

Evaluating the COVID–19 impact on tourism and access routes to Spain: A counterfactual analysis

Aida Galiano Martínez^{*}, Juan Manuel Martín-Alvarez, Miguel Angel Del Arco Osuna, Lara Mata Martínez

Universidad Internacional de La Rioja (UNIR), Spain

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ABSTRACT

This research examines the impact of COVID-19 on Spanish international tourism, focusing on the routes of access to the country. Using data from October 2015 to March 2024, a counterfactual analysis was conducted to calculate the severity of the impact on Foreign Tourism Access to Spain by Air Transport, Road, Railway, and Maritime Transport. Benchmark series were calculated using the SARIMA model and validated with Machine Learning methods. Results show significant increases in Air and Road access post-pandemic, with even larger increases in Railway and Maritime routes, indicating early recovery trends since May 2023. These findings highlight the need for adaptive marketing strategies to align with new travel preferences for sustainable and health-conscious travel options.

1. Introduction

International tourism in Spain has undergone a particular evolution between 2015 and 2024, influenced by various economic, social, and global factors. This period witnessed remarkable growth in tourism, a devastating impact due to the COVID-19 pandemic, and a subsequent recovery process that reshaped the sector's dynamics. In the current context, the travel paths used by international tourists have become increasingly important. This is particularly evident as they reflect changes in tourist behaviors and preferences resulting from the COVID-19 crisis and the measures taken to address it and reduce its spread. Understanding these trends is essential for developing new marketing strategies aimed at promoting a more sustainable and less harmful form of tourism. By reconsidering access management and focusing on more balanced growth, Spain can continue to draw a large number of tourists while mitigating the negative impacts of tourism and promoting long-term sustainability in the sector.

In 2020, the COVID-19 pandemic had a profound global impact (Yang, Zhang, & Rickly, 2021), leading to mobility restrictions, border closures, and lockdown measures. This resulted in a steep decline in tourist arrivals worldwide. According to the World Tourism Organization (UNWTO), global tourism revenues fell by over 70 % in 2020 (World Tourism Organization – UNWTO, 2021). This sharp decline has

resulted in widespread job losses and economic instability for businesses dependent on tourism. In Spain, the number of international visitors plummeted by 77 % (Table 1), directly impacting the economy and employment within the tourism sector. Arrivals across all access routes – air, road, rail, and sea – drastically decreased, highlighting the severity of the health and economic crisis. Table 1 presents annual Foreign Tourist Arrivals (FTAs) data, total and by different access, using data from the Spanish National Statistics Institute (Statistics of tourist movements at the border, Spanish Institute of Statistics, 2024). The COVID-19 pandemic led to a dramatic decrease in tourist arrivals through various access points. In 2020, the total number of international tourists arriving in Spain by air dropped by 80.1 %, from 68.7 million in 2019 to just 13.5 million in 2020. Similarly, arrivals by sea fell by 74 %, with numbers plummeting from 1.7 million to 0.2 million. Land border crossings (road) also experienced a significant decline, with a 61 % reduction, dropping from 12.7 million in 2019 to 4.9 million.

As restrictions began to ease and mass vaccination campaigns were implemented in 2021 and 2022, the first signs of recovery in the tourism sector were seen. International tourists started to return, and by 2022, the international tourism indicator was steadily climbing towards pre-pandemic levels (García-Esteban, Gómez-Loscos, & Machuca, 2023) as well as occurred in Spain, measured by Foreign Tourist Arrivals (National Statistics Institute, 2024). Data from Table 1 shows that figures for

^{*} Corresponding author at: Avda. de la Paz, 137, 26006 Logroño, La Rioja, Spain.

E-mail address: aida.galiano@unir.net (A. Galiano Martínez).

Table 1

Total number (sum of monthly arrivals) by via of access – air, road, rail, and sea.

	Total	Air Transport	Road	Railway	Maritime Transport
2016	75.315.009	60.343.654	12.973.075	362.849	1.635.428
2017	81.868.522	66.639.513	12.889.671	373.662	1.965.674
2018	82.808.412	67.545.674	12.912.410	338.241	2.012.088
2019	83.509.151	68.691.897	12.749.717	346.757	1.720.782
2020	18.933.103	13.657.665	4.961.727	90.400	223.311
2021	31.180.803	24.431.890	6.383.396	138.561	226.954
2022	71.659.282	59.307.852	10.964.073	235.136	1.152.223
2023	85.169.048	69.564.231	13.404.168	341.292	1.859.358

National Statistics Institute (2024).

2023 exceed those of previous years. By 2023 and 2024, data indicate a positive trend with a steady increase in international tourist numbers, underscoring the sector's resilience and the effectiveness of tourism promotion strategies. In March 2024, the number of tourists visiting Spain via different routes varied. Most tourists, 5,355,404 in total, arrived by air, showing a 19.61 % increase compared to March 2023, accounting for 84.4 % of all arrivals. This highlights the significance of airports in major Spanish tourist cities such as Madrid, Barcelona, and Palma de Mallorca. Additionally, there was a notable increase in tourists entering Spain by road, with 908,791 visitors using this method, marking a 27.86 % increase compared to the previous year. This surge can be attributed to Spain's proximity to countries like France and Portugal.

While railway access constitutes a smaller fraction, it has seen notable growth, with 20,426 tourists arriving by train in March 2024, a 40.22 % increase from the previous year. This rise may correlate with improved railway connections and a rising preference for sustainable travel options (European Travel Commission, 2022). Similarly, arrivals by sea have risen significantly, with 62,895 tourists using maritime transport in March 2024, up by 40.79 % compared to the same month in the previous year. This increase is likely linked to expanding cruise services and enhanced port infrastructure in key destinations such as the Balearic Islands (SEGITTUR turismo e innovación, 2024).

Spain's tourism recovery shows promising signs; however, this resurgence must be managed carefully to align with sustainable tourism development. If not handled properly, it could intensify protests against the negative consequences of mass tourism. The extractive nature of mass tourism has long been recognized as a contributor to environmental degradation and socio-economic inequalities in many destinations, particularly as tourists increasingly penetrate residential areas (Celata & Romano, 2020). This growing critique of overtourism reflects broader socioecological conflicts, highlighting the need to explore alternative frameworks to achieve truly sustainable tourism (Fletcher, Murray Mas, Blanco-Romero, & Blázquez-Salom, 2019). Recognizing these issues presents an opportunity for the tourism sector to adopt a more responsible and balanced approach to growth—one that prioritizes environmental sustainability and the well-being of local communities over mass tourism practices. This aligns with recent research on the complex relationships between tourism, space, and place, which calls for rethinking tourism in ways that emphasize justice, inclusivity, and the reconfiguration of socio-spatial dynamics (Córdoba-Azcárate, 2024).

The pandemic accelerated changes in tourist preferences, notably increasing demand for sustainable and less crowded destinations. Throughout the crisis, stringent health protocols significantly altered travel behaviors, potentially reshaping traditional travel routes. As a result, post-pandemic travelers may increasingly prefer to avoid highly crowded tourist areas in favor of quieter, less congested locations, reflecting heightened concerns for safety and self-protection. This shift may also influence their choice of travel mode (Cheng, Bao, de Vreede, de Vreede, & Gu, 2024) and introduce preferences focused on proximity tourism (Agudo-Sánchez, García-Marín & Moreno-Muñoz, 2022; Ríos-Rodríguez, Nieto Masot & Cárdenas Alonso, 2023). Consequently,

arrivals by road and rail may become more appealing to tourists looking to avoid air travel. Furthermore, these modifications in travel choices are expected to continue post-pandemic, as ongoing travel restrictions and health concerns lead travelers to favor trains over planes. As Javadinasr, Maggasy, Mohammadi, Mohammadain, et al. (2022a, 2022b) pointed out, many travelers expect to take fewer flights post-pandemic, indicating a potential shift in travel preferences. This prediction by Javadinasr et al. (2022a, 2022b) serves as a foundation for our study, where we evaluate the extent to which their anticipated behavioral changes have materialized in Spain's tourism recovery. While air travel has shown a robust rebound, as indicated by the data, the notable growth that we find in other access route suggests that shifts towards alternative and sustainable modes of transport are indeed emerging. This reinforces the relevance of their prediction and aligns with our findings, providing evidence of the evolving dynamics in post-pandemic travel behavior.

This study explores how the gradual resurgence of travel demand and the evolving preferences and behaviors of post-pandemic travelers have influenced the recovery of tourism access routes in Spain. As far as we know, this is the first time that the analysis of tourism recovery after COVID-19 focuses on the modes of transportation tourists use, and how their preferences were affected by the COVID-19. Previous studies have explored the pandemic's effects on tourism, particularly its impact on air travel and emerging sustainable travel preferences (Barczak, Dembińska, Rozmus, & Szopik-Depczyńska, 2022; Barczak, Dembińska, Szopik-Depczyńska, & Rozmus, 2022; Ríos-Rodríguez et al., 2023; Suau-Sanchez, Voltes-Dorta, & Cuguero-Escofet, 2020). By examining the evolution of foreign tourist arrivals in Spain from 2015 to 2024, we analyze the various access routes utilized by international tourists and the significant impacts of COVID-19 on these patterns. Our central hypothesis suggests that the pandemic and the subsequent strategies implemented to address its challenges have notably changed these dynamics, potentially reshaping access routes to accommodate shifts in traveler preferences. The growing inclination of tourists towards less crowded and more environmentally conscious destinations and modes of transport presents an opportunity to develop a tourism model that fosters long-term harmony between visitors and residents. This approach aims to ensure that the benefits of tourism are widely shared while minimizing negative impacts.

This research contributes to a better understanding of how crises impact tourism dynamics, specifically regarding travel modes. By identifying changes in access routes and preferences, we propose a strategic framework that destinations can use to enhance their marketing efforts and strengthen resilience against future disruptions. Our work highlights the strengths of Spain's tourism sector and enriches academic understanding of the evolving patterns of post-COVID tourism. This information is vital for stakeholders looking to develop strategies that ensure continued growth and adaptability in the industry. In summary, we provide a comprehensive analysis of COVID-19's impact on international tourism in Spain through a multi-modal transportation perspective.

Our study fills a significant gap in the existing literature by adopting a comprehensive, multi-modal transport framework. While previous research has explored the pandemic's effects on tourism, few studies have investigated the differential impacts across various transportation modes in an integrated manner. This multi-modal transport approach allows us to explore the effects of the pandemic across various means of transport—air, road, rail, and maritime. This method provides a comprehensive view of how the crisis has impacted access routes to Spain. Unlike previous studies that often focus on individual transport modes, our research examines the interconnections between these systems, which is essential for understanding the broader implications of COVID-19 on tourism infrastructure.

2. Literature framework

Health crises have consistently demonstrated their potential to disrupt the tourism industry significantly (Karabulut, Bilgin, Demir & Doker, 2020). Prior research has highlighted the vulnerabilities that arise during such events. For instance, Meltzer, Cox, and Fukuda (1999) estimated the economic impact of major pandemics on the U.S. economy, while Beutels et al. (2009) examined the effects of the SARS outbreak on the Chinese economy. Similarly, Joo et al. (2019) analyzed the impact of MERS-CoV on the tourism sector in South Korea in 2015. These studies illustrate how health crises can lead to immediate declines in tourist arrivals and substantial economic repercussions across various regions.

Before the COVID-19 pandemic, Spain had solidified its status as one of the premier global tourist destinations (Castillo-Manzano, Castro-Nuño, López-Valpuesta, & Vassallo, 2020; García-Esteban, Gómez-Loscos, & Machuca, 2023; Rodríguez-Antón & Alonso-Almeida, 2020). Its tourism landscape was largely characterized by sun-and-sand offerings often linked to mass tourism (Sánchez-Sánchez & Sánchez-Sánchez, 2024). The country's inherent attractiveness, coupled with its high level of competitiveness in the tourism sector, contributed to a surge in international tourist arrivals, surpassing 10 million visitors in September 2019 (Spanish National Statistic Institute, 2024). This influx significantly bolstered the Gross Domestic Product and job creation within the sector, with most tourists arriving by air, aided by robust air connectivity and the proliferation of low-cost airlines (Ramos-Pérez, 2016; Vera Rebollo & Ivars Baidal, 2009).

However, the onset of the COVID-19 pandemic in 2020 profoundly affected the global tourism landscape, marking one of the most significant crises in modern history (Yang et al., 2021). The pandemic led to widespread mobility restrictions, border closures, and lockdown measures across the globe, resulting in an unprecedented decline in international travel (Chinazzi et al., 2020). Although these restrictions were controversial, studies like Moosa and Khatatbeh (2020) justified international travel bans as measures to contain the virus. The severity of this crisis varied by country and largely depended on the significance of tourism to their economies (Demir, Dalgıç and Ergen, 2021; Cardoso, Carta, Doménech, & Más, 2021). Research has consistently highlighted the vulnerability of tourism-dependent economies, particularly in developing nations (Sigala, 2020). In Spain, the pandemic triggered a severe tourism crisis, disproportionately affecting regions heavily reliant on international visitors due to stringent travel restrictions and a subsequent collapse in demand (Donaire, Galí, & Camprubi, 2021; Ríos-Rodríguez et al., 2023; Bank of Spain, 2022).

Beyond the immediate drop in tourist arrivals, the COVID-19 pandemic has catalyzed a significant shift in consumer preferences and travel habits. Studies by Brodeur, Gray, Islam, and Bhuiyan (2021) and Duro, Pérez-Laborda, Turrión-Prats, and Fernández-Fernández (2021) indicate a growing trend among travelers towards local, less crowded destinations and safer modes of transport, reflecting heightened concerns for health and safety. These evolving preferences, initially shaped by the pandemic, continue to influence travel decisions in the present day.

While significant research has focused on the effects of COVID-19 and its restrictions on various outcomes, such as the hospitality and hotel industry (Alonso-Almeida and Bremser, 2013; Robina-Ramírez, Medina-Merodio, Moreno-Luna, Jiménez-Naranjo, & Sánchez-Oro, 2021; Bremser, Alonso-Almeida and Llach, 2018; Rodríguez-Antón & Alonso-Almeida, 2020; González-Torres, Rodríguez-Sánchez & Pelechano-Barahona, 2021 and tourism demand (Duro, Fernández-Fernández, Pérez-Laborda, & Rosselló, 2024), there is another type of literature regarding the pandemic-induced changes in tourists' behavior and preferences in the way they choose the route of access and their tourism practices.

Previous research has explored the pandemic's effects on tourism extensively. For instance, Barczak, Dembińska, Rozmus, and Szopik-

Depczyńska (2022), Barczak, Dembińska, Szopik-Depczyńska, and Rozmus (2022) analyzed the impact on air transport passenger markets across selected EU countries, highlighting significant discrepancies in passenger numbers compared to pre-pandemic trends. Similarly, Suau-Sánchez et al. (2020) examined the broader implications of COVID-19 on air transportation, identifying it as one of the most affected sectors. While these studies focus on air travel, others, such as Ríos-Rodríguez et al. (2023), assessed the pandemic's impact on tourism flows more generally, identifying emerging trends in sustainable travel preferences. By incorporating these perspectives, our study builds on existing literature and provides a comprehensive analysis across multiple transportation modes.

The tourism industry has demonstrated remarkable adaptability, especially in response to the significant changes prompted by the COVID-19 pandemic. Stakeholders within the industry have adopted various adaptation strategies to maintain resilience, as highlighted in the study by Kristiana, Pramono, and Brian (2021). This responsiveness not only facilitates smoother travel experiences but also reflects a broader trend within the industry to embrace change and innovate in the face of evolving demands.

Recent studies have underscored the need for sustainable tourism practices, emphasizing the importance of integrating environmental considerations into transportation planning. In this context, stakeholders within the industry have implemented diverse adaptation strategies, such as offering flexible fare options and increasing the frequency of regional transport, to maintain resilience, as highlighted in the study by Kristiana et al. (2020). This responsiveness not only facilitates smoother travel experiences but also reflects a broader trend within the industry to embrace change and innovate in the face of evolving demands. By prioritizing flexible transport options, the industry can more effectively meet the diverse expectations of modern travelers, thus enhancing the overall tourism experience (Weidmann, Filep, & Lovelock, 2023) while paving the way for a more sustainable future.

The impact of COVID-19 on the aviation sector was enormous, being the highest-hit sector (Suau-Sánchez et al., 2020; Sun, Wandelt, & Zhang, 2020), but it also induced changes in passenger behavior (Zhang, Yang, Wang, Bian, & Zhang, 2021). In the same line, Barczak, Dembińska, Rozmus, and Szopik-Depczyńska (2022) and Barczak, Dembińska, Szopik-Depczyńska, and Rozmus (2022) highlight significant differences in the drop in the number of passengers handled at airports across selected EU countries during the pandemic compared to pre-pandemic trends, noting that countries like Spain, Germany, France, and Italy experienced the greatest discrepancies. However, the recovery has significantly transformed the aviation industry in an unprecedented way (Barczak, Dembińska, Rozmus, & Szopik-Depczyńska, 2022; Barczak, Dembińska, Szopik-Depczyńska, & Rozmus, 2022). For the United States, Sugishita, Mizutani, and Hanaoka (2024) conclude that the recovery of domestic airline networks was characterized by significant changes in structure and dynamics, highlighting the flexibility of different airline types during the recovery process.

Furthermore, the pandemic has accelerated the demand for sustainable tourism practices, pushing destinations to adapt their offerings to meet these new expectations. A report from the European Travel Commission (2022) indicates that tourists are increasingly inclined towards sustainable travel options that prioritize environmental conservation and local culture. The shift towards sustainable travel options extends to road transport, as many tourists are increasingly opting for greener alternatives. The report highlights the potential for enhancing road infrastructure to support electric vehicles and promote shared transportation services, which can significantly reduce carbon emissions (European Travel Commission, 2022). Additionally, the advances in modern railways, such as high-speed trains, have facilitated the post-pandemic shift towards more sustainable transport.

Finally, we refer to the literature that focuses on forecasting tourism flows. Over the years, researchers have employed various strategies to forecast this series. Numerous studies have reviewed the different

forecasting models used to predict international tourism demand (Jaipuria, Parida, & Pritee, 2021; Song & Zhang, 2024; Xiaoying & Jason, 2018). Among these, the SARIMA models, developed by Box and Jenkins (1976) are widely adopted in the tourism forecasting literature due to their suitability for handling both stationary and non-stationary series, as well as their ability to incorporate seasonal and non-seasonal elements (Chang & Liao, 2010; Chu, 1998; Kulendran & Witt, 2001; Pankratz, 1983). Seasonality is a significant characteristic of the tourism time series (Koc & Altinay, 2007). These models have been recently applied to forecast the trend and seasonal components with a 12-month cycle in tourism arrival data (Agosto, Galos, Obejas, et al., 2024; Arshad et al., 2023; Praprom & Laipaporn, 2021; Wai Ming To & Lee, 2024). We rely on advanced analytical tools, including Machine Learning methods, to enhance the robustness of the models used.

3. Data and methods

Tourism demand is typically analyzed through metrics such as tourist arrivals. In our study, we focus on analyzing the trends in foreigners' decisions to visit Spain, which are reflected in the Foreign Tourist Arrivals and represent the international tourism demand in Spain.

The series we use, a proxy of international tourism demand (Song, Li, Witt & Fei, 2010). So we use a panel of monthly data for Foreign Tourist Arrivals spanning from October 2015 to March 2024, sourced from the Statistics of Tourist Movements at the Border (FRONTUR), a monthly survey conducted by Spain's National Statistical Institute (INE). The sample is collected at the primary access points for non-resident travelers. This dataset provides insights into the number of tourists entering or leaving the country, including those spending nights and those passing through Spain in transit.

To achieve our objectives, we use a benchmark or counterfactual analysis. This methodological approach enables us to evaluate what might have happened under different scenarios. It has been crucial in assessing the effects of various policy decisions, travel restrictions, and health measures during the pandemic. By comparing actual outcomes with hypothetical scenarios where certain variables differ, we can gain deeper insights into the relative impacts of these factors on tourism performance. For example, previous studies have employed counterfactual analysis to estimate the economic losses faced by the tourism sector due to specific travel restrictions, contrasting real outcomes with scenarios that exclude the impacts of COVID-19 (Rhee, 2024).

In this study, we applied the SARIMA model to analyze and forecast Foreign Tourist Arrivals to Spain from 2022 to 2024. This allowed us to generate a counterfactual series that reflects expected tourism behavior without the influence of the COVID-19 pandemic. Using the fitted SARIMA model, we forecasted the next 24 months of Foreign Tourist Arrivals based on historical data, providing insights into anticipated tourism trends free from pandemic-related disruptions.

To ensure the robustness of our forecasts, we validated the results through out-of-sample testing, comparing the predicted values with actual arrivals from a subset of the data. This validation process helped confirm the reliability of the counterfactual series generated by the SARIMA model.

Our estimations focused on tourist arrivals, categorized by access route, which includes air transport, road access, rail, and maritime transport. This distinction is essential for understanding how the COVID-19 crisis has changed travel behavior, particularly in light of new security measures and shifts in travel preferences. Consequently, we analyzed a dataset comprising 408 observations (4 access routes over 102 months).

The estimation of the parameters of the ARIMA and SARIMA models is carried out assuming the four basic assumptions of the ARIMA methodology:

1. The estimation of the parameters of the ARIMA and SARIMA models is carried out assuming the four basic assumptions of the ARIMA methodology:
2. The time series does not contain atypical points.
3. The time series is composed of a single variable that, with its past values, helps to make the predictions.
4. The time series is stationary.
5. The model parameters and errors are constant throughout the period.

Additionally, the SARIMA models control for stationarity, which is a standard fact of the tourism series. The general SARIMA model is mathematically represented as follows; In our case, each equation is modified to incorporate an index i , which represents the different transport modes (air, road, rail, maritime):

$$\Phi_p(B^m)\phi_p(B)(1-B^m)^D(1-B)^d y_{t,i} = \Theta_Q(B^m)\theta_q(B)w_{t,i}$$

Where $y_{t,i}$ is the non-stationary time series of tourist arrivals for transport mode i (air, road, rail, maritime), $w_{t,i}$ is the Gaussian white noise process for transport mode i , $\phi_p(B)$ is a non-seasonal autoregressive polynomial, $\Theta(B)$ is a non-seasonal moving average polynomial, and D is the seasonal differencing (the term is equal to 1 or 2, etc.).

However, the value of $D = 1$ is sufficient to impose stationarity on the data, $\Phi(B^m)$ is a seasonal autoregressive polynomial, and $\Theta(B^m)$ is a seasonal moving average polynomial. Where B is defined as the backtracking operator, which is expressed as follows:

$$B^k \cdot y_{t,i} = y_{(t-k),i}$$

The expressions for the moving average model (2), non-seasonal autoregressive model (1), seasonal AR model (3), and seasonal MA model (4) are provided below, specifying each transport mode i :

$$\phi(B) = 1 - \phi_{1,i}B - \phi_{2,i}B^2 - \dots - \phi_{p,i}B^p \quad (1)$$

$$\theta(B) = 1 + \theta_{1,i}B + \theta_{2,i}B^2 + \dots + \theta_{q,i}B^q \quad (2)$$

$$\Phi_p(B^m) = 1 - \phi_{1,i}B^m - \phi_{2,i}B^{2m} - \dots - \phi_{p,i}B^{pm} \quad (3)$$

$$\Theta_Q(B^m) = 1 + \theta_{1,i}B^m + \theta_{2,i}B^{2m} + \dots + \theta_{Q,i}B^{Qm} \quad (4)$$

Indicators are used to judge the accuracy of the time series analysis once the parameters of the ARIMA and SARIMA models have been estimated and the predictions have been produced. These indicators include the partial autocorrelation function (PACF), the Akaike information criterion (AIC), the autocorrelation function (ACF), and the Bayesian information criteria (BIC). These metrics show how the time series' observations relate to one another. While PACF correlates the time series with its own lagged values spaced by specific time units, ACF provides the correlation of the time series data with its prior time series data. The AIC and BIC penalized likelihood criterion's values are related; the lower they are, the more probable it is that the model will be accepted as a genuine model. Additionally, this study's evaluation criteria include mean error (ME), root mean square error (RMSE), mean absolute error (MAE), mean percentage error (MPE), mean absolute percentage error (MAPE), and scaled mean absolute error (MASE).

In a time series, autocorrelation is the relationship between the most recent observation and lagging observations. The ACF describes the linear relationship between the observation at time t and the observation at a previous time, and the autocorrelation plot is the time series' representation of autocorrelation vs delays ($t-k$). To illustrate, the ACF for the time series y_t is given by:

$$ACF(y_t, y_{t-k}) = \frac{\text{Covariance}(y_t, y_{t-k})}{\text{variance}(y_t)} \quad (5)$$

where k is the delay and is defined as the difference between y_t and y_{t-k} .

On the other hand, in partial autocorrelation, the intermediate observations are considered when calculating the correlation between two observations at different times. For example, consider that a time series y_t . The PACF between two observations y_t and y_{t-2} (assuming $k = 2$) can be written as shown in the equation.

$$PACF(y_t, y_{t-2}) = \frac{Covariance(y_t, y_{t-2} | y_{t-1})}{\sqrt{variance(y_t | y_{t-1})} \sqrt{variance(y_{t-2} | y_{t-1})}} \quad (6)$$

Testing the created models is necessary to see how well they function in terms of elucidating the relationships between the variables. We have evaluated a model's ability to explain relationships using the information criteria. AIC and BIC are two widely used measures that assess the quality of models by rewarding those that have fewer mistakes and penalizing those that have too many parameters. The following is how AIC is mathematically represented:

$$AIC = -2\log L(\hat{\theta}) + 2K \quad (7)$$

Where K is the total number of model parameters and $\log L(\hat{\theta})$ is the likelihood function. BIC is a different model selection criterion in a similar vein. Compared to AIC, BIC imposes a lower penalty on the quantity of parameters. The model with the highest probability value is represented by the lower value in both the AIC and BIC settings. As a result, it aids time series analysts in selecting the optimal model from among the limited number of generated alternative models. The following is how BIC is mathematically represented:

$$BIC = -2\log L(\hat{\theta}) + K\log N \quad (8)$$

Where N is the number of observations.

MAE, RMSE, MAPE, MPE, ME and MASE are often used to assess the accuracy of the ML models (Gupta, Ghanshala, & Joshi, 2021; Kasihmuddin, Mansor, Alzaeemi, & Sathasivam, 2021), which are given by the following equations:

$$MAE = \frac{1}{n} \sum_{i=1}^n |y_i - \hat{y}_i| \quad (9)$$

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (y_i - \hat{y}_i)^2} \quad (10)$$

$$MAPE = \frac{1}{n} \sum_{i=1}^n \left| \frac{y_i - \hat{y}_i}{y_i} \right| \quad (11)$$

$$MPE = \frac{1}{n} \sum_{i=1}^n \frac{y_i - \hat{y}_i}{y_i} \quad (12)$$

$$ME = \frac{1}{n} \sum_{i=1}^n y_i - \hat{y}_i \quad (13)$$

$$MASE = \frac{\frac{1}{n} \sum_{i=1}^n |y_i - \hat{y}_i|}{\frac{1}{T-1} \sum_{t=2}^T |y_t - y_{t-1}|} \quad (14)$$

Where \hat{y}_i is the prediction made by the model and y_i is the actual value.

The scripts were created using the R programming language, which was set up in the RStudio environment, to accomplish the goal mentioned in this study (R Core Team, 2021). The *tidyverse* and forecast libraries have also been used to clean the data, estimates, and graphic representations (Wickham, 2019; Hyndman & Khandakar, 2008; Hyndman & Athanasopoulos, 2021).

4. Results

In this section, we will compare the actual series of Foreign Tourist Arrivals from October 2015 to March 2024 with the forecasted series from January 2020 to March 2024. This thorough analysis will be the foundation of our findings.

Our forecasting model has demonstrated a high level of accuracy, as evidenced by the assessment metrics presented in the previous section. Table 2 shows a MAPE (Mean Absolute Percentage Error) of 1.695 for the total FTAs data, indicating the overall precision of our model. The MAPE for visitor arrivals from each country is generally commendable, reflecting the accuracy of our projections. However, Maritime Transport stands out with the highest deviation at 13.791, indicating less accuracy in predicting arrivals from that specific country.

Table 3 shows the differences between the actual and forecasted numbers of tourists from January 2022 to March 2024. Positive differences in the table indicate that the actual number of tourists exceeds the estimates made by the models, which is a positive sign, showing that the actual level of tourism is higher than what was projected by our model. Figs. 1 and 2 further demonstrate these results by showing the real, simulated, and forecasted numbers.

It is essential to clarify that our analysis does not aim to demonstrate an overall increase in tourism. Instead, it focuses on a counterfactual analysis to assess potential visitor levels had COVID-19 not occurred. The fact that actual visitor numbers exceeded our predictions is a positive sign in this context, indicating that our projections suggest the flow of tourists would likely have been greater without the pandemic's impact. This finding underscores the substantial effects of COVID-19 on tourism dynamics, indicating that visitor numbers to Spain would have been even higher than those currently observed.

The data in the first column of Table 3 reveals a gradual but steady recovery of total tourist arrivals from the impact of the ongoing COVID-19 pandemic. While significant negative differences persist, hindering the flow of tourists, there are positive differences in the final quarter of 2023 compared to the model's predictions, indicating a marked improvement in the current situation. In December 2023, the estimate shows a positive difference of 10.25 %, representing the most favorable situation during the entire period. At the start of 2024, the differences are smaller but still positive, at 2.22 % and 3.65 %, respectively, hinting at a promising future.

While the positive values and the improved situation compared to previous years are encouraging, it's important to note that the recovery is not yet complete, as evidenced by the summer months of 2022 and 2023. The trend of recovery will require further observation, and it's crucial to maintain a watchful eye until the summer of 2024 to ascertain if the positive trend continues during that season as well.

In Fig. 1, we can observe the actual and forecasted numbers of tourists. The yellow line represents a simulation using the same model to show how tourist arrivals would have evolved without the impact of COVID-19. This simulation is then used to predict tourist arrivals for the years 2022 to 2024. According to the forecast, the actual tourist arrivals are significantly lower than the estimated model in 2022 (as shown by the red line). However, by the end of 2024, the situation changes, and the black line is above the red line, indicating a recovery in the sector after the last quarter of 2023.

Our research has revealed the remarkable resilience of the tourism industry in Spain, as evidenced by the recovery trends of Foreign Tourist Arrivals for different access routes used by visitors. The data, presented in Table 3 (columns two onwards) and Fig. 2, paints a promising picture of the recovery of foreign tourism through all access routes as of October 2023, mirroring the positive trajectory of the total series.

Air transport presents the same recovery pattern as the total series, thus setting the pattern observed in the series of Foreign Tourist Arrivals. As observed by the total series from October 2023, it reaches figures above those predicted by the model in a context without COVID-19. However, as it is observed in the total series of Foreign Tourist

Table 2
Selected SARIMA models for forecasting total tourism flow.

	SARIMA (p,d,q)(P,D,Q,m)	ME	RMSE	MAE	MPE	MAPE	MASE
Air Transport	(0,1,1) (1,1,0,12)	-19,834.946	13,8372.475	82,314.200	-0.536	1589	0.382
Road	(0,0,0) (0,1,0,12)	-3144.020	57,356.198	28,949.420	0.053	2778	0.845
Maritime Transport	(0,1,1) (0,1,1,12)	-4651.067	31,052.009	18,512.657	-6.585	13,791	0.735
Railway	(0,0,0) (1,1,0,12)	175.319	1722.154	1010.858	-0.500	4750	0.324
Total	(0,1,1) (0,1,1,12)	-27,045.449	188,308.335	113,463.171	-0.515	1695	0.471

Table 3
Differences between the actual and the forecasted FTA series from January 2022 to March 2024. Total and access routes.

		TOTAL	Air Transport	Road	Railway	Maritime Transport
2022	January	-43,84 %	-45,74 %	-20,36 %	-25,05 %	-72,26 %
	February	-31,21 %	-32,02 %	-16,45 %	-29,61 %	-54,29 %
	March	-30,32 %	-27,92 %	-41,52 %	-36,24 %	-32,63 %
	April	-16,78 %	-12,47 %	-26,37 %	-16,36 %	-47,53 %
	May	-15,52 %	-13,06 %	-20,96 %	-31,98 %	-3,39 %
	June	-16,66 %	-16,17 %	-18,80 %	-3,27 %	29,63 %
	July	-11,81 %	-12,52 %	-0,61 %	-36,34 %	10,77 %
	August	-15,80 %	-12,26 %	-17,91 %	-37,15 %	-30,75 %
	September	-15,27 %	-13,69 %	-11,87 %	-4,54 %	-39,59 %
	October	-9,02 %	-8,51 %	-1,82 %	-10,77 %	-27,05 %
	November	-11,89 %	-10,52 %	-6,52 %	22,37 %	-33,48 %
	December	-10,62 %	-13,36 %	12,70 %	-10,81 %	-33,93 %
2023	January	-9,31 %	-7,88 %	0,08 %	5,63 %	-23,77 %
	February	-8,60 %	-7,62 %	2,35 %	14,50 %	-14,40 %
	March	-11,11 %	-9,77 %	-11,85 %	-9,77 %	-10,64 %
	April	-2,89 %	-0,67 %	-0,42 %	2,39 %	-14,27 %
	May	-0,92 %	-2,45 %	22,99 %	30,18 %	35,95 %
	June	-8,73 %	-9,17 %	-6,72 %	6,58 %	91,99 %
	July	-2,85 %	-3,75 %	11,23 %	-12,88 %	35,95 %
	August	-4,03 %	-2,78 %	-0,52 %	-18,55 %	14,21 %
	September	-5,14 %	-3,94 %	-1,86 %	15,69 %	-3,94 %
	October	2,41 %	3,09 %	5,80 %	23,20 %	35,14 %
	November	2,20 %	3,18 %	8,32 %	229,81 %	38,93 %
	December	10,28 %	5,26 %	41,84 %	146,25 %	215,61 %
2024	January	2,22 %	3,64 %	17,28 %	117,17 %	9,44 %
	February	3,65 %	7,26 %	2,19 %	77,44 %	125,91 %
	March	5,65 %	6,52 %	12,70 %	38,99 %	35,76 %

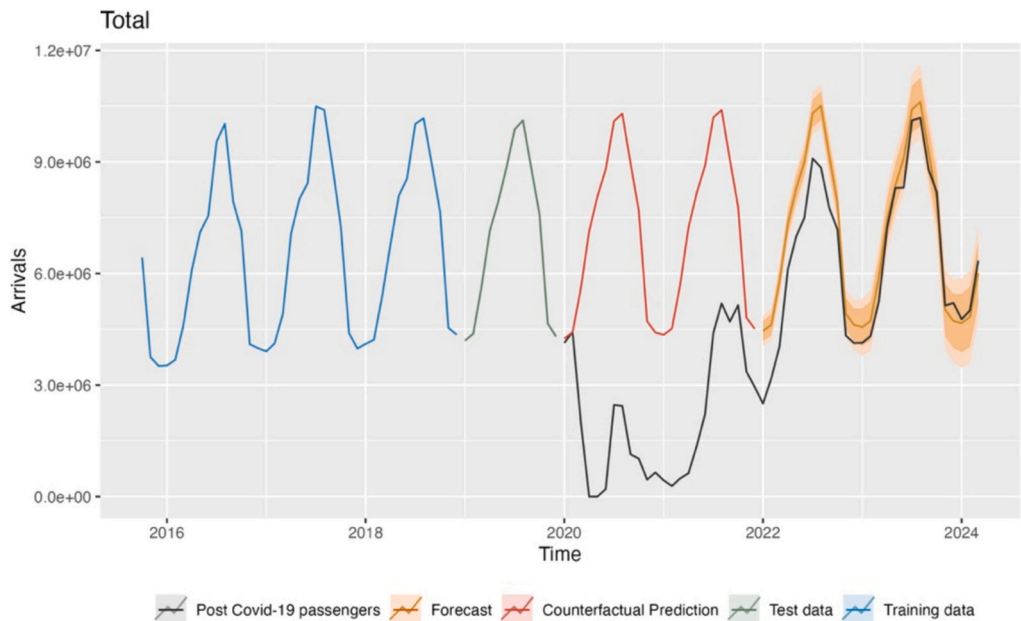


Fig. 1. Total Foreign tourist arrivals: actual data, counterfactual prediction and forecast.

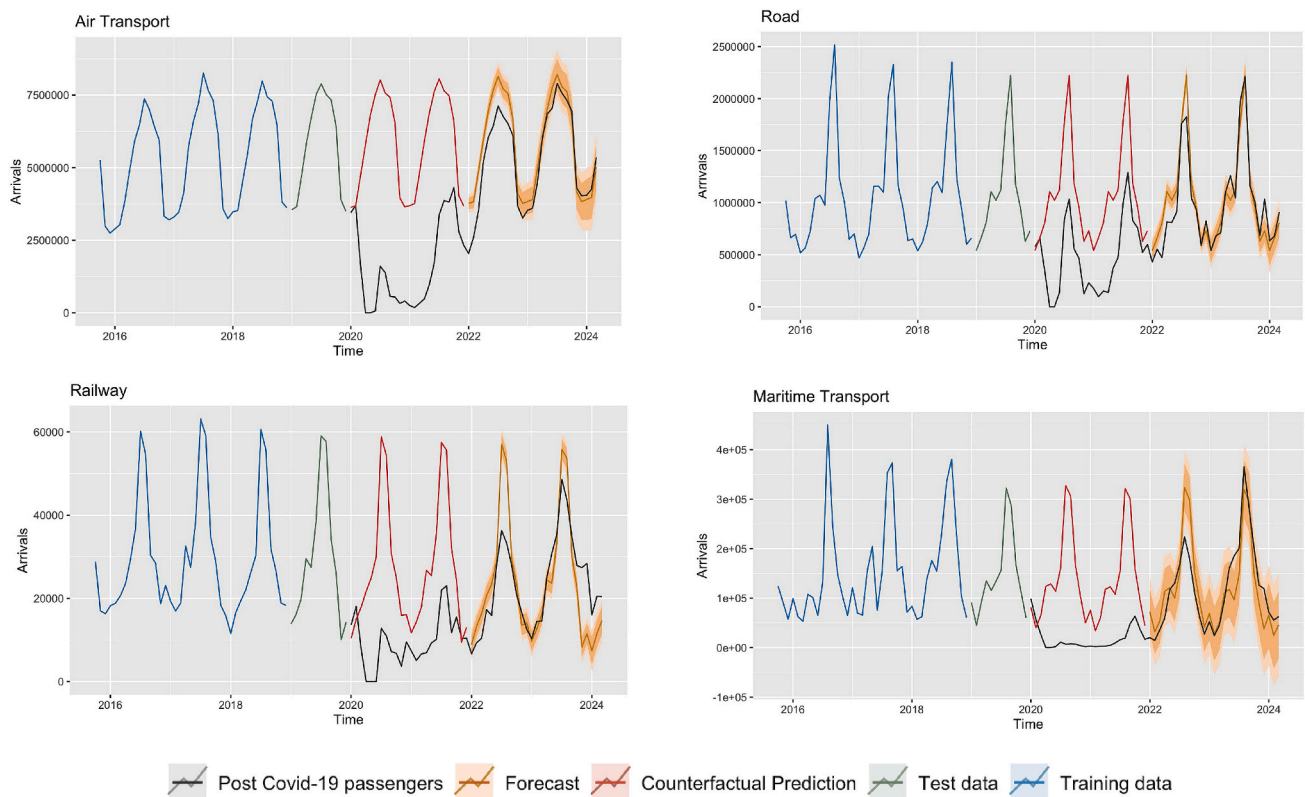


Fig. 2. Foreign tourist arrivals by access route used by visitors: actual data, counterfactual prediction and forecast.

Arrivals, the previous figures are all below the levels predicted by the model, which undoubtedly shows the great impact that COVID-19 had on this route of access. A similar pattern, although with a stronger recovery, is demonstrated by road arrivals. Although there are already signs of recovery in some months at the end and beginning of the year, this recovery already observed in mid-2023 is strengthened in the case of arrivals by train and by sea since both series show a strong recovery starting in May 2023. Furthermore, the recovery figures are surprising in the case of these two access routes, being well above the values predicted by the model.

These findings reveal a notable shift in tourist behavior regarding their preferred routes of access. Specifically, tourists increasingly prefer train travel, facilitated by the expansion of train transportation networks across Spain. Additionally, there is a growing inclination towards cruise tourism, as more travelers seek unique experiences offered by cruise trips. According to the International Association of Cruise Lines (Cruise Lines International Association, 2024), this shift can be attributed not only to Spain's inherent attractiveness and the proactive promotional efforts by port authorities but also to the strategic adjustments made by shipping companies in response to the pandemic-related closure of certain markets and ongoing geopolitical challenges.

The expansion and modernization of the high-speed rail network in Spain are a promising strategy to alleviate the seasonality of tourism arrivals (Boto-García & Pérez, 2023). The liberalization of the Spanish rail market has introduced competition and lowered prices making train travel a more attractive option (Villalba-Sanchis, Arroyo-López, Insa-Franco, Martínez-Fernández, & Salvador-Zuriaga, 2023; European Travel Commission, 2022). Moreover, the role of railways also has a significant influence on tourism at international level, with passenger traffic increasing year on year. The rising preference for sustainable and comfortable transportation options has further boosted train travel, offering a more environmentally friendly alternative to planes and cars (European Travel Commission, 2022).

5. Discussion

The results of our analysis offer a comprehensive and nuanced perspective on the post-pandemic recovery of Spain's tourism industry, revealing several significant insights.

Firstly, air travel experienced the greatest setback among all access routes, as consistent with findings in the literature (Suau-Sanchez et al., 2020; Zhang et al., 2021). However, it is worth highlighting the resilience and adaptability of this sector, which has not only recovered to pre-pandemic levels but has also closely approached the scenario predicted in our counterfactual analysis. This demonstrates the aviation sector's capacity to swiftly adapt to renewed demand, evidenced by the reinstatement of flight routes and the restoration of traveler confidence. As Gudmundsson, Cattaneo, and Redondi (2021) noted, the pandemic acted as a "temporary correction" to the previous growth levels in aviation, underlining the sector's robust recovery trajectory.

Secondly, the unexpected growth in train and sea travel highlights a significant shift in traveler preferences. The notable increase in train travel suggests a growing preference for sustainable and safer modes of transport, aligning with the findings of Cheng et al. (2024). Complementing this trend is the resurgence of cruise tourism, which has seen an increase surpassing pre-pandemic levels (Spanish National Statistic Institute, 2024; SEGITTUR turismo e innovación, 2024; Cruise Lines International Association, 2024). These developments reflect an evolving landscape in travel behavior, where tourists increasingly prioritize eco-friendly and health-conscious travel options. Our counterfactual framework further reveals that the COVID-19 pandemic has positively altered the growth trajectory of certain transportation modes, particularly trains, with actual performance exceeding estimated trajectories. This finding resonates with studies that identify train and sea travel as healthier alternatives (European Travel Commission, 2022).

Thirdly, the increase in train and sea arrivals can be attributed to improvements in infrastructure and effective marketing efforts. Enhanced rail and port facilities have made these modes of travel more

attractive and efficient, while strategic marketing campaigns have successfully emphasized the unique experiences offered by train and cruise travel (Villalba-Sanchis et al., 2023; European Commission, 2024; Cruise Lines International Association, 2024; European Travel Commission, 2022). These advancements underscore the adaptability and resilience of Spain's tourism industry, particularly in embracing new tourism options and catering to changing traveler demands.

Finally, the shift towards train and sea travel reflects broader sustainability trends within the tourism sector. As travelers become increasingly conscious of their environmental impact, there is a noticeable preference for travel modes that offer uncrowded spaces and more sustainable options. This growing demand is likely to influence future investment and policy decisions, shaping the industry towards a more sustainable trajectory (European Travel Commission, 2022; Ríos-Rodríguez et al., 2023; Cheng et al., 2024).

These insights collectively highlight the resilience and adaptability of Spain's tourism sector while emphasizing the need for continued alignment with evolving sustainability and traveler behavior trends. Moreover, they are in line with those found by other authors and advance research in this field by analyzing which types of transport were most impacted by the pandemic, as proposed by the work of Barczak, Dembińska, Rozmus, and Szopik-Decpczyńska (2022), Barczak, Dembińska, Szopik-Decpczyńska, and Rozmus (2022). Their study highlights significant differences in the number of passengers handled at airports across selected EU countries during the pandemic compared to pre-pandemic trends, noting that countries like Spain, Germany, France, and Italy experienced the greatest discrepancies. Our article builds on these findings by offering a comparative analysis of various modes of transport, not only focusing on air travel but also examining how rail transport and other sectors were affected.

By expanding the scope of analysis to include various transport modes, we provide a more comprehensive understanding of the pandemic's impact and offer insights into which sectors may take longer to recover. This knowledge can help stakeholders in the transport industry to strategize effectively for the future. Our findings underscore the interconnectedness of the transport sector, as disruptions in air travel have ripple effects across other modes. This highlights the need for united and cooperative efforts in developing holistic approaches to transportation planning and recovery.

In summary, while air travel remains a dominant force in Spain's tourism sector, the notable increase in train and sea travel highlights a significant shift in traveler preferences and the importance of adapting to these changes. The findings suggest a robust recovery and a promising future for Spain's tourism industry, driven by both traditional and evolving travel modes. Continued monitoring and adaptation to these trends will be crucial for maintaining growth and ensuring sustainable development in the sector.

6. Conclusions

Tourism has always been a cornerstone of Spain's economy (Balaguer & Cantavella-Jorda, 2002). Spain is the top international tourist destination for foreigners (Castillo-Manzano et al., 2020; Rodríguez-Antón & Alonso-Almeida, 2020), primarily due to its sun-and-sand tourism, which is frequently associated with mass tourism (Sánchez-Sánchez & Sánchez-Sánchez, 2024).

The COVID-19 pandemic severely impacted the tourism industry, causing a significant drop in the number of international travelers and leading to the closure of borders in major tourist-sending countries. International travel plummeted by 72 % in 2020, making it the worst year on record for tourism, resulting in 1.1 billion fewer international tourists worldwide (overnight visitors), returning the number of travelers to levels of 30 years ago (World Tourism Organization – UNWTO, 2020). So that, the pandemic led to a dramatic decrease in global travel, and Spain was no different. According to data from the Spanish Institute of Statistics (2024), the tourism industry experienced major disruptions

in 2020 and 2021, with a significant drop in arrivals by all modes of transportation. For instance, air travel saw a decrease of 80.1 % in 2020, with respect to 2019, while land and sea routes experienced a 77.33 % drop. This led to economic difficulties, especially in tourism-dependent areas.

Despite the formidable challenges, 2022 marked a significant turning point for Spain's tourism industry due to the drop in tourists flows produced by the pandemic effect. As the world adapted to new health protocols and travel restrictions eased, tourist numbers in Spain began to rise. By the end of 2023, all access routes had not only recovered but also experienced a significant increase in tourist arrivals, signaling a robust recovery for Spain's tourism industry and its resilience in the face of adversity. Several studies from respected Spanish institutions, including CaixaBank Research (2024) and the Bank of Spain, point this out, as detailed in a study by Hernández de Cos (2024). Their analysis supports the projection that international tourism rebounded to pre-pandemic levels by the end of 2023.

In this paper, we comprehensively analyze monthly data of foreign tourist arrivals (Foreign Tourist Arrivals) from October 2015 to March 2024, sourced from Spain's National Statistical Institute (INE), to identify key trends and patterns in the recovery of the Foreign Tourist Arrivals to Spain by different routes of access. We build a counterfactual analysis and use the Seasonal Autoregressive Integrated Moving Average (SARIMA) to compute the counterfactual or benchmark Foreign Tourist Arrivals series using until the last data available, March 2024.

We employ SARIMA models to build the counterfactual or benchmark series for the Foreign Tourist Arrivals. The dependability of the selected model was rigorously evaluated using analytical methods within the context of Machine Learning methodology. This rigorous evaluation ensures the validity and reliability of our findings, enhancing the credibility of our research. Moreover, our evaluation of ARIMA and SARIMA model accuracy using various metrics provides a robust framework for forecasting Foreign Tourist Arrivals. The objective is to examine whether the Foreign Tourist Arrivals in Spain are now at the level they would have been in a hypothetical scenario in which the pandemic crisis had not occurred. This methodology allows us to identify potential growth opportunities and evaluate the industry's resilience after the pandemic.

Furthermore, our research highlights the importance of adapting marketing strategies to these new dynamics. By identifying the changes in tourist access routes and preferences, we offer a strategic framework that destinations can use to tailor their marketing efforts more effectively. This approach not only helps in targeting potential tourists more precisely but also ensures that the tourism sector can better withstand future disruptions. The comprehensive analysis provided in this study serves as a valuable resource for policymakers and industry professionals, offering guidance on optimizing tourism recovery and promoting sustainable growth in the post-pandemic era.

Our findings also reveal that, among the different methods of travel, air travel experienced a rapid resurgence, reaching pre-pandemic levels due to airlines' reinstatement. At the end of 2023, airports bustled with activity again, reflecting the renewed confidence of international travelers. However, the most surprising part of this recovery was the significant increase in arrivals by train and sea. While air travel has historically been dominant, these modes experienced an unprecedented surge in popularity.

Therefore, our contribution, in light of the existing literature on this topic, arises from conducting a counterfactual analysis that enables us to identify shifts in traveler behavior and preferences. The figures related to international train arrivals indicate that the situation should be worse (based on the predicted series from our model). However, actual data surpasses the predicted figures, reflecting the positive evolution of this mode of transportation.

Our results are consistent with those found by other authors, such as Barczak, Dembińska, Rozmus, and Szopik-Decpczyńska (2022), Barczak, Dembińska, Szopik-Decpczyńska, and Rozmus (2022), and we

acknowledge their contribution to this field. Their study highlights significant differences in the number of passengers handled at airports across selected EU countries during the pandemic compared to pre-pandemic trends, noting that countries like Spain, Germany, France, and Italy experienced the greatest discrepancies. Our article builds on these findings by offering a comparative analysis of various modes of transport, not only focusing on air travel but also examining how rail transport and other sectors were affected. This collaborative approach to research is essential for advancing our understanding of the complex effects of the pandemic on the transportation industry.

In addressing the gap identified in the literature, we recognize that Barczak et al. propose further exploration of transport trends. Specifically, they suggest that “the performed analysis can serve as the basis for another research”. Our analysis not only focuses on air transport but adopts a multimodal approach to consider the evolution of international tourism flows to Spain after the pandemic. In this regard, we address the gap identified by Barczak, Dembińska, Rozmus, and Szopik-Depczyńska (2022) and Barczak, Dembińska, Szopik-Depczyńska, and Rozmus (2022), who suggest that their analyses could be compared with other modes of transport, such as rail, to determine which mode experienced greater declines in passenger numbers and, therefore, which sector of transport proved to be more sensitive to the pandemic. Our approach expands on this line of research by integrating multiple modes of transport (air, rail, and others), thus allowing for a more comprehensive assessment of the pandemic’s impact on international tourism flows to Spain.

In conclusion, while air travel remains the dominant mode for international tourists visiting Spain, the unexpected and significant growth in train and sea travel post-2023 has been a remarkable development. This trend not only signifies a broader recovery for Spain’s tourism sector but also underscores the evolving preferences of modern travelers seeking varied and sustainable travel experiences. Spain’s tourism infrastructure’s resilience and adaptability have positioned the country well to embrace this new era of travel, sparking optimism for the future of Spain’s tourism industry. However, ensuring sustainable growth and resilience in Spain’s tourism sector requires ongoing monitoring of tourism trends and targeted interventions.

This study acknowledges several limitations, including the availability of data limited to a specific time frame, which may not reflect the most recent changes in passenger behavior. Additionally, some of the predicted patterns of potential behavior, such as what may occur in the upcoming summers, could become obsolete by the time the reader engages with this study, as these events may have already transpired. Additionally, the analysis conducted does not have a geographical scope, which prevents us from identifying the origin of the travelers who have contributed to the findings and detected changes in habits. This leads us to an immediate future investigation that would involve identifying the origin of travelers coming to Spain. Therefore, for future research, we suggest applying the same methodology to examine the origin of international visitors to Spain. This approach would facilitate a comparative analysis of how tourist arrivals have changed by country of origin and deepen our understanding of behavioral changes among different European tourists regarding their pre-pandemic travel preferences to Spain. Moreover, considering all variables, access routes, and travelers would give us an idea of the preferred method of transportation by country of origin and how factors such as proximity to Spain influence the choice of transportation mode. It would also allow us to consider governmental measures that may be favoring one type of transport over another. This would also contribute to filling the gap identified in the literature Barczak, Dembińska, Rozmus, and Szopik-Depczyńska (2022) and Barczak, Dembińska, Szopik-Depczyńska, and Rozmus (2022), which analyzes by country of origin but considering only air transport.

CRediT authorship contribution statement

Aida Galiano Martinez: Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Juan Manuel Martín-Alvarez:** Writing – original draft, Software, Formal analysis, Data curation, Conceptualization. **Miguel Angel Del Arco Osuna:** Writing – original draft, Visualization, Methodology, Formal analysis, Data curation. **Lara Mata Martínez:** Writing – original draft, Validation, Investigation, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Aida Galiano Martínez PhD in quantitative methods in economics, with over 20 years teaching statistics and econometrics. Her research on business cycles has led to 10+ indexed publications. She is a full-time researcher at UNIR.

Juan Manuel Martín Alvarez PhD in quantitative analysis for decision-making in economics. An Associate Professor at UNIR, leading the MSc in Business Intelligence, with over 15 indexed articles on quantitative methods and prediction.

Miguel Angel Del Arco Osuna PhD student at UNIR, researching data analysis and machine learning in regional data clustering. Published papers in data-driven methodologies.

Lara Mata Martínez PhD and member of UNIR's Data Analytics and Innovation Department, focusing on educational innovation and entrepreneurship data analysis.