe et al	2008	No	Agriculture	Post-Communist Economies
Barros et al	2009	Yes	Hotel	Applied Economics
Blank & Valdmanis	2009	No	Hospitals	Health Care Management Science
Barros & Peypoch	2009	Yes	Airlines	International Journal of Production Economics
Barros & Garcia del Barrio	2010	No	Football clubs	Journal of Productivity Analysis
Barros et al	2010	No	Insurance	European Journal of Operational Research
Alexander et al	2010	No	Schools	Journal of Productivity Analysis
Assaf & Agbola	2011	Yes	Hotel	Tourism Economics
Barros et al	2011	Yes	Touristic regions	Tourism Management
Benito et al	2014	Yes	Touristic regions	Tourism Economics
Lee	2014	No	Manufacture	The Singapore Economic Review
Tsui et al	2014	Yes	Airports	Journal of Air Transport Management
Oukil et al	2016	Yes	Hotel	Journal of Hospitality and Tourism Management
Chowdhury & Zelenyuk	2016	No	Hospitals	Omega
Defung et al	2016	No	Bank	Applied Economics
Wanke & Barros	2016	No	Ports	International Journal of Shipping and Transport Logistics
Pulina & Santoni	2018	Yes	Hotel	Tourism Economics
Chaabouni	2018	Yes	Touristic regions	Journal of Destination Marketing & Management
Cabrera-Suárez & Pérez-Rodríguez	2018	No	Bank	Revista Española de Financiación y Contabilidad
Fall	2018	No	Finance	Revue D'économie Politique
Agostino & Trivieri	2018	No	Manufacture	Journal of Small Business Management
Nurmatov et al	2020	Yes	Touristic regions	Tourism Economics
Yobe et al	2020	No	Agriculture	Agrekon

Table 11: Reviewed literature employing the two-stage double bootstrap DEA

In tourism and leisure economics, is particularly popular as a means to assess the efficiency of hotels (Pestana Barros & Dieke, 2008; Barros et al, 2009; Assaf & Agbola, 2011; Oukil et al, 2016; Pulina & Santoni, 2018; Kularatne et al, 2019), touristic destinations (Barros et al, 2011; Benito et al, 2014; Chaabouni, 2018; Nurmatov et al, 2020), trade shows (Alberca-Oliver et al, 2015), and even of football clubs (Barros & Garcia del Barrio, 2010).

The framework of this study can be summarized as follows:

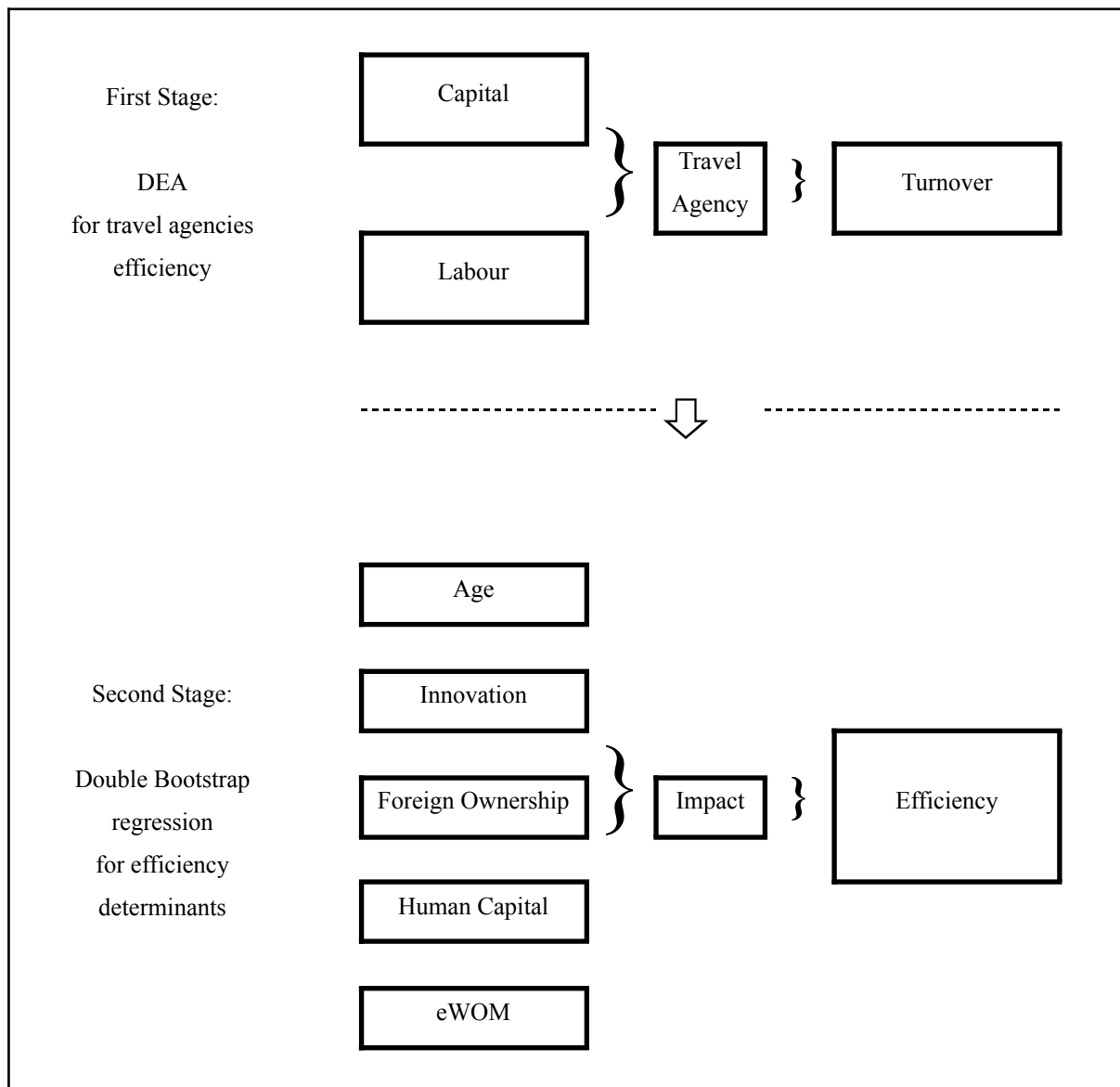


Figure 7: Research framework

The first stage of the study consists of the data envelopment analysis considering two main inputs, capital and labor, and one output, turnover. DEA can either be conducted through an input-oriented model or an output-oriented model. Given the nature of the travel agency business, the first approach was employed, as these firms may achieve higher levels of efficiency by optimizing their inputs. Regarding the first stage, the Simar & Wilson methodology employs, by default, a constant returns to scale DEA, based on the original analysis by Charnes, Cooper, and Rhodes (1978). However, as a robustness check, this research has also additionally employed a variable returns to scale model.

Following, the post-DEA analysis consists of a double bootstrap truncated regression that assesses the determinants of the efficiency scores obtained in the first stage. The truncated regressions employed are as follows:

$$\lambda_{i,t} = \alpha + \beta_1 PAT_{i,t} + \beta_2 FO_{i,t} + \beta_3 AGE_{i,t} + \beta_4 HK_{i,t} + \beta_5 ASK_{i,t} + \beta_6 PAY_{i,t} + \beta_7 RENG_{i,t} + \beta_8 QKNG_{i,t} + \beta_9 VOL_{i,t} + \beta_{10} VAL_{i,t} + \beta_{11} FIVE_{i,t} + \beta_{12} ONE_{i,t} + \varepsilon_{i,t}$$

Here,  $i$  and  $t$  represent the cross-section and time-series observations, being individual firms and years of operation respectively.  $\lambda$ , the dependent variable, is the technical efficiency score. Following, the control variables are PAT which represents the possession of patents by each firm, as a proxy for their innovative efforts. FO denotes foreign majority ownership. AGE represents the number of years since the firm began operating. HK is the average cost per employee, used as a proxy for human capital. Following, are dichotomous variables denoting whether the company asks their clients for their ORs (ASK), if they engage in further investments in eWOM (PAY), if they indeed respond to the majority of the negative ORs (RENG), and if they quickly respond to negative ORs (QKNG). Next, the research-specific variables for eWOM are VAL, VOL, FIVE, and ONE, representing the valence, volume, and variance of the ORs each observed company has in Trustpilot. Last,  $\varepsilon$  is the error term.

### 3.3.2 Data

The microdata employed in this research was obtained from two main sources.

First, firm-level financial and corporate information was obtained from the Orbis database. This resource is highly valuable for microeconomic analysis since it not only provides data on more than 400 million companies globally but also standardizes and harmonizes the data to enable comparable studies (Bureau Van Dijk, 2021). Following previous studies that have established the foundation for conducting productivity analysis at the firm level using the Orbis database (Ahmad et al, 2018; Gal, 2018), the following variables were selected:

- Output: Total firms revenue
- Labour: Number of employees
- Capital: Tangible fixed assets

In addition, information regarding firms' age, innovation efforts, ownership, and human capital was also retrieved. Due to data availability restrictions, the average employee cost was employed as a proxy for human capital, and the number of patents was used to represent the firms' innovation efforts.

Second, firm-level data on eWOM was scraped from Trustpilot. This eWOM platform was chosen among its counterparts for several reasons. First, it's an eWOM platform that specializes in Online Reviews on the firm level, whereas other platforms support ORs on the product level. Second, at the time of conducting this research, Trustpilot does not limit the accessibility to its information through web scraping techniques in its terms and conditions. Lastly, Trustpilot offers a “business transparency” section that is highly valuable for assessing the proactive management of eWOM from the firms' perspective. The data scraped from Trustpilot include both the eWOM related to each company and how each individual company manages eWOM, as follows:

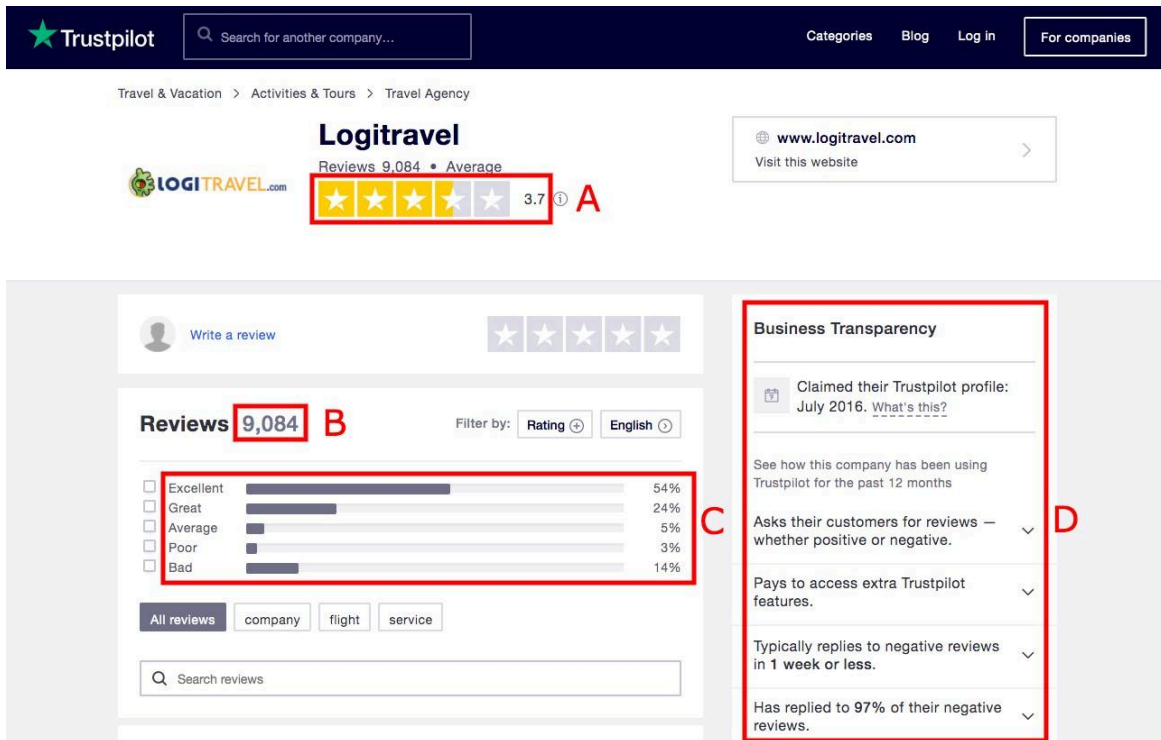


Figure 8: Data scraped from Trustpilot

The 380 Spanish firms in the travel industry with active profiles on Trustpilot were scraped. For each company, 12 pieces of data were obtained. Regarding the eWOM and UGC, the following data were collected:

- Valence (A): Overall qualification of the business
- Volume (B): Amount of online reviews posted on the business
- Variance (C): Amount of online reviews categorized as each of the 5 star ratings

Regarding the way the business manages eWOM (D), the following data was procured.

- The business claimed its profile on Trustpilot
- The business asks its customers for their reviews, whether positive or negative
- The business pays to access extra features on Trustpilot
- The business replies to negative reviews within a week
- The business replies to most negative reviews

The first variable identifies the month when the company first started managing their Trustpilot profile. The rest of the data pieces are assigned by a dummy variable represented by 1s for positive and 0s for negative actions.

More information regarding the web scraper and code employed is available in Annex 1.

### 3.4 Results & Discussion

In table 12, the variables employed in the analysis are presented, followed by their descriptive statistics, presented in table 13.

Variable	Description
turnover	firms' turnover
employees	Total number of the firms' employees
capital	Value of the firms' tangible fixed assets
age	Years since foundation
humancapital	Average cost of the firms' employees
foreign	Dichotomous variable indicating foreign majority ownership
patents	Number of patents owned by the firm
claimed	Dichotomous variable indicating if the firm has claimed their Trustpilot profile
ask	Dichotomous variable indicating if the firm asks travellers for their reviews
reng	Dichotomous variable indicating if the firm answers negative reviews
qkng	Dichotomous variable indicating if the firm quickly answers negative reviews
pay	Dichotomous variable indicating if the firm pays to access further functionalities in Trustpilot
vol	Volume of reviews in Trustpilot
val	Overall rating in Trustpilot in a scale of 1 to 5
five	Share of five star reviews in the overall reviews
four	Share of four star reviews in the overall reviews
three	Share of three star reviews in the overall reviews
two	Share of two star reviews in the overall reviews
one	Share of one star reviews in the overall reviews

Table 12: Variables description

Variable	Obs.	Mean	Std. Dev.	Min	Max
TURNOVER	376	126,000,000.00	396,000,000.00	79600.88	2,470,000,000
LABOUR	376	709.10	2,241.41	1	13,732
CAPITAL	376	142,000,000.00	462,000,000.00	49953.86	4,390,000,000
HK	376	33.46	11.65	0.07	110.30
AGE	376	23.14	17.43	5	116
FO	376	0.21	0.41	0	1
INN	376	0.06	0.32	0	2
ASK	376	0.15	0.36	0	1
RENG	376	0.15	0.36	0	1
QKNG	376	0.09	0.28	0	1
PAY	376	0.15	0.36	0	1
VOL	376	1,013.75	3,305.47	0	17000
VAL	376	2.63	1.53	0	4.8
FIVE	376	0.32	0.34	0	1
ONE	376	0.30	0.36	0	1

Table 13: Descriptive statistics

Next, the results for the DEA study are presented in table 14. The DEA considered turnover as the output, and capital (tangible fixed assets) and labour (number of employees). Two models were estimated, considering both constant results of scale, as well as variable results of scale. This table presents the mean value of the technical scores of the studied firms, depending on how they manage eWOM.

Variable	Description	Condition	CRS model	VRS model
valence	Valence over 4 star	Y	0.451	0.398
		N	0.328	0.241
volume	More than 50 reviews	Y	0.537	0.414
		N	0.266	0.201
postive variance	More than 50% of 4 and 5 star reviews	Y	0.341	0.273
		N	0.350	0.260
negative variance	More than 50% of 1 and 2 star reviews	Y	0.421	0.271
		N	0.315	0.262
ask	The firm asks their clients for their reviews	Y	0.524	0.405
		N	0.316	0.240
pay	The firm pays to access further functionalities of TrustPilot	Y	0.479	0.338
		N	0.323	0.252
reng	The firm replies to most negative reviews	Y	0.587	0.484
		N	0.305	0.226
qkng	The firm quickly replies to negative reviews	Y	0.701	0.603
		N	0.314	0.233

Table 14: DEA results

Next are the descriptive statistics of the technical efficiency:

	CRS model	VRS model
# Efficient DMUs	6	19
# Inefficient DMUs	370	357
Mean all sample	0.265	0.347
Median all sample	0.171	0.259
Mean inefficient unit	0.253	0.312
SD	0.245	0.287
Observations	376	376

Table 15: Descriptive statistics of technical efficiency

Last, table 16 and table 17 present the results of the Simar & Wilson estimation for the determinants of efficiency.

	Model 1	Model 2	Model 3	Model 4
Patents	-0.181 (0.213)	-0.222 (0.233)	-0.168 (0.194)	-0.190 (0.223)
FO	0.197 (0.151)	-0.007 (0.159)	0.233 (0.157)	0.288 (0.153)
age	-0.012 *** (0.005)	-0.012 ** (0.005)	-0.010 ** (0.005)	-0.009 ** (0.005)
humancapital	0.023 *** (0.009)	0.025 ** (0.010)	0.020 ** (0.009)	0.019 ** (0.008)
ask	0.570 *** (0.237)			
pay		0.533 ** (0.254)		
reng			0.636 ** (0.290)	
qkng				0.826 ** (0.351)
volume				
valence				
five				
one				
_cons	-0.766 (0.501)	0.485 (0.537)	-0.678 (0.509)	-0.647 (0.445)
/sigma	0.455 *** (0.090)	0.485 *** (0.088)	0.438 *** (0.087)	0.439 *** (0.083)

Note: \*Significant at 10%; \*\*significant at 5%, \*\*\*significant at 1%  
Number of bootstrap replications = 1000

Table 16: Simar & Wilson results

	Model 5	Model 6	Model 7	Model 8
Patents	-0.266 (0.25)	-0.271 (0.247)	-0.379 (0.256)	-0.276 (0.245)
FO	0.204 (0.183)	0.295 (0.192)	0.282 (0.189)	0.280 (0.198)
age	-0.016 ** (0.006)	-0.016 ** (0.006)	-0.016 ** (0.006)	-0.017 ** (0.006)
humancapital	0.027 ** (0.012)	0.029 ** (0.047)	0.027 ** (0.011)	0.029 ** (0.012)
ask				
pay				
reng				
qkng				
volume	0.000 (0.000)			
valence		-0.032 (0.582)		
five			0.351 (0.226)	
one				0.105 (0.193)
_cons	-0.908 (0.607)	-0.858 (0.582)	-0.996 (0.625)	-0.989 (0.6)
/sigma	0.509 *** (0.102)	0.516 *** (0.103)	0.505 *** (0.098)	0.517 *** (0.102)

Note: \*Significant at 10%; \*\*significant at 5%, \*\*\*significant at 1%

Number of bootstrap replications = 1000

Table 17: Simar & Wilson results - continued

The results in the previous section show the correlation between firms' eWOM and eWOM management and their efficiency levels. This research employed a two-stage double bootstrap data envelopment analysis. As a first stage, a DEA was conducted. Table 14 illustrates the average technical efficiency according to the eWOM at the firm level. The results show that firms that have a valence of more than 4 stars tend to have a significantly higher efficiency score, with an average of 0.451 for the constant returns of scale model, and 0.398 for the

variable returns of scale model. In contrast, firms with a smaller valence have average efficiency scores of 0.328 and 0.241, respectively. Furthermore, firms with a larger volume of reviews also tend to be more efficient than those with less eWOM. In the VRS model, firms with more than 50 reviews have an average efficiency score of more than double that of those with fewer reviews, with average efficiency scores of 0.414 and 0.201, respectively. The difference in the CRS model is slightly smaller but still substantial. These results support the confirmation of hypothesis 2, indicating that having more eWOM about firms positively correlates with companies' performance by enhancing user credibility and providing more learning opportunities for firms. Surprisingly, the DEA results provide no evidence that variance, neither concentrated in 4 and 5 star reviews nor on 1 and 2 star reviews, have an impact on average firms' efficiency. Thus, hypothesis 3 is not confirmed. In addition, the DEA results show that firms that have proactive management of eWOM tend to have significantly higher efficiency than those who are oblivious of this channel. In particular, firms that ask their customers to share their reviews online, contributing to spreading the eWOM while at the same time validating their services, tend to double the efficiency of those that don't. Considering the CRS model, for example, the average efficiency score for firms that promote eWOM is 0.524, whereas for those companies that don't ask for their customers' engagement the average efficiency is 0.316. This difference is also evident when considering variable results of scale, when the first ones get an average score of 0.405, whereas the latter, of 0.240. This difference in average efficiencies can be observed throughout all variables denoting managerial actions. Those companies that reply to most of the negative reviews online have an average score of 0.587, compared to the 0.305 score of those that leave the comments unattended. Those firms that are fast to reply to their customers after a negative experience is shared are also more efficient than those that are not fast. This difference is even larger than for the previous action, with a 0.701 for those companies that are fast to respond, and 0.314 for those that leave the review unattended for some time. This difference is slightly smaller when considering variable returns of scale, but still evident, with an average efficiency score of 0.603 for companies that are fast to reply to negative eWOM, and of 0.233 for those that take more time. Last, there is also a significant difference in efficiency scores between companies that proactively manage eWOM and those that don't is evident when looking at firms that invest in getting extended functionalities from Trustpilot. Companies that pay to access extra features on the eWOM platform have a higher average efficiency score than those that don't, with efficiency scores of 0.479 and 0.323, respectively.

A further step has been taken in assessing how eWOM and eWOM management correlate with firms' productivity. The Simar & Wilson analysis, presented in Table 16 and Table 17, provides information on the determinants of efficiency. The age of the firm, along with its human capital, are significant variables in determining the firms' efficiency. Foreign majority ownership and possession of patents do not appear to be significant variables in achieving higher levels of efficiency. To focus on eWOM-specific variables, models 1 to 4 present the analysis of each individual managerial action available in Trustpilot. In each model, it is evident that proactive management of these communication channels positively correlates with achieving higher levels of efficiency. Asking users for their reviews has a significant and positive correlation with firms' efficiency, with a coefficient of 0.570. This, together with the DEA results, confirms hypothesis 4. Investing in additional functionalities to manage eWOM has a positive and significant correlation with firms' efficiency, with a coefficient of 0.533, thus confirming hypothesis 7. Furthermore, engaging in deeper communication with customers who shared a negative experience also positively and significantly correlates with higher levels of efficiency. Responding to most negative reviews presents a coefficient of 0.636, while doing so promptly has a coefficient of 0.826. In this way, hypotheses 5 and 6 are confirmed. Although variables representing eWOM management clearly show a positive correlation with efficiency, the traditional variables of eWOM do not show such clear results. Volume has a positive coefficient of 0.000028 but does not yield significant results. Valence presents an unexpected negative sign, with a coefficient of 0.032, but again, is not significant. Lastly, neither variance toward five-star reviews nor one-star reviews yield significant results. Therefore, the double bootstrap methodology does not contribute to further confirming hypotheses 1, 2, and 3, in addition to the DEA results.

Table 18 summarises the hypotheses' confirmation status:

Hypothesis	Results
H1	Partially confirmed
H2	Partially confirmed
H3	Partially confirmed
H4	Confirmed
H5	Confirmed
H6	Confirmed
H7	Confirmed

Table 18: Hypotheses' confirmation summary

### 3.5 Conclusion

The travel industry has traditionally been characterized as a sector with low labor productivity. With the accelerated processes of digitization and innovation across various industries, productivity is increasing in most sectors. Therefore, the travel industry faces the challenge of not falling behind in this regard. Moreover, the COVID-19 crisis has had a severe impact on this industry, surpassing the impact on most others. This situation calls for an urgent response to build resilience and in particular, address the existing productivity challenges. The travel industry, especially the distribution sector, faces an additional obstacle within this challenge, which is its delocalization. Since many customers book their trips in advance, the learning processes that could lead to improved procedures and ultimately higher productivity are harder to systematize. In this context, eWOM could potentially become a powerful tool to help firms enhance their productivity. This can be achieved by learning from their customers, fostering deeper relationships with them, reaching out to new audiences, and validating their services. However, it is noteworthy that most firms are currently not proactively managing eWOM as part of their business strategies. Furthermore, there is even a certain level of skepticism among some managers regarding the trustworthiness of eWOM platforms as a source of data.

This research has addressed this question and applied a two-stage double bootstrap data envelopment analysis to identify if eWOM helps travel firms achieve higher levels of

productivity. The main innovation of this paper is to apply this methodology to travel firms beyond the hospitality sector, as well as intersecting this analysis with eWOM data scrapped from digital platforms. This research focuses on the period 2012-2019, and has been deliberately delimited to travel agencies, including OTAs, comparison platforms, DMC, activities companies, and specialized travel agencies.

Results have shown that travel agencies that have a higher valence, or overall qualification, tend to be closer to the efficiency frontier. This naturally relates to higher levels of customer satisfaction, and in time, more credibility for acquiring new customers. In line with this, travel agencies that have high volumes of online reviews are also on average twice as efficient as those with few reviews. According to previous literature on online reviews, a higher volume increases firms' credibility by having more customers try out the firms' services, therefore validating the firm. This research could not confirm the relationship between review variance and firms' efficiency. Also, when studying the factors determining firms' efficiency, no causal relationship was found between valence, volume, and variance, and firms' efficiency. Regarding how travel agencies manage eWOM, the data envelopment analysis has shown that firms that proactively manage eWOM tend to be considerably closer to the efficiency frontier. Asking customers for their feedback on eWOM platforms not only helps businesses increase diffusion and validate their services but also allows firms to better understand their perceived performance, leading to better learning processes. The impact of asking customers for their feedback on eWOM platforms could not only remain at these but go further as to, for example, improve the performance of search engine optimization strategies. These results were further confirmed by the second stage bootstrapped regression, which revealed a positive and significant correlation between asking customers for their ORs and firms' efficiency. Previous academic literature has revealed a contradiction on how to deal with negative reviews. While some managers prefer not to answer publicly so as to solve problems directly and discreetly with the unsatisfied customer, others prefer to show their proactiveness and their problem-resolution processes publicly by answering online to the negative OR. Additionally, this contradiction regarding how to deal with negative ORs has also been identified in the literature, with research on diverse sectors as gastronomy or hospitality pointing in different directions. The present research shows that, for travel agencies, answering publicly to negative ORs has a positive and significant correlation on firms' efficiency, and that firms that do so tend to be, on average, twice as efficient as those that don't engage in the eWOM communication. These results are even more evident when

travel agencies quickly respond to the negative ORs. Doing so in a prompt manner also has a positive and significant correlation to achieving higher levels of efficiency, and firms that do so tend to be almost three times as efficient as those that don't reply quickly to negative ORs. Last, results also showed that firms that decide to invest in eWOM, such as those that pay to access further functionalities in the eWOM platform under study, also tend to be considerably closer to the efficiency frontier. Investing in these channels has a positive and significant correlation with travel agencies' efficiency.

Since this research has focused on efficiency at the firm level, most implications rely on the managerial level. First and foremost, the data envelopment analysis has shown that there is still great room for optimizing efficiency in the sector. This challenge must be faced by an arsenal of actions, to which eWOM should be a pillar. Understanding client satisfaction, the services' aspects for improvement, as well as detecting the firms' key perceived benefits by customers can be done by proactively managing eWOM. Not only that travel agencies must be vigilant to the ORs as a marketing and diffusion channel, but they should also systematize customer relationship management actions. This includes, but is not limited to, asking users to share their opinions (whether positive or negative) online, implementing claim-solving processes on eWOM platforms, and answering (fast) to negative experiences shared online. This will help capitalize on the learning opportunities raised by eWOM and reach a more extensive audience.

There are several limitations to this study. First, this research focuses on the Spanish case, and therefore, its conclusions might not be applied to other regions. Second, due to data availability restrictions, only travel agencies are considered in the study. Last, given the reasons presented in section 3, this research focuses on only one eWOM platform out of several. Further research could extend the horizon of this work by analyzing different regions, eWOM platforms, and other sectors from the travel industry, such as transportation and attractions.

### 3.6 References

- Ahmad, S., Oliver, S., & Peters, C. (2018). Using firm-level data to compare productivities across countries and sectors: Possibilities and Challenges. U.S. International Trade Commission. Economics Working Paper Series, 2018-07-A.
- Alberca-Oliver, P., Rodríguez-Oromendía, A., & Parte-Esteban, L. (2015). Measuring the efficiency of trade shows: A Spanish case study. *Tourism Management*, 47, 127–137.
- Assaf, A. G., & Agbola, F. W. (2011). Modelling the Performance of Australian Hotels: A DEA Double Bootstrap Approach. *Tourism Economics*, 17(1), 73–89.
- Barros, C. P., & Dieke, P. U. C. (2008). Technical efficiency of African hotels. *International Journal of Hospitality Management*, 27(3), 438–447.
- Barros, C. P., Botti, L., Peypoch, N., & Solonandrasana, B. (2009). Managerial efficiency and hospitality industry: the Portuguese case. *Applied Economics*, 43(22), 2895–2905.
- Barros, C. P., & Garcia-del-Barrio, P. (2010). Productivity drivers and market dynamics in the Spanish first division football league. *Journal of Productivity Analysis*, 35(1), 5–13.
- Barros, C. P., Botti, L., Peypoch, N., Robinot, E., Solonandrasana, B., & A., G. A. (2011). Performance of French destinations: Tourism attraction perspectives. *Tourism Management*, 32(1), 141–146.
- Benito, B., Solana, J., & López, P. (2014). Determinants of Spanish Regions' Tourism Performance: A Two-Stage, Double-Bootstrap Data Envelopment Analysis. *Tourism Economics*, 20(5), 987–1012.
- Blake, A., Sinclair, M. T., & Soria, J. A. C. (2006). Tourism productivity. *Annals of Tourism Research*, 33(4), 1099–1120.

Bore, I., Rutherford, C., Glasgow, S., Taheri, B., & Antony, J. (2017). A systematic literature review on eWOM in the hotel industry: Current trends and suggestions for future research. *Hospitality & Society*, 7(1), 63–85.

Brown, K., Jie, F., Le, T., Sharafizad, J., Sharafizad, F., & Parida, S. (2022). Factors Impacting SME Business Resilience Post-COVID-19. *Sustainability*, 14(22), 14850.

Bureau Van Dijk (2021). Orbis. Accessed on May 4th, 2021 at <https://www.bvdinfo.com/es-es/nuestros-productos/datos/internacional/orbis>

Burgess, S., Sellitto, C., Cox, C. & Buultjens, J. (2009). User-generated content (UGC) in tourism: Benefits and concerns of online consumers. 17th European Conference on Information Systems.

Chaabouni, S. (2018). China's regional tourism efficiency: A two-stage double bootstrap data envelopment analysis. *Journal of Destination Marketing & Management*.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429–444.

Chen, W., Gu, B., Ye, Q. & Zhu, K. X. (2019). Measuring and Managing the Externality of Managerial Responses to Online Customer Reviews. *Information Systems Research*, 30(1).

Cox, C., Burgess, S., Sellitto, C., & Buultjens, J. (2009). The Role of User-Generated Content in Tourists' Travel Planning Behavior. *Journal of Hospitality Marketing & Management*, 18(8), 743–764.

De Jorge, J., & Suárez, C. (2013). Productivity, efficiency and its determinant factors in hotels. *The Service Industries Journal*, 34(4), 354–372.

Duverger, P. (2013). Curvilinear Effects of User-Generated Content on Hotels' Market Share: A Dynamic Panel-Data Analysis. *Journal of Travel Research*, 52(4), 465–478.

Fernández-Miguélez, S. M., Díaz-Puche, M., Campos-Soria, J. A., Galán-Valdivieso, F. (2020). The Impact of Social Media on Restaurant Corporations' Financial Performance. *Sustainability*, 12(4), 1646.

Fuentes, R. (2011). Efficiency of travel agencies: A case study of Alicante, Spain. *Tourism Management*, 32(1), 75–87.

Gal, P. (2018). Measuring Total Factor Productivity at the Firm Level using OECD-ORBIS. OECD Economics Department Working Papers No. 1049.

García de los Salmones, M. del Mar, Herrero, A., & Martínez, P. (2020). Determinants of Electronic Word-of-Mouth on Social Networking Sites About Negative News on CSR. *Journal of Business Ethics*.

Godes, D., & Mayzlin, D. (2004). Using Online Conversations to Study Word-of-Mouth Communication. *Marketing Science*, 23(4), 545-560.

Hennig-Thurau, T., Gwinner, K. P., Walsh, G., & Gremler, D. D. (2004). Electronic word-of-mouth via consumer-opinion platforms: What motivates consumers to articulate themselves on the Internet? *Journal of Interactive Marketing*, 18(1), 38–52.

Hernández-Ortega, B., San Martín, H., Herrero, Á., & Franco, J. L. (2020). What, how and when? Exploring the influence of firm-generated content on popularity in a tourism destination context. *Journal of Destination Marketing & Management*, 18, 100504.

Herrero, Á., San Martín, H., & Garcia-De los Salmones, M. del M. (2017). Explaining the adoption of social networks sites for sharing user-generated content: A revision of the UTAUT2. *Computers in Human Behavior*, 71, 209–217.

Herrero, Á., San Martín, H., & Hernández, J. M. (2015). How online search behavior is influenced by user-generated content on review websites and hotel interactive websites. *International Journal of Contemporary Hospitality Management*, 27(7), 1573–1597.

Hong, S., & Pittman, M. (2020). eWOM anatomy of online product reviews: interaction effects of review number, valence, and star ratings on perceived credibility. *International Journal of Advertising*, 1–29.

Hu, Y., & Kim, H. J. (2018). Positive and negative eWOM motivations and hotel customers' eWOM behavior: Does personality matter? *International Journal of Hospitality Management*, 75, 27–37.

Huete-Alcocer, N. (2017). A Literature Review of Word of Mouth and Electronic Word of Mouth: Implications for Consumer Behavior. *Frontiers in Psychology*, 8.

Inchausti-Sintes, F., Pérez-Granja, U., & Morales-Mohamed, J. J. (2020). Analysing labour productivity and its economic consequences in the two Spanish tourist archipelagos. *Tourism Economics*, 135481662091786.

Kim, Y. (2019). The Impact of Spatial Clustering on the Labour Productivity of the UK Tourism and Hospitality Industry.

Kim, Y. R., Williams, A. M., Park, S., & Chen, J. L. (2021). Spatial spillovers of agglomeration economies and productivity in the tourism industry: The case of the UK. *Tourism Management*, 82, 104201.

King, R. A., Racherla, P., & Bush, V. D. (2014). What We Know and Don't Know About Online Word-of-Mouth: A Review and Synthesis of the Literature. *Journal of Interactive Marketing*, 28(3), 167–183.

Kularatne, T., Wilson, C., Månsson, J., Hoang, V., & Lee, B. (2019). Do environmentally sustainable practices make hotels more efficient? A study of major hotels in Sri Lanka. *Tourism Management*, 71, 213–225.

Lee, K. Y., & Yang, S.-B. (2015). The role of online product reviews on information adoption of new product development professionals. *Internet Research*, 25(3), 435–452.

Levy, S., E., Duan, W., & Boo, S. (2012). An Analysis of One-Star Online Reviews and Responses in the Washington, D.C., Lodging Market. *Cornell Hospitality Quarterly*, 54(1), 49–63.

Litvin, S. W., Goldsmith, R. E., & Pan, B. (2008). Electronic word-of-mouth in hospitality and tourism management. *Tourism Management*, 29(3), 458–468.

Liu, A., & Wu, D. C. (2019). Tourism productivity and economic growth. *Annals of Tourism Research*, 76, 253–265.

Magnani, M. (2020). The economic and behavioral consequences of online user reviews. *Journal of Economic Surveys*.

Mariani, M. M., & Borghi, M. (2020). Online Review Helpfulness and Firms' Financial Performance: An Empirical Study in a Service Industry. *International Journal of Electronic Commerce*, 24(4), 421–449.

Mauri, A. G., & Minazzi, R. (2013). Web reviews influence on expectations and purchasing intentions of hotel potential customers. *International Journal of Hospitality Management*, 34, 99–107.

Melián-González, S., & Bulchand-Gidumal, J. (2016). A model that connects information technology and hotel performance. *Tourism Management*, 53, 30–37.

Muritala, B. A., Sánchez-Rebull, M.-V., & Hernández-Lara, A.-B. (2020). A Bibliometric Analysis of Online Reviews Research in Tourism and Hospitality. *Sustainability*, 12(23), 9977.

Nurmatov, R., Fernandez, X. L., & Coto Millán, P. P. (2020). The change of the Spanish tourist model: From the Sun and Sand to the Security and Sand. *Tourism Economics*, 135481662092865.

Oukil, A., Channouf, N., & Al-Zaidi, A. (2016). Performance evaluation of the hotel industry in an emerging tourism destination: The case of Oman. *Journal of Hospitality and Tourism Management*, 29, 60–68.

Papathanassis, A. & Knolle, F. (2011). Exploring the adoption and processing of online holiday reviews: a grounded theory approach. *Tourism Manage.* 32 (2), 215–224.

Park, S.-Y., & Allen, J. P. (2012). Responding to Online Reviews. *Cornell Hospitality Quarterly*, 54(1), 64–73.

Pham, T. D. (2019). Tourism Productivity Theory and Measurement for Policy Implications: The Case of Australia. *Journal of Travel Research*, 004728751983597.

Phillips, P., Barnes, S., Zigan, K., & Schegg, R. (2016). Understanding the Impact of Online Reviews on Hotel Performance. *Journal of Travel Research*, 56(2), 235–249. doi:10.1177/0047287516636481

Pourfakhimi, S., Duncan, T. and Coetzee, W.J.L. (2020), Electronic word of mouth in tourism and hospitality consumer behaviour: state of the art. *Tourism Review*, 75(4), 637-661

Pulina, M., & Santoni, V. (2018). A two-stage DEA approach to analyse the efficiency of the hospitality sector. *Tourism Economics*, 24(3), 352–365.

Reyes-Menendez, A., Correia, M.B., Matos, N., Adap, C. (2020), Understanding Online Consumer Behavior and eWOM Strategies for Sustainable Business Management in the Tourism Industry. *Sustainability*, 12(21), 8972.

Romão, J., & Nijkamp, P. (2017). Impacts of innovation, productivity and specialization on tourism competitiveness – a spatial econometric analysis on European regions. *Current Issues in Tourism*, 1–20.

Sann, R., Lai, P.-C., & Chen, C.-T. (2020). Review papers on eWOM: prospects for hospitality industry. *Anatolia*, 1–30.

Sann, R., Lai, P.-C., & Chen, C.-T. (2020). Review papers on eWOM: prospects for hospitality industry. *Anatolia*, 1–30. doi:10.1080/13032917.2020.1813183

Schuckert, M., Liu, X., & Law, R. (2015). Hospitality and Tourism Online Reviews: Recent Trends and Future Directions. *Journal of Travel & Tourism Marketing*, 32(5), 608–621.

Senecal, S., & Nantel, J. (2004). The influence of online product recommendations on consumers' online choices. *Journal of Retailing*, 80(2), 159–169.

Simar, L., & Wilson, P. W. (2007). Estimation and inference in two-stage, semi-parametric models of production processes. *Journal of Econometrics*, 136(1), 31–64.

Toubes, D. R., De Araújo, A. F., & Antonio, J. (2023). Resilience and individual competitive productivity: The role of age in the tourism industry. *Humanities and Social Sciences Communications*, 10(1), 1-11.

Web Scraper (2021). Web Scraper - The #1 web scraping extension. Accessed on May 4th, 2021 at [www.webscraper.io](http://www.webscraper.io)

World Tourism Organization (2018). *Tourism for Development – Volume I: Key Areas for Action*, UNWTO, Madrid.

Xie, K. L., Zhang, Z., & Zhang, Z. (2014). The business value of online consumer reviews and management response to hotel performance. *International Journal of Hospitality Management*, 43, 1–12. doi:10.1016/j.ijhm.2014.07.007

Yang, S.B., Lee, K. Y., Animesh, A. & Akhlaghpour, S. (2015). Electronic Word of Mouth and User Generated Content. *Asia Pacific Journal of Information Systems*. 25. 712-718.

Zhang, Y., Gao, J., Cole, S., & Ricci, P. (2020). How the Spread of User-Generated Contents (UGC) Shapes International Tourism Distribution: Using Agent-Based Modeling to Inform Strategic UGC Marketing. *Journal of Travel Research*. <https://doi.org/10.1177/0047287520951639>

4. Filling up empty seats in cars as a responsible transportation production practice: exploring the effect of carpooling on aggregate road transport demand

## Abstract

The climate change emergency calls for the urgent decoupling of resource usage from economic growth and shifting to more responsible production and consumption practices. The travel industry is responsible for approximately 5% of the global CO<sub>2</sub> emissions resulting from human activity, with transportation being its main component. Among different transportation means, private vehicles are among the most polluting, and their environmental impact depends directly on the number of passengers in the vehicles. Worryingly, most vehicles on roads circulate with idle capacity, with an average of 1.47 passengers per vehicle. Sharing economy platforms are addressing this issue by revitalizing a long-standing transportation alternative: carpooling. Digital platforms such as BlaBlaCar enable drivers to share the empty seats in their vehicles with travelers heading to the same destination. Short-distance carpooling has already been recognized as a way to reduce traffic on urban roads. This paper presents exploratory research into the impact of long-distance leisure carpooling on private vehicle road transport demand. The study applies a time-series methodology to assess the impact of the adoption of carpooling innovation on aggregate road transport demand. Results suggest that long-distance carpooling can have a positive impact on road transportation demand. By promoting carpooling, communities can benefit from an expanded transportation network, reduced traffic congestion, cost-saving opportunities for travelers, and directly contribute to reducing the carbon footprint of their transportation needs.

**Keywords:** sharing economy, carpooling, blablacar, aggregate road transport demand, time series.

## 4.1 Introduction

The climate change emergency calls for the urgent decarbonization of the travel industry, and the transformation of the tourism model into sustainable formats. Decoupling resource usage and carbon emissions from economic growth is one of the main objectives of the Paris Agreement to mitigate climate change. In the travel industry, shifting to more responsible production and consumption practices is essential to this end.

During the last few decades, the globalization of markets, technological advancements, improved worldwide connectivity, and affordable air travel have all contributed to a steady expansion of global mobility. In fact, it is expected that the mobility of the average world citizen, measured in kilometers, will have increased by a factor of 4.5 from the year 2000 to the year 2050 (Schafer & Victor, 2000). In the context of tourism, the same trend is expected. Forecasts estimate that from 2005 to 2030, international tourist arrivals will more than double, increasing from 700 million to 1.8 billion (United Nations World Tourism Organization and International Transport Forum, 2019). Domestic tourist arrivals are also expanding at an accelerated rate, growing from 4 billion arrivals in 2005 to 15.6 billion in 2030. The tourism industry contributes about 5% of global anthropogenic CO<sub>2</sub> emissions, with transportation being its largest component, representing between 75% (United Nations World Tourism Organization & United Nations Environment Programme, 2008) and 94% (Gössling, 2002) of the sector's total emissions.

Road transport demand has also been on the rise over the last few decades. Transportation by private vehicles is the primary form of mobility in almost all countries. When considering different transportation means such as passenger cars, buses, trolleys, rail, metro, tram, waterborne means, and air transportation, private vehicles represent 72.9% of the total passenger kilometers traveled (Profillidis & Botzoris, 2019). Focusing on tourism alone, transportation by private vehicles accounts for 44% of worldwide domestic passenger travel (UNWTO & International Transport Forum, 2019). This heavy reliance on private vehicles is particularly concerning when reviewing the CO<sub>2</sub> emissions associated with them. The same study estimated that the environmental impact of transportation by private car is 0.1135 kilograms of CO<sub>2</sub> per passenger kilometer. This is even higher than for air transportation, which generates 0.1042 kilograms per passenger kilometer.

The relative efficiency of cars, as measured by the number of CO<sub>2</sub> emissions per passenger kilometer, naturally depends on the number of passengers in the vehicle. Emissions from a car will only slightly vary depending on whether only the driver is on board or if it's a fully occupied vehicle (European Commission, 2022). However, it's concerning that while the number of vehicles per capita is increasing, the occupancy rate of vehicles has been declining. In 1980, the average occupancy rate of vehicles in Europe was 1.74 passengers per vehicle, but by 2006, this number had decreased to 1.45 (European Environment Agency, 2010). In Spain, 70% of vehicles are operated with only one person onboard ("Un solo ocupante," 2000). Over the same period, the vehicle ownership index in Europe has grown from 0.29 vehicles per person to 0.43.

At the same time that more people have access to private vehicles, a counter-wave of innovation is emerging. This innovation wave, often referred to as the sharing economy, is facilitated by digital platforms that create open marketplaces where consumers gain temporary access to goods or services provided by other individuals (European Commission, 2016). The early adopters of this innovation are transitioning from owning products to accessing them on-demand. In the context of road transportation, digital platforms are revitalizing a long-standing mobility solution: carpooling.

Carpooling is a form of transportation in which two or more people, who do not belong to the same household, share a trip and contribute to the journey's expenses (Ciari, 2012; Rodrigue et al, 2006; Gheorghiu & Delhomme, 2018). Sharing a ride to split the cost of the journey is not a new phenomenon. The following figure presents an advertisement from the year 1791 offering a shared ride from Madrid to the city of León in Spain.

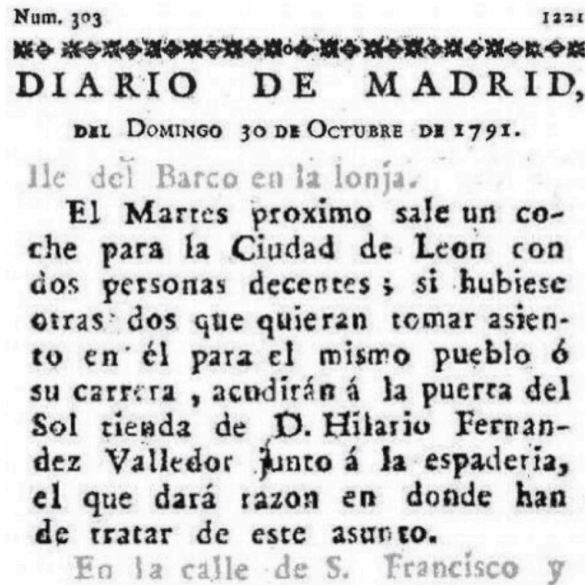


Figure 9: Carpooling advertisement in a Spanish paper from 1791.

Source: Brisbe, 2022

Despite not being a new phenomenon, carpooling has always struggled to gain popularity. This is due to inherent complications, such as the creation of trust between driver and passenger, difficulties in communication, or fairness in splitting costs (Correia & Viegas, 2011; Bachmann et al, 2018; Gheorghiu & Delhomme, 2018). Sharing economy platforms such as BlaBlaCar, Amovens, CarpoolWorld, Lyftshare, and Carma have tapped into carpooling, employing digital technologies to solve those complications.

The French company BlaBlaCar is often regarded as one of the flagship firms of long-distance carpooling and the sharing economy as a whole. BlaBlaCar operates a two-sided market (Rochet & Tirole, 2006) consisting of drivers and passengers. Drivers can reduce the costs of their trips by splitting expenses with passengers, while passengers can avoid making trips with their own vehicles and benefit from reduced transportation prices, along with increased flexibility in departure times, pick-up locations, and drop-off locations compared to other public transportation alternatives. Trips shared through BlaBlaCar have an average distance of 263 kilometers (BlaBlaCar, 2019), mainly serving internal tourism (UNWTO, 2023), which includes both domestic and incoming tourism, encompassing the trips of residents and non-residents of a country. Globally, BlaBlaCar has more than 100 million users, and every quarter, over 25 million trips are shared through the platform (BlaBlaCar, 2022a). In Spain, the platform has significant penetration, with more than 8

million travelers having used it. According to the company's data, 37% of Spanish youths aged between 18 and 35 years old are users of the platform (Bermejo, 2021).

By filling up the empty seats in their cars, drivers are not only splitting the costs of the journey but also making a more significant contribution to reducing the strain on transportation systems and utilizing idle resources more efficiently. Drivers are, therefore, saving the need for additional transportation services for their passengers, resulting in reduced carbon emissions. Previous literature (Minett & Pearce, 2011; Santi et al, 2014; Bruck et al, 2017) has identified that short-distance carpooling can contribute to CO<sub>2</sub> savings by minimizing the number of kilometers driven by cars, and reducing the traffic on roads. However, the study of long-distance carpooling's impact on road transportation systems remains relatively unexplored. To address this gap, this research presents an exploratory analysis of the influence of long-distance carpooling on an aggregate road transport demand model. From a theoretical standpoint, long-distance carpooling should contribute to reducing the production of transportation services, as carpooling passengers are occupying otherwise empty seats. This paper aims to statistically test whether this effect is observable in road transport demand.

To this date, although there is a nascent body of literature regarding carpooling digital platforms, no research has addressed the issue questioned by this paper. Furthermore, no previous research has applied econometric methodologies to deepen on the impact of carpooling on transport demand. Last, most literature on carpooling has analyzed carpooling to work (frequent, short distance, with prearranged origin and destinations), and considerably fewer on leisure carpooling (Gheorghiu & Delhomme, 2018).

This paper is structured as follows. First, section 1 has presented a brief introduction to the research topic, detailing the research objective and its contribution to academic literature. Section 2 presents the literature review. This section is subdivided into the following topics: transport, carpooling, and the body of literature regarding the platform BlaBlaCar. Section 3 presents the methodology employed in this research, in terms of the model studied, the method employed, and the data sources used in this research. Section 4 presents the results of the econometric analysis and the subsequent discussion. Last, sections 5 and 6 present the conclusion of the study, and the references for the research.

## 4.2 Background & Literature Review

### 4.2.1 Transport

Transport is an essential activity for human development, without which people would be confined to a few kilometers from their settlements. Transport can be defined as the movement of people or goods through physical space (De Rus et al, 2003). Therefore, transport is a provisional estate that ends when the person or goods arrive at its destination. Three elements are essential in transport. First, the element being transported, either a person or a good. Transportation differs substantially depending on the element being transported, each requiring different technologies, means, infrastructure, or even industrial organization. Second, the mode of transport refers to how the transportation is conducted. And last, the infrastructure on which the transportation mode runs. There are 7 main transport modes, which include road, rail, air, and sea transportation, as well as inland waterways, and, for shorter distances, cycling and walking (Profillidis & Botzoris, 2019). Road transportation consists of private cars, trucks, motorcycles, and buses, operating on road infrastructure. This research focuses on private car road transportation, operating on long-distance or non-urban roads.

Transport demand studies seek to forecast the volume of people or goods being transported by specific transport means. Transport demand is considered a derived demand since transport is normally not consumed because of its own characteristics but is driven by the necessity of consumption elsewhere. Few exceptions, such as leisure cruises or tourist trains, apply. For this reason, tourism demand studies have long questioned the relationship between transport demand and regional economic growth (Flores & Chang Rojas, 2020). Previous literature has identified that the development of transport infrastructure positively impacts economic growth (Pradhan & Bagchi, 2013). Furthermore, a circular relationship between the development of transport infrastructure and economic growth exists. The latter generates resources for investment in transport infrastructure, while this unlocks additional growth opportunities for regional economies (Button & Yuan, 2013).

Road transport has become the most popular transportation means for medium distances, surpassing rail transport during the second half of the 20th century (De Rus et al, 2003). Road

transport has been growing at an accelerated pace. In Spain, road transport has grown more rapidly than the population and real GDP (González & Marrero, 2012). Both the contribution of transport to economic growth and the accelerated growth of road transport call for the need to understand the determinants of road transport. Previous literature has extensively studied the determinants of road transport demand (González & Marrero, 2012; Sheng & Sharp, 2019). Income level has been identified as one of the main drivers of transport demand (Boarnet & Sarmiento, 1998; Potoglou & Kanaroglou, 2008; Liddle, 2009; Zegras, 2010; Chatman, 2013; Chi, 2016; Khan, 2020) because as there is more disposable income, there is greater transport consumption, both for goods and for travel. Additionally, the literature agrees that the price of fuel is another key determinant of road transport demand (Wang & Skinner, 1984; Hensher et al, 1990; Goodwin, 1992; Espey, 1998; Chao et al, 2015; Khan, 2020) since higher fuel prices lead to reduced transport consumption. The vehicle fleet has also been identified as a key driver of road transport demand (Hansen & Huang, 1997; Noland, 2001; Noland & Cowart, 2000; Fulton et al, 2000; Hymel et al, 2010). In some studies, the vehicle fleet is also linked to the fleet's age, considered a proxy for safety on the road. An aging fleet is considered less safe, therefore negatively impacting road transport demand (Zolnik, 2018). Furthermore, a newer fleet can positively impact road transport demand due to technical improvements in fuel consumption or regulatory measures that encourage the use of newer vehicles (Greening et al, 2000). Some authors have also highlighted that induced transport demand should be considered in modeling transport demand. Induced transport demand refers to the additional demand that occurs due to the construction of new infrastructure, in this case, road network capacity (González & Marrero, 2012; Hymel et al, 2010; Khan, 2020). Another relevant driver of road transport demand is transport costs. In addition to the cost of fuel, the prices of alternative transport means, such as rail or flights, can also impact road transport demand (Fearnley et al, 2018; Khan, 2020). Other determinants, such as population growth (Gately, 1990; Paravantis & Georgakellos, 2007), the unemployment rate (Prevedouros & An, 1998), and the urbanized population (Khan, 2020), have also been identified as determinants of road transport demand.

Transportation by private vehicles is not only one of the most popular transportation means globally but also one of the most polluting. The following chart presents the global average CO<sub>2</sub> emissions in kilograms per passenger kilometer according to the mode of transport.

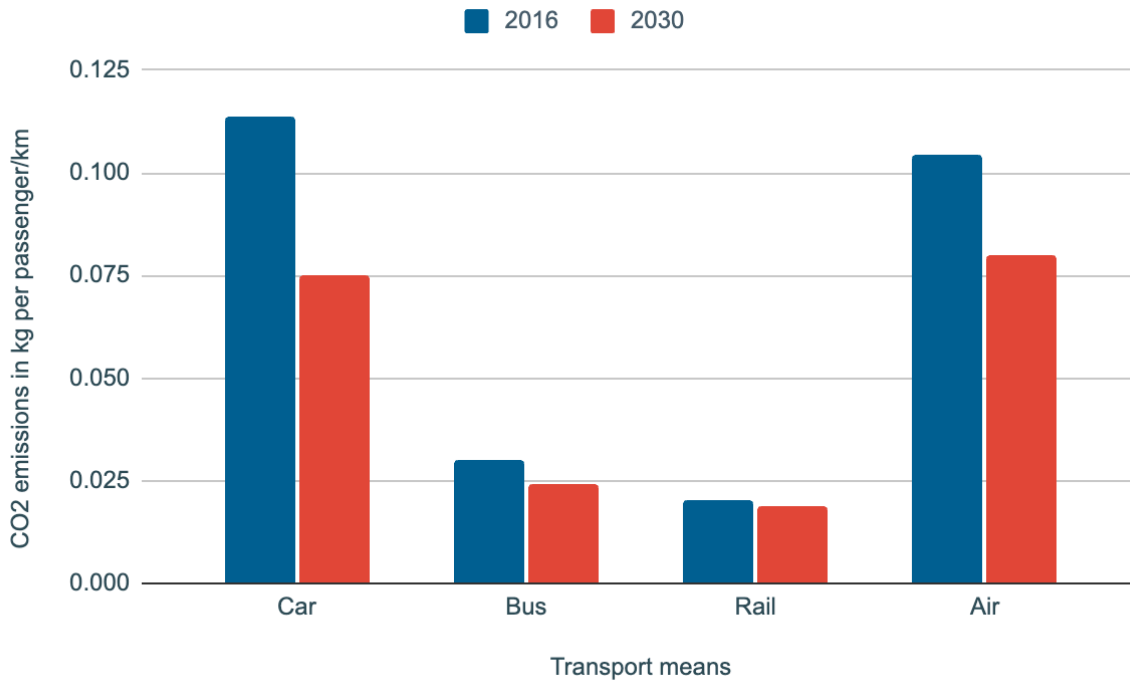


Figure 10: Global average CO<sub>2</sub> emissions in kilograms per passenger kilometer (PKM)

Source: United Nations World Tourism Organization and International Transport Forum, 2019

The number of passengers in vehicles naturally affects the relative efficiency of cars. Whether there is only the driver inside or the car is fully occupied, the difference in the car's emissions is marginal (European Commission, 2022). As more people have access to owning vehicles, as shown in the passenger vehicle ownership index below, each year, vehicles are circulating with increasing idle capacity:

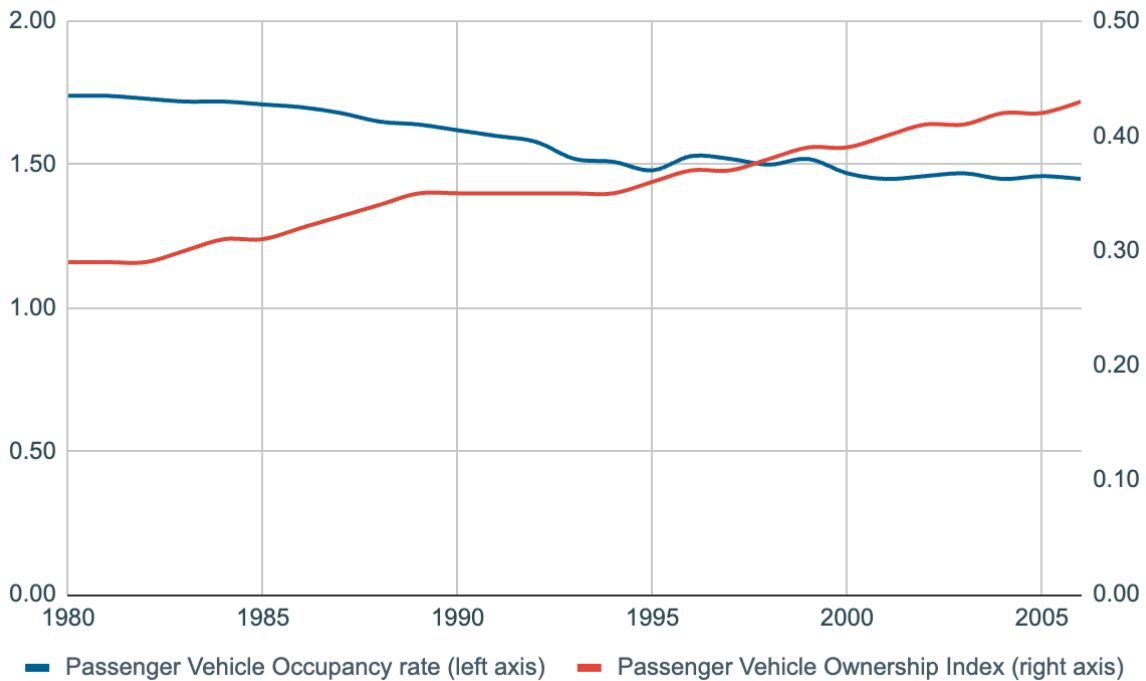


Figure 11: Passenger vehicle occupancy rate and ownership index in Europe<sup>1</sup>

Source: Own elaboration with data from the European Environment Agency (2010), Eurostat, and OCDE

Private vehicles in Europe are circulating with an average occupancy of 1.45 people per car. In other words, vehicles are operating with an idle capacity of between 60% to 70%. Increasing the occupancy rate of vehicles could enhance the relative efficiency of cars while alleviating the strain on transportation systems.

#### 4.2.2 Carpooling

In the context of the growing popularity of the sharing economy, and due to the diffusion of geolocation technologies, people are increasingly adopting mobile applications to share rides with others while traveling in private vehicles (Shaheen & Cohen, 2018).

<sup>1</sup> The historical data corresponds to 3 European countries that provided the information made available by the European Environment Agency (2010): Denmark, the Netherlands, and the United Kingdom. This data is coherent with other publications that confirm the trend in other European countries. For the Spanish case in particular, 70% of vehicles are only occupied by the driver ("Un solo ocupante", 2000), and private vehicles in Barcelona ran in 2015 with an average occupation of between 1.2 and 1.7 persons per vehicle (Ajuntament de Barcelona, 2016).

There are multiple ways in which travelers can share their rides, and ridesharing as a concept encompasses several transportation means by which people get together to share a vehicle for one or more trips (Chan & Shaheen, 2012). Carpooling is a specific type of ridesharing and can be defined as a form of transportation where two or more people, not belonging to the same household but with a similar mobility need, share a trip or part of the trip and contribute to the driver's expenses (Ciari, 2012; Rodrigue et al, 2006; Gheorghiu & Delhomme, 2018).

Several concepts are usually used interchangeably with carpooling but differ in many aspects (Gheorghiu & Delhomme, 2018; Olsson et al, 2019). One of these terms is car-sharing, which refers to a group of people that share the use of vehicles they do not own, frequently on a minute or hourly basis (Katzev, 2003; Millard-Ball et al, 2005). The fleet is normally owned by a car-sharing organization but can also be owned by other individuals in the organization. The aim of car-sharing is to reduce car ownership while keeping car accessibility but not necessarily to reduce rides. Examples of platforms serving car-sharing are Share Now, Wible, and Zipcar. Another term that can lead to confusion is ride-hailing. This term refers to mobility-on-demand services that connect individuals with drivers willing to take them to their destinations and charge for this transportation service by means of a mobile application (Heno & Marshall, 2018; Tirachini, 2019). Examples of platforms serving ride-hailing services are Uber, Lyft, and Cabify. Some of these platforms offer shared services through which they connect several individuals with a similar origin and destination with one driver, giving rise to another concept, usually referred to as cab-sharing (Shaheen & Cohen, 2018). This is the case of the services offered by Uber, called UberPool and Lyft's Line. Last, hitchhiking (also called "slugging") is one type of carpooling, in which a person waits on the roadside waiting to be picked up by a passing-by driver, therefore having little impact on the driver's trajectory or trip length (Ma & Wolfson, 2013). Normally, the driver doesn't charge nor split the fuel costs with the hitchhiker.

The literature has identified extensive benefits to carpooling. People sharing rides means higher vehicle occupancy and therefore fewer vehicles on the road, resulting in great CO<sub>2</sub>-saving potential (Bruck et al, 2017). Previous research has estimated that carpooling can reduce the number of kilometers driven by a car by 40% (Santi et al, 2014), not only helping in reducing emissions but also preserving the state of the vehicles. Lastly, a significant body of literature has analyzed the impact of urban carpooling on traffic in cities (Xu et al, 2015; Zhang et al, 2015; Ma et al, 2016; Hirnig et al, 2017; Mao et al, 2019; Ma & Yao, 2020;

Anthopoulos & Tzimos, 2021; Lee, 2022). This body of literature agrees that short-distance carpooling contributes to reducing traffic in urban environments. In line with this, a study estimated that casual carpooling in the city of San Francisco is contributing to savings of 1.7 to 3.5 million liters of gasoline each year (Minett & Pearce, 2011). But also, carpooling presents a sustainable mobility alternative that adds value to national transportation networks, connecting cities and towns in much more flexible ways than other means of transport and proving more reactive to external crises, such as train or airport strikes (Yeung & Zhu, 2020).

Carpooling was a popular transportation method in the late 20th century but saw a decline around 1990. Several factors contributed to its decline, such as an increased vehicle ownership rate, falling fuel costs, and higher educational attainments among travelers (Ferguson, 1997). However, the sharing economy is giving carpooling a second wave, with platforms such as BlaBlaCar, Carma, or Amovens digitalizing this mobility alternative and delivering it to new audiences. Through these digital platforms, drivers can post their itineraries online and get connected with travelers needing to go to the same destination, splitting the journey's costs and filling up the vehicle's empty seats. Previous research (Delhomme & Gheorghiu, 2016; Gheorghiu & Delhomme, 2018; Olsson et al., 2019) has identified that carpooling is currently most frequently used for leisure trips and is very weakly related to socio-demographic variables. Carpooling users are mostly motivated by judgmental factors, including time-saving or economic convenience, socializing opportunities, comfort, safety, and environmental awareness. Also, external factors contribute to carpooling adoption, such as poor alternative transport connectivity, public interventions (such as high-occupancy vehicle lanes), and increases in fuel prices (Bento et al, 2013).

Despite the benefits of carpooling, and although it is accepted and practiced, this transportation system is still underused (Gheorghiu & Delhomme, 2018). From an organizational perspective, carpooling has struggled to gain popularity due to the difficulties in finding vehicles or people to share the rides with. From a social perspective, there are psychological barriers associated with riding with a stranger (Correia & Viegas, 2011; Bachmann et al, 2018). The sharing economy is solving these two barriers by providing digital platforms that deliver robust sharing systems while at the same time creating the conditions for trust.

### 4.2.3 Blablacar

BlaBlaCar is the leading long-distance carpooling platform. This company offers an online marketplace that connects drivers with passengers and helps them split the cost of the journey. This way, drivers can fill up the empty seats in their vehicles and share the journey's expenses, whereas passengers can find a more convenient alternative to reach their destinations. As of 2022, BlaBlaCar has more than 100 million users, and every quarter, more than 25 million trips are shared through the platform (BlaBlaCar, 2022a). BlaBlaCar was established in 2006 in France and followed an incremental internationalization process that led to a presence in 22 countries of operation (Pérez-Pérez et al, 2021). This internationalization process has included several acquisitions of competing platforms (Casprini et al, 2018), such as the German “carpooling.com,” and the Mexican “Aventones.” The platform's current area of operation is mostly Europe but includes other regions. BlaBlaCar is present in Portugal, Spain, France, Italy, Germany, the United Kingdom, Belgium, the Netherlands, Luxembourg, Poland, Romania, Croatia, Czech Republic, Hungary, Serbia, Slovakia, Ukraine, Turkey, as well as in Brazil, India, Mexico, and Russia.

Based on the distance of the journey, the anticipated cost of fuel and tolls, and other factors, BlaBlaCar suggests a "recommended price" for the journey to the driver, which does not depend on the vehicle nor the number of available seats. The driver can accept the suggestion or change the amount within a 50% upper or lower limit than the recommended price. This amount is paid by the passenger to the driver through the BlaBlaCar platform, which also charges the passenger a service fee in the range of 15% to 20%. Since the payment collected by the driver represents a split of the journey's costs and not a remuneration, BlaBlaCar has not been subject to regulatory battles like other mobility platforms in the sharing economy, such as Uber or Lyft (Farajallah et al, 2019).

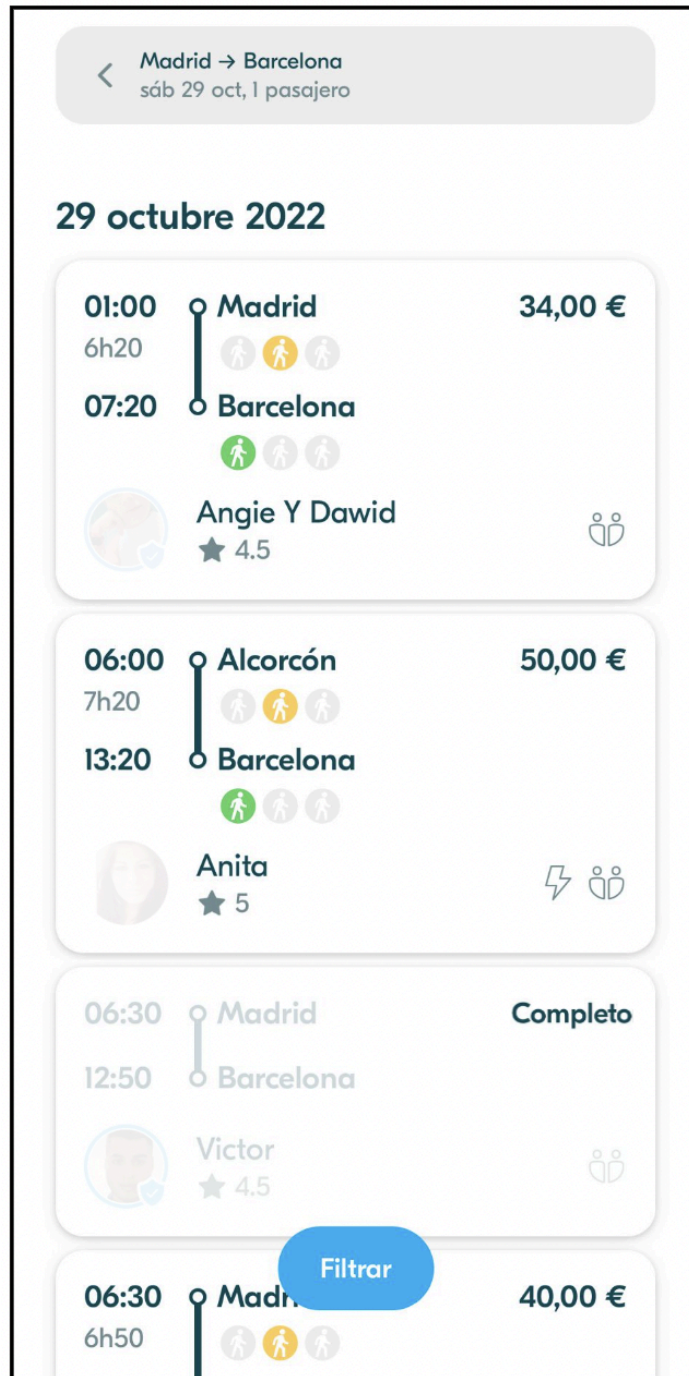


Figure 12: BlaBlaCar platform

One of the main issues that BlaBlaCar had to address to gain user adoption was building trust between drivers and passengers (Saxena et al, 2020). BlaBlaCar not only had to convince users to get in the car with a stranger but also had to deal with trust issues where drivers would oversell seats out of fear that passengers wouldn't show up, and passengers would overbook due to concerns that drivers wouldn't pick them up. To resolve these issues,

BlaBlaCar implemented several trust measures. Firstly, the platform began asking passengers to pay upfront for their journeys. Additionally, they established a bidirectional review system that allows users to read the review they received only after both parties have completed the process or the reviewing period has elapsed. Lastly, to further enhance the trust ecosystem, BlaBlaCar enabled verifiable data, such as verified phone numbers and social media accounts linked to users' profiles.

In Spain, the platform's penetration is significant. According to the company's figures, there are more than 8,000,000 users of BlaBlaCar in Spain (BlaBlaCar, 2022b). This represents approximately 17% of the Spanish population. Furthermore, the platform's penetration is even greater when considering younger audiences. The company has estimated that 37% of Spanish youths, aged 18 to 35 years old, have used the platform (Bermejo, 2021).

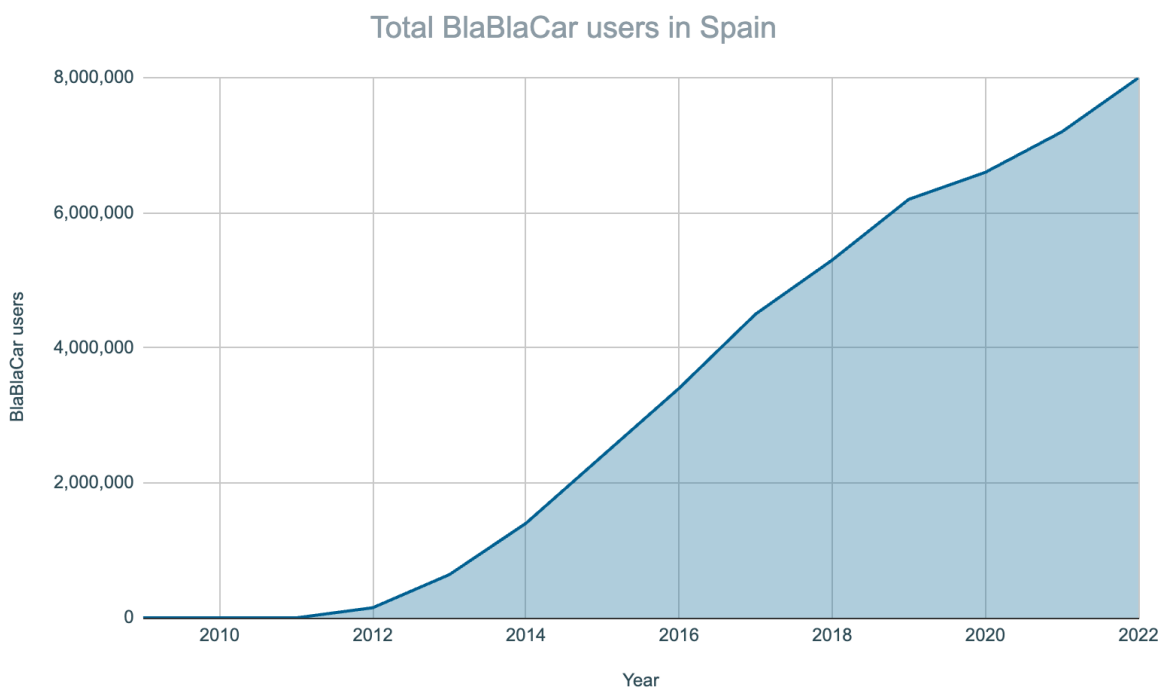


Figure 13: Year-over-Year growth of BlaBlaCar users in Spain

Source: Own elaboration with data from BlaBlaCar, 2022b

The reasons for the adoption of carpooling, and in particular of BlaBlaCar, as a means of transportation have attracted the attention of many researchers, and there is a nascent body of literature studying the subject. This literature (De Luca & Di Pace, 2015; Casprini et al, 2018; Aquino et al, 2020; Arteaga-Sánchez et al, 2020; Zalega, 2020) has identified that the main

reason users have for adopting this innovation is economic, both regarding the opportunities for drivers to split costs and for passengers to find less expensive means of transportation to their destinations. The environmental benefit of occupying an otherwise empty seat and therefore reducing the carbon footprint has been identified as a secondary benefit. Other identified reasons for adopting BlaBlaCar include better travel conditions (including more convenient schedules, pick-up and drop-off places, and more private space, among others), human interaction, and the sense of community created by the platform. Regarding demographics (Shaheen et al, 2017), unsurprisingly, users with lower incomes tend to be passengers, whereas those with higher incomes tend to be drivers. On another aspect, users of carpooling platforms tend to be younger and have achieved higher levels of formal education than travelers using other means of transportation. Travelers mostly use the platform for leisure trips, with weekend getaways being the most popular offered routes on the platform (Mericskay, 2019).

In 2018, BlaBlaCar commissioned the research consultancy firm Le BIPE to conduct an analysis of the platform's environmental contribution (BlaBlaCar, 2019). This study utilized three main data sources: real BlaBlaCar usage data, country-level data on energy consumption and CO<sub>2</sub> emissions, and a survey of almost 8,000 users of the platform. The results of this study provide relevant background for the present research. First, the research detected two sources of CO<sub>2</sub> savings promoted by BlaBlaCar. On one side, the direct savings caused by the platform's usage, and on the other, those promoted by the travelers' behavioral change beyond the platform. Regarding the first, the main source of CO<sub>2</sub> is caused by the occupation of otherwise empty seats in private vehicles. The average private vehicle occupation in the countries analyzed in the study is 1.9 people per vehicle. However, in the same countries, BlaBlaCar journeys have an average occupation of 3.9 people per vehicle. The estimation is that BlaBlaCar carpooling contributes to directly saving 894.000 tonnes of CO<sub>2</sub> per year. However, further positive externalities increase this number, since the surveys also provided insights into other CO<sub>2</sub> savings practices. For example, 22% of drivers reduce their speed when carpooling, and 35% of drivers check their tire pressure more often. Regarding indirect CO<sub>2</sub> savings, the study estimated that due to the 115.9 million yearly carpooling journeys that happened outside the platform but by people who first met through BlaBlaCar, an additional 593,000 tonnes of CO<sub>2</sub> are saved. Another significant contribution of this study is the assessment of how both drivers and passengers would have traveled if organized carpooling was not an option.

### How would carpooling drivers have reached their destination if carpooling was not an option?

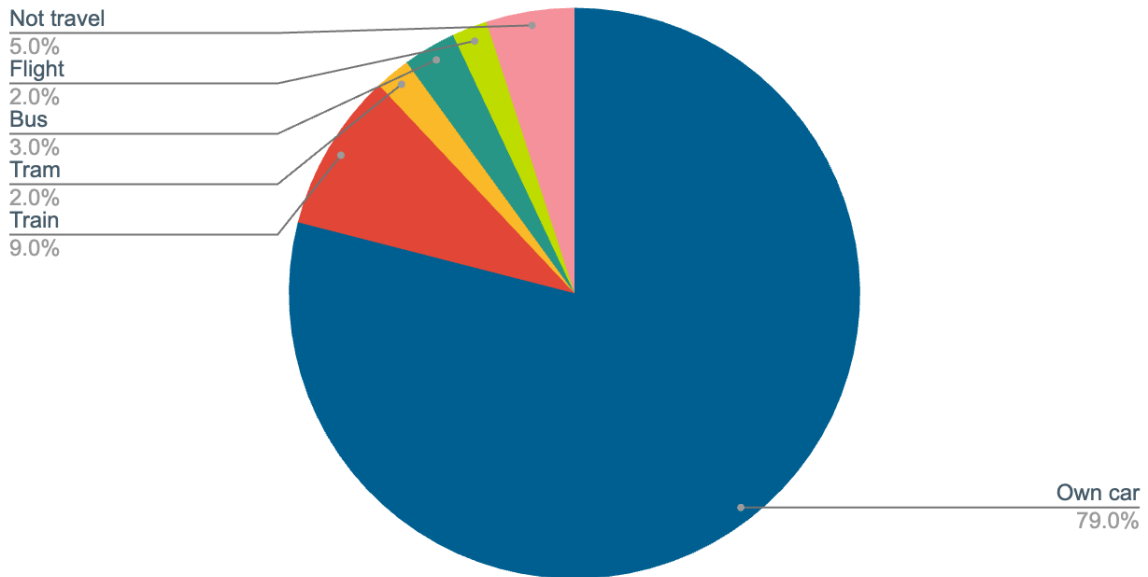


Figure 14: Preferred transport means alternatives for carpooling drivers

Source: Own elaboration with data from BlaBlaCar, 2019

Most drivers (79%) stated that they would still have traveled in their own cars with empty seats. Fewer claimed that they would have used alternative transportation means, such as the train (9%), tram (2%), bus (3%), or flights (2%). Finally, 5% of drivers claimed that they would not have traveled if they couldn't split the driving expenses.

## How would carpooling passengers have reached their destination if carpooling was not an option?

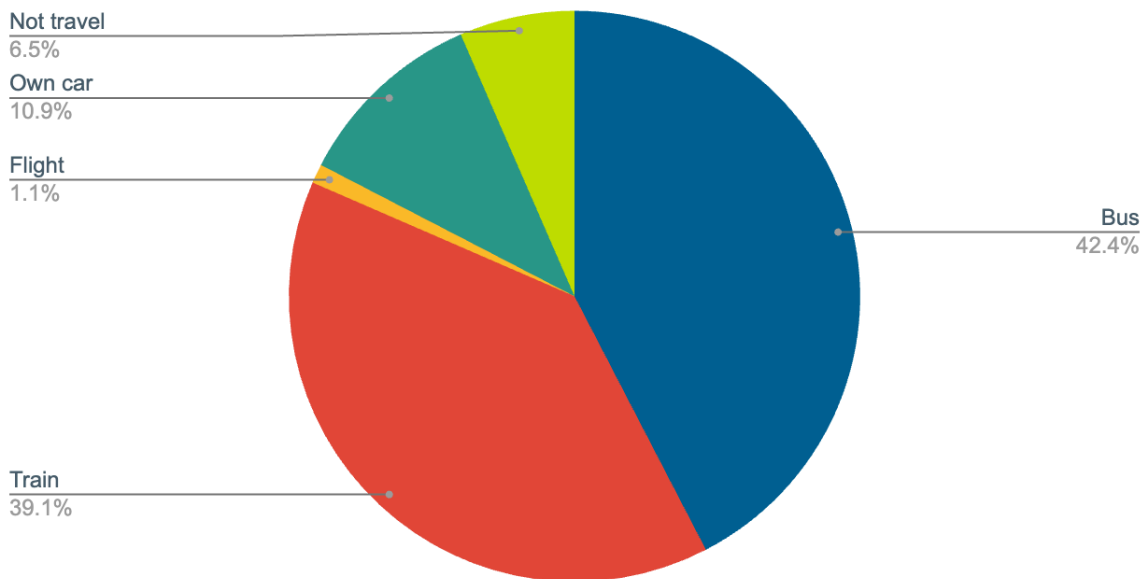


Figure 15: Preferred transport means alternatives for carpooling passengers

Source: Own elaboration with data from BlaBlaCar, 2019

Regarding passengers, if carpooling had not been an option, the predominant alternatives would have been taking a bus (42.4%), a train (39.1%), or flights (1.1%). Lastly, some carpooling passengers also declared that they would choose to travel in their own private vehicles (10.9%), and some others that they would not have traveled at all (6.5%). This study, therefore, suggests that drivers would have still traveled in their private vehicles if carpooling had not been an option and that passengers would have chosen different transportation alternatives to reach their destination. In this way, carpooling is indeed filling up otherwise empty seats and reducing the stress on transportation systems.

Given the context of previous literature confirming that short-distance carpooling contributes to reducing traffic in cities, the potential of carpooling digital platforms to increase the occupancy rate of private vehicles on long-distance roads, as well as the high penetration rate of leisure long-distance carpooling as a transport practice in Spain, the objective of this research is to analyze the impact of leisure long-distance carpooling on private vehicle road transport demand. As carpooling is adopted by the population, car drivers are filling the empty seats in their vehicles. Additionally, travelers are avoiding the need for additional vehicles on the road, thus reducing their carbon footprint. Therefore, the main hypothesis of

this research is that the adoption of carpooling innovation is contributing to less traffic on intercity roads. Nonetheless, to observe the impact of carpooling on road transport demand, an even larger adoption of carpooling may be necessary. For this reason, this research presents an exploratory analysis of the impact that the nascent innovation of carpooling is having on road transport demand.

The following section presents the methodology employed in the present research, detailing the framework, the model estimated, as well as the data sources employed in the research.

## 4.3 Methodology

### 4.3.1 Framework

In order to explore whether carpooling is indeed contributing to reducing the number of vehicles on the roads, this research employs a time series approach to analyze the aggregate road transport demand model. In its simplest form, aggregate road transport demand is specified as a function of its main determinants. Aggregate road transport demand can be modeled as:

$$Q_t = f(y_t; p_t; \varepsilon_t)$$

In this model,  $Q$ , the total quantity of demanded private road transportation, depends on its two main determinants:  $y$ , the income of the travelers, and on  $p$ , the price of the transportation.

The aforementioned model is analyzed using a time series methodology. This method aims to explain the causal effects of the explanatory variables on the dependent variable. This research employs two different methods for the analysis: an ordinary least-squares regression (OLS) model and a vector error correction (VECM) model. The first is one of the most popular methods for analyzing time series models due to its simplicity, consistency, and efficiency. Furthermore, it is often preferred by researchers because of its flexibility in

adapting to a wide range of models and providing highly interpretable coefficients. As a robustness check, this research also applies the VECM model. VECM is a powerful method that models the long-run equilibrium relationships between the variables, as well as their short-run dynamics. By including an error correction term, the VECM model allows variables to adjust back to their long-run relationship after short-term shocks. VECM is employed here to enhance the reliability and robustness of the OLS analysis.

Regarding the time series structure and data availability, two analyses have been conducted: a monthly time series analysis and a yearly time series study. In both time series used in this analysis, the data is stationary. The Dickey-Fuller test for the unit root has been conducted, and the dataset has undergone a logarithmic transformation.

This research includes a causality test to confirm the presence and direction of causality between the different variables used in this time series analysis. The method employed is the Granger-causality test (Engle & Granger, 1987; Granger, 1988), which is a popular tool for detecting the presence of unidirectional, bidirectional, or no causality in transport demand models (Fernandes & Pacheco, 2010; Küçükönel & Sedefoğlu, 2017; Akinyemi, 2018; Duvarcı & Duran, 2022).

Naturally, this study requires some delimitations. For the purposes of this research, the Spanish case has been analyzed. There are several reasons for this decision. First, this research is part of a larger study on the impact of digital platforms on the travel industry, which is centered on the Spanish economy. Methodologically, Spain represents a good case study for this research since it is the second economy to which the leading carpooling platform BlaBlaCar expanded and has shown significant adoption of the carpooling innovation. Furthermore, Spain has a strong transport infrastructure that allows for a mix of transportation means. Lastly, Spanish and European institutions provide public access to the necessary data to conduct the study. Regarding the time-series delimitation, this study focuses on the period from 2003 to 2022. This decision is primarily based on methodological requirements. It is desired that the phenomenon under analysis (in this case, the introduction and adoption of the carpooling innovation) occurs somewhere in the middle of the time series. As can be observed in the preceding Figure 13, the early adopters of the carpooling innovation started using the BlaBlaCar platform back in 2009, but it wasn't until 2011 that

BlaBlaCar reached the milestone of 1 million Spanish users, and it wasn't until 2017 that it reached 5 million users in Spain.

### 4.3.2 Model

The literature on transportation demand modeling suggests that the two primary determinants of private vehicle road transport demand are the income of travelers and the price of travel, typically measured by the price of fuel (Profillidis & Botzoris, 2019). However, there may be additional factors influencing road transport demand. Therefore, the following empirical literature has been reviewed to identify the most common drivers of road transport demand, as well as the methods used for its analysis:

	Dependent Variable	Income	Fuel Price	Kms of lanes (infrastructure)	Fleet	Population	Alternative Transport Means	Employment	Number of Drivers	Fuel Use	Fleet age	Urbanization	Method
Gately, 1990	Vehicles/Mile	X	X						X				OLS
Hensher et al, 1990	Vehicles/Km	X	X					X					3SLS
Hansen & Huang, 1997	Vehicles/Mile	X		X		X							GLS
Boarnet & Sarmiento, 1998	Trips			X		X		X					Probit
Noland & Cowart, 2000	Vehicles/Mile	X	X	X		X							2SLS
Fulton et al, 2000	Vehicles/Mile	X		X		X							FE regression
Noland, 2001	Vehicles/Mile	X	X	X		X							OLS + Zellner SUR
Liddle, 2009	Vehicles/Km	X	X		X					X			Granger-causality
Zegras, 2010	Vehicles/Km	X		X			X						OLS
Hymel et al, 2010	Vehicles/Mile		X	X	X								3SLS
Chi, 2016	Vehicles/Km	X	X	X									ARDL
Zolnik, 2018	Vehicles/Mile	X	X	X	X		X						Multilevel models
Sheng & Sharp, 2019	Vehicles/Km	X	X	X	X		X	X			X		Zellner SUR
Profillidis & Botzoris, 2019	Vehicles/Mile		X		X								OLS
Khan, 2020	Passengers/Mile	X	X	X								X	ARDL

Table 19: Reviewed literature modeling road transport demand

As shown in the table above, the most common dependent variable for studying private vehicle road transport demand is the number of vehicles per kilometer or mile. Some studies also focus on the number of passengers per kilometer or mile, or the total number of trips taken on the studied lanes. Regarding explanatory variables, as expected, most studies agree that income and the price of fuel are the main determinants of road transport demand. The total infrastructure, measured by the number of kilometers of constructed highways or lanes, is also popular in studies that examine the effect of induced road transport demand. This

concept explains the additional road transport demand generated as a result of the construction of new roads. This variable is commonly used in studies focusing on induced road transport demand but is not present in studies that focus on other aspects of the subject. Other explanatory variables are present in some models, such as fleet size, fleet age, the total number of licensed drivers, the population of the country or region, the employment rate, the price of alternative transportation means, fuel usage, or the degree of urbanization of the region. Despite this list of explanatory variables, the most robust results for the present study were obtained when incorporating only the two key determinants: income and price. This result aligns with the study conducted by Profillidis and Botzoris (2019) published in the book "Modeling of Transport Demand". In this study, the authors conclude that road transportation is best explained by the simplest form of the model, in which private vehicle road transport demand is determined by the income of the population and the price of fuel.

Considering this analysis, as well as the body of literature presented in section 2 of the present study, the following model has been developed:

$$VKM_t = \alpha INC_t^{\beta_1} PFU_t^{\beta_2} CPO_t^{\beta_3} \mu \varepsilon_t$$

In this road transport model, the dependant variable is VKM, the number of vehicles per kilometer of road, which varies according to several explanatory variables. INC is the income of the traveler and can be represented either by disposable income or by GDP per capita. Next, PFU represents the price of making the trip. When studying private road transport, the most appropriate variable to depict the price of making the trip is that of the price of fuel or petrol. Furthermore, this model incorporates one variable, CPO, representing the carpooling innovation, as it is expected to also impact the number of vehicles on the road. Last,  $\varepsilon$  is the error term.

The coefficient of most interest to the effect of the research question this study raises is  $\beta_3$ . If carpooling has significantly contributed towards reducing the number of cars on the road, this coefficient should be significant and negative. If its effects on the number of vehicles on the road are not yet visible due to insufficient adoption of the innovation, the coefficient should not be significant. However, the possibility also exists that BlaBlaCar drivers could have

chosen to travel else how and choose to carpool because of the opportunity to share costs, in which case, its coefficient should be positive.

### 4.3.3 Data

Following are the main observations and considerations regarding the data and data sources employed for this analysis.

#### Dependent variable: vehicles per kilometer

Regarding the dependent variable, the most common data used to represent road transport demand is the number of vehicles per mile or kilometer. This variable is utilized in 13 out of the 15 studies reviewed in Table 19. The popularity of this variable in road transport demand studies stems from its ability to quantify the intensity of road traffic in a particular region. This enables the assessment of how much road capacity is being utilized and how many vehicles are actively using the road infrastructure. For this research, the selected data is the number of vehicles per kilometer on public tolled highways. This data is collected and published by the Transport, Mobility, and Urban Agenda Ministry (Ministerio de Transporte, Movilidad y Agenda Urbana) of Spain. The data is published as a monthly time series and allows for the differentiation of light and heavy vehicles. To avoid potential circularity between GDP and freight transportation, this research considers only the total number of light vehicles, excluding all traffic related to freight.

#### Independent variables: price, income, and carpooling:

Regarding the independent variables, income data was collected from the OECD's Quarterly National Accounts. Two variables were obtained to represent income. On one hand, national disposable income, and on the other, gross domestic product per capita. The first, in Euros, current prices, and in quarterly levels, while the second, in US dollars, fixed PPPs, and seasonally adjusted. The models are estimated using both variables.

Regarding the price of fuel, two data sources were considered. For the monthly time series, Eurostat's data of harmonised index of consumer prices (HICP) for fuels of personal transport was employed. For the yearly time series, the International Monetary Fund's dataset of

primary commodity price system, gave access to the price of crude oil, specifically Spot Crude U.K. Brent.

Regarding the variables used to represent the carpooling innovation, the ideal dataset would have been carpooling journeys conducted during the analyzed period. Unfortunately, this data is not publicly available. Therefore, a proxy was employed, consisting of the monthly data on BlaBlaCar's website traffic. This dataset shows the total number of sessions per month on BlaBlaCar's website in Spain, primarily consisting of travelers seeking to carpool. Although BlaBlaCar's users can also use the platform's mobile application, and there is some data loss by using only website data, the website traffic provides sufficient insight into BlaBlaCar's growth and their users' behavior. The data was obtained from the Ahrefs platform, a leading tool for marketing professionals used for SEO and benchmarking analyses, among other functions. Ahrefs has recently started to be used for scientific purposes (Adi, 2015; Kostagiolas et al, 2020). For the yearly time series dataset, another variable has been integrated, representing the total number of users that BlaBlaCar has in Spain. The yearly time series for this information was publicly published by the firm. One consideration has been made, taking into account that this data can be misleading, as it represents the accumulated and not active users, since users typically do not unsubscribe from the platform. For this reason, this variable was transformed into a yearly growth rate, representing the growth of the carpooling phenomenon in Spain.

## 4.4 Results & Discussion

This section presents the analysis of the aggregate road transport demand equation in Spain and how its main explanatory variables determine it. The model incorporates the two primary explanatory variables for road transport: income and fuel price. Furthermore, it includes two additional variables to represent the carpooling phenomenon, one for the monthly time series analysis and a second one used in the yearly analysis.

Table 20 presents the variables employed in the analysis:

<b>Variable</b>	<b>Description</b>
vkm	Vehicles per kilometer on the road
gdp	Gross domestic product per capita
din	Disposable income
pfu	Price of fuel
bbt	BlaBlaCar's website traffic (for monthly time series)
bbu	BlaBlaCar's number of users (for yearly time series)

Table 20: Variables description

Next, the variables' descriptive statistics are presented. Table 21 presents the variables employed in the monthly time series, whereas Table 22 presents the variables employed in the yearly time series.

<b>Variable</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Observations</b>
vkm	20.999	0.316	180
gdp	10.473	0.049	180
din	12.299	0.315	180
ppt	4.904	0.214	180
bbt	6.914	8.007	180

Table 21: Descriptive statistics - Monthly time series

<b>Variable</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Observations</b>
vkm	9.613	0.561	20
gdp	10.467	0.043	20
din	13.644	0.145	20
ppt	4.737	0.325	20
bbu	6.566	7.492	20

Table 22: Descriptive statistics - Yearly time series

Following, the results of the model estimations are presented. Two different time series were estimated, one on a monthly level presented in Table 23, and a second on a yearly level presented in Table 24. For each time series, four models were estimated. Two of them employ a GDP per capita variable to represent the income, whereas the other two employ disposable income. Moreover, for each time series, two models are analyzed by means of an OLS regression, whereas the others are analyzed by means of the VECM method.

Variable	(1)	(2)	(3)	(4)
gdp	4.356 ***		4.070 ***	
din		0.108		2.649 ***
ppt	-0.120	-0.155	-0.394	0.076
bbt	-0.024 ***	-0.013 ***	-0.029 ***	-0.038 **
_cons	-23.864 ***	20.527 ***	-19.360	-11.510
R <sup>2</sup>	0.438 ***	0.084 ***		
Observations	180	180	178	178

Notes: Models (1) and (2) employ OLS model. Models (3) and (4) employ VECM. Coefficient for each value is provided. \*\*\* significant at 1%; \*\* significant at 5%; \* significant at 10%. The dependant variable is vkm. VECM interpretation requires sign inversion. VECM results here presented already include inverted signs for increased readability.

Table 23: Results - Monthly time series

Variable	(5)	(6)	(7)	(8)
gdp	6.031 **		8.416 ***	
din		2.919 **		-3.385 ***
ppt	-0.192	-0.855 *	-0.456 ***	1.892 ***
bbu	-0.026	-0.049 **	-0.018 ***	0.039 ***
_cons	-52.430 *	-25.846	-76.437	-47.481
R <sup>2</sup>	0.327 *	0.330 *		
Observations	20	20	18	18

Notes: Models (5) and (6) employ OLS model. Models (7) and (8) employ VECM. Coefficient for each value is provided. \*\*\* significant at 1%; \*\* significant at 5%; \* significant at 10%. The dependant variable is vkm. VECM interpretation requires sign inversion. VECM results here presented already include inverted signs for increased readability.

Table 24: Results - Yearly time series

The results of the estimations show a positive and significant impact of income on road transport demand. Seven out of the 8 models present a robust coefficient for this explanatory variable, with only one estimation (2) presenting a non-significant coefficient. This result is consistent with the literature on this topic (Boarnet & Sarmiento, 1998; Potoglou & Kanaroglou, 2008; Liddle, 2009; Zegras, 2010; Chatman, 2013; Chi, 2016; Khan, 2020), which suggests a direct relationship between the income of the population and the number of trips the population makes. In times of economic growth, people tend to travel more frequently. Additionally, all the results for the explanatory variable of the price of fuel also present coefficients with the expected negative sign. Out of the 8 models estimated, four of them present significant coefficients (models 3, 6, 7, and 8). The literature suggests that the price of fuel is a determinant variable of road transport. As the price of fuel increases, fewer people are inclined to employ their cars for travel, which has a negative impact on road transport demand (Wang & Skinner, 1984; Hensher et al, 1990; Goodwin, 1992; Espey, 1998; Chao et al, 2015; Khan, 2020).

In the context of this research, the most relevant explanatory variable is the one representing the carpooling phenomenon, specifically the development of BlaBlaCar. As previously detailed, the two time series models include different variables to explain this innovation. The monthly time series includes a variable representing the platform's website traffic, while the

yearly time series includes a variable representing the total number of users the platform has in Spain. All eight estimations consistently show robust results regarding the impact of BlaBlaCar on road transport demand. The coefficients obtained are significant and have the expected negative sign in all cases. The coefficients range from a negative -0.013 to a negative -0.049. Despite the consistency of these results across all eight models, the coefficient values are relatively small. The interpretation of the results suggests that a 1% increase in the usage of carpooling results in a decrease in road transport demand in the range of 0.01% to 0.04%. These results are consistent with the previous research's finding that 10.9% of carpooling passengers would have chosen to drive their own cars if they could not have joined a vehicle going to their destination (BlaBlaCar, 2019).

Last, this research presents a Granger-causality test to assess the direction of causality between the different variables in the model.

Null hypothesis	chi2	p-value	Decision
ln_gdp does not cause ln_vkm	7.77	0.0053	ln_gdp ↔ ln_vkm (bidirectional causality)
ln_vkm does not cause ln_gdp	5.23	0.0222	
ln_ppt does not cause ln_vkm	6.8	0.0091	ln_ppt → ln_vkm (unidirectional causality)
ln_vkm does not cause ln_ppt	0.01	0.9096	
ln_bbt does not cause ln_vkm	4.51	0.0337	ln_bbt → ln_vkm (unidirectional causality)
ln_vkm does not cause ln_bbt	0.73	0.3941	

Table 25: Causality test for road transport demand model

As presented in the precedent table, the Granger-causality test shows a bidirectional granger-causality between the number of vehicles per kilometer in highways and the GDPpc. However, both in the case of the price of petrol, and of the carpooling innovation, the Granger-causality is unidirectional. Results from the test suggest that the price of petrol and the carpooling innovation Granger-cause vehicles per kilometer, and not vice-versa.

These results confirm that the adoption of carpooling, and in particular drivers sharing the empty seats in private vehicles while making road journeys, is having a negative effect on the number of vehicles on intercity roads.

## 4.5 Conclusion

The global climate crisis has evidenced the need to decouple resource usage from economic growth, and in particular, to shift to more responsible production and consumption practices across all industries and sectors. The travel and tourism industry is responsible for approximately 5% of all CO<sub>2</sub> global emissions product of human activity. Considering the high environmental impact of this sector, it is particularly concerning that travel, and the emissions derived from it, are on an unstoppable growth pace. International tourist flows are expected to have doubled in the period 2005-2030, and domestic tourist flows are expected to have tripled by the same time.

Passenger transportation is the main contributor to the travel industry's carbon footprint, being responsible for 75% of the sector's emissions. Out of all the different transportation means, private vehicle road transportation is not only one of the least environmentally efficient transportation means, even more polluting than air transportation, but is also one of the most popular means. 44% of worldwide domestic passenger travel is made by private road vehicles. Since the relative environmental efficiency of private vehicles depends on the number of passengers onboard, it's again alarming that the average vehicle runs with less than 1.5 passengers per vehicle. If more people shared their journeys, the relative environmental efficiency of private vehicles could increase significantly.

The sharing economy has been on the rise in different sectors, and the adopters of these innovations are willing to move from owning products to accessing them on demand, and from using products on exclusivity, to sharing them. In the road transportation sector, digital platforms have given a second life to a sharing transportation alternative: carpooling. By means of carpooling digital platforms, drivers and travelers can share the empty seats on vehicles and split the costs of the journeys. Since travelers are occupying otherwise empty seats, carpooling contributes to avoiding unnecessary production of further transportation services for travelers, while increasing the relative environmental efficiency of vehicles. The adoption of carpooling is growing steadily, and currently, the leading carpooling platform, BlaBlaCar, allows drivers and passengers to share more than 25 million trips every quarter on a global scale. In Spain alone, this platform accounts for more than 8 million users. Carpooling has been proven to have a negative impact on road transportation demand and

reduce traffic in urban environments. However, no previous research has analyzed the impact of carpooling on long-distance private vehicle road transportation demand.

This research has addressed this gap and has set to statistically test whether leisure long-distance carpooling is having an impact on private vehicle road transport demand. To conduct this analysis, a time series study has been developed. This research, delimited to the Spanish case in the period 2003-2022, has applied an econometric approach, studied by means of the OLS and VECM methodologies. In the developed model, private vehicle long-distance road transportation demand is explained by its two key determinants: income and price. An additional variable has been introduced in the model to detect the effects of the adoption of the carpooling innovation on private vehicle long-distance road transportation demand.

Results showed that indeed, the changes in the population's income, and the price of fuel plays a major role in private vehicle road transportation demand. Regarding the effect of carpooling on private vehicle road transportation demand, seven of the eight estimations presented a negative and significant coefficient. These results suggest that carpooling can indeed contribute to reducing private vehicle road transportation. The interpretation of the coefficient suggests that an increase of 1% in the usage of carpooling can cause a decrease in the range of 0.01% to 0.04% in the number of vehicles per kilometer. This result is in line with previous studies that identified that carpooling to work also has a negative impact on urban traffic and that there are significant CO<sub>2</sub> emissions savings as a result of leisure long-distance carpooling.

Carpooling can be beneficial as a way to use idle resources, in this case, seats in vehicles, to their maximum capacity. This way, travelers can consume transportation more responsibly, avoiding the unnecessary production of further transportation services by joining otherwise empty seats. By doing so, carpooling participants, both drivers and travelers, are increasing the relative environmental efficiency of the vehicles. Also, they are having a negative impact on road transportation demand, reducing traffic and stress on transportation systems. Furthermore, by carpooling, drivers are enabling further public transport connections to their unique destinations. Naturally, this extended connectivity network focuses on popular origins and destinations, but can also include smaller towns with a weaker public transportation network. Furthermore, technological implementations by carpooling platforms might enable

stops on the road. This allows passengers to get off the vehicles in their destinations within the drivers' trajectory, unlocking even more connectivity. This is particularly interesting for towns that experienced a rural exodus and are currently underserved by public transportation.

Given carpooling's benefits (which include reduced traffic congestion, reduced carbon footprint, savings potential for travelers, and an enhanced transportation network), public authorities should consider promoting this innovation. First, authorities should raise awareness of this innovation so that the general public can know of its existence and trust it as a transportation alternative. This can be implemented by different types of awareness campaigns on digital and traditional media. Second, incentives could be implemented for people who carpool, including vehicle tax rebates or reduced toll fees. This could lead to an increased offer, with more people wanting to offer free seats on their vehicles. Dedicated carpooling lanes have also been a public policy implemented by cities that want to promote carpooling, but are fitter to urban carpooling, than to long-distance. However, other alternatives like express toll lanes could be a better fit for long-distance carpooling. Promoting entrepreneurship should always be part of the equation when dealing with innovation. Despite the existence of different players in the market already offering carpooling solutions, there is always space for new developments, which can be particularly targeted at niches, such as minority groups, specific locations, or carpooling between neighboring towns. Last, private-public partnerships can also help promote carpooling and benefit from its positive externalities. Some partnerships can include developing multi-modality transportation platforms, where users can find and connect both their carpooling service but also their last-mile transportation solution (including public bikes, buses, train, or metro).

The main innovation and contribution to the academic literature of this paper is the analysis of the effect of carpooling adoption on long-distance private vehicle road transport demand. Previous studies examining carpooling's impact on road transportation have primarily focused on urban traffic. Furthermore, this study represents the first attempt to analyze the effect of carpooling on the equation for private vehicle road transportation demand and to review it using econometric techniques.

There are several limitations to this study that future research could address in greater detail. Firstly, this research has focused on the Spanish case, which may not necessarily reflect the

impact of carpooling on road transportation demand in other economies or regions. Additionally, this study specifically concentrated on the BlaBlaCar platform as a representative of the carpooling innovation, but there are other platforms promoting this solution in the market. Furthermore, due to data availability restrictions, this research used BlaBlaCar's website traffic and user base growth as variables to represent the adoption of carpooling innovation, but a more representative data source, such as the number of carpooled journeys, would have been preferable.

Further studies could complement the present research by analyzing the effect of carpooling digital platforms on road transportation demand in other regions or economies. Furthermore, it would be relevant to delve into the differentiated impact this innovation might have on urban and rural environments. This would serve as a reference to understand carpooling as a means to reduce inequalities and generate sustainable transportation alternatives in less favorably connected geographies.

## 4.6 References

Adi, A. (2015). Occupy PR: An analysis of online media communications of Occupy Wall Street and Occupy London. *Public Relations Review*, 41(4), 508–514.

Ajuntament de Barcelona (2016). Enquesta de mobilitat en dia feiner (EMEF). Retrieved on March 7, 2023, from <http://hdl.handle.net/11703/98761>

Akinyemi, Y. C. (2018). Determinants of domestic air travel demand in Nigeria: cointegration and causality analysis. *GeoJournal*.

Anthopoulos, L. & Tzimos, D. (2021). Carpooling Platforms as Smart City Projects: A Bibliometric Analysis and Systematic Literature Review. *Sustainability* 13(19).

Aquino, L., Barbosa, M. & Barbosa, J.W. (2020). O processo de cocriação de valor nas experiências de consumo colaborativo em turismo: o caso Blablacar. *Revista Turismo Em Análise*, 31(3), 417-434.

Arteaga-Sánchez, R., Belda-Ruiz, M., Ros-Galvez, A., & Rosa-Garcia, A. (2020). Why continue sharing: Determinants of behavior in ridesharing services. *International Journal of Market Research*, 62(6), 725–742.

Bachmann, F., Hanimann, A., Artho, J., & Jonas, K. (2018). What drives people to carpool? Explaining carpooling intention from the perspectives of carpooling passengers and drivers. *Transportation Research Part F: Traffic Psychology and Behaviour*, 59, 260–268.

Bento, A. M., Hughes, J. E., & Kaffine, D. (2013). Carpooling and driver responses to fuel price changes: Evidence from traffic flows in Los Angeles. *Journal of Urban Economics*, 77, 41–56.

Bermejo, I. (2021). BlaBlaCar alcanza los 7 millones de usuarios en España. *La Razón*. 19 de Octubre de 2021.

BlaBlaCar. (2019). Zero empty seats: A study into BlaBlaCar's environmental contribution. Available online at: [https://drive.google.com/file/d/13UImrdhW6ceUuZPq8yQuCJur\\_dqI6X87/view](https://drive.google.com/file/d/13UImrdhW6ceUuZPq8yQuCJur_dqI6X87/view). Accessed October 25th 2022.

BlaBlaCar. (2022). About us. Available online at <https://blog.blablacar.com/about-us>. Accessed 25th October 2022.

BlaBlaCar. (2022). BlaBlaCar alcanza los ocho millones de usuarios en España. Accessed online on November 1, 2022. Available at <https://blog.blablacar.es/newsroom/noticias/blablacar-alcanza-los-ocho-millones-de-usuarios-en-espana>.

BlaBlaCar. (2022). BlaBlaCar alcanza los ocho millones de usuarios en España. Available online at: <https://blog.blablacar.es/newsroom/noticias/blablacar-alcanza-los-ocho-millones-de-usuarios-en-espana>. Accessed 25th October 2022.

Boarnet, M. G., & Sarmiento, S. (1998). Can Land-use Policy Really Affect Travel Behaviour? A Study of the Link between Non-work Travel and Land-use Characteristics. *Urban Studies*, 35(7), 1155–1169.

Brisbe, C. (2022). “El BlaBlaCar del siglo XVIII”: El anuncio de 1791 para compartir coche que ha impactado a Twitter. *La Vanguardia*. Available online at <https://www.lavanguardia.com/cribeo/viral/20220808/8455274/blablacar-siglo-xviii-anuncio-compartir-coche-1791-impresionado-twitter.html>

Bruck, B. P., Incerti, V., Iori, M., & Vignoli, M. (2017). Minimizing CO2 emissions in a practical daily carpooling problem. *Computers & Operations Research*, 81, 40–50.

Button, K. & Yuan, J. (2013). Airfreight Transport and Economic Development: An Examination of Causality. *Urban Studies* 50(2), 329–340.

Casprini, E., Di Minin, A., & Paraboschi, A. (2018). How do companies organize nascent markets? The BlaBlaCar case in the inter-city shared mobility market. *Technological Forecasting and Social Change*.

Chan, N. D., & Shaheen, S. A. (2012). Ridesharing in North America: Past, Present, and Future. *Transport Reviews*, 32(1), 93–112.

Chao, M.-C., Huang, W.-H., & Jou, R.-C. (2015). The asymmetric effects of gasoline prices on public transportation use in Taiwan. *Transportation Research Part D: Transport and Environment*, 41, 75–87.

Chatman, D. G. (2013). Does TOD Need the T? *Journal of the American Planning Association*, 79(1), 17–31.

Chi, J. (2016). Long- and short-run asymmetric responses of motor-vehicle travel to fuel price variations: New evidence from a nonlinear ARDL approach. *Transport Policy*, 50, 126–134.

Ciari, F. (2012). Why do people carpool? Results from a Swiss survey. Paper presented at the Swiss Transport Research Conference.

Correia, G., & Viegas, J. M. (2011). Carpooling and carpool clubs: Clarifying concepts and assessing value enhancement possibilities through a Stated Preference web survey in Lisbon, Portugal. *Transportation Research Part A: Policy and Practice*, 45(2), 81–90.

De Luca, D; Di Pace, R (2015). Modelling users' behaviour in inter-urban carsharing program: A stated preference approach. *Transportation Research Part A: Policy and Practice*, vol. 71(C), pages 59-76.

de Rus, G., Campos, J. & Nombela, G. (2003). *Economía del transporte*. SERBIULA (sistema Librum 2.0).

Delhomme, P., & Gheorghiu, A. (2016). Comparing French carpoolers and non-carpoolers: Which factors contribute the most to carpooling? *Transportation Research Part D: Transport and Environment*, 42, 1–15.

Duvarci, Y., & Duran, H.E. (2022). The relationship between transportation demand and supply: Granger-Causality test using time-series data. *Pamukkale Univ Muh Bilim Derg*, 28(6), 786-801

El 70% de los automóviles que circulan por ciudad lleva un solo ocupante (2000, May 2). *El País*. Retrieved March 7, 2023, from [https://elpais.com/diario/2000/05/02/sociedad/957218415\\_850215.html](https://elpais.com/diario/2000/05/02/sociedad/957218415_850215.html)

Engle, R. F., & Granger, C. W. J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, 55(2), 251.

Espey, M. (1998). Gasoline demand revisited: an international meta-analysis of elasticities. *Energy Economics*, 20(3), 273–295.

European Commission (2016). A European agenda for the collaborative economy, Retrieved June 20, 2020, from <https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-356-EN-F1-1.PDF>

European Commission (2022). Passenger mobility statistics. ISSN 2443-8219. Retrieved March 7, 2023, from [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger\\_mobility\\_statistics#Passenger\\_car\\_occupancy](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_mobility_statistics#Passenger_car_occupancy)

European Environment Agency (2010). Occupancy rates of passenger vehicles. Retrieved March 7, 2023, from [https://www.eea.europa.eu/ds\\_resolveuid/184dba3e07eb2da6e87fadbd04196cfe](https://www.eea.europa.eu/ds_resolveuid/184dba3e07eb2da6e87fadbd04196cfe).

Farajallah, M; Hammond, RG; Penard, T (2019). What drives pricing behavior in Peer-to-Peer markets? Evidence from the carsharing platform BlaBlaCar. *Information economics and policy* (48), 15-31

Fearnley, N., Currie, G., Flügel, S., Gregersen, F. A., Killi, M., Toner, J., & Wardman, M. (2018). Competition and substitution between public transport modes. *Research in Transportation Economics*.

Fernandes, E., & Pacheco, R. R. (2010). The causal relationship between GDP and domestic air passenger traffic in Brazil. *Transportation Planning and Technology*, 33(7), 569–581.

Ferguson, E. (1997). The rise and fall of the American carpool: 1970–1990. *Transportation*, 24(4), 349–376.

Flores, A. & Chang Rojas, V. (2020). Relación entre la demanda de transporte y el crecimiento económico: Análisis dinámico mediante el uso del modelo ARDL. *Cuadernos de Economía* (2020) 43, 145-163

Fulton, L., Noland, R., Meszler, D. & Thomas, J. (2000). A statistical analysis of induced travel effects in the US mid-Atlantic region. *Journal of Transportation and Statistics* 3, 1–14.

Gately, D. (1990). The U.S. Demand for Highway Travel and Motor Fuel. *The Energy Journal* Vol. 11, No. 3 (July 1990), pp. 59-73

Gheorghiu, A., & Delhomme, P. (2018). For which types of trips do French drivers carpool? Motivations underlying carpooling for different types of trips. *Transportation Research Part A: Policy and Practice*, 113, 460–475.

González, R. M., & Marrero, G. A. (2012). Induced road traffic in Spanish regions: A dynamic panel data model. *Transportation Research Part A: Policy and Practice*, 46(3), 435–445.

Goodwin, P.B. (1992). A review of new demand elasticities with special reference to short and long run effects of price changes. *Journal of Transport Economics and Policy* 26 (2), 155–163.

Gössling, S. (2002). Global environmental consequences of tourism. *Global Environmental Change*, 12(4), 283–302.

Granger, C. W. J. (1988). Causality, cointegration, and control. *Journal of Economic Dynamics and Control*, 12(2-3), 551–559.

Greening, L., Greene, D., & Difiglio, C. (2000). Energy efficiency and consumption — the rebound effect — a survey. *Energy Policy*, 28(6-7), 389–401.

Hansen, M., & Huang, Y. (1997). Road supply and traffic in California urban areas. *Transportation Research Part A: Policy and Practice*, 31(3), 205–218.

Henao, A., & Marshall, W. E. (2018). The impact of ride-hailing on vehicle miles traveled. *Transportation*.

Hensher, D., Milthorpe, F., & Smith, N. (1990). The Demand for Vehicle Use in the Urban Household Sector: Theory and Empirical Evidence. *Journal of Transport Economics and Policy*, May, 1990, Vol. 24, No. 2, pp. 119-137

Hirnig, S., Sikic, L. & Grzin, E. (2017). Systems fo sharing car ourneys with the aim of reducing the number of traffic jams by keeping the achieved level of population mobility. *Journal of polytechnics of Rijeka Vol 5(1)*. Pages 107-124.

Hymel, K. M., Small, K. A., & Dender, K. V. (2010). Induced demand and rebound effects in road transport. *Transportation Research Part B: Methodological*, 44(10), 1220–1241.

Katzev, R. (2003). Car Sharing: A New Approach to Urban Transportation Problems. *Analyses of Social Issues and Public Policy*, 3(1), 65–86.

Khan, M. Z. (2020). Analyzing Road Transport (Passenger and Freight) Demand in Pakistan with Auto-Regressive Distributed Lag Co-Integration Approach. *Transportation Research Record: Journal of the Transportation Research Board*, 036119812097400.

Kostagiolas, P., Strzelecki, A., Banou, C., & Lavranos, C. (2020). The impact of Google on discovering scholarly information: managing STM publishers' visibility in Google. *Collection and Curation*, 40(1), 1–8.

Küçükönal, H., & Sedefoğlu, G. (2017). The Causality Analysis of Air Transport and Socio-economics Factors: The Case of OECD Countries. *Transportation Research Procedia*, 28, 16–26.

Lee, J.B. (2022). Company-Wide Carpooling for Long Distance Commuting in South Korea and Its Effects on Reducing Transportation Problems. *KSCE Journal of Civil Engineering* 26, 3226–3234

Liddle, B. (2009). Long-run relationship among transport demand, income, and gasoline price for the US. *Transportation Research Part D: Transport and Environment*, 14(2), 73–82.

Ma, M., Han, F., Han, Y., & Zhou, X. (2016). Study on the Relationship between Passenger Cars' Empty-loaded Rate and Traffic Volume on Shenyang Arterial Road. *Procedia Engineering*, 137, 531–536.

Ma, R.M. & Yao, L.F. (2020). A Side-Constrained Peer-to-Peer Carpooling Stochastic User Equilibrium Model. *Technical Gazette* 27, 2(2020), 638-647

Ma, S., & Wolfson, O. (2013). Analysis and evaluation of the slugging form of ridesharing. *Proceedings of the 21st ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems - SIGSPATIAL'13*.

Mao, L., Li, W., Hu, P., Zhou, G., Zhang, H., & Zhou, X. (2019). Urban Arterial Road Optimization and Design Combined with HOV Carpooling under Connected Vehicle Environment. *Journal of Advanced Transportation*, 2019, 1–11.

Mericskay, B. (2019). Potentials and limits of (geo)digital footprints in mobility analysis: the example of the data from the BlaBlaCar carpooling platform. *Cartographie, Imagerie, SIG*

Meyer, I., Leimbach, M., & Jaeger, C. C. (2007). International passenger transport and climate change: A sector analysis in car demand and associated emissions from 2000 to 2050. *Energy Policy*, 35(12), 6332–6345.

Millard-Ball, M., Murray, G., Ter Schure, J., Fox, C., & Burkhardt, J. (2005). *Car-Sharing: Where and How It Succeeds*. Transit Cooperative Research Program (TCRP) Report 108, published by Transportation Research Board, Washington.

Minett, P., & Pearce, J. (2011). Estimating the Energy Consumption Impact of Casual Carpooling. *Energies*, 4(1), 126–139.

Noland, R. & Cowart, W. (2000). Analysis of metropolitan highway capacity and the growth in vehicle miles of travel. Proceedings of the 79th Annual Meeting of the Transportation Research Board. Washington, D.C.

Noland, R. B. (2001). Relationships between highway capacity and induced vehicle travel. *Transportation Research Part A: Policy and Practice*, 35(1), 47–72.

Olsson, L. E., Maier, R., & Friman, M. (2019). Why Do They Ride with Others? Meta-Analysis of Factors Influencing Travelers to Carpool. *Sustainability*, 11(8), 2414.

Paravantis, J. A., & Georgakellos, D. A. (2007). Trends in energy consumption and carbon dioxide emissions of passenger cars and buses. *Technological Forecasting and Social Change*, 74(5), 682–707.

Pérez-Pérez, C., Benito-Osorio, D., & García-Moreno, S. M. (2021). New Puppets in the Old School: The Applicability of Traditional Internationalisation Theories in the Sharing Economy. *Administrative Sciences*, 11(3), 98.

Perkumiene, D., Vienažindiene, M., Švagždiene, B. (2021). The Sharing Economy towards Sustainable Tourism: An Example of an Online Transport-sharing Platform. *Sustainability*, 13(19).

Potoglou, D., & Kanaroglou, P. S. (2008). Modelling car ownership in urban areas: a case study of Hamilton, Canada. *Journal of Transport Geography*, 16(1), 42–54.

Pradhan, R.P. & Bagchi, T.P. (2013). Effect of transportation infrastructure on economic growth in India: The VECM approach. *Research in Transportation Economics* 38, 139-148

Prevedouros, P.D. & An, P. (1998). Automobile ownership in Asian countries: historical trends and forecasts, *ITE Journal* 68 (4), 24–29.

Profillidis, V. A., & Botzoris, G. N. (2019). *Modeling of Transport Demand: Analyzing, Calculating, and Forecasting Transport Demand*. Elsevier. Amsterdam. ISBN: 978-0-12-811513-8

Rochet, J.-C., & Tirole, J. (2006). Two-sided markets: a progress report. *The RAND Journal of Economics*, 37(3), 645–667.

Rodrigue, J.P., Comtois, C. & Slack, B. (2006). Urban transportation. *The Geography of Transport Systems*. Routledge, New York, pp. 171–203.

Santi, P., Resta, G., Szell, M., Sobolevsky, S., Strogatz, S. H., & Ratti, C. (2014). Quantifying the benefits of vehicle pooling with shareability networks. *Proceedings of the National Academy of Sciences*, 111(37), 13290–13294.

Saxena, D., Muzellec, L., & Trabucchi, D. (2020). BlaBlaCar: Value creation on a digital platform. *Journal of Information Technology Teaching Cases*, 204388691988594.

Schafer, A., & Victor, D. G. (2000). The future mobility of the world population. *Transportation Research Part A: Policy and Practice*, 34(3), 171–205.

Shaheen, S., & Cohen, A. (2018). Shared ride services in North America: definitions, impacts, and the future of pooling. *Transport Reviews*, 1–16.

Shaheen, S., Stocker, A., Mundler, M. (2017). Online and App-Based Carpooling in France: Analyzing Users and Practices—A Study of BlaBlaCar. In: Meyer, G., Shaheen, S. (eds) *Disrupting Mobility*. Lecture Notes in Mobility. Springer, Cham.

Sheng, M., & Sharp, B. (2019). Aggregate road passenger travel demand in New Zealand: A seemingly unrelated regression approach. *Transportation Research Part A: Policy and Practice*, 124, 55–68.

Tirachini, A. (2019). Ride-hailing, travel behaviour and sustainable mobility: an international review. *Transportation*.

UNWTO & International Transport Forum (2019), *Transport-related CO2 Emissions of the Tourism Sector – Modelling Results*, UNWTO, Madrid.

UNWTO & United Nations Environment Programme (2008), *Climate Change and Tourism – Responding to Global Challenges*, UNWTO, Madrid.

UNWTO (2023). Glossary of terms. Accessed online on July 25, 2023. Available at <https://www.unwto.org/glossary-tourism-terms>

Wang, G. H. K., & Skinner, D. (1984). The impact of fare and gasoline price changes on monthly transit ridership: Empirical evidence from seven U.S. transit authorities. *Transportation Research Part B: Methodological*, 18(1), 29–41.

Xu, H., Pang, J.-S., Ordóñez, F., & Dessouky, M. (2015). Complementarity models for traffic equilibrium with ridesharing. *Transportation Research Part B: Methodological*, 81, 161–182.

Yeung, T. & Zhu, D. (2022). Intercity Ridesharing to the Rescue: Capacity Flexibility and Price Stability of BlaBlaCar During the 2018 French Railway Strike

Zalega, T. (2020). The Sharing Economy and the Behaviour of Young Polish Singles: The Case of BlaBlaCar. *Gospodarka Narodowa. The Polish Journal of Economics*, 304(4), 105-134. <https://doi.org/10.33119/GN/128215>

Zegras, C. (2010). The Built Environment and Motor Vehicle Ownership and Use: Evidence from Santiago de Chile. *Urban Studies*, 47(8), 1793–1817.

Zhang, Z., Wang, G., Cao, B., & Han, Y. (2015). Data Services for Carpooling Based on Large-Scale Traffic Data Analysis. 2015 IEEE International Conference on Services Computing.

Zolnik, E. J. (2018). Effects of additional capacity on vehicle kilometers of travel in the U.S.: Evidence from National Household Travel Surveys. *Journal of Transport Geography*, 66, 1–9.

## 5. Conclusions

## 5. Conclusions

Digitalization is changing the rules of different industries across the globe. From healthcare to gaming, and from education to logistics, two-sided platforms are transforming how people and companies interact, and are creating unique value across all sides of the markets. The travel industry is no exception, and platforms like Airbnb, Tripadvisor, and BlaBlaCar are certainly contributing to reshaping the future of this sector. Tourism is an economic powerhouse, contributing to approximately 10% of the global GDP and representing 1 out of 10 jobs in the world. However, the COVID-19 pandemic has brought the travel industry to a halt, and revealed the vulnerability of the sector. As tourism navigates its way to recovery, several challenges have come to the forefront. First, to regain the growth that may ensure the job and wealth creation with which this sector contributes to global economies. Second, to build resilience, allowing the industry to increase their efficiency and improve their processes in order to better withstand future crises. And last, to transition to more sustainable practices, reducing the impact that this sector has on the environment.

This research has set its course to assess how two-sided digital platforms are contributing to the transformation of the travel industry. This research focuses on these three specific challenges: to revitalize growth, enhance resilience, and promote sustainability. Each of the chapters in this research has reviewed the effect of a different innovation on one of the aforementioned challenges. The main conclusion of this research is that two-sided platforms are certainly reshaping the travel industry, and evidence of their effects can be found across different areas in the industry. Two-sided platforms are redefining the rules of interaction between different sides of the market. Platforms innovated by connecting people and firms with complementary needs and helping them create value in unique ways. Tripadvisor and Trustpilot innovated by connecting consumers with something to say about a product, with potential consumers seeking information, and also with companies willing to learn from their customers. BlaBlaCar and Amovens innovated by connecting drivers with empty seats on their vehicles, with travelers needing to reach the same destination. Airbnb and Vrbo innovated by connecting people who have spare space in their dwellings, with travelers visiting their destinations. All these connections would have hardly happened without the proper digital environment that facilitates these interactions: the platforms. These interactions

generate value out of idle resources, either space in dwellings, seats in cars, or even knowledge, and in this way having a positive transformational potential in the travel industry.

Each chapter of this research has delved into different innovations and analyzed their effects on specific challenges that the travel industry is facing. First, the chapter entitled "The impact of P2P accommodation on tourism demand" analyzed the effect of Airbnb's innovation on international tourist flows. By studying the adoption of the P2P accommodation innovation, evidence was found that suggested positive spillover effects that could be caused by increased tourism demand product of this innovation. The tourism demand equation was studied, and it was concluded that the P2P accommodation innovation has had a positive and significant impact on international tourism demand in the analyzed geography. This increased international tourist flows, enabled by the better use of idle resources, contributes to economic growth.

Second, the chapter entitled "eWOM platforms as productivity catalyzers in the travel industry" studied how travel agencies are managing the used-generated content published in the form of online reviews, and in particular, the effect this has on their productive efficiency. By enabling new ways to collect feedback from their customers and engage in a deeper relationship with them, firms can develop new learning processes that positively correlate to increased efficiencies. The results of this research showed that firms that have higher qualifications in eWOM platforms are also the firms with the highest productive efficiency. Furthermore, results showed that proactively managing eWOM has a positive and significant correlation with travel agencies' productive efficiency. Increasing the productivity of travel companies is essential for ensuring the resilience of the sector, in particular, when systematizing learning processes is particularly hard for travel agencies, and also given the increased risk of disintermediation they are facing.

Last, the chapter entitled "Filling up empty seats in cars as a responsible transportation production practice" explores the potential that the carpooling innovation has for creating a more sustainable way of producing and consuming transportation. By joining vehicles with otherwise empty seats, carpooling passengers are avoiding the production of further transportation services. Carpooling had already been confirmed as a contributor to reducing traffic on urban roads, and this research set out to extend the understanding of this innovation and explore the effect of leisure long-distance carpooling on aggregate road transport

demand. Results showed that long-distance carpooling can indeed have a negative and significant impact on aggregate road transport demand. Therefore, long-distance carpooling can represent an opportunity to move into more responsible production and consumption practices for road transportation.

Overall, these chapters present evidence of a positive contribution of two-sided platforms on tackling the challenges the travel industry is facing, of revitalizing growth, enhancing resilience, and promoting sustainability.

## 5.1 Policy implications

The findings from the present research provide evidence that two-sided platforms are transforming the travel industry, and presenting instruments to tackle some of the challenges that the sector is facing. The evidence collected in this research suggests that platforms contribute in different ways. They can foster tourism demand, with the subsequent positive economic impact generated by it. They can help travel companies increase their productivity. And they can promote more responsible ways for the production and consumption of road transportation. Considering that platforms frequently innovate in ways that sometimes do not fit existing regulatory systems, policymakers should firstly develop a regulatory framework that may provide a secure environment for entrepreneurs to innovate and for platforms to grow, whilst securing fair competition, consumer safety, employment protection, and data privacy. This normative system should be developed in collaboration with different stakeholders, including civil society, authorities, entrepreneurs, and companies. Furthermore, this regulatory framework should target at harmonizing the divergent regulations existing on a local, national, and transnational levels, in the aim of giving both consumers and entrepreneurs the necessary confidence in two-sided platforms. Taking into consideration that two-sided platforms might have negative externalities, mitigating tools should also be integrated into these normative frameworks. For example, in touristic destinations that are experiencing overtourism, or are close to their saturation point, since sharing economy platforms foster tourism arrivals, this regulatory system should allow dynamic tools to restrain offer or to disincentivize the demand. Additionally, policymakers should promote the creation of public-private partnerships that may help capitalize the positive externalities

enabled by two-sided platforms. Data-sharing initiatives by means of application programming interfaces (APIs) can result in seamless consumer experiences. For example, integrating carpooling content into public multi-modality mobility solutions (MaaS platforms) can help reduce the carbon footprint on transportation, while simplifying the users' journey planning. To ensure equality in access to the benefits of digital platforms, authorities should also seek to guarantee digital training to travelers and tourism industry professionals. Moreover, policymakers should provide the digital infrastructure on which both firms and entrepreneurs can run the business, but also customers can operate with the necessary guarantees. Additionally, policymakers should promote investment in research and development, providing the necessary incentives for the private sector, and in particular to travel technology firms, to develop new technologies that can be applied to the sustainable development of the sector. Concrete actions can range from tax deductions or direct aids, to public procurement of innovation initiatives. In securing that all the aforementioned initiatives are indeed sustainable and the benefits are shared, they should always count with the participation of local communities and local tourism stakeholders. These public policies can contribute in developing the appropriate environment for the diffusion of two-sided digital platforms in the tourism industry, and maximize their benefits for both visitors and for local communities.

## 5.1 Academic Contributions & Limitations

This research contributes to the academic literature by extending the understanding of how two-sided digital platforms are transforming the travel industry. Furthermore, it provides evidence across different innovations and platforms and on their effects on different challenges that the tourism industry is facing. More particularly, this research also fills several gaps in academic literature. First, this research makes the original contribution of analyzing the effect of the P2P accommodation innovation on tourism flows, and helps understand the effect that innovations can have on tourism demand. Second, no previous research had analyzed the contribution of eWOM and eWOM management on travel agencies' productivity. Last, this is the first research to study the impact of long-distance carpooling on aggregate road transport demand.

Despite these contributions, this research naturally has several limitations. First, although this research intends to analyze how two-sided digital platforms are transforming the travel industry, it is delimited to three specific challenges that the sector is facing. Each chapter has analyzed how one innovation is contributing to facing a specific challenge. However, more than one externality can exist outside the scope of the research objectives. For example, this research has found evidence on how the P2P accommodation innovation contributes to fostering growth. However, at the same time, it can have a negative impact on promoting sustainability by causing increases in the prices of the housing market, or causing tourism-induced gentrification. In this way, this research is restricted by its own delimitation but does not intend to diminish the effect that the digital platforms analyzed in this research have on other societal challenges. Furthermore, this research has a further limitation by focusing its analysis on the Spanish economy. The choice of centering the study on this economy is intended as a methodological delimitation. However, it's necessary to acknowledge that the effect of digital platforms and their innovations might be different across different countries or regions. For example, it is not expected that tourism demand in Latin American countries would have the same elasticity to the price reduction caused by the P2P accommodation as it does in a European economy. Therefore this innovation might not necessarily be fostering international tourist flows in that region, as it does in Spain. Last, there are different methodological limitations regarding data availability and econometrical techniques in each of the chapters. These have been addressed in the corresponding sections within each chapter.

### 5.3 Lines for future research

This research is contained within the studies of tourism economics, innovation, and two-sided markets. In this context, future studies can extend this line of research by analyzing the effect of further innovations and two-sided platforms on the transformation of the travel industry. Two-sided platforms, and in particular sharing economy platforms, are operating in diverse areas such as mobility, accommodation, transportation, education, access to information, and crowdfunding, among others. Such diverse applications also open up different lines of research, exploring the effects of these innovations on our society. Additionally, future research can address the effect of two-sided platforms on other societal challenges. Last,

future research could also extend the reach of this study by analyzing the effect of two-sided platforms on different economies or regions.

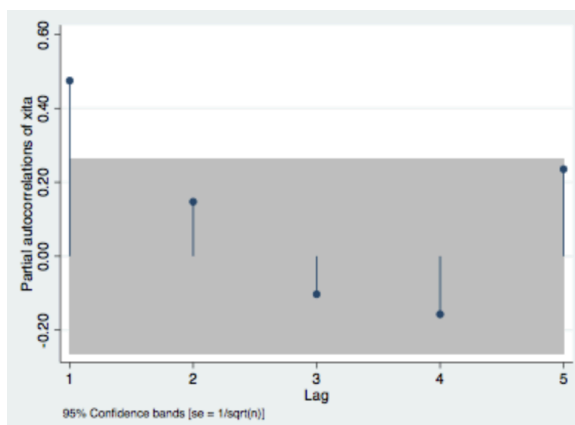
# Annexes

## Annex 1: Partial Autocorrelation analysis

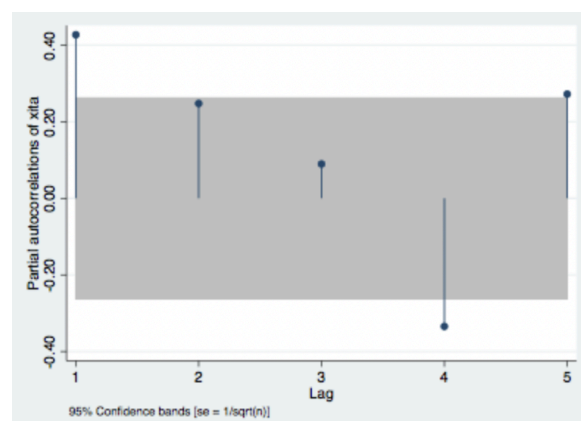
When choosing how many lags to employ in order to conduct the estimations a partial autocorrelation analysis has been executed. In this way, its is analyzed how much correlation there is with the previous lags of the dependant variable.

As observed below, in every partial autocorrelation analysis for each of the ten countries analyzed, the first lag is always out of the confidence interval and significantly distinct from zero. Therefore, there is a lag of one quarter that must be considered in the model. Additionally, many countries present significance in the fourth lag. This is logic, since the fourth lag represents the same quarter in the previous year.

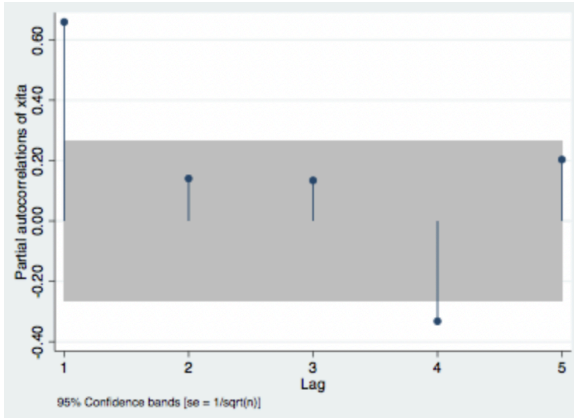
For this reason, the analyzed models shall include one and four lags.



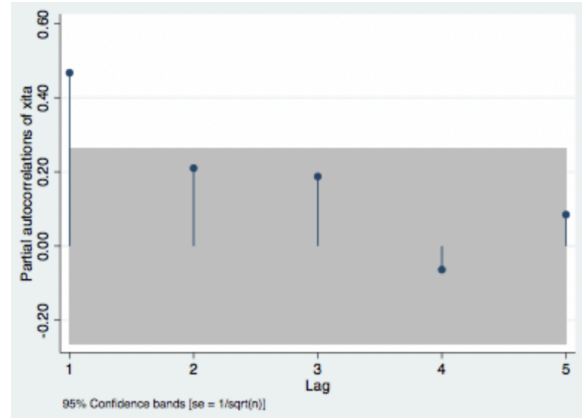
Belgium



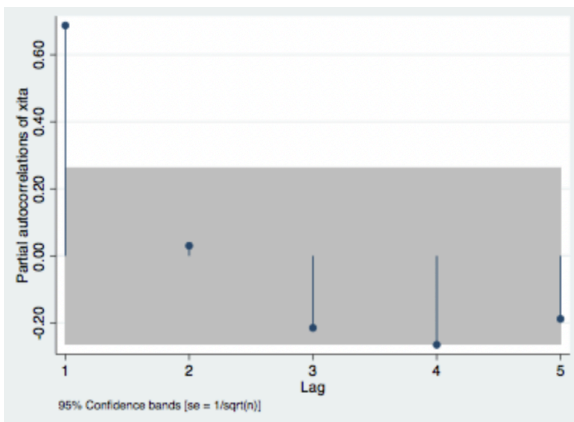
Switzerland



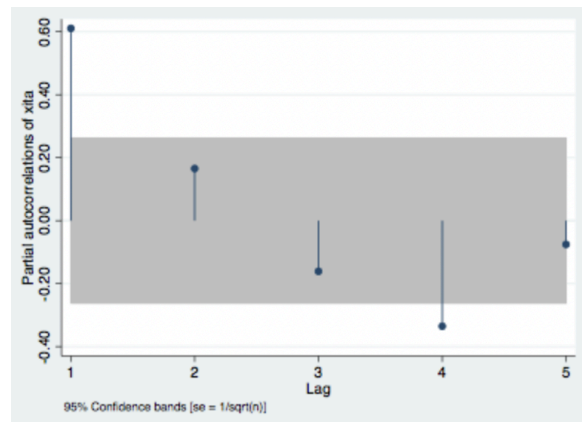
Germany



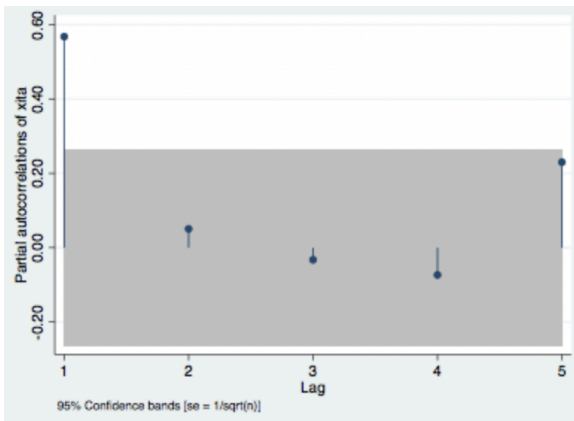
France



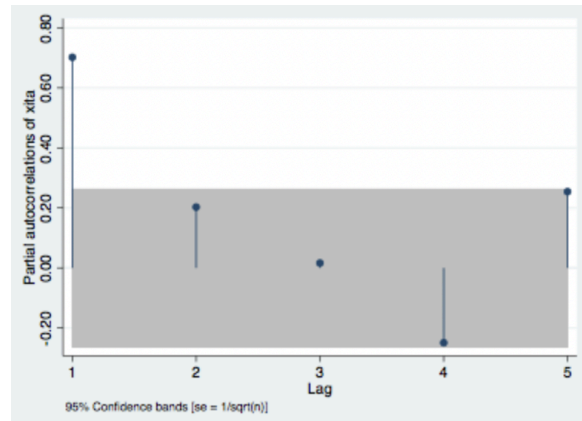
Ireland



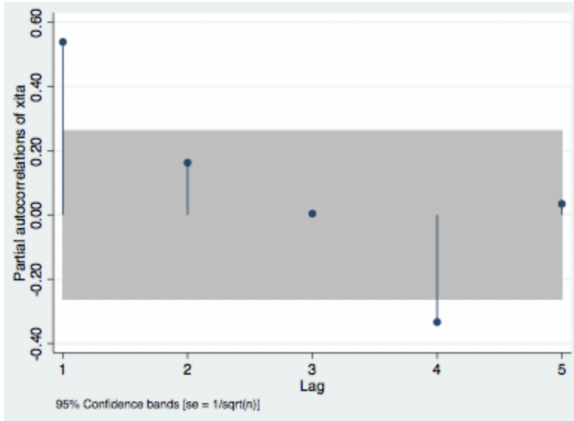
Italy



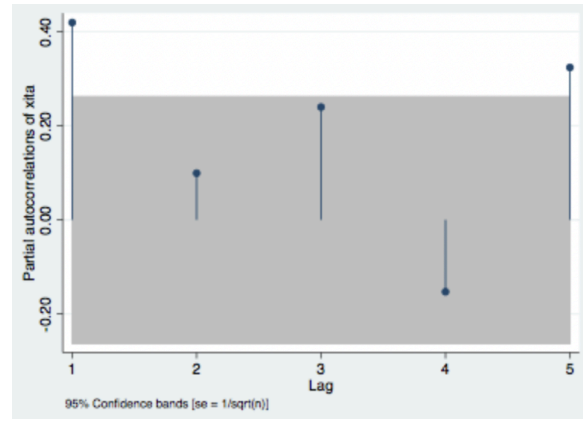
Netherlands



Portugal



United Kingdom



United States

Figure 16: Partial autocorrelation analysis per country

## Annex 2: Web Scraper information and code

The web scraper employed in this research is developed by Limited Liability Company “Web Graph” (Webscraper.io, 2021).

The JSON code employed to web scrape Trustpilot is as follows:

```
{ "_id": "trustpilotscraper", "startUrl": ["https://es.trustpilot.com/categories/travel_vacation?numberofreviews=0&page=[1-20]&status=all&timeperiod=0"], "selectors": [{"id": "company", "type": "SelectorLink", "parentSelectors": ["_root"], "selector": ".styles_categoryBusinessListWrapper__2H2X5a", "multiple": true, "delay": 0}, {"id": "name", "type": "SelectorText", "parentSelectors": ["company"], "selector": "span.multi-size-header__big", "multiple": false, "regex": "", "delay": 0}, {"id": "volume", "type": "SelectorText", "parentSelectors": ["company"], "selector": "span.headline__review-count", "multiple": false, "regex": "", "delay": 0}, {"id": "valence", "type": "SelectorText", "parentSelectors": ["company"], "selector": "p.header_trustscore", "multiple": false, "regex": "", "delay": 0}, {"id": "variance", "type": "SelectorGroup", "parentSelectors": ["company"], "selector": "div.chart__cell__value", "delay": 0, "extractAttribute": ""}, {"id": "claimed", "type": "SelectorGroup", "parentSelectors": ["company"], "selector": ".claimed_sectionp", "delay": 0, "extractAttribute": ""}, {"id": "transparency", "type": "SelectorGroup", "parentSelectors": ["company"], "selector": "div.activity-box", "delay": 0, "extractAttribute": ""}, {"id": "category", "type": "SelectorGroup", "parentSelectors": ["company"], "selector": "ol", "delay": 0, "extractAttribute": ""}, {"id": "website", "type": "SelectorGroup", "parentSelectors": ["company"], "selector": "div.badge-card__header", "delay": 0, "extractAttribute": ""} ] }
```