The Relationship between Air Transportation and Tourism in Italy: A Composite Indicator for Italian Airports

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Abstract: *Tourism is strongly related to infrastructure and services: in this case should be mentioned the presence of low cost airlines, that have changed the dynamics of air travels and consequently of tourism, allowing cheap travels.*
According to this concept in the period of economical recession the development of such infrastructures as airports, railway stations, roads and their prices becomes very important to improve tourism sector in Italy. The attractiveness of the territories not only depends on the natural and cultural heritage but also on the level of areas' promotion and the level of development of infrastructures, services, means of transportation, hotels, prices, etc.
The aim of this paper is to construct a composite indicator that would explain airports' organization, where the important features are selected and weighted through the method of principal component analysis. To aggregate these components two methods were chosen: the first is the linear aggregation sum and the second is the rank method. Interesting results were attained implementing the correlation analysis to verify the robustness of two methods and the differences between them.
This work is the first step to comprehend the influence of the development level of infrastructures on domestic and international tourism.
Keywords: *air transportation; Tourism; Composite indicator; Attractiveness; Airports.*

1. INTRODUCTION

The most significant feature of tourism sector is the capacity to generate development and employment opportunities. In the actual period of economic recession, the countries that have tourist attractions are interested to stimulate the economy arising tourist arrivals and permanence through entertainments and special events, but it is important as well to create sufficient level of comfort for arrivals of tourists and their permanence in the destination points.
Nowadays tourism is a leading sector in Italian economy already due to the presence of many tourist attractions such as historical towns and monuments, museums, sea areas, natural parks. But only the presence of tourist attractions is not enough, since even the countries that have enough number of tourist attractions are unknown because of the lack of services and means of transportation.
The paper aims to analyze the importance for passengers of infrastructures' and services' quality in 39 italian airports through a composite indicator because the quality of these structures could improve mobility in Italy stimulating tourist arrivals via air transportation.

2. METHODOLOGY AND DATA

The key variables concern the year 2010, the source of data is Ente Nazionale per l'Aviazione Civile (ENAC) supplemented by information given on the airports' websites. To evaluate the importance of airports were selected the following significant variables that may actually affect passengers' choices:

1. distance to the centre of the nearest town;
2. low cost airlines that operate in airport;
3. number of gates;
4. number of check in desks;
5. number of infrastructures for direct access to airport: all kinds of roads, direct trains, ports.
6. opening hours of airports;
7. the area occupied by the airport;
8. traditional airlines that operate in airport.
9. typology of services: shuttle; taxi; helicopter leasing; airtaxy; car rental; bank or automatic teller machine (ATM); bar and restaurant; parking free; parking; hotel booking or travel agency; wireless; info point; baggage protection wrapping; tourist medical; shop; chapel; pharmacy; VIP Lounge; internet point; unaccompanied minors; hairdresser; post office.

The distance of the airport from the town centre is essential for choosing a place, because the airports that are relatively near the town could be considered more comfortable for tourists, in this case adequately organized means of direct access to the town situated nearby are very important for passengers. The presence of both: low cost airlines or traditional is important because it lets travelers to choose a type of travel on the basis of own economic capacity and so arises the number of trips.

Number of gates and check-ins are indirect indicators: in fact, increasing the number of gates increases the number of flights that can departure simultaneously, while a high number of check-ins may have influence on the speed of operations of departure. The size of airports is very important and obviously this variable is strongly correlated to the presence of services, number of gates and check-ins, etc. The presence of various kinds of services is another important feature of airports, because they let to spend the time of attendance with pleasure.

The first step of this work was to investigate the distribution of the variables to individuate outliers. The only variable characterized by high outliers is “opening hours”, so it was decided to eliminate this variable not to distort the analysis. After eliminating the variable, the distribution of all other variables was checked. The conducted analysis of the key variables have shown the necessity to exclude two particular cases: “Roma Fiumicino” and “Milano Malpensa”. These two airports were eliminated because the analysis could be distorted by extreme values (about three times higher than average). In particular, “Roma Fiumicino” and “Milano Malpensa” are the largest airports in Italy, so there are a lot of services, check-ins, desks, airlines etc. The first one in 2010 had 35.956.295 passengers; “Milano Malpensa” - 18.714.187 passengers, when the rest of the airports that we have analyzed had less than 10.000.000 passengers. So in the end the number of analyzed airports is 37 (Table 1).

Table 1: Descriptive statistics of key variables

	N	Minimum	Maximum	Mean	Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic
infr	37	,00	11,00	2,3243	2,14805
area	37	8	385	200,95	97,418
dist	37	1,0	37,0	10,014	8,1586
gates	37	1,00	24,00	10,1081	7,12891
checkin	37	2,00	74,00	22,7297	20,47851
serv	37	2,00	17,00	7,4324	3,43625
trad air	37	,00	22,00	4,4865	5,26847
low air	37	1,00	28,00	7,0811	5,83751
Valid N (listwise)	37				

To make the variables comparable, after exclusion of outliers, we have normalized 37 variables with the re-scaling method (1).

$$I_{qc}^{t} = \frac{x_{qc}^{t} - min_c\ (x_q^t)}{max_c\ (x_q^t) - min_c\ (x_q^t)} \quad (1)$$

After normalization we have evaluated the degree of correlation, and with the method of principal component analysis we have calculated the percentage of explained variance. These values of explained variance (EV) are multiplied for the factor scores (FS) of the rotated component matrix, that will stand for the weight for each variable (W):

$$W = EV \cdot FS \quad (2)$$

This weight of variable is multiplied for all normalized values in the variable.

To aggregate the weighted and normalized variables, the first method used is the linear aggregation with a simple sum of absolute values:

$$CI = \sum_{q=1}^{Q} w_q I_{qc} \quad (3)$$

Another method used is the summation of resulting ranking. The method is based on the ordinal information and the absolute values are lost:

$$CI = \sum_{q=1}^{Q} Rank_{qc} \quad (4)$$

To verify the robustness of the composite indicators, we used as dependent variable the flows of passengers in 2010 and we verified the various levels of correlation between these two composite indicators.

3 . RESULTS

The table of correlation shows that the variables the area occupied by the airport, gates; check-ins, services, traditional airlines and low cost airlines are strongly and significantly correlated (Table 2), so for this significant level of correlation, to estimate variables weights, we can use principal components method.

The existing literature offers a wide choice of alternative weighting methods. Statistical models such as principal components analysis (PCA) could be used to group individual indicators according to the degree of actual correlation.

Table 2: Correlation

		Dist	sed	gates	checkin	serv	infr	trad air	low air
dist	Pearson Correlation	1							
	Sig. (2-tailed)								
	N	37							
area	Pearson Correlation	,085	1						
	Sig. (2-tailed)	,619							
	N	37	37						
gate	Pearson Correlation	,128	,601**	1					
	Sig. (2-tailed)	,451	,000						
	N	37	37	37					
checkin	Pearson Correlation	-,136	,447**	,810**	1				
	Sig. (2-tailed)	,421	,006	,000					
	N	37	37	37	37				
serv	Pearson Correlation	,011	,530**	,514**	,599**	1			
	Sig. (2-tailed)	,948	,001	,001	,000				
	N	37	37	37	37	37			
infr	Pearson Correlation	-,075	,316	,113	,080	,066	1		
	Sig. (2-tailed)	,661	,056	,504	,637	,698			
	N	37	37	37	37	37	37		
trad air	Pearson Correlation	-,108	,384*	,465**	,540**	,559**	,042	1	
	Sig. (2-tailed)	,523	,019	,004	,001	,000	,807		
	N	37	37	37	37	37	37	37	
low air	Pearson Correlation	-,144	,345*	,467**	,580**	,542**	-,008	,847**	1
	Sig. (2-tailed)	,395	,037	,004	,000	,001	,964	,000	
	N	37	37	37	37	37	37	37	37

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Through analysis of the principal components, extracting all the components, 76% of variance is explained, in which the first factor represents 45,5%. Applying the Varimax rotation we have obtained the values of weights for all key-variables.

Table 3: Total Variance Explained

Comp	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var.	Cumul.%	Total	% of Var.	Cumul.%	Total	% of Var.	Cumul.%
1	3,779	47,242	47,242	3,779	47,242	47,242	3,651	45,642	45,642
2	1,231	15,383	62,625	1,231	15,383	62,625	1,289	16,112	61,754
3	1,086	13,569	76,194	1,086	13,569	76,194	1,155	14,440	76,194
4	,713	8,910	85,104						
5	,521	6,512	91,616						
6	,407	5,082	96,699						
7	,151	1,892	98,591						
8	,113	1,409	100,000						

Extraction Method: Principal Component Analysis.

In the table 4 is confirmed the importance of variables strongly correlated, the values of factor scores are in fact higher than others, while the variables linked to access and to the distance result as a the second and third factor. Principal component analysis groups collinear indicators creating a composite indicator on the basis the information that individual indicators have in common. The PCA method is to account for the highest possible variation in the indicator set using the smallest possible number of factors.
According to principal component analysis, weighting intervenes only to correct the overlapping information between correlated variables. In fact if no correlation between the variables is found, weights that were calculated to create the composite indicator cannot be estimated with the method of component analysis.
Varimax rotation changes the factor loadings (Table 3), the proportion of explained variance of the first component is (3,651/3,651+1,289+1,155)= 0,599; the second component is (1,289/3,651+1,289+1,155)=0,211; the third component is (1,155/3,651+1,289+1,155)=0,189. We have calculated the weights multiplying the factor scores (Table 4) with the variance explained so that the highest factor scores of the first factors are multiplied for 0,599 (size of airports, gates, check-in desks, typology of services, number of low cost airlines, number of traditional airlines), the variables in the second factor are multiplied for 0,211 (number of infrastructure direct accesses to airport) and the other for 0,189 (distance to the centre of the nearest town).

Table 4: Rotated Component Matrix

	Component		
	1	2	3
Dist	-,063	-,083	**,920**
Area	**,572**	,563	,270
Gate	**,767**	,262	,321
checkin	**,832**	,158	,002
Serv	**,774**	,127	,102
Infr	-,033	**,913**	-,146
trad air	**,843**	-,071	-,208
low air	**,854**	-,126	-,241

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

The table 5 highlights the dependence of ranking to the aggregation method, the result rankings differ a lot, so there is much difference between the linear aggregation and the method of ranking.
To verify the robustness of indicators with the different methods, we have used the correlation between the composite indicators and the traffic of passengers in each airport. The Pearson's correlation coefficient is 0,796 (Table 6) between passengers (y axe) and composite indicator calculated (x axe) achieved with the method of linear aggregation sum (fig.1); in the second figure changes only the x axe, that stands for other composite indicator calculated with the sum of ranks of the sub indicators is -0,766 (Table 7 - Fig.2).
The graphs represent the absolute values of the composite indicator on the x axe, the different signs of correlation coefficient are so because the first method for the best performances of the airports have the higher values, while in the ranking method to represent the best performance for each key variable correspond the lower value, and for this reason the correlation is negative.

Table 5: Ranks

Airports	Sum	Ranks
Milano Linate - E.Forlanini	1	1
Venezia - Marco Polo	2	2
Bologna - G.Marconi	3	4
Olbia - Costa Smeralda	4	14
Napoli - U.Niutta	5	8
Torino - Città di Torino	6	3
Pisa - G.Galilei	7	5
Bergamo - Orio al Serio	8	6
Verona - V.Catullo	9	6
Rimini - F.Fellini	10	9
Catania - F.Eredia	11	11
Brindisi - A.Papola	12	10
Palermo - Falcone e Borsellino	13	15
Bari - K.Woytila	14	12
Trieste – F.V.Giulia	15	13
Cagliari - M.Mameli	16	19
Roma Ciampino - G.B.Pastine	17	17
Ancona - R. Sanzio	18	18
Alghero - Riviera del Corallo	19	16

Airports	Sum	Ranks
Genova - C. Colombo	20	20
Lamezia Terme - S.Eufemia	21	22
Firenze - A. Vespucci	22	23
Treviso - A. Canova	23	27
Pescara - I.d'Abruzzo	24	29
Brescia - G. d'Annunzio	25	21
Perugia - S.F. d'Assisi	26	24
Forlì - L. Ridolfi	27	27
Crotone - S. Anna	28	26
Cuneo - Levaldigi	29	24
Bolzano - F. Baracca	30	32
Trapani - V. Florio	31	29
Reggio Calabria - T.Minniti	32	31
Parma - G. Verdi	33	34
Salerno - M. Martucci	34	32
Lampedusa	35	35
Pantelleria	36	35
Elba - Marina di Campo	37	37

Table 6: Correlations with composite indicator: linear sum method.

		passengers	CI_sum
passengers	Pearson Correlation	1	,796**
	Sig. (2-tailed)		,000
	N	37	37
CI_sum	Pearson Correlation	,796**	1
	Sig. (2-tailed)	,000	
	N	37	37
**. Correlation is significant at the 0.01 level (2-tailed).			

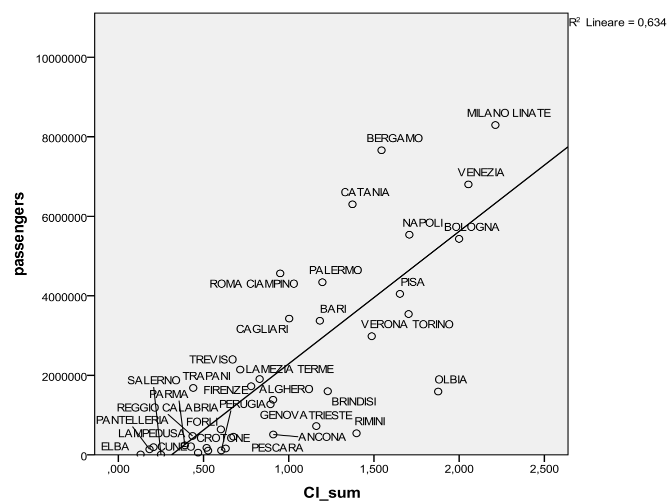
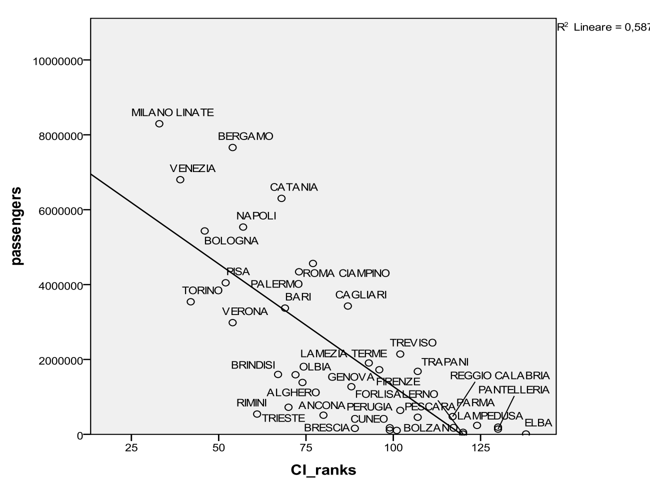


Table 7: Correlations with composite indicator: ranks method.

		CI_ranks	passengers
CI_ranks	Pearson Correlation	1	-,766**
	Sig. (2-tailed)		,000
	N	37	37
passengers	Pearson Correlation	-,766**	1
	Sig. (2-tailed)	,000	
	N	37	37
**. Correlation is significant at the 0.01 level (2-tailed).			



4 . CONCLUSION

From the analysis conducted could be suggested that the travellers prefer larger airports with a good presence of services, gates, check-ins, traditional and low cost airlines. The distance from airport to the town centre and the direct accesses to the airport are not such significant as other variables as the analysis of principal component presents. While the presence of low cost airlines could be considered the most important feature in the composite indicator constructed.

The rank of the airports depends on the choice of the used method of calculating the composite indicator (linear sum aggregation and the sum of ranks method). Observing the correlation between number of passengers and two composite indicators emerges that the linear sum aggregation method could be considered more adequate than the sum of ranks method to explain the passengers' choice. Should be considered that there is no big difference between the top-ranked ten airports, that are mostly located in the north of Italy. The only difference between the methods is that according the first method from the top ranked airports are excluded "Olbia - Costa Smeralda" and "Napoli - U.Niutta"; and according the second one "Napoli - U.Niutta" and "Brindisi - A.Papola". Since the most important airports are located in the north and centre of the country, the Southern region needs to invest in the airport structures more, because it could be a very important source of income. To stimulate tourist flows in the southern Italy destination points, arrivals and departure with all means of transports: trail, boats, cruises should be more comfortable and organized better. Moreover, the quality of airports is especially important for international tourists, for which a good organized infrastructure could be a reason to choose a destination point of the trip and to make a decision to come back.

The first step of this work was to implement two significant analysis methods to analyse the quality of the airports. The obtained results show that the chosen key variables represent the actual situation of the air transportation and the airports' condition.

The next analysis to conduct may be the study of the specific relation between quality of airports and attractiveness of Italian provinces for tourists as on the basis of the already analysed key variables, as on the basis of new ones.

References

Dall'Ara G., Morandi F., (2006), "I Sistemi Turistici Locali", Halley Editrice Srl, Matelica.

Gismondi R., Russo M.A., (2004), "Definizione e calcolo di un indice territoriale di turisticità: un approccio statistico multivariato.",XLII Riunione scientifica SIS

Maggino F., (2006), "Gli indicatori statistici: concetti, metodi e applicazioni", Firenze University Press, Archivio E-Prints, Firenze.

Morelli P., (2003), "Beni culturali e turismo nelle città d'arte italiane", Franco Angeli, Milano.

Nardo M., Saisana M., Saltelli A., Tarantola S. (EC/JRC), (2005),a cura di Hoffman A. and Giovannini E., Handbook on constructing composite indicators: methodology and user guide OECD, Statistics Working Paper

Osservatorio Nazionale del Turismo, (2009), "Il turismo balneare in Italia. Modelli, strategie e performance", Roma.

Osservatorio Nazionale sul turismo, (2008-2009-2010), "Vacanze degli Italiani - Indagine quantitativa sui comportamenti turistici degli italiani".

Osservatorio permanente sul turismo natura et al., (2008), "VI Rapporto ecotur sul turismo natura", Il Sole 24 Ore Business Media, Milano.

Pearce L. P., (1991), "Analysing Tourist Attraction. The journal of tourism studies", Vol.2, N.1.

UnionCamere Impresa turismo, (2008-2009-2010-2011), ISNART istituto nazionale ricerche turistiche (a cura di). Roma.