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Has passenger satisfaction at airports changed with the onset of COVID-19? The case of Seville Airport (Spain)

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ABSTRACT

The changes that have come about at airports in recent decades in the areas of security, deregulation, and technological advances have affected both airport management and the passenger experience at airport facilities. In addition, all around the world, the airport sector has been struck by the COVID-19 pandemic during 2020 and 2021. Using a broad sample of data taken from Airport Service Quality (ASQ) surveys and robust econometric methodology, specifically, an Ordered Logit model with Principal Component Analysis, this paper seeks to cover the gap in the academic literature regarding the effect of a worldwide pandemic on passenger satisfaction at airports during the 2015–2021 period, while taking into consideration the passenger profile and journey and airport attributes. It takes as its reference a Spanish regional airport, which had been experiencing a strong expansion process prior to the pandemic. With respect to the variables linked to the passenger profile, a differential behavior is observed in satisfaction depending on nationality, motive for travel, and destination. In addition, the four facility- and airport process-related dimensions are significant, with cleanliness and comfort standing out above all others. These are even more important in a health emergency scenario such as is currently being experienced. Lastly, 2021 is shown to cause a downturn in the positive passenger satisfaction with the airport that had been observed during the first year of the pandemic. Therefore, more long-term management is required alongside the initial rapid and efficient action taken by airports, with up-to-date information for passengers to internalize the inconveniences associated with this long-drawn-out period of uncertainty.

1. Introduction

The air transportation industry has changed considerably in recent years. The effects of deregulation on the industry, the evolution of low-cost airlines, inter-airport competition, technological advances, and terrorism have affected the industry and led to major transformations in airport settings. As a consequence, people's habits and travel options have also changed (Bellizzi et al., 2020) and had a drastic impact on the airport experience all around the world (Tuchen et al., 2020).

Along with the changes for airlines and airports brought about by the emergence of the low-cost phenomenon (Francis et al., 2004; Gillen and Lall, 2004), rapid implementation of technological advances has led to the rollout of new automated systems for check-in, security checks, and boarding without the need for any external personnel to intervene (Negri et al., 2019; Otieno and Govender, 2016; Sava et al., 2019), resulting in time savings but also possibly generating a certain degree of rejection among more elderly passengers (Castillo-Manzano and

Lopez-Valpuesta, 2013; Miskolczi et al., 2021). In other respects, since the 9/11 attacks, security procedures have required passengers to arrive at the airport much earlier, exposed them to long delays at checkpoints, and even, in some extreme cases, seeing their airport closed (Gkritza et al., 2006). Airport operators can take advantage of these longer stays at the airport to turn waiting time into consumption time, thus directly affecting the passengers' experiences and their purchasing intention and also benefiting non-aeronautical revenues (Castillo-Manzano et al., 2018).

In addition to all this, in 2020, the COVID-19 pandemic spread throughout the world and generated significant changes in society and the aviation industry (Linden, 2021), with Ultra Long-Haul point-to-point flights even being proposed to bypass crowded and potentially infected international hubs (Bauer et al., 2020). Health authorities have laid down protocols at airports to afford passengers greater safety and guarantees in the face of COVID-19. Some limitations were also placed on air travel to reduce transmission of the virus between several regions

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and countries, which even led to airport closures. In figures, in 2020, demand (revenue passenger kilometers) fell by 65.9% compared to the full year of 2019, considered to be the steepest fall in air traffic in the history of aviation (IATA, 2021). However, air travel has picked up over 2021 despite interruptions due to the emergence of the Omicron variant. Notwithstanding, demand in 2021 was 58.4% down on 2019 (IATA, 2022).

Faced with these changes in airport morphology and an uncertain environment due to COVID-19, managers in the aeronautical market must adapt and prepare for future crises by developing more resistant organizations with a greater learning capacity (Linden, 2021). In this sense, one of the greatest challenges that airport operators face is the measurement, analysis, and mining of relevant information for passengers' perception of the service quality of their airport service. This information is required to improve the airport's operating indicators and to raise the quality of the services offered to passengers (Negri et al., 2019) to make their passage through the airport as stress-free as possible (Kalakou et al., 2015). Moreover, collecting information about these experiences at this particular time, during the pandemic, is crucial. Following Tuchen et al. (2020), airports should be regarded in the same way as education centers, with the experience of all the users that come together in them used to achieve more agile and flexible management that benefits their recovery and prepares them for adapting to any future crises.

Passengers' perceptions of airport service attributes can be analyzed using data from airport review websites such as Skytrax (Bogicevic et al., 2013; Merkert and Assaf, 2015) or through a quantitative survey given to passengers during their passage through the airport. One example of the latter is the Airports Council International's (ACI) Airport Service Quality (ASQ) surveys (Isa et al., 2020), which will be used in this study. ACI ASQ surveys are currently carried out at 386 airports worldwide and over 75% of the 100 top airports in the world are ASQ survey members (ACI, 2022).

In this context, this paper's objective is to analyze global passenger satisfaction at Seville Airport (Spain) over a broad 7-year time period from 2015 to 2021, which includes the months after the state of alarm was declared in Spain (March 14, 2020) due to the COVID-19 pandemic to the end of 2021, to cover the gap in the academic literature regarding the effect of a worldwide pandemic on passenger satisfaction. Our broad sample spans 84 months, 22 of which were during the declared COVID-19 pandemic, and covers the successive waves of the virus (six waves in Spain up to February 2022), which enabled us to differentiate between 2020 and 2021. The inclusion of these months allows an analysis of whether this health and mobility crisis has resulted in any changes in passenger satisfaction compared to the previous normality context, with important implications for airport management. Other factors that traditionally might influence satisfaction have also been included, such as passenger sociodemographic profiles, the flight and airport characteristics, and the facilities and services offered. For this, a broad database of ASQ surveys administered to passengers at Seville Airport was used and a discrete demand level-based methodology with Principal Component Analysis was applied.

The choice of Seville Airport as the case study is justified by its status as a regional airport under expansion in recent years. Specifically, the airport experienced 75% growth in passenger numbers in the last five years (2015–2019), reaching 7,544,473 travelers in 2019, the highest figure for the third consecutive year and the highest in its history. However, as in other airports, the current situation regarding the international COVID-19 pandemic has put a brake on the growth that it had been experiencing since 2015. Specifically, in 2020, the total number of passengers fell by 69.3% compared to the previous year, with only 2,315,610 passengers passing through the airport facilities, while a slight recovery was noted in 2021 with a total of 3,444,459 passengers, which equates to a 48.7% increase over 2020 and almost half the number of passengers reached in 2019 (AENA, 2022). So, this airport's experience of a continual growth trend at the beginning of the period

and a fall at the end due to COVID-19 can serve as an example to identify the factors that influence passengers' global ratings of an airport and help airport managers to adapt their facilities to their customers' needs in times of uncertainty around health due to the pandemic.

To meet this objective, this paper is organized as follows. After the Introduction, Section 2 analyzes the academic literature on passenger satisfaction at airports. Section 3 describes the chosen methodology and the variables and data used in the analysis. Section 4 presents the results of the econometric analysis and links them to the academic literature. Section 5 sets out the paper's main conclusions and is followed by the bibliographical references.

2. Measurement of passenger satisfaction at airports: a literature review

Customers' perception of quality is the basis for their satisfaction with the service (Brady and Cronin, 2001). It is, therefore, a critical component of the service industry's marketing strategy due to its effect on satisfaction, customer retention, and loyalty (Gounaris et al., 2010), and an organization's profitability and competitive advantages (Alexandris et al., 2002; Parasuraman et al., 1995).

In the academic literature, many authors have devoted their analyses to the perception of the service quality and customer satisfaction in various sectors such as health services (Lee et al., 2015); bank services (Goyal and Chanda, 2017); the hospitality industry (Ju et al., 2019; Lin et al., 2019), and hotel services (Hu et al., 2021). Studies can also be found in the transport sector focused on cruises (Chiou et al., 2021); public transport (Morton et al., 2016), and high-speed trains (Chen et al., 2020).

In the sphere of air transport, measuring service quality has become an increasingly pertinent issue in recent years. Several different contributions can be cited in the aeronautics industry as a whole. For example, Walia et al. (2021) analyzed the variety of factors involved in the quality of airline services that have a direct significant relationship with passenger satisfaction and showed that passenger satisfaction is significantly and positively related to loyalty; Koklic et al. (2017) examined the relationships between the quality of the personnel and satisfaction with the airline and the intention to repeat and recommend the airline, finding that personnel quality positively affects satisfaction and that satisfaction, in turn, affects the intention to repeat and recommend; more specifically, in the case of airports, Prentice and Kadan (2019) confirmed that the general quality of the airport service was significantly related to reuse of the airport and returning to the destination. Meanwhile, Merkert and Assaf (2015) investigated airport efficiency by combining both perceived service quality and profitability in their measurement, concluding that excluding quality can distort the overall efficiency ranking of airports. Also, according to Suárez-Alemán and Jiménez (2016), a more market-oriented airport management focus with competition in airfares or the inclusion of private participation leads to a higher perception of quality.

A set of studies on the topic of passengers' perception of quality at airports can also be found. Miskolczi et al. (2021) used Artificial Intelligence to examine travelers' perceptions of airport services and showed that their attraction is greater for Generation Z (digital native) and Y (millennial) travelers. Other studies have focused on investigating the differences in the perception of service quality based on different passenger attributes such as nationality (Bellizzi et al., 2018), gender, employment situation, and travel frequency (Liou et al., 2011). In the same line, Jiang and Zhang (2016a) demonstrated significant discrepancies between passengers' expectations of service quality and their perceptions, while Allen et al. (2020) analyzed the heterogeneity of passengers' perceptions and identified passenger groups with similar service evaluations. More specifically, Seneviratne and Martel (1991) established a list of variables related to passengers' perceptions at airport terminals.

Focusing on passenger satisfaction through the evaluation of service

quality, [Fakfare et al. \(2021\)](#) examined the asymmetric effect of the airport quality attributes on passenger satisfaction in the terminal. The [Yang et al. \(2015\)](#) analysis showed that passenger satisfaction with each of the studied factors was lower than their initial expectations. [Pantouvakis and Renzi \(2016\)](#) determined the specific components of service quality that can lead to greater traveler satisfaction in an international airport setting and evaluated how satisfaction levels vary according to different nationalities. However, [Bogicevic et al. \(2016\)](#) identified the airport attributes that are enhancers of passenger satisfaction but without taking different user characteristics into account. Another study that carried out a similar analysis was [Bogicevic et al. \(2013\)](#), which distinguished the key factors for passenger satisfaction in the airport context via the airport service quality attributes most often mentioned by passengers in comments published on an airport evaluation website. [Isa et al. \(2020\)](#) concluded that a positive significant relationship existed between some of the airport service quality dimensions and general passenger satisfaction. Similarly, [Pandey \(2016\)](#) showed that service quality at the airports under study was satisfactory, although some areas required improvement. [Bezerra and Gomes \(2015\)](#) identified the airport service quality dimensions and examined the effects of these dimensions on the passengers' general satisfaction along with the related variables.

In other respects, from the point-of-view of airport facilities, [Kan-kaew \(2020\)](#) studied the way that architectural design affects passenger satisfaction in airport settings; [Correia et al. \(2008\)](#) evaluated the general service level of terminals according to user perception, as did [Dayarathna et al. \(2017\)](#), who measured the level of passenger satisfaction with the facilities in the departures, arrivals, and transit terminal building.

Lastly, some recent studies have studied the influence of the COVID-19 pandemic on passenger satisfaction. While [Tuchen et al. \(2020\)](#) developed a literature review and conceptual model to analyze the airport user experience, other studies such as [Monmosseau et al. \(2020\)](#) and [Sulu et al. \(2021\)](#) have analyzed the main components of passengers' subjective experiences of the airline based on the feedback left on social networks during the COVID-19 outbreak.

In this context, this paper contributes to the extant literature by covering the gap observed regarding studies that explain whether the COVID-19 pandemic and the associated mobility restrictions have sparked any change in airport-related passenger satisfaction. The study considers a long 7-year temporal series (2015–2021), the last two years of which were marked by the pandemic (2020–2021), and a broad sample based on ASQ surveys, which enables other factors that affect passenger satisfaction to be taken into account, such as the passenger profile and journey and airport attributes.

3. Data and methodological framework

3.1. ASQ survey

The data used in this work have been taken from the 9119 ASQ surveys carried out at Seville Airport during the 2015–2021 period. This is, therefore, a broad 7-year time period that, as a novelty, covers the months after the state of alarm was declared in Spain on March 14, 2020 as a consequence of the COVID-19 pandemic for the whole of 2021. Apart from this novelty, this is also a much longer period than has been used in other studies with time periods equal to or shorter than a year ([Bezerra and Gomes, 2015](#); [Eboli and Mazzulla, 2009](#); [Jiang and Zhang, 2016a](#); [Prentice and Kadan, 2019](#)).

As commented in the Introduction, ASQ surveys enable passengers to rate airport performance in different service areas and have been used in the prior academic literature. Specifically, ACI ASQ surveys are divided into three parts. The first part focuses on passenger flight data; the second, on the evaluation of the various services offered by the airport, including categories such as check-in, security, signage, and environment and comfort, and lastly, the questionnaire includes questions on

the passenger profile, including nationality, country of residence, gender, and age group.

In the specific case of Seville Airport, the surveys are distributed to passengers by airport employees in the Departures area. The surveys were recorded on paper until 2019, but since 2020, mobile devices have been used. They have been carried out every three months at different times of the day and on different days of the week with different flights. The number of distributed questionnaires is based on criteria set by ACI according to the number of seats offered on the flight schedule, with a minimum of 1400 passenger surveys per year (a minimum of 350 per quarter), with the exception of 2020 (see [Table 1](#)), when the number was lower due to the declaration of a state of alarm in Spain and the lower number of passengers in said year.

The survey's technical characteristics used in this paper are presented in [Table 1](#) and the sample characteristics are shown in [Table 2](#).

3.2. Methodology and variables

The academic literature has used different methodologies to measure service quality at airports depending on the type of customer satisfaction data collected and the measurement scale adopted to capture their judgments. By way of example: structural equation models ([Prentice and Kadan, 2019](#)); the Minimum Partial Least Squares method ([Isa et al., 2020](#)), and the Rasch Modeling Technique ([Pantouvakis and Renzi, 2016](#)) have all been used.

Discrete Demand Models have been used in our work. These are applied when the dependent variable refers to different choice categories or options. Specifically, Ordered Logit has been chosen as the surveys to analyze passenger satisfaction use ordinal measurement scales. Previous studies can be found on passenger airport satisfaction in the academic literature that have used this methodology, both Ordered Logit ([Bezerra and Gomes, 2015](#); [Bellizzi et al., 2018](#); [Eboli and Mazzulla, 2009](#)) and Ordered Probit ([Allen et al., 2020](#)).

Our model is shown in the following equation ([Greene and Hensher, 2010](#)):

$$y_i^* = x_i\beta + u_i \tag{1}$$

where:

- Subindex i indicates the i -th of the surveyed n individuals.
- y_i^* is the latent response variable,
- x_i is a linear combination of k explanatory variables that are assumed to be strictly independent of u_i .
- β is the vector of the k parameters that is the object of estimation.
- u_i is the error term

In general, for an m -alternative ordered model, we define the observed discrete outcome as:

$$y_i = j \text{ if } \mu_{j-1} < y_i^* \leq \mu_j \tag{2}$$

where $\mu_0 = -\infty$ and $\mu_m = \infty$; $\mu_1 < \dots < \mu_{m-1}$ are defined as $m-1$ thresholds between which the categorical responses are estimated, and j denotes the j -th of the m alternatives.

The aim is to measure how changes in the explanatory variables translate into the likelihood of observing a particular ordinal outcome. We can express the likelihood of each ordinal outcome as:

$$\begin{aligned} Pr[y_i = j] &= Pr[\mu_{j-1} < y_i^* \leq \mu_j] = Pr[\mu_{j-1} < x_i\beta + u_i \leq \mu_j] \\ &= Pr[\mu_{j-1} - x_i\beta < u_i \leq \mu_j - x_i\beta] = F_j(\mu_j - x_i\beta) - F_{j-1}(\mu_{j-1} - x_i\beta) \end{aligned} \tag{3}$$

where F is the cumulative distribution function of u_i . For the ordered logit model, u is logistic distributed.

Before running the calculations, the Principal Component Analysis method was used to condense the information in the variables related to the quality of the various airport services (see [Table 3](#)) into a smaller set

Table 1
ASQ survey technical characteristics.

Airport traffic		2015	2016	2017	2018	2019	2020	2021
		5,583,517	5,225,741	5,108,817	6,380,483	7,544,473	2,315,610	3,444,459
Information gathering	Questionnaire	Available in four languages						
Sampling	Sample size by year	1402	1401	1400	1402	1399	557	1558
	Sample size	9119						
	General	Departing passengers >16 y.o.						
	Method	Random						
Fieldwork	Location	Departure Hall - Boarding Gates, Seville Airport						
	Frequency	Every three months						
	Schedule	Daily. At different times of the day						
	Years	2015–2021						

Source: Prepared by authors.

Table 2
Sample sociodemographic and airport/flight characteristics.

		Freq	%
Age	16–21	799	9.04
	22–25	1088	12.32
	26–34	2078	23.52
	35–44	1755	19.87
	45–54	1625	18.39
	55–64	1033	11.69
	65–78	387	4.38
	>76	69	0.78
Gender	Male	4113	47.33
	Female	4577	52.67
Nationality	Spanish	5426	62.76
	European	2137	24.72
	Non-European	1083	12.53
Motive for travel	Business	1477	16.51
	Leisure	5766	64.00
	VFR (Visiting Friends and Relatives)	1703	19.00
Destination	Domestic, mainland	3486	38.72
	Domestic, island (Spanish archipelagos)	1576	17.50
	EU-28	3687	40.95
	Outside EU-28	255	2.83
Airline	Low-Cost company	7430	81.81
	Full-Service Network carrier	1652	18.19
Season	Summer season	4994	54.75
	Other seasons	4128	45.25
Weekend	Saturday/Sunday	2685	29.43
	Monday-Friday	6437	70.57

Source: Prepared by authors.

of variables, as had been done in other studies such as Allen et al. (2020), Bezerra and Gomes (2015), Bogicevic et al. (2016), and Jiang and Zhang (2016a).

The definitions of the variables used in our study are given in Table 3.

The independent variables have been classified into four groups. Although, as previously stated, these variables have mostly been taken from ASQ surveys, they have previously been used in the academic literature to analyze satisfaction, as shown below.

First, the variables COVID-19 (2020) and COVID-19 (2021) have been included since, as Tuchen et al. (2020) indicate, the pandemic affected passenger behavior and, consequently, their experience of passing through the airport. Therefore, the aim was to capture the effect that the restrictions and checks imposed in airports as a result of the declaration of the pandemic had on passenger satisfaction, compared to the previous context of “normality”. The chosen time period was from the declaration of the state of alarm in Spain in March 2020 to the end of 2021. The two years were separated in case the perpetuation of the pandemic or the vaccination campaign in Spain throughout 2021¹ had

¹ The vaccination campaign began in Spain in 2021. According to Spanish Ministry of Health figures for February 2022, 81.9% of the population received all their required COVID-19 vaccinations and 86.6% received at least one dose.

any influence on passenger satisfaction.

The second and third groups include the variables related to the passenger sociodemographic profile and the airport and flight attributes. In this sense, previous studies also analyzed some of these variables, including Bezerra and Gomes (2015), with variables for nationality, gender, and motive of travel; Pantouvakis and Renzi (2016), with nationality; Jiang and Zhang (2016a) with business trip-related services; Allen et al. (2020) with age, destination, and motive of travel; Jiang and Zhang (2016b) with gender, nationality, and motive of travel variables, among others, and Eboli and Mazzulla (2009) with age, nationality, country of residence, and motive of travel variables.

Lastly, ratings for various airport items are considered, including security check and check-in processes; the cleanliness and comfort of the facilities; help with navigating one’s way around the airport using the on-screen information, and distances to be covered. In this sense, earlier works were found such as Bogicevic et al. (2013), which studies cleanliness and the pleasantness of the atmosphere for spending time there, the security check and signage. The work of Eboli and Mazzulla (2009) is similar and puts the emphasis on signage, security, and cleanliness. Pantouvakis and Renzi (2016) considered signage and cleanliness, and Gkritza et al. (2006) highlighted the security check. In the same line of research, other authors such as Bezerra and Gomes (2015) analyzed check-in, security, comfort, and mobility, while Jiang and Zhang (2016a) focused on comfort. Bellizzi et al. (2018) also investigated visualization and signage as well as the cleanliness and comfort of the terminal, and Kankaew (2020) emphasized the cleanliness of the terminal in general and, more specifically, the cleanliness of the restrooms. Other authors can also be cited, such as Isa et al. (2020), who analyzed several dimensions such as facilities, check-in, and security and Fakfare et al. (2021), who established several attributes as significant: airport signage and design, flight information screens or security.

4. Results and discussion

Table 4 gives the results of the Principal Component Analysis (with varimax orthogonal rotation procedure) conducted for the service quality attribute items. The data present a sufficiently good level, with a Kaiser-Meyer-Olkin (KMO) value of 0.919 and a significance level of <0.01 for the Bartlett sphericity test. Only the factors with eigenvalues above 1.0 have been considered significant (Hair et al., 2018) and the items with an absolute loading of >0.5 have been included in each factor. Results suggest that four dimensions can be obtained: Security; Cleanliness & Comfort; Check-in, and Information & Mobility. As a diagnostic measure, Cronbach’s alphas have been calculated and present a satisfactory fit (>0.8) for all the dimensions (Hair et al., 2018).

Table 5 presents the results of the Ordered Logit model to explain the possible relationship between the explanatory variables in Table 3 and the global satisfaction level of passengers at Seville Airport. The Stata

Table 3
Definitions of the variables used.

Variable	Definition
Endogenous variable	
Satisfaction	Degree of global satisfaction with the airport
Independent variable: COVID-19 pandemic	
COVID-19 (2020)	1 if survey carried out after state of alarm declared in Spain due to COVID-19 pandemic (14-03-2020) until 31-12-2020; 0 otherwise
COVID-19 (2021)	1 if survey carried out during 2021; 0 otherwise
Independent variables: passenger sociodemographic profile	
Age	Age of person surveyed (1: 16 to 21; 2: 22 to 25; 3: 26 to 34; 4: 35 to 44; 5: 45 to 54; 6: 55 to 64; 7: 65 to 75; 8: >76)
Gender	1 if female; 0 if male
Nationality (Base category: Spanish)	European: 1 if nationality of an EU-28 country; 0 otherwise Non-European: 1 if nationality of a country outside the EU-28; 0 otherwise
Motive of travel (Base category: Leisure)	Business: 1 if the motive is business; 0 otherwise VFR: 1 if the motive is visiting Friends and Relatives; 0 otherwise
Independent variables: airport and flight characteristics	
Traffic	Total passenger traffic (in 10 ⁵) at Seville Airport in the survey month
Boarding gate	Distance in minutes from security check to corresponding boarding gate
Destination (Base category: Domestic, mainland)	Domestic, island: 1 if the destination is one of the Spanish archipelagos; 0 otherwise EU: 1 if the destination is the EU-28; 0 otherwise Non-EU: 1 if the destination is outside the EU-28; 0 otherwise
Airline	1 if Low-Cost company; 0 otherwise
Season	1 if summer season; 0 otherwise
Weekend	1 if Saturday/Sunday; 0 otherwise
Time (cluster)	Year in which survey carried out (1 = 2015; 2 = 2016; 3 = 2017; 4 = 2018; 5 = 2019; 6 = 2020; 7 = 2021)
Independent variables: rating of different airport items	
a) Security check	
Stringency of security	Rating of the stringency of the security measures
Feeling of safety	Rating of feeling of being protected and safe
Security courtesy	Rating of the courtesy and friendliness of security personnel
Wait for security	Rating of waiting time prior to security check
b) Cleanliness & Comfort	
Restroom cleanliness	Rating of cleanliness of restrooms
Restroom availability	Rating of availability of restrooms
Terminal Cleanliness	Rating of cleanliness of airport terminal
Terminal Comfort	Rating of comfort in waiting areas/boarding gates
c) Check-in processes	
Check-in efficiency	Rating of efficiency of check-in personnel
Check-in courtesy	Rating of courtesy and friendliness of check-in personnel
Wait for check-in	Rating of waiting time prior to check-in
d) Information & Mobility	
Screens	Rating of flight information screens
Signage	Rating of ease of finding one's way round/signs
Distance	Rating of distance to cover on foot inside terminal

Note: Satisfaction ratings on following Likert scale: (1 = bad; 2 = fair; 3 = good; 4 = very good; 5 = excellent).

15.1 statistical analysis software tool was used. An Ordered Logit has been chosen over an Ordered Probit as it presents higher pseudo R² and maximizes the log pseudolikelihood.²

Standard errors robust to heteroscedasticity have been estimated by cluster by year (from 2015 to 2021) to take into account the exogenous factors that have changed at different moments in time in the survey. Moreover, the LR test shows the joint significance of the explanatory variables in the model and the mean of the VIFs is much lower than 5, which shows that there are no correlation issues. Lastly, the final sample used is 4080 observations, which once again demonstrates the strength

of our analysis compared to other satisfaction studies with samples of under 1500 (Correia et al., 2008; Dayarathna et al., 2017; Elias and Caetano, 2017; Jiang and Zhang, 2016a; Koklic et al., 2017; Liou et al., 2011; Pantouvakis and Renzi, 2016; Prentice and Kadan, 2019).

As in all other discrete choice models, only the sign of the coefficient can be directly interpreted in Ordered Logit models. So, to obtain more information for analysis, Table 5 also shows the estimations of the average marginal effects (AME), which provide us with more information about relationships between explanatory variables and the dependent variable. Only statistically significant coefficients are shown and, to simplify the number of coefficients, only the highest possible value that the dependent variable, Satisfaction, can take is considered (5 = excellent).

The first thing that stands out is the number of significant variables, which shows the importance of the variables chosen to analyze passenger satisfaction at the airport.

Specifically, the variable COVID-19 presents a positive and significant coefficient at 5% for 2020, which indicates a positive relationship between actions taken at airports during the months after the state of alarm was declared in Spain (March 2020) and passenger satisfaction. As Table 5 indicates, during the initial months of the health crisis, the average likelihood that the passenger would give the airport a rating of excellent (5) rises by 2.8 percentage points compared to a situation of health normality. However, the COVID-19 variable presents a significant negative value at 1% for 2021, which shows a trend change in the airport ratings given by passengers, who are 3.8 percentage points less likely to rate airports with the highest score. These results can be explained by the swift short-term action taken by airports to address the pandemic with cleanliness, disinfection, and social distancing measures, and the implementation of health facilities (a clinic was set up at Seville Airport where passengers could take Covid tests). However, as the months went by, dependency and the negative effects of the pandemic on mental health, quality of life, and wellbeing (Geirdal et al., 2021) could have influenced the passenger satisfaction of travelers who were having to deal with a more complex airport experience because of the protocols around the presentation of the Health Check Form, the new vaccination certificate, and the different types of COVID-19 tests. In addition, the expectations that had been generated as to the effects of the vaccination campaign and the coming of a new “normality” that was freer of COVID-19 were not fulfilled, as demonstrated by the successive waves of the virus in Spain in 2021. This all could have contributed to the general population becoming frustrated and dissatisfied, especially airport passengers, as many of the inconveniences caused by the requirements for documents and health checks are more greatly concentrated when taking a flight.

Focusing on the variables related to the passenger sociodemographic profile, the variable Gender is not significant, as was the case for Bezerra and Gomes (2015), and nor is the variable Age. The latter contrasts with Jiang and Zhang (2016a), who observed that the elderly give higher ratings to airport services.

According to our results for the variable Nationality, foreign passengers both from within the European Union (EU) and from outside the European Union are less satisfied with the airport compared to domestic passengers at a 1% significance level. The explanation may be that the usual anxiety that departure times, directions, distances, and security at an airport cause is compounded by the unease of being in another country, possibly with a different language and different rules and regulations for flights, including, in the case of passengers from outside the EU, the doubts associated with the documentation required to enter/leave the European area. These results are consistent with the Jiang and Zhang (2016a) study for Melbourne (Australia) Airport, where Australian citizens were more satisfied with the majority of the services offered than travelers from Asia, Europe, and North America. However, the findings of Pantouvakis and Renzi (2016) were different. These authors found that Italian travelers tended to undervalue the service quality at airports in their country of origin compared to their foreign

² The Ordered Probit results are available from the authors on request.

Table 4
Service quality dimensions and PCA results.

Variables	Security	Cleanliness & Comfort	Check-in	Information & Mobility	Uniqueness
Stringency of security	0.7379	0.2192	0.2637	0.2207	0.2892
Feeling of safety	0.7186	0.242	0.2469	0.2458	0.3037
Security courtesy	0.6981	0.2313	0.2871	0.2297	0.324
Wait for security	0.6663	0.2175	0.2945	0.2467	0.3611
Restroom cleanliness	0.1904	0.7698	0.1558	0.1479	0.325
Restroom availability	0.1916	0.7218	0.2031	0.2244	0.3508
Terminal Cleanliness	0.2812	0.6670	0.2254	0.2672	0.3538
Terminal Comfort	0.2507	0.6554	0.2073	0.1991	0.425
Check-in efficiency	0.2446	0.1861	0.8279	0.1942	0.1824
Check-in courtesy	0.2905	0.1956	0.7278	0.1957	0.3093
Wait for check-in	0.2487	0.1935	0.6872	0.2002	0.3884
Screens	0.2517	0.2573	0.2403	0.7110	0.3072
Signage	0.3012	0.2233	0.2386	0.7071	0.3024
Distance	0.2835	0.2556	0.2407	0.6047	0.4307
Cronbach's alpha	0.8850	0.8685	0.8728	0.8508	

Table 5
Ordered Logit model results.

Independent Variables		Satisfaction (coefficient)	Satisfaction = 5 (Average Marginal Effects)
Covid-19 pandemic			
Covid-19 (2020)		0.2718 (0.1209)**	0.0280
Covid-19 (2021)		-0.3698 (0.0745)***	-0.0380
Passenger sociodemographic profile			
Age		-0.0022 (0.0186)	
Gender		0.0920 (0.0678)	
Nationality (Base category: Spanish)	European	-0.3228 (0.0783)***	-0.0330
	Non-European	-0.3262 (0.1100)***	-0.0340
Motive for travel (Base category: Leisure)	Business	-0.3475 (0.1464)**	-0.0360
	VFR	0.1350(0.0717) *	0.0140
Airport and flight characteristics			
Traffic		0.0172(0.0445)	
Boarding gate		0.0138(0.0116)	
Destination (Base category: Domestic, mainland)	Domestic, island	-0.1491 (0.1103)	
	EU	-0.0913 (0.0378)**	-0.0090
	Non EU	-0.0507 (0.1060)	
Airline		0.1422(0.1767)	
Season		-0.0349 (0.0612)	
Weekend		-0.0424 (0.0611)	
Rating of different airport items			
Security		1.1798(0.0740) ***	0.1220
Cleanliness & Comfort		2.1876(0.0847) ***	0.2270
Check-in		0.9439(0.0380) ***	0.0980
Information & Mobility		1.0444(0.0445) ***	0.1080
LR chi2		3972.75***	
Pseudo R2		0.4089	
Log pseudolikelihood		-2871.0979	
VIF (max/mean)		1.74/1.21	
No. observations		4080	

Note: Standard errors by cluster in the year survey carried out (Time) in parentheses. Statistical significance at 1% (***), 5% (**), 10% (*).

counterparts. These results do not agree with the results of the [Bezerra and Gomes \(2015\)](#) study, which finds that nationality bears no influence.

Regarding the variable Motive for travel, passengers on business trips present less satisfaction with the airport than people traveling for leisure reasons, whereas passengers traveling for VFR (visiting friends and relatives) present a higher satisfaction level, although only at 10% significance. Perhaps the stress involved in a work trip, which requires stricter adherence to schedules and timetables, might make passengers on a business trip 3.6 percentage points less likely to rate airports with the highest score on average, compared to passengers traveling for leisure motives, for whom the experience is more relaxed with no job obligations. Similarly, the explanation might be that VFR passengers are not so concerned about other preparations linked to holidays, such as organizing day trips and travel, and entrust these to their friends and relatives at the destination.

In the following group of variables, linked to the attributes of the airport and the flight, the only significant variable is Destination. As far as the destination is concerned, passengers flying to European Union destinations are less satisfied than those traveling within the Spanish mainland at 5% significance. It is curious that flights within the EU, where the required documents and the entire process have been simplified and put on the same level as domestic flights, show a lower satisfaction level for these passengers. Lastly, the lack of significance of the coefficients associated with the airline, the time that the flight is taken (variables Season and Weekend), and airport congestion (variable Traffic) is striking.

Focusing on the fourth group of variables, which rate the various airport processes, facilities, and services, all these factors are observed to be significant at 1%, which indicates that they have a clear influence on overall satisfaction with the airport.

Of all the AME in [Table 5](#), the variable Cleanliness & Comfort is observed to be the most important factor in passengers' global rating decisions for the airport. Specifically, passengers who give cleanliness a rating of 5 (compared to those who give it a rating of 1) are 90.8 percentage points more likely to consider the airport "excellent". This is consistent with the result reported by [Kankaew \(2020\)](#) and [Yang et al. \(2015\)](#), who demonstrated, among other things, that cleanliness is a key factor in the airport context. The key airport satisfaction factors for [Bogicevic et al. \(2013\)](#) are also comfort and that the atmosphere is pleasant for spending some time there, with the stress on the cleanliness of the facilities, including the restrooms.

The importance of the variable Security comes next. The feeling of safety, the waiting times for the security check, and the courtesy and stringency of these checks clearly contribute to satisfaction with the airport. Other studies exist in the previous academic literature such as [Isa et al. \(2020\)](#), [Bezerra and Gomes \(2015\)](#), and [Bogicevic et al. \(2013\)](#) who recognize this as a key factor that influences general satisfaction, as

does the present study.

The variable Information & Mobility also stands out. This variable encompasses information, visualization, signage, and distance. It is essential for travelers to have reliable information and straightforward signage at their disposal to help them feel safe and confident when moving around the airport. This is a fundamental factor for global passenger satisfaction for both Bellizzi et al. (2018) and Bogicevic et al. (2013). In this sense, Correia et al. (2008) stress that a poor signage system in an airport leads to longer distances having to be covered on foot, especially by users who are not familiar with the airport.

Lastly, the variable Check-in has the least influence on global satisfaction with the airport. This might be due to check-in being one of the first events in the airport experience, which means that it, therefore, has a lesser effect on end satisfaction. This result is consistent with Bogicevic et al. (2013), who establish that passengers do not perceive check-in processes as determinants of their satisfaction, rate other variables above check-in, and do not consider it the most relevant option for the passenger airport experience. Check-in is not significant for predicting the variation in satisfaction in the Isa et al. (2020) model, either. However, for Bezerra and Gomes (2015), the higher passengers' level of satisfaction with the check-in dimension, the more likely they are to give higher scores to general satisfaction with the airport.

5. Conclusions

Measuring and interpreting the quality of a service is more complex than for a physical product, due to the intangibility of the delivery of a service. However, this paper, with its broad sample of data and use of a robust econometric methodology, specifically an Ordered Logit model with a PCA analysis, has been able to determine the factors that influence general passenger satisfaction with the airport during a time period beginning in 2015 and ending in 2021, which therefore covers the two years of the worldwide COVID-19 pandemic. Notwithstanding, as the surveys used in our study have been obtained from a regional airport, it would be appropriate for the results to be replicated at traditional hub airports or even at the new Ultra Long-Haul hubs that could emerge in the post-COVID-19 era (Bauer et al., 2020) to verify whether a differential behavior exists depending on the airport's size and flight typology.

In view of the obtained results, it can be stated that satisfaction depends on many factors, not one alone, and can be influenced by unexpected external factors such as the COVID-19 pandemic, which has affected every airport worldwide.

Specifically, in relation to the variable COVID-19, the different sign presented by this variable for the two years of the pandemic, 2020 and 2021, stands out. After the declaration of the state of alarm in Spain in March 2020 (a very short time after the declaration of a worldwide pandemic by WHO), the effort and rapid response of airports to be safe, clean, and disinfected environments with automated processes and social distancing resulted in a positive relationship between the COVID-19 variable and passenger satisfaction. This result is probably related to the fact that the cleanliness and comfort of the terminal is the variable that presents the highest value in our model, as cleanliness and hygiene measures now, more than ever, are prioritized over any other factor and passengers seek health and safety as they pass through airports.

However, the significant negative sign of the COVID-19 variable at 1% for 2021 shows a trend change. Fatigue brought on by the ongoing pandemic; its effects on emotional distress; the unfulfilled expectations regarding the effects of the vaccination campaigns in Europe and, more especially, Spain, where a very high percentage of the population was vaccinated, and the additional disincentive of the Covid passport with the obligation to present the results of other tests, may all have influenced satisfaction with airport environments to a lesser degree, as these are places where the travel restrictions and requisites imposed in this new scenario are most prevalent.

So, looking to the future and a scenario in which we have to live with

the pandemic (there is already talk of treating coronavirus as if it were the flu), additional efforts are required based on information campaigns at the entrance to airports and on airport websites to inform about the new restrictions and the additional papers required for air mobility. Full, up-to-date information will contribute to the internalization of these inconveniences and their being included in our travel routines in the same way that the greater security checks did post 9/11. With respect to these checks, our results also show that security is the airport service with the second greatest impact on passenger satisfaction, which indicates that security, in general, is another variable that can be applied to the current scenario triggered by the COVID-19 crisis.

Focusing on the variables that measure the passenger's sociodemographic aspects and the journey's characteristics, the profile of the passenger with the lowest satisfaction level can be described as a non-Spaniard on a business trip to an EU destination. Our results, therefore, enable airport managers to propose a range of improvement actions depending on the market segment that they are designed for. For example, airports should be more welcoming to foreign travelers and provide more information desks or boards to answer any questions that they might have and also help them to go through all the bureaucratic processes when they pass through the airport. Similarly, business passengers should be taken into account and made to feel more at ease, with the provision of some suitable facilities with workspaces and connections to the internet. This result is important as air travel for business will most likely be one of the most affected forms in the post-pandemic world. As Schmalz et al. (2021) indicate, the development of communication technologies, the proliferation of high-speed internet connections, and cheap technical devices have benefited telecommuting, with online meetings replacing business flights and, in other cases, viable alternatives being sought such as private vehicles on short-distance routes.

In general, information to reduce stress and improve the quality of the passenger airport experience is essential for these two profiles. Thus, our results show that Information is a fundamental factor in the perception of service quality and, consequently, passenger satisfaction. There is absolutely no doubt that the more information the passengers receive, especially foreigners and travelers subject to a work schedule, the easier and more agreeable their passage through the airport will be, which will impact their global satisfaction. Clear and direct signage not only helps passengers but in the final instance offers an image of reliability and concern for travelers.

For all these reasons, analysis of passenger satisfaction surveys can help to improve airport performance, which results in increased revenue and better performance. So, if we take into account the factors in the airport manager's sphere the responsibility, economic resources should be aimed at attending to foreign and business passengers; optimizing on-screen information and distances, and strengthening security controls, among other things, but without ever overlooking the comfort, cleanliness, and hygiene of the terminal and the restrooms, and much more so now, in the current pandemic context.

Lastly, it should be highlighted that, as when strict security checks impacted the passenger's airport experience two decades ago, current different national mobility and health requirement regulations are making passengers feel less sure and more stressed. As our results show, airport management played a fundamental role in turning this perception round through a strong commitment to clean and friendly surroundings with clear signage, which turned airports into veritable test benches to extrapolate their user experiences to other infrastructure or events that require the same or similar operating procedures. Nonetheless, despite their rapid short-term response, which sparked a positive passenger perception during the first months of the pandemic, airports need to make an additional, longer-term effort to win back passenger satisfaction during this long-drawn-out period of uncertainty.

Author contribution statements

Lourdes Lopez-Valpuesta conceived the presented idea and supervised the project. Diana Casas-Albala contributed to sample preparation and Lourdes Lopez-Valpuesta processed the experimental data and performed the econometric model. Both authors discussed the results and contributed to the final manuscript.

Declaration of competing interest

Diana Casas-Albala is currently working in the HR department at the Seville Airport, which is managed by AENA (the public company that manages general interest airports in Spain). However, this does not cause any conflict of interest regarding her involvement in this work, which forms part of her research training at the University of Seville.

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