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DRIVERS OF AIRPORT SCHEDULED TRAFFIC IN EUROPEAN WINTER TOURISM AREAS: INFRASTRUCTURE, ACCESSIBILITY, COMPETITION AND CATCHMENT AREA

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ABSTRACT

Ski resorts in Europe are major tourism destinations that can generate traffic for their local airports. These airports can offer the airlines unparalleled accessibility to the resorts, but their catchment areas are typically not well populated. Local authorities are keen to develop scheduled flights but have failed many times in the past. In this context, there is no previous study that analyses the drivers of scheduled airport traffic in winter tourism regions. To that end, we compiled a large dataset of European airports and ski resorts and carry out a Poisson regression. Results show that catchment area, competition, and infrastructure outweigh accessibility to ski resorts as the main drivers of scheduled traffic at small mountain airports. This is linked to the dominance of low-cost carriers that prefer to operate out of major airports due to economies of density. Small airports are recommended to focus on premium markets with smaller aircraft.

Keywords: Winter Tourism, Airport Development, Ski Resorts, Poisson Regression.

1. INTRODUCTION

Ski resorts in Europe are major tourism destinations that can generate traffic for the airports in their vicinity, as well as a substantial economic impact to the surrounding communities (Lasanta et al., 2007). Ski resorts are typically located in remote, mountain areas, and several authors have noted the importance of accessibility as a driver of service quality for ski tourists (Konu et al., 2011; Zemła, 2008). Indeed, access cost (linked to travel distance) represents a substantial part of the cost of a skiing trip, particularly for international visitors (Godfrey, 1999; Miragaia and Martins, 2015). Hence, the resorts can benefit from non-stop airline connectivity (Perboli et al., 2015), complemented with good local transport services by road or rail to transfer between the airport and the resort (Flagestad and Hope, 2001). Regarding how accessibility can affect visitor choice, two opposite arguments can be made. On one hand, winter tourism markets in Europe are still dominated by charter airlines, where bundling of travel services (flight, transfer, accommodation, forfeit) is common (Perboli et al., 2015). Hence, passengers may not be sensitive to the cost of transfer services if it is included in the full price of the package. On the other hand, the strong penetration of low-cost carriers in European tourism markets during the last decades (Dobruszkes, 2013), and the consequent unbundling of travel services raises the question of whether winter tourists, and the airlines that serve this segment of demand, value the proximity to a ski resort when deciding to fly to a given airport.

This is a question of great importance for the airports located in areas with a high density of ski resorts. These airports, typically of small size and located in mountain regions, can offer the airlines unparalleled non-stop accessibility to the resorts. Trying to leverage on that competitive advantage, a common aspiration of local authorities and airport managers is to develop scheduled traffic, and, during the last decade, many failed attempts have been recorded. We can mention Bolzano, Aosta, or Annecy airports, that, despite their prime geographical location to support winter tourism, have either failed to sustain public service obligation (PSO) routes, or to justify the subsidy given to an air carrier for regular flights given the lack of traffic. Indeed, there is consensus in the airport business performance literature about the challenges of sustaining a profitable operation in small airports due to economies of scale (Martín et al., 2011). There is also an element of strong traffic seasonality if the airports serve highly touristic regions dominated by charter traffic, which creates challenges to plan and manage human resources (Halpern, 2008, 2011) and can decrease operational efficiency (Fernández et al., 2018). All these points justify the interest of airport managers to attract and sustain scheduled flights.

In this context, we note that there is no previous study that analyses the drivers of scheduled airport traffic in winter tourism regions. Thus, we aim to shed light on the question of whether small mountain airports can be successful in sustaining scheduled traffic based on their prime accessibility to ski resorts or they need to complement that characteristic with other desirable features to deliver a more attractive option to airlines. The chosen variables are given by the literature on airport business performance, which highlights the role of airport size, local population, and competition.

In order to achieve our research objectives, we compile a comprehensive dataset of commercial airports (with and without scheduled traffic) and ski resorts in Europe and employ a Geographical Information System (ArcGIS) to identify the relevant airport sample and obtain the accessibility measures. Given the scarcity of publications on small winter airports, we perform an exploratory analysis of our data to provide initial insights on the importance of the chosen variables to generate airport traffic and design our econometric approach. We then employ a zero-inflated Poisson regression, in which the indicators of infrastructure and competition are set as drivers of the propensity of the airports to capture zero scheduled traffic. This is a key differentiating aspect with respect to past papers, as we include airports without traffic in the analysis[1] and discuss, based on the estimated coefficients of the Poisson model, which ones have the highest potential to develop regular flights. The results from our analysis contribute to the literature on the sustainability of small tourist airports, which is almost exclusively geared towards analysing the effects of summer seasonality in coastal areas. In relation to the broader literature on tourism seasonality, we find the use of air traffic data to be common in this subject (e.g. Roselló and Sansó, 2017) and indeed the presence of strong winter seasonality has been documented for areas with high density of ski resorts (Ferrante et al., 2018). However, these studies employ country-level data that cannot be translated to the airport-specific approach we employ here.

The remainder of this paper is structured as follows: Section 2 introduces the literature on airport business performance that supports our choice of variables. Section 3 presents the small winter airports dataset and performs an exploratory data analysis to obtain insights of methodological relevance. In addition, the Poisson regression model is explained in detail. Section 4 presents the results and discusses their main implications. Section 5 concludes with a summary of the main findings.

2. AIRPORT BUSINESS PERFORMANCE

The importance of size, local population, and competition on airport business performance is well established in the literature. A common approach to evaluate the role of airport size is to define a break-even threshold in terms of annual passenger throughput. The traditional figure of 1 million annual passengers was determined by the seminal paper of Doganis and Thompson (1974), but this figure has substantially decreased with the strong development of non-aeronautical sources of revenue for airports in the last decades (Lei and Pagliari, 2013). The European Commission placed that threshold between 500,000 to 700,000 passengers (EC, 2002). Other studies that support the importance of airport size on profits or operational

[1] For example, the analysis of Perboli et al. (2015) about tourist airports in Italy does not include Bolzano Airport because it did not have regular traffic. These airports are the precisely the focus on this research.

efficiency are Fuerst and Gross (2018), Abruzzo et al. (2016), Fasone and Zapata-Aguirre (2016) or Tsekeris (2011), the latter highlighting the existence of economies of scale. Small airports, due to their reduced infrastructure cannot offer the airlines the ability to scale their operations. This links well with a common characteristic of small airports: short runway length, which can pose a restriction to the aircraft types that the airport can serve and thus become unattractive for airlines. Therefore, we will incorporate the impact of airport size in the analysis using a proxy related to the size of the available infrastructure.

Competition is also a key driver of airport business performance. Van Dender (2007) and Bel and Fageda (2010) note how airport revenues and the level of airport charges are negatively affected by the presence of nearby airports that can serve as viable substitutes for the airlines. This is of much relevance for small mountain airports, also in combination with the point above, since the presence of a larger hub in the same region can exert too much of a competitive pressure in terms of delivering the infrastructure and the scale of operations that the small airport cannot. Even low-cost carriers, that traditionally operated out of small, secondary airports due to lower airport charges, have recently moved to primary airports as part of their process of hybridisation (Morandi et al., 2015). Thus, the threat posed by major nearby airports must be included as part of our model.

Offering a strong catchment area is also a key element in attracting airline business (Doganis, 2009). A large population within a short distance to the airport can serve to mitigate the dependence on tourism flows to sustain traffic and allow the airline to serve both locals and visitors to boost their load factors. The positive impact of local population growth in the profitability of small airports was recently noted by Zuidberg (2017). From the perspective of small and remote mountain airports, this can become another source of competitive disadvantage since their catchment areas many be unattractive due to low population. Against that aspect, it is common that local authorities resort to PSO flights, particularly in Nordic countries and other sparsely populated areas in continental Europe (ITF, 2018). However, current European legislation emphasizes that PSOs should be used for domestic connections with the countries' capitals or the regional centres of population or economic activity. Thus, PSOs are not a suitable instrument to support international routes in tourist markets. Introducing measurements of catchment area into the model, like local number of residents within a certain distance, will allow us to characterize the relative strength or weakness of the sample airports in this aspect.

3. DATA AND METHODOLOGY

3.1. Airport sample

Based on the review of the literature, four aspects are considered when benchmarking the potential of small airports serving winter destinations to sustain scheduled air traffic: infrastructure (runway length), accessibility to ski resorts, catchment area (local population), and competition from alternative airports. The accessibility criterion is the key one, however, when determining which airports in Europe will be part of our sample of "small winter airports", which is the first step in our methodology. To that end, we combined two main data sources: one for airports and a second one with information about ski resorts. The raw airport dataset includes all commercial airports in Europe, with information about their geographical location, traffic data for the period 2009-2019 (aircraft movements), and infrastructure (number of runways and runway length). This was collected from OAG (Official Airline Guide) and the airports' Aeronautical Information Publications (AIPs). The second dataset provides information about 3,407 ski resorts in Europe, including their location and characteristics, such as km of slopes per level of difficulty ("black" slopes are the most advanced), the resorts' elevation difference (i.e. "steepness"), and their user rating. This represents 93.7% of all European resorts listed in www.skiresort.info that could be processed using the Google Maps Geocoding API. The data was then imported into ArcGIS for spatial analysis to determine the population and number of ski resorts located within the airports' catchment areas (one, two, and three-hour driving time). Population figures all refer to 2018 and come from ESRI's demographic databases provided with ArcGIS.

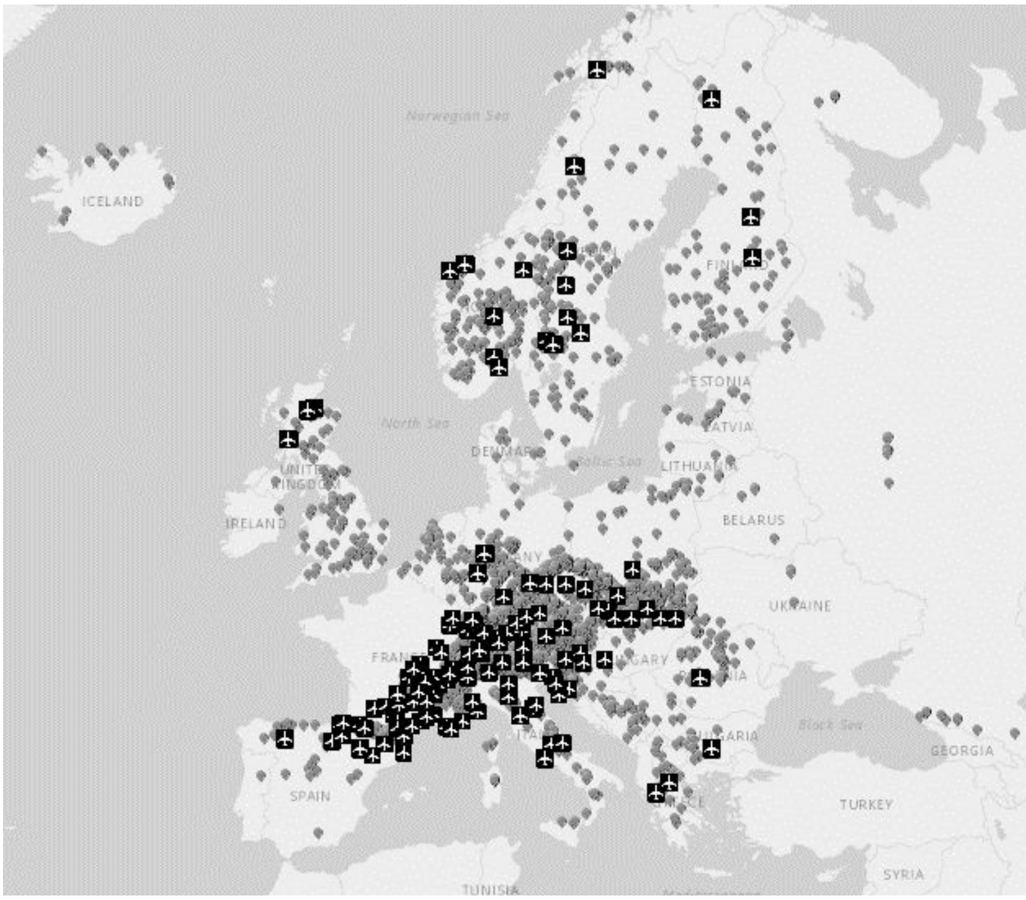

Figure 1. Dataset of European ski resorts and selected airports (black)
Sources: www.skiresort.info, OAG

A subsample of 104 "small winter airports" was selected from the broader airport dataset using the following criteria: a) maximum activity of 15,000 landings in 2018 (to remove large airports that are not within the scope of this research), b) minimum runway length of 1,200 m (to exclude airports that cannot safely operate an ATR-42), and c) minimum of 20 km of ski slopes accessible in less than 2 h driving time from the airport. The geographical distribution of the winter airport sample is shown in Figure 1 and, as expected, it includes airports from all major mountain ranges in the continent. More details are shown in Table 1. The most represented region (37 airports) is the Alps (primarily France, Italy, Switzerland, and Austria), whose airports are located in the most populated areas, also with the highest density and size of ski resorts (in terms of km of slopes). 10 small airports serve the Pyrenees (Spain, France and Andorra). These present a much lower density of ski resorts but the second highest resort size and the highest average elevation, which facilitates alpine skiing. On the contrary, the 17 airports serving Nordic resorts operate in more remote areas and with much less average elevation, which suggests a stronger focus on cross-country skiing.

Table 1. Breakdown of selected airports according to region

Region	*Alps*	*Carpathians*	*Pyrenees*	*Nordic*	*Scotland*	*Other*
Number of airports	37	7	10	17	2	31
Avg. elevation (m)	366	301	328	230	8	374

Avg. runway length (m)	2,093	2,607	2,242	2,037	1,576	2,061
Avg. Population 1h	1,669,596	1,065,168	937,639	73,028	123,174	1,183,170
Avg. Population 2h	7,135,018	5,289,610	4,226,427	317,321	376,713	6,687,203
Avg. Number of ski resorts 2h	122	98	9	11	4	46
Avg. length ski slopes 2h (km)	1,889	260	423	118	37	158
Avg. elevation difference (m)	412	181	645	283	256	256
Avg. share of black slopes	11.64%	8.92%	13.16%	14.75%	20.86%	9.12%

Sources: www.skiresort.info, ESRI

3.2. Exploratory analysis

The data used in this section can be found in Appendix A. Out of the 104 sample airports, 85 served scheduled traffic at any point in the last ten years (Winter 2009/2010 - Winter 2018/2019), but only 71 of them had scheduled flights in 2018. This leaves 14 airports that discontinued scheduled operations prior to 2018 and 19 airports that did not serve any scheduled flights in the last decade.

The challenge to commence and sustain scheduled operations can be first linked to the types of airlines that use these airports. As seen in Table 2, the market is led by low-cost carriers such as Ryanair and Easyjet, as it is common from point-to-point tourism markets in Europe (Dobruszkes, 2013). A key characteristic of this traffic is the use of a reduced pool of aircraft models (the most popular is the Boeing 737-800) around 180-190 seats. This has implications for small airports that want to tap into these international massive tourism flows: runway length becomes an obstacle if it is not long enough (at least 1,800-2000 m) to welcome the critical aircraft types. Domestic markets, however, do not present such important restrictions due to smaller aircraft. The airport's elevation and surrounding terrain can also become a problem as the need for special pilot training clashes with the cost-saving approach to human resources typically used by low-cost operators (Doganis, 2009). Carriers traditionally focused on the charter business also operate scheduled international frequencies on the same range of seat capacity than low-cost airlines.

Table 2. Top-ten scheduled airlines serving the sample airports (international flights only)

Airline	*Total arriving seats Winter 18/19*	*Arriving Frequencies*	*Avg. seats per frequency*
Ryanair	358,533	1,897	189
Lufthansa German Airlines	268,829	2,625	102
Easyjet	254,340	1,464	174
Austrian Airlines AG dba	242,628	2,681	90
Eurowings	214,713	1,646	130
Transavia.com	171,476	964	178
Air France	132,214	1,261	105
British Airways	114,138	860	133
Vueling Airlines	113,640	788	144
TUI Airways	104,124	524	199

Source: OAG

The traffic frequencies during the most recent winter season are shown in Figure 2 alongside the accessibility, catchment area, and competition variables. The latter separates between airports with and without a large competitor (more than 15,000 landings) within 2 hours driving distance. The chart indicates that exceptional accessibility to ski resorts is no guarantee of success due to the influence of other factors. We can see the gap in traffic levels between Annecy and Chambery (due to differences in runway length), and between Innsbruck and Sion, with the first operating in relative isolation within the Austrian Alps and the second under the shadow of Geneva Airport. There is also a clear trade-off between local population and airport competition: airports with a stronger local catchment area will also be more likely to face the competition of a large airport. A second trade-off can be seen between local population and accessibility, since the best mountain locations will tend to be less populated than low-elevation areas[2]. These two trade-offs suggest that a "sweet spot" of desirable conditions for small airports to develop scheduled winter traffic may exist. Most Austrian airports in the sample seem to benefit from these conditions: Innsbruck, Klagenfurt, Graz and Linz all have catchment areas between 500 thousand and 1.5 million residents, above-average accessibility to the resorts and little-to-no competition from major airports.

Figure 2. Accessibility, catchment area, competition, and traffic indicators for the sample airports
Sources: www.skiresort.info, OAG, ESRI, Own Elaboration.

In spite of that, scheduled winter traffic can also be found in airports with extremely small catchment areas. There is a cluster of primarily Nordic airports in the bottom left corner of Figure 2. Most of these airports only receive PSO traffic (which means that the impact of local regulations must be accounted for in our regression). A notable exception to the generalized PSO protection is Kittilä (Finland), an archetypical example of good accessibility to ski resorts in combination with a small catchment area leading to an extremely seasonal winter operation (Halpern, 2008). Other airports with extreme winter seasonality are Chambery and Grenoble, which do not typically serve scheduled traffic outside the winter season. However, this is not the general norm, and, in fact, many sample airports have their peak activity in the third quarter instead. This indicates that proximity to ski resorts can be a source of year-round traffic, as many resorts turn to hiking, trail running, and other types of adventure tourism during the summer. From a methodological perspective, the implication is that both annual and winter frequencies should be considered when analysing the role of accessibility to ski resorts as a driver of scheduled airport traffic.

[2] Indeed, the two variables are negatively correlated (see Appendix B).

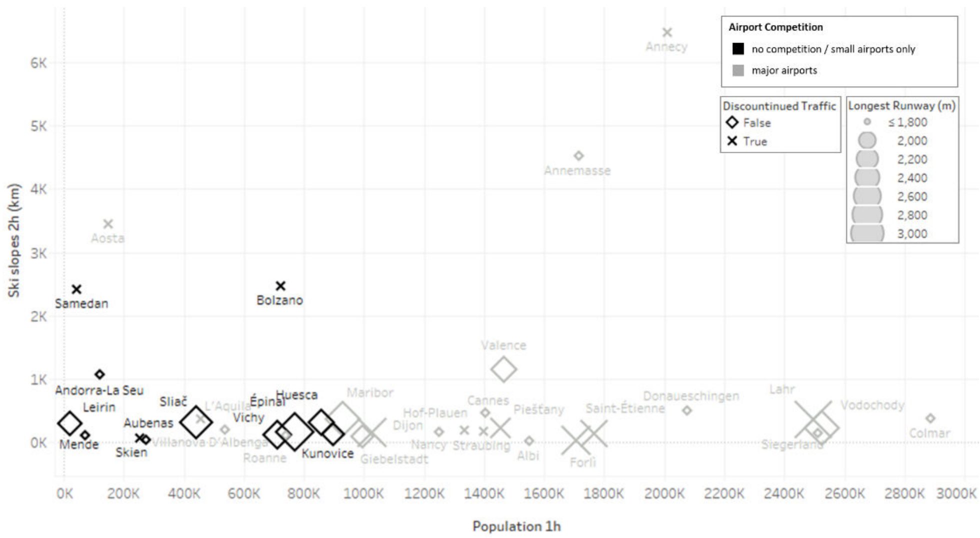

Figure 3. Accessibility, catchment area, competition, infrastructure, and traffic indicators for the airports without scheduled traffic

Sources: www.skiresort.info, OAG, ESRI, Own Elaboration.

Figure 3 plots the airports without scheduled traffic during 2018, separating the airports that discontinued traffic from those that never had scheduled flights. There are many examples of failed efforts to bring steady regular flights to these airports. These include cancelled PSOs (Annecy, Bolzano) or ineffective subsidies by local authorities that often own and operate the airports directly (Aosta, Straubing, Hof-Plauen, and St. Etienne). Figure 3 shows that all airports with a runway longer than 1,800 m that discontinued traffic faced the competition of a larger airport and those that without strong competition (e.g. Samedan) have short runways. This again suggests that infrastructure and competition may have an impact on the propensity of an airport to have no scheduled traffic. Looking at the case of Andorra-La Seu d'Urgell Airport (LEU), we hypothesize that an interaction may exist between both variables. Its very short runway (1,362 m) can extend the degree of competition further to include the primary hub airport Barcelona, which is more than 3 hours away from the ski resorts in the Eastern Pyrenees. Indeed, airlines like Jet2.com market scheduled routes to Andorran resorts out of Barcelona, where economies of density can be exploited with aircraft types that cannot operate from LEU.

In relation to accessibility and catchment area, the data reveals that most of the airports without scheduled traffic have either less than 1,000 km of slopes within a 2-hour catchment area or less than 200,000 residents within an hour driving time. However, we can find exceptions to this due to short runways and high competition (Bolzano, Valence, Annemasse, and Annecy). There are also airports with less accessibility, yet enough runways and low competition (e.g. Vichy, Huesca). In the presence of these complicated relationships between variables, it is difficult to argue which of these airports would offer the best conditions. Ranking the airports' potential to develop scheduled traffic requires first to determine whether the chosen factors have a significant influence on traffic, and, if any, which one is the most relevant. This justifies the use of a regression approach.

3.3 Zero-inflated Poisson regression

Based on the exploratory discussion above and the review of the literature, four alternative traffic indicators are considered as dependent variables: the scheduled arriving frequencies during 2018 (total and international), and the arriving frequencies during the winter season 18/19 (total and international). All these variables only take non-negative integer values and thus, they can be defined as count data. Poisson regressions are typically used when working with count data and they have been applied to model air traffic in the past (e.g. Mao et al., 2015). However, Poisson models assume that the mean of the dependent variable is equal to its variance. This assumption is not met by our traffic indicators, as shown in Table 3, as all of them present significant overdispersion. A key source of overdispersion in the data comes from the large number of airports with zero traffic. Thus, we employ a zero-inflated Poisson regression (Lambert, 1992), which models two separate data generation processes for each airport (one for zero counts and another for Poisson counts).

For airport i (Y_i), the zero-generating process is chosen with probability φ_i and the Poisson process with probability (1- φ_i):

(1) $\mu_i = \exp(x_i'\beta)$

(2) $P(Y_i = 0|x_i, z_i) = \varphi_i(z_i'\gamma) + \left(1 - \varphi_i(z_i'\gamma)\right)\exp(-\mu_i)$

(3) $P(Y_i = y_i|x_i, z_i) = (1 - \varphi_i(z_i'\gamma))\frac{\mu_i^{y_i}\exp(-\mu_i)}{y_i!}$

The φ_i probability is modelled against a subset of airport characteristics (z_i) using a logistic function with parameters γ to be estimated. The Poisson process has mean μ_i that is regressed against another subset of airport characteristics (x_i) using a log-linear specification with parameters β. The mean and variance of the zero-inflated Poisson model are given by:

(4) $E(y_i|x_i, z_i) = \mu_i(1 - \varphi_i)$

(5) $V(y_i|x_i, z_i) = \mu_i(1 - \varphi_i)(1 + \mu_i\varphi_i)$

As seen in Eq. 5, overdispersion is accounted for (i.e. variance is higher than the mean).

After the regression coefficients are estimated, we rank the sample airports with no scheduled traffic according to their predicted zero-inflated Poisson counts. This will show the airports that have the best conditions to attract scheduled airlines and shed light on the relevance of the different drivers of traffic included in this study.

3.4 Regression variables and descriptive statistics

As the variables in x (which affect the Poisson counts), we consider the following indicators that relate to the local catchment area and accessibility to ski resorts: a) the population (2018) within the 1-hour and 2-hour driving time catchment area, as well as the cross-border nature of the latter, which is a binary variable indicating if the local catchment area is domestic only (=0) or cross-border (=1). b) The number of ski resorts within the 2-hour catchment area, as well as the average resort size (in km of slopes), average user rating (0 to 5 stars from www.skiresort.info), and the average share of “black” slopes (most advanced level) per resort within the same 2-hour boundary. The Poisson equation is completed with a set of country-level fixed effects which capture two main aspects: 1) the level of government protection afforded to small airports with PSO routes that is characteristic of Nordic countries, 2) the differences in travel costs across ski destinations in Europe associated to differences in currency and price levels. This second aspect can have an impact on the attractiveness of ski resorts to attract international visitors and thus, on the ability of airports to capture this traffic.

Table 3. Descriptive statistics of the estimation sample

Variable	*No. observations*	*Mean*	*Std. Dev.*	*Min*	*Max*
frequencies (total)	104	1,431	2,392	0	14,250
frequencies (international)	104	689	1,716	0	12,293
winter frequencies (total)	104	546	937	0	4,861
winter frequencies (international)	104	241	655	0	4,067
population 1h	104	1,122,824	1,041,269	1,173	4,593,128
population 2h	104	5,353,253	4,576,341	21,440	23,109,768
cross-border 2h	104	0.63	0.48	0.00	1.00
no. resorts 2h	104	66.76	83.31	1.00	338.00
avg. km slopes 2h	104	16.11	15.57	0.89	75.75

avg. rating 2h	104	2.45	0.42	0.00	3.45
share black slopes 2h	104	0.12	0.05	0.00	0.30
main runway length (m)	104	2,113	545	1,246	3,500
short runway	104	0.32	0.47	0.00	1.00
airport elevation (ft)	104	1,086	873	7	5,600
no. airports 2h	104	3.07	2.10	0.00	8.00
frequencies largest airport 2h	104	48,808	60,952	0	242,944
frequencies largest airport 3h	104	93,486	73,629	0	242,944

As the variables in *z* (which affect the zero counts), we consider five indicators that relate to the suitability of runway infrastructure and the degree of competition faced by the airports: a) A "short runway" binary variable indicating if the longest runway is shorter than 1,800 m (=1), and the airport elevation (in ft). Both a shorter runway and higher elevation are expected to have a negative impact on traffic, particularly international, due to the restrictions on aircraft operations. b) the number of airports with scheduled traffic within a 2-hour-driving-time catchment area the number of annual arriving frequencies (2018) of the largest airport operating within the same 2-hour boundary. The zero-inflation equation is completed with an interaction between the short runway variable and the frequencies of the largest airport within 3 hours, to test if shorter runways extend the range of competition. These competition metrics are considered suitable drivers of the probability of a given airport to have zero scheduled traffic, as an airport with otherwise high levels of accessibility, infrastructure, and local catchment area, may not serve regular flights due to the presence of a large hub in the vicinity with superior connectivity or, if owned by the same operator, a predefined arrangement to concentrate all commercial traffic in one airport and leave the secondary airport for general aviation[3].

Table 3 provides descriptive statistics on the explanatory variables. Judging by the coefficient of variation (mean/std.dev.), the sample airports are most diverse in the number of accessible resorts and the frequency of the largest competitor, while they are most similar in average user ratings and runway length. The population variables also present a broad range, from the airport in Augsburg (Bavaria), which is close to more than 4.5 million residents, to the small remote airport in Hemavan (Sweden), with less than 1,2 thousand residents within an hour's driving time. The inclusion of such remote airports is necessary for the regression model to properly characterize the role of catchment areas in supporting scheduled traffic. The linear correlation coefficients between the variables are shown in Appendix B.

4. RESULTS AND DISCUSSION

The estimated coefficients of the four zero-inflated Poisson regression models are presented in Table 4. Vuong's test (Vuong, 1989) confirms the significance of the zero-inflated specifications with respect to the base Poisson. The regression results clearly indicate the importance of the airport's immediate catchment area (one hour driving time) as a driver of scheduled traffic since the coefficients are positive and significant at 95% confidence for all models. However, the results for the two-hour catchment area show a negative impact on traffic, which we interpret in relation to the strong correlation of this variable with the presence of a primary airport in the region (See Appendix B) that is more likely to dominate the international markets. Another conclusion is that airports with domestic catchment areas (i.e. located entirely within the airport's country) tend to be more successful in attracting regular frequencies, as opposed to those in cross-border regions. Since ski resorts have an extremely local economic effect (Lasanta et al., 2007), it is easier to justify offering public incentives for airline development if the economic benefits are going to remain in the same country. However, the negative impact is much lower in the international models, thus suggesting that cross-border regions are stronger in attracting international visitors.

[3] This allows our inflated model to discriminate between "true zeros" and "excessive zeros" (Greene, 1994).

Table 4. Estimation results of the zero-inflated Poisson equations

Dependent variable	*Frequencies (total)*			*Frequencies (international)*			*Winter frequencies (total)*			*Winter freqs (international)*		
	coeff.	*s.d.*	*prob.*	*coeff.*	*s.d.*	*prob.*	*coeff.*	*s.d.*	*prob.*	*coeff.*	*s.d.*	*prob.*
population 1h	2.2E-07	5.4E-09	0.000	6.9E-07	7.2E-09	0.000	1.5E-07	9.7E-09	0.000	6.8E-07	1.3E-08	0.000
population 2h	-1.3E-09	1.4E-09	0.346	-1.2E-07	1.9E-09	0.000	9.2E-09	2.4E-09	0.000	-8.5E-08	3.2E-09	0.000
cross-border 2h	-7.3E-02	7.9E-03	0.000	-1.1E+00	1.4E-02	0.000	-5.2E-02	1.3E-02	0.000	-1.3E+00	2.6E-02	0.000
no. resorts 2h	1.7E-03	5.8E-05	0.000	6.2E-03	8.3E-05	0.000	3.4E-03	9.3E-05	0.000	8.5E-03	1.4E-04	0.000
avg. km slopes 2h	-7.8E-03	3.6E-04	0.000	-4.2E-02	9.5E-04	0.000	-7.7E-03	5.8E-04	0.000	-2.4E-02	1.5E-03	0.000
avg. rating 2h	3.2E-01	1.1E-02	0.000	7.8E-01	4.2E-02	0.000	4.0E-01	1.6E-02	0.000	6.9E-01	7.2E-02	0.000
share hard slopes 2h	-7.6E+00	9.5E-02	0.000	-1.0E+01	2.3E-01	0.000	-6.8E+00	1.5E-01	0.000	-5.4E+00	4.1E-01	0.000
country_BG	-2.2E+00	5.1E-02	0.000	-2.1E+00	5.5E-02	0.000	-2.5E+00	9.8E-02	0.000	-2.6E+00	1.0E-01	0.000
country_CH	-1.4E+00	1.6E-02	0.000	-1.6E+00	2.1E-02	0.000	-2.2E+00	3.4E-02	0.000	-3.3E+00	5.4E-02	0.000
country_CZ	-1.9E+00	1.8E-02	0.000	-1.7E+00	2.1E-02	0.000	-2.6E+00	3.8E-02	0.000	-2.0E+00	4.4E-02	0.000
country_DE	-1.1E+00	1.5E-02	0.000	-1.7E+00	2.1E-02	0.000	-1.2E+00	2.4E-02	0.000	-2.3E+00	3.6E-02	0.000
country_ES	-5.7E-01	1.7E-02	0.000	1.4E+00	3.0E-02	0.000	-1.2E+00	3.4E-02	0.000	-4.4E-01	5.9E-02	0.000
country_FI	-7.5E-01	2.0E-02	0.000	-3.3E+00	5.7E-02	0.000	-2.2E-01	2.9E-02	0.000	-2.1E+00	6.9E-02	0.000
country_FR	-6.9E-01	1.2E-02	0.000	-7.0E-01	1.9E-02	0.000	-4.1E-01	2.0E-02	0.000	-6.2E-01	3.3E-02	0.000
country_GB	5.7E-01	2.0E-02	0.000	-1.3E+00	4.2E-02	0.000	6.1E-01	3.2E-02	0.000	-1.4E+00	7.6E-02	0.000
country_GR	-2.3E+00	3.6E-02	0.000	-2.5E+00	1.1E-01	0.000	-1.8E+00	5.1E-02	0.000	-3.9E+01	7.6E+06	1.000
country_HR	-1.3E+00	3.5E-02	0.000	-7.0E-01	4.2E-02	0.000	-1.9E+00	7.9E-02	0.000	-1.3E+00	1.1E-01	0.000
country_IT	-4.7E-02	1.4E-02	0.001	1.1E-01	2.1E-02	0.000	-7.1E-03	2.4E-02	0.766	-2.2E-01	3.8E-02	0.000
country_NO	-6.6E-02	1.6E-02	0.000	-2.3E+00	3.7E-02	0.000	2.6E-01	2.6E-02	0.000	-1.8E+00	6.7E-02	0.000
country_SE	-8.4E-01	1.8E-02	0.000	-4.3E+00	1.1E-01	0.000	-6.8E-01	2.8E-02	0.000	-2.4E+00	1.3E-01	0.000
country_SI	-3.5E+00	9.6E-02	0.000	-2.8E+00	9.7E-02	0.000	-1.8E+01	4.6E+02	0.969	-2.0E+01	1.0E+03	0.985
country_SK	-1.3E+00	1.9E-02	0.000	-1.1E+00	2.1E-02	0.000	-1.1E+00	3.3E-02	0.000	-6.7E-01	3.6E-02	0.000
constant	8.2E+00	2.8E-02	0.000	7.7E+00	9.4E-02	0.000	6.8E+00	4.2E-02	0.000	6.1E+00	1.6E-01	0.000
Excess zeros												
no. airports 2h	4.0E-01	1.5E-01	0.006	3.3E-01	1.4E-01	0.019	3.5E-01	1.3E-01	0.009	2.4E-01	1.3E-01	0.064
freq. largest airport 2h	2.5E-06	4.7E-06	0.592	-4.2E-06	5.0E-06	0.402	-1.4E-07	4.6E-06	0.975	-6.4E-06	4.9E-06	0.186
short runway	1.7E+00	8.3E-01	0.043	3.9E+00	1.2E+00	0.001	9.6E-01	7.8E-01	0.219	3.0E+00	1.1E+00	0.006
airport elevation	4.9E-04	2.8E-04	0.086	7.2E-04	3.1E-04	0.021	5.1E-04	2.6E-04	0.050	6.5E-04	3.1E-04	0.040
short rway*freq. lgest apt 3h	1.1E-06	6.2E-06	0.861	-9.5E-06	7.8E-06	0.222	3.1E-06	6.1E-06	0.611	-6.3E-06	7.5E-06	0.405
constant	-3.5E+00	7.6E-01	0.000	-2.7E+00	6.7E-01	0.000	-2.7E+00	6.4E-01	0.000	-1.7E+00	5.8E-01	0.004
Number of observations			104			104			104			104
Zeros			33			47			38			56
Likelihood ratio chi2(24)			55,421			68,015			27,685			26,267
Prob > chi2			0			0			0			0
Vuong test z			5.530			7.220			7.630			5.870
Prob > z			0.000			0.000			0.000			0.000

Note: "short rway*freq. lgest apt 3h" denotes an interaction between "short runway" and "number of frequencies of the largest airport within 3 hours"

In regards to the dimension of accessibility, the number of resorts available within two hours from the airport is what drives scheduled traffic (as noted by Perboli et al., 2015). This can be linked to the importance of diversity in the choice of slopes that Konu et al. (2011) discussed as a key segmentation criterion for visitors to ski resorts. The impact of diversity is much stronger when considering winter frequencies and international markets. The opposite is observed in relation to the average size of the resorts. This disagrees with Miragaia and Martins (2015) in that skiable distance drives the choice of resort. However, in peak season, large resorts can also be linked to congestion and overcrowding, and thus, detract from the users' satisfaction with the experience (Zemła, 2008). Results also highlight the positive impact of customer ratings and the negative impact of the level of difficulty of the slopes, which can restrict the choice of resort if travelling in beginner-level groups. The country-level dummy variables are mostly negative and significant since Austria, the country with the most traffic in the airport sample, is the one used as reference category. The consistently negative and significant coefficient of the Swiss airports (particularly for international winter frequencies) hints at the influence of high travel costs in reducing demand from European visitors. In addition, the relative ranking of the Norway coefficient in comparison with the other countries varies widely depending on the dependent variable (total vs. international traffic) due to the largely domestic focus of the PSO-driven airports.

The number of airports with scheduled frequencies within a two-hour catchment area was found to be the strongest indicator of the negative impact of competition, while the frequencies at the largest competitor did not present a significant coefficient in any of the models. As expected, having a short runway and a higher elevation increase the propensity of the airport to have zero scheduled traffic. The operating restrictions associated with runway length are more problematic for international markets, since domestic winter traffic in Europe can be served with smaller aircraft that can land and take off in shorter runways. Contrary to what was hypothesized, there is no significant effect of runway length on extending the geographical area of competition.

The 33 sample airports with zero scheduled traffic are ranked in Table 5 according to the predicted zero-inflated flight counts. These predictions are obtained by combining the airport's accessibility, infrastructure, competition, and catchment area characteristics with the estimated coefficients from Table 4, which represent the weights of the respective variables. We interpret the ranking of these predicted counts as an indication of the airports' relative potential (in comparison to the others) to attract and sustain scheduled traffic. Airports like Vichy, Forlì, Ingolstadt, or St. Etienne appear in the top ten positions for all different models. This clearly indicates that catchment area exercises the biggest influence on scheduled traffic, as none of these airports stands out in terms of accessibility to ski resorts with respect to other European airports in the sample. It is not surprising that three of these airports, as well as seven out of the top ten airports have had scheduled traffic in the past. The case of Vichy stands out, though, because it has not had regular flights in the last ten years, yet it is the only top ranked airport with a runway longer than 1,800 m and no competition from large airports (despite the many small airports in the Auvergne region of France).

Table 5. Ranking of the 33 airports without regular traffic according to their predicted potential

Airport	*Code*	*Discontinued traffic (1=TRUE)*	*Ranking frequencies (total)*	*Ranking frequencies (international)*	*Ranking winter frequencies (total)*	*Ranking winter frequencies (international)*
Forlì	FRL	1	1	1	3	2
Vichy	VHY	0	2	4	2	4
Bolzano	BZO	1	3	15	1	14
Dijon	DIJ	1	4	8	4	10
Ingolstadt	IGS	1	5	5	6	5
Saint-Étienne	EBU	1	6	3	7	3
Lahr	LHA	1	7	11	8	12
Skien	SKE	1	8	25	5	23
Giebelstadt	GHF	0	9	10	9	11
Villanova D'Albenga	ALL	0	10	24	11	25
Roanne-Renaison	RNE	0	11	20	10	16
Piešťany	PZY	1	12	9	13	7
Vodochody	VOD	0	13	6	27	9
Oberpfaffenhofen	OBF	0	14	2	12	1
Huesca	HSK	0	15	12	26	22
Aubenas	OBS	0	16	23	15	21
Nancy-Essey	ENC	0	17	14	22	17
Colmar	CMR	0	18	7	14	6
Valence	VAF	0	19	13	16	8
Straubing	RBM	1	20	16	21	19
Aosta	AOT	1	21	32	19	29
Albi	LBI	0	22	18	17	15
Cannes	CEQ	0	23	31	20	28
Andorra-La Seu d'Urgell	LEU	0	24	21	30	30
L'Aquila	QAQ	1	25	19	23	13
Kunovice	UHE	0	26	17	31	20
Annecy	NCY	1	27	29	18	24
Samedan	SMV	1	28	28	33	33
Hof-Plauen	HOQ	1	29	27	28	31
Mende-Brenoux	MEN	0	30	33	25	32
Annemasse	QNJ	0	31	30	24	26
Siegerland	SGE	0	32	22	29	18
Donaueschingen	ZQL	0	33	26	32	27

The airport in Bolzano (Italy) has the strongest predicted potential to attract scheduled winter traffic but only from domestic/short-haul markets. Despite its exceptional level of accessibility, its ranking falls when considering international markets on account of its short runway and the dominance of Innsbruck on the other side of the Alps. The airport failed to sustain a PSO route to Rome, served with a 50-seater Saab 5000 by Darwin Airlines, which was cancelled in Winter 2015, and charter flights (mostly domestic) last operated in summer 2018. There have been attempts in recent years to close the airport due to excessive public spending. The same applies to the Aosta Airport (Italy), in the heart of the Dolomites, which has an even shorter runway (1,246 m) and, in addition, it operates within the catchment area of Geneva airport. This explains its ranking in the bottom half of the list. Local authorities funded a regular connection to Rome operated by Air Vallee with a 32-seater Dornier 328jet. This endeavour also ended in failure in 2012 due to lack of traffic. Despite the difference in rankings between these two airports, we submit that they both illustrate the limitations of domestic/short-haul markets to sustain profitable airport/airline operations while delivering a massive, non-differentiated tourism product. In relation to international markets, these airports clearly face structural shortcomings that cannot be mitigated by just granting financial incentives to airlines. With a very short runway as well, the Government of Andorra is currently exploring alternatives to incentivize scheduled traffic to the airport of Andorra-La Seu d'Urgell. In the past, there have been attempts to commence flights with small aircraft but none of them was successful. The past experiences of similar airports, in combination with the low ranking in Table 5, indicate that there is a low probability for that airport to sustain scheduled traffic based only on its own characteristics.

Therefore, the main conclusion of this paper is that accessibility to ski resorts does not translate automatically into a higher potential. This can be linked to the dominance of low-cost carriers that are incentivized to operate out of major, more distant, airports due to economies of density. Despite the ability of low-cost tourists to unbundle travel services, the carriers still offer the ability to add car and transfer services to the customer's bookings. While the provision of disaggregated price information (as opposed to fixed bundle prices from charter operators) can increase the sensitivity of demand to transfer costs, this is not enough to boost the attractiveness of the airport with the best location.

Aside from infrastructure (which can only be expanded in the long run, and, in mountain regions, possibly facing strong environmental restrictions), airport managers and local authorities have little control over the drivers of traffic included in this study. Thus, small mountain airports with less-populated catchment areas and short runways face a big challenge to attract airlines. Based on the interpretation of the regression results and the subsequent ranking, we recommend airports to a) focus on premium demand segments where passengers place value on accessibility (which is usually the small airport's main strength), b) invest in differentiation (via e.g. destination marketing) and exclusivity of the service in order to reduce price sensitivity and boost operating margins for the airline, and c), if the runway limits international traffic, operate domestic routes with smaller aircraft that can reduce the incentives of the carriers to operate out of major airports, while enabling them to achieve break-even load factors from smaller catchment areas.

5. SUMMARY

This paper analyses the drivers of scheduled traffic for small airports serving European winter tourism destinations and ranks their potential to develop regular flights. To that end, a zero-inflated Poisson regression is carried out on a dataset of 104 small airports selected for their proximity to winter tourism attractions.

The results from the regression and subsequent ranking confirm the importance of the airport's immediate catchment area (one hour driving time) as opposed to the extended one (two hours), which is more likely to attract competition from other airports. Accessibility to ski resorts does not translate automatically into a higher potential for scheduled winter traffic. This is linked to the dominance of low-cost carriers that are incentivized to operate out of major, more distant, airports due to economies of density. Diversity in the choice of ski resorts is also a key driver of scheduled traffic, as opposed to the average size of the resorts. Results also highlight the positive impact of customer satisfaction ratings and the negative impact of the difficulty of the slopes. The number of airports with scheduled frequencies within the catchment area was found to be the strongest indicator of the impact of competition, while, as expected, having a short runway and a higher elevation increase the propensity of the airport to have zero scheduled traffic. The flight restrictions with short runways are more problematic for international markets, since domestic winter traffic in Europe can be served with smaller aircraft. However, past experience from the airports that have discontinued traffic suggests that domestic markets focused on a massive tourism product may not be sufficient to sustain airline operations. We recommend small airports to focus on premium markets where passengers place value on accessibility and exclusivity, invest in service differentiation, and keep serving routes with small aircraft that enable carriers to achieve break-even load factors with thinner traffic flows.

This paper is limited in its exclusive focus on scheduled traffic. Many of the selected airports with and without regular flights welcome charter flights in peak season. This has been excluded from the scope of this research because scheduled operations are the primary objective of local authorities when considering how to leverage their airport infrastructure to achieve steady and sustainable economic development in their regions. Still, future research could analyse whether the drivers of charter traffic at European winter destinations differ from those that apply to scheduled, low-cost traffic on account of the higher flexibility in terms of aircraft types. There is also the opportunity to apply our methodological approach to other countries and markets, such as the United States, as well as to expand the analysis to take into consideration airport revenues and profitability, on account on the public subsidies typically given to airlines in this context.

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APPENDIX A. Sample data

Country	*Airport Name*	*Scheduled arrivals 2018*	*Scheduled arrivals winter 18/19*	*Peak quarter*	*Discontinued traffic (TRUE=1)*	*Main runway length (m)*	*Population 1h (2018)*	*Ski slopes 2h (km)*	*Annual freqs largest airport 2h (2018)*
AT	Graz	6,662	2,598	3	0	3,000	1,359,102	822	0
AT	Innsbruck	5,167	3,090	1	0	2,000	593,471	5,407	0
AT	Klagenfurt	1,732	676	1	0	2,720	583,925	1,748	11,942
AT	Linz	2,553	790	3	0	3,000	1,356,718	1,057	8,278
AT	Salzburg	8,278	4,131	1	0	2,750	1,152,784	3,581	197,353
BG	Plovdiv	409	110	1	0	2,500	720,155	63	25,833
CH	Bern Belp	2,014	11	3	0	1,730	1,638,720	2,555	124,113
CH	Lugano	1,532	631	3	0	1,350	2,369,622	968	88,140
CH	Samedan	0	0	2	1	1,800	42,887	2,414	0
CH	Sion	322	18	1	0	2,000	611,161	4,890	72,963
CH	St Gallen	847	346	1	0	1,500	2,134,689	3,657	123,266
CZ	Brno-Tuřany	1,802	413	3	0	2,650	1,764,512	162	117,646
CZ	Karlovy Vary	208	78	1	0	2,150	691,314	189	65,356
CZ	Kunovice	0	0	0	0	2,000	898,347	128	7,080
CZ	Ostrava	1,606	221	3	0	3,500	1,648,226	295	12,141
CZ	Pardubice	309	60	3	0	2,500	832,857	262	65,356
CZ	Vodochody	0	0	0	0	2,500	2,523,657	219	65,356
DE	Augsburg	344	158	1	0	1,594	4,593,128	1,120	197,353
DE	Donaueschingen	0	0	0	0	1,290	2,076,877	502	124,113
DE	Friedrichshafen	2,990	1,252	3	0	2,356	1,573,386	2,824	124,113
DE	Giebelstadt	0	0	0	0	1,982	994,528	83	242,944
DE	Hof-Plauen	0	0	1	1	1,480	1,334,140	193	20,596
DE	Ingolstadt	0	0	1	1	2,940	3,899,604	629	197,353
DE	Lahr	0	0	3	1	3,000	2,496,296	351	54,225
DE	Memmingen	4,539	1,909	4	0	2,981	2,118,898	2,021	197,353
DE	Oberpfaffenhofen	0	0	0	0	2,286	4,288,268	2,049	197,353
DE	Paderborn	3,182	1,250	4	0	2,180	3,490,956	125	103,096
DE	Siegerland	0	0	0	0	1,620	2,510,854	145	242,944
DE	Straubing	0	0	1	1	1,350	1,396,664	173	197,353
ES	Andorra-La Seu	0	0	0	0	1,340	121,122	1,069	186
ES	Girona	5,984	594	3	0	2,400	2,835,280	164	160,115
ES	Huesca	0	0	0	0	2,100	858,288	303	1,608
ES	Leon	399	152	3	0	2,100	355,814	72	5,322
ES	Lleida-Alguaire	186	90	1	0	2,500	440,182	108	2,800
ES	Logroño	265	119	3	0	2,000	688,255	27	22,742
ES	Pamplona	1,530	610	3	0	2,207	947,477	269	22,742
FI	Kajaani	1,069	536	1	0	2,499	47,680	35	0
FI	Kittilä	1,307	1,035	1	0	2,500	7,686	116	0
FI	Kuopio	2,007	887	1	0	2,800	167,014	44	0
FR	Albi	0	0	0	0	1,560	1,550,504	23	42,314
FR	Annecy	0	0	1	1	1,630	2,010,262	6,482	72,963
FR	Annemasse	0	0	0	0	1,300	1,715,458	4,529	72,963
FR	Aubenas	0	0	0	0	1,425	275,035	27	725
FR	Aurillac	528	231	3	0	1,700	181,618	183	972
FR	Cannes	0	0	0	0	1,610	1,404,662	462	41,841
FR	Carcassonne	1,134	308	3	0	2,050	1,440,910	134	42,314
FR	Castres	776	329	3	0	1,825	552,195	23	42,314
FR	Chambéry	480	426	1	0	2,020	2,396,062	6,011	72,963
FR	Clermont-Ferrand	3,074	1,200	3	0	3,013	810,902	197	53,470
FR	Colmar	0	0	0	0	1,610	2,887,898	381	124,113
FR	Dijon	0	0	2	1	2,400	1,027,861	156	53,470
FR	Dole-Tavaux	318	126	4	0	2,231	1,112,862	296	53,470
FR	Épinal-Mirecourt	90	0	3	0	2,700	768,008	163	2,552
FR	Grenoble-Isère	836	637	1	0	3,050	2,988,471	3,776	72,963
FR	Le Puy-Loudes	466	203	1	0	1,393	280,121	192	3,074
FR	Lyon-Bron	2	0	4	0	1,820	3,581,799	2,794	72,963
FR	Mende-Brenoux	0	0	0	0	1,300	71,681	107	3,074
FR	Montpellier	8,707	3,214	3	0	2,600	1,629,180	28	41,841
FR	Nancy-Essey	0	0	0	0	1,400	1,250,740	164	26,266
FR	Pau	4,666	2,026	1	0	2,500	764,606	784	42,314
FR	Perpignan	2,095	674	3	0	2,500	808,321	398	8,707
FR	Roanne-Renaison	0	0	0	0	1,460	739,964	104	53,470
FR	Rodez-Marcillac	972	382	3	0	2,040	299,228	83	42,314
FR	Saint-Étienne	0	0	4	1	2,300	1,765,010	127	53,470
FR	Strasbourg	8,777	3,353	4	0	2,400	2,084,333	337	54,225

FR	Tarbes	1,419	458	2	0	3,000	608,010	974	42,314
FR	Toulon	3,091	1,049	3	0	2,120	1,055,493	29	41,841
FR	Valence	0	0	0	0	2,100	1,465,363	1,155	53,470
FR	Vichy	0	0	0	0	2,200	711,549	118	3,074
GB	Inverness	5,901	2,057	1	0	1,887	219,506	50	0
GB	Oban	536	254	1	0	1,264	26,842	25	0
GR	Filippos	95	51	1	0	1,822	157,736	76	0
GR	Ioannina	770	409	1	0	2,400	152,951	31	0
HR	Rijeka	947	171	3	0	2,488	259,154	25	19,078
IT	Aosta	0	0	1	1	1,246	149,469	3,450	72,963
IT	Bolzano	0	0	3	1	1,297	722,249	2,473	13,525
IT	Brescia	7	4	1	0	2,990	3,484,112	313	88,140
IT	Cuneo	415	126	3	0	2,104	1,190,535	569	18,594
IT	Forlì	0	0	1	1	2,410	1,707,460	24	31,660
IT	L'Aquila	0	0	2	1	1,409	455,795	358	151,537
IT	Parma	266	88	3	0	2,122	1,700,375	79	47,444
IT	Peretola	14,250	4,861	3	0	1,654	2,191,008	136	31,660
IT	Pescara	2,500	903	3	0	2,418	1,080,896	311	0
IT	Trieste	3,995	1,695	4	0	3,000	1,240,431	341	11,942
IT	Villanova D'Albenga	0	0	0	0	1,429	538,646	191	32,447
NO	Ålesund	6,013	2,389	1	0	2,314	82,991	77	0
NO	Leirin	8	0	1	0	2,049	19,836	287	0
NO	Molde	2,894	1,162	1	0	2,110	72,909	49	0
NO	Narvik	4,321	1,847	1	0	2,815	35,479	38	0
NO	Notodden	364	147	1	0	1,393	87,495	113	10,276
NO	Røros	606	268	1	0	1,720	14,051	93	0
NO	Skien	0	0	1	1	1,401	251,774	59	10,276
SE	Åre Östersund	3,622	1,712	1	0	2,500	83,822	244	0
SE	Borlange	634	67	3	0	2,310	211,121	79	0
SE	Hagfors	868	400	1	0	1,509	61,562	107	1,271
SE	Hemavan	430	245	1	0	1,601	1,173	71	2,359
SE	Mora	206	28	1	0	1,814	54,102	241	634
SE	Sveg	555	251	1	0	1,700	5,767	187	0
SE	Torsby	434	200	4	0	1,591	37,017	160	1,271
SI	Maribor	110	0	2	0	2,500	929,689	361	19,078
SK	Košice	3,053	1,014	3	0	3,100	768,239	156	0
SK	Piešťany	0	0	2	1	2,000	1,455,128	230	117,646
SK	Poprad-Tatry	209	91	3	0	2,600	481,897	541	3,053
SK	Sliač	98	0	3	0	2,400	439,826	312	209

APPENDIX B. Linear correlation matrix between the explanatory variables

	pop. 1h	*pop. 2h*	*cross-border*	*no. resorts 2h*	*avg. km slopes 2h*	*avg. rating 2h*	*share hard slopes 2h*	*main runway length*	*airport elevation*	*no. airports 2h*	*freq. largest airport 2h*	*freq. largest airport 3h*
population 1h	1.000											
population 2h	0.808	1.000										
cross-border	0.325	0.197	1.000									
no. resorts 2h	0.502	0.524	0.464	1.000								
avg. km slopes 2h	-0.055	-0.186	0.148	-0.216	1.000							
avg. rating 2h	-0.229	-0.326	-0.013	-0.279	0.649	1.000						
share hard slopes 2h	-0.261	-0.367	-0.081	-0.198	0.352	0.503	1.000					
main runway length	0.151	0.058	0.174	0.068	-0.086	-0.114	-0.228	1.000				
airport elevation	-0.107	-0.002	0.089	0.281	0.099	0.038	-0.008	-0.213	1.000			
no. airports 2h	0.684	0.690	0.177	0.272	0.046	-0.143	-0.277	-0.063	-0.084	1.000		
freq. largest airport 2h	0.670	0.753	0.196	0.575	-0.134	-0.273	-0.272	-0.040	0.087	0.515	1.000	
freq. largest airport 3h	0.503	0.683	0.224	0.588	-0.134	-0.204	-0.147	-0.119	0.116	0.377	0.605	1.000

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