A priori assessing the quantitative effect of new investments on tourism flows: a Beta regression model

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Abstract: Planning and implementing strategies to develop tourism has long been a priority issue for policy makers and decision makers: hence, a remarkable interest for quantitative methods aimed to assess the extent to which possible modifications of some determinants can affect the tourism flows of the destination country. Over the last decades, indeed, in Italy as well as in many other destinations worldwide, most of policy makers have shifted their priority from the promotion of inbound tourism to the promotion of domestic tourism. In this framework, the present study builds on an Italian regional dataset and implements a beta regression model that allows to simulate and *a priori* assess the quantitative effect of making new investments, such as new accommodation facilities or new congress centres, on tourism flows, relative market shares and competitive position of any destination.

Key-Words: Domestic tourism, Italian regions, Beta regression model, Travel-in rate, Tourism planning

1 Introduction

Despite occasional shocks, tourism has shown over time a virtually uninterrupted growth. International tourist arrivals – or *inbound* tourists, defined as overnight visitors who travel to a country other than that in which they have their usual residence [13] – have increased from 25 million globally in 1950, to 278 million in 1980, 674 million in 2000 and 1186 million in 2015 (+4.6% over the previous year). The year 2015 was indeed the sixth consecutive year of above-average growth in international tourism following the 2009 global economic crisis. Likewise, international tourism receipts earned by destinations worldwide have surged from 2 billion dollars in 1950 to 104 billion in 1980, 495 billion in 2000 and 1260 billion in 2015 (+4.4% in real terms over the previous year) [4, 14, 15]. Tourism is actually an economic sector of major importance worldwide and its contribution to the economic welfare of the community will most likely continue to increase in future decades.

Also because of the opportunities it offers for both regional development and job creation, tourism has also experienced across time an increased international competition among destinations, "*triggered by factors like the reduction of transportation costs and the Information and Communications Technology (ICT) revolution. New destination have emerged, leading to a sharp reduction in the concentration of international tourist arrivals. In 1950, the top five countries in terms of international arrivals (USA, Canada, Italy, France and Switzerland) accounted for around 71% of international arrivals worldwide. In 2006 the corresponding value was 33%, and the list of top five destinations changed (in that year, they were France, Spain, USA, China and Italy)*" [18]. As a result, planning and implementing strategies and programs to develop tourism has become a major concern for policy makers and decision makers.

Over the last decades, indeed, tourism strategists have shifted their priorities from the promotion of inbound tourism to the promotion of *domestic* tourism [7], involving residents of a given country travelling within the country itself [4, 14]. This component accounts by far for most of the total tourism activity: it is estimated that more than 80 per cent of the tourist arrivals worldwide per year correspond to domestic tourism [7].

From decision makers' point of view, some relevant issues stem from this framework. Why do people prefer a destination to another one? Or, in other words, why do some destinations experience a much higher visitor interest than others? What modifications in the tourism policy, what regional planning, what new investments, if any, could persuade people to change their preferences about the destination region? What interventions could enhance, or just preserve, the tourist attractiveness of an area?

The present study builds on an Italian regional dataset and fits a beta regression model with the aim to assess the extent to which possible modifications in some determinants of domestic tourism can affect people's destination preferences. The relevance of the paper really consists in offering to strategists and a powerful and versatile tool to *a priori* assess the quantitative effect of new investments on the tourism flows, the relative market shares and the competitive position of any destination.

The paper is organized as follows. The following Section discusses some preliminary issues about recent trends of Italian tourism flows, describes the outline of the study and review some technical notes about the proposed modelization. The case-study is described and the model is fitted in Section 3. Section 4 shows how the model can be used and presents the results of a simulation study; finally, it also draws some concluding remarks.

Table 1: Internal tourism in Italy (2010-2015): domestic *versus* inbound tourism flows (arrivals and nights)

Year	Domestic		Inbound	
	Arrivals	Nights	Arrivals	Nights
2010	55019507	210340052	43794338	165202498
2011	56263060	210420670	47460809	176474062
2012	54994582	200116495	48738575	180594988
2013	50599125	184423279	48623439	180046980
2014	54916852	190978299	51635500	186792507
2015	58320992	200155956	55033682	192607930

(source: ISTAT, Osservatorio Nazionale del Turismo)

Table 2: Domestic tourist arrivals and nights in Italy (2010-2015): percentage difference over the previous year

Year	Domestic		Inbound		Internal	
	Arrivals	Nights	Arrivals	Nights	Arrivals	Nights
2010	—	—	—	—	—	—
2011	2.26	0.04	8.37	6.82	4.97	3.02
2012	-2.25	-4.90	2.69	2.34	0.01	-1.60
2013	-7.99	-7.84	-0.24	-0.30	-4.35	-4.27
2014	8.53	3.55	6.19	3.75	7.39	3.65
2015	6.20	4.81	6.58	3.11	6.38	3.97

(source: ISTAT, Osservatorio Nazionale del Turismo)

2 Preliminary issues

2.1 Recent patterns and trends in Italian domestic tourism flows

With over 113 million arrivals and almost 393 million nights in 2015 (Tab. 1), tourism confirms to be one of Italy's most profitable economic activities: it generates 171 billion euros (11.8% of national Gross Domestic Product) and 3.1 million jobs (12.8% of jobs, considering direct and indirect impact and satellite activities) [*source*: ISTAT]. After a serious drop in 2012 and 2013 (Tab. 2), Italian internal tourism – consisting of both domestic and inbound tourism [4] – has shown indeed an impressive recovery in 2014 (+7.39% and +3.65% over the previous year, respectively), which has been confirmed in 2015 (+6.38% and +3.97% over 2014, respectively).

Table 3: Domestic tourism weights (%) on the internal tourism flow in Italy (2010-2015)

Year	Domestic arrivals (%)	Domestic nights (%)
2010	55.68	56.01
2011	54.24	54.39
2012	53.02	52.56
2013	51.00	50.60
2014	51.54	50.55
2015	51.45	50.96

(source: ISTAT, Osservatorio Nazionale del Turismo)

Table 4: Domestic tourism weights (%) at regional level (2013-2015) : region = 100

Italian regions	2013		2014		2015	
	Arrivals	Nights	Arrivals	Nights	Arrivals	Nights
Abruzzo	87.52	85.87	87.66	86.15	88.51	86.60
Basilicata	86.76	91.16	85.91	89.76	85.78	90.06
Calabria	82.73	79.21	82.80	79.15	83.32	79.80
Campania	56.96	54.21	57.92	54.72	55.91	54.01
Emilia-Romagna	72.29	73.01	72.55	72.24	73.09	73.70
Friuli-V. Giulia	50.14	47.19	49.41	45.67	49.37	45.62
Lazio	35.29	33.13	34.81	32.89	35.75	37.96
Liguria	55.73	60.22	55.52	60.50	54.87	59.96
Lombardy	48.65	43.17	48.21	42.62	48.02	42.59
Marche	82.50	82.20	82.35	81.81	82.76	81.12
Molise	91.26	90.51	90.46	89.95	91.04	90.43
Piedmont	65.15	60.17	64.64	60.56	59.89	56.18
Apulia	80.93	81.69	79.71	80.81	78.74	80.22
Sardinia	53.91	54.05	54.19	53.21	53.68	52.89
Sicily	55.22	50.67	55.80	52.19	55.67	51.98
Tuscany	44.02	45.74	44.92	46.34	44.69	46.04
Trentino	44.16	41.48	43.15	40.08	44.68	41.19
Umbria	70.99	63.56	70.39	63.53	70.39	63.16
Aosta Valley	64.60	62.50	61.75	59.43	62.76	60.37
Veneto	34.49	33.57	34.83	33.23	35.02	33.27
Italy	**51.61**	**50.96**	**51.54**	**50.55**	**51.45**	**50.96**

(source: ISTAT, Osservatorio Nazionale del Turismo)

More than half of the internal tourism is generated by the domestic component (Tab. 3), which has shown an upward trend over the last years: after a shock in 2013, domestic arrivals and domestic nights have actually shown an average growth rate of 7.36% and 4.18% in the period 2013-2015.

Table 5: Domestic tourism shares (nights %) of Italian regions in 2015 and 2007: Italy = 100

2015		2007	
Molise	0.2	Molise	0.3
Basilicata	1.0	Basilicata	0.8
Aosta Valley	1.0	Aosta Valley	1.0
Friuli-V. Giulia	1.8	Umbria	1.9
Umbria	1.9	Friuli-V. Giulia	2.4
Abruzzo	2.6	Piedmont	2.8
Calabria	3.2	Abruzzo	3.0
Sardinia	3.3	Calabria	3.4
Piedmont	3.8	Sardinia	3.8
Sicily	3.8	Sicily	4.1
Liguria	4.3	Apulia	4.6
Marche	4.9	Liguria	4.8
Campania	5.1	Lazio	5.0
Apulia	5.4	Marche	5.3
Lazio	6,0	Campania	5.4
Lombardy	8.1	Lombardy	6.5
Trentino	9.4	Trentino	9.1
Tuscany	10.2	Tuscany	10.2
Veneto	10.5	Veneto	12.0
Emilia-Romagna	13.5	Emilia-Romagna	13.6
Italy	**100.0**	**Italy**	**100.0**

(source: ISTAT, Osservatorio Nazionale del Turismo)

The prevalence of the domestic tourism registered at national level is also confirmed in the period 2013-2015 in almost all regions (Tab. 4). Among the exceptions, where the inbound component overcomes the domestic tourism flows for both arrivals and nights, there are regions belonging to the richest area of Italy such as Veneto, Lazio, Trentino, Friuli, Lombardy and Tuscany.

As regards domestic tourism shares of Italian regions (Italy = 100), they do not show substantial changes in 2015 with respect to 2007 (Table 5). However it is worth noting that nine regions maintained the same position in the ranking (Emilia-Romagna, Veneto, Tuscany, Trentino, Lombardy at the top, Sicily in the middle, and Molise, Basilicata, Aosta Valley at the bottom), four regions improved their own position (Umbria, Piedmont, Apulia, Lazio), while the remaining seven regions dropped down in the rank order. In this scenario, it is fundamental to address some issues: what can regions do to compete and increase, or at least preserve, their relative market shares? What can regions do to pursue strategies for tourism development that enable them to achieve economic and social goals? These are important questions for any tourism destination today.

Fig.1: Interregional tourism flows across Italian regions (year 2012). To simplify the structure, links smaller than 300000 units are not displayed.

2.2 *Outline of the study*

In this paper, domestic tourism flow in Italy is analyzed in terms of interregional tourism flows. It can be thought and graphically represented by a network, where the nodes are the regions (the first-level administrative divisions in Italy: sub-national territorial decision areas where tourism management and planning can develop) and the links are directed connections between two nodes. By way of example, Figure 1 shows a map chart where the colors of Italian regions change gradually between the dark blue and the light blue according with the number of arrivals in the reference time period (year 2012): the darker the blue color, the greater the number of tourists that visited the region in the period.

Indeed, the core measure we propose to investigate the factors why do domestic tourists prefer a region rather than another one is the *travel-in rate* (TIR). It is a normalized indicator of the domestic tourism inflow into each region, computed as the ratio of the number of visitor arrivals in the region to the total number of national arrivals in Italy within a time period. This measure ranges from 0 (no arrival in the region) to 1 (all arrivals concentrated in a single region): the larger the TIR, the larger the attractiveness of the region in terms of domestic tourism inflow. On this basis, it is straightforward for any decision maker to distinguish "critical" regions, characterized by low attractiveness rates, from "successful" regions, characterized by travel-in rates close to one.

In addition, the regional TIR indicator can be used as response variable in a beta regression model to investigate its relation with some explanatory variables (such as the number of accommodation facilities, congress centers, theme parks, etc.), in such a way to identify the statistically significant determinants that cause people to prefer a region to another one.

Finally, since the final aim of the study is prediction, a cross validation procedure is performed to validate the model: it allows to assess how the results can be generalized to an independent dataset or, in other words, how accurately the model will perform in practice. If the result of the cross-validation is a low value of the root mean square error (RMSE), the fit model can be properly used to simulate the effect of a new investment in any region and assess the change of the regional TIR *before* really making the investment itself.

2.3 Some technical notes about beta regression model

Beta regression model is tailored for situations where the response variable y takes on values within the real open interval (0, 1). For such variables, that tipically stem from rate and proportions, the normality assumption underlying the linear regression model is not supported: bounded range continuous variables usually display heteroscedasticity (the variance is smaller near the extremes) and asymmetry; linear fitted values could exceed the lower and upper bounds of y, resulting in invalid and misleading outcomes.

Instead, the beta distribution is a very flexible model for variables within the standard unit interval: its density, given by

$$f(y;p,q) = \frac{\Gamma(p+q)}{\Gamma(p)\Gamma(q)} y^{p-1}(1-y)^{q-1} I_{(0,1)}(y) \quad (1)$$

can have quite different shapes depending on the values of the two parameters $p>0$, $q>0$, and can accommodate skew and asymmetry. The expected value and the variance of y are $E(y) = p/(p+q)$ and $V(y) = pq/[(p+q)^2(p+q+1)]$. For modelling purposes, a different parameterization of the beta density was proposed by Ferrari and Cribari-Neto [4] by setting $\mu = p/(p+q)$ and $\varphi = p+q$, i.e. $p = \mu\varphi$ and $q = (1 - \mu)\varphi$:

(2)

where $0<\mu<1$ and $\varphi>0$. The expected value and the variance of y, in the new parameterization, are $E(y) = \mu$ and $V(y) = \mu(1-\mu) / (1+\varphi)$, so that μ is the mean of y and φ can be regarded as a precision parameter: for fixed μ, the larger the value of φ, the smaller the variance of y.

Let $y_1, \ldots, y_j, \ldots, y_n$ be independent random variables, where each y_j, $j = 1,\ldots, n$ is Beta distributed with mean μ_j and unknown precision φ, and $(x_{j1}, \ldots, x_{ji}, \ldots, x_{jk})$ be observations on k covariates, which are assumed as fixed and known. The beta regression model can be written as

$$g(\mu_i) = \sum_{i=1}^{k} x_{ji}\beta_i \quad (3)$$

where $\boldsymbol{\beta} = (\beta_1, \ldots,\beta_i \ldots, \beta_k)' \in \Re^k$ is a vector of unknown regression parameters and $g(\cdot)$ is a strictly monotonic and twice differentiable link function that maps (0, 1) to $\Re$. Several choices are possible for the link function$g(\mu)$, such as the logit function $\log[\mu/(1-\mu)]$ (the inverse cumulative distribution function of the logistic) or the probit function $\Phi^{-1}(\mu)$ (the inverse cumulative distribution function of the standard normal variable). Extensions of the beta regression model outlined above were proposed by Smithson and Verkuilen [9], Simas, Barreto-Souza and Rocha [8], Cook, Kieshnik, McCullogh [2] among others.

3 Case study and results

Dataset of the study consists of the national arrivals in the twenty-one Italian regions in 2012 (regions are twenty-one instead of twenty because South Tyrol Trentino was split in two autonomous provinces: Bolzano and Trento). The travel-in rate has been computed for each region and assumed as response variable of a Beta regression model. Table 1 shows travel-in rates for some critical regions, *i.e*. regions characterized by TIR lower than 3 per cent. For example, Aosta Valley presents 672278 arrivals on a total of about 55000000 arrivals in Italy: its travel-in rate is equal to 1.22%. In addition, the value of the following potential predictors of the TIR have been observed or computed for each region [*Sources*: GeoWebStarter[1], I.Stat[2], MOVIMPRESE[3]]:

- *district:* number of towns in the region;
- *pilgrimage:* number of pilgrimage areas;
- *outlet:* number of great shopping centres (we consider just centres having more then 10 stores);
- *parks:* number of theme parks (we consider just parks having more than 85000 square meters);
- *hospitals:* number of public and private hospitals divided by the number of districts;
- *facilities1:* number of hotel facilities;
- *facilities2:* number of others accommodation facilities;
- *congress*: number of exhibitions and conference centres;
- *food*: number of food services.

Table 1: Critical regions within the Italian tourism network (total arrivals in 2012: 54994582)

Regions	*Arrivals (I)*	*TIR (%)*
Aosta V.	672,268	1.22%
Friuli	1,088,400	1.98%
Umbria	1,561,746	2.84%
Abruzzo	1,386,602	2.52%
Molise	164,923	0.30%
Basilicata	457,302	0.83%
Calabria	1,264,836	2.30%
Sardinia	1,247,003	2.27%

[1] It is a web platform for the analysis of socio-economic phenomena of territory, provided by GuglielmoTagliacarne Institute of Unioncamere.

[2] It is a warehouse of statistics currently provided by Italian National Institute of Statistics.

[3] It is the quarterly statistical analysis of the birth/death rate for businesses, run by InfoCamere.

The R package `betareg` [3] was used to fit a Beta regression model with a probit link, where the travel-in rate depends on all factors listed above. Bias corrected ML estimates [5] of the β_i parameters are numerically obtained by using the BFGS method and are shown in Table 2, together with their own statistical significance: the number of outlets, hotels and other accommodation facilities as well as the number of hospitals are significant predictors of TIR. The *estimated* travel-in rate $\hat{y}_j$ for each region (j = 1, …, n, where n=21) can be written as

$$\hat{y}_j = g\left(\hat{\mu}_j\right) = \sum_{i=1}^{k} x_{ji}\hat{\beta}_i \quad (4)$$

The explained variation is 86% of the total variation (pseudo R-squared = 0.8579) and a ten-fold cross-validation yields a reasonable value for the root mean square error (RMSE = 0.045).

Table 2: Beta regression model: bias corrected ML estimates and their statistical significance.

	β_i estimates	*Significance*
(Intercept)	-2.34900	<0.000***
district	0.00018	0.0791 ·
pilgrimage	0.02590	0.638
outlet	0.08584	0.0329 *
parks	0.00482	0.8945
facilities1	0.00011	0.0133 *
facilities2	0.00001	0.0136 *
hospitals	1.37300	0.0243 *
congress	-0.00016	0.1278
food	0.00000	0.6842

4 Simulation study and conclusions

A simulation study was performed with the aim of investigating the effect of modifications of the initial conditions on the travel-in rates.

Table 3: Critical nodes: values of the covariates and model estimates $\hat{y}_j$

Critical nodes	outlet	facilities 1	facilities 2	hospital	$\hat{y}_j$	*arrivals*
Aosta V.	0	482	576	0.0270	1.26%	672268
Friuli	2	742	4347	0.0833	2.83%	1088400
Umbria	0	554	3324	0.1630	2.40%	1561746
Abruzzo	1	800	1580	0.0951	2.33%	1386602
Molise	0	108	429	0.1103	1.35%	164923
Basilicata	0	238	567	0.1221	1.42%	457302
Calabria	0	840	1900	0.1418	2.21%	1264836
Sardinia	0	913	3191	0.1087	2.07%	1247003

Table 3 shows the values of the covariates that enter the model (4) and the estimates y_j for the critical nodes displayed in Table 1, while Table 4 shows the new estimates y_j after generating the following (quite hypothetical) modifications in the covariates:

– for all critical regions except Friuli, the determinant “outlet” = 0 was modified by hypothesizing the presence of one commercial centre;

– for all regions, the covariate “facilities 2” was modified by simulating an increase of 5 per cent in the value (due for example to the launch of new bed-and-breakfasts).

In all critical regions, these perturbations successfully increase the travel-in rate: for example, the estimated TIR of Calabria is assessed to increase from 2.21% (Table 3) to 2.70% (Table 4).

Table 4: Simulation studies: perturbed values (in bold) and new model estimates y_j

Critical nodes	outlet	facilities 1	facilities 2	hospital	y_j	*arrivals* in_{est}
Aosta V.	**1**	482	**605**	0.0270	**1.56%**	**859621**
Friuli	2	742	**4564**	0.0833	**2.84%**	**1561139**
Umbria	**1**	554	**3490**	0.1630	**2.94%**	**1616737**
Abruzzo	1	800	**1659**	0.0951	**2.34%**	**1287559**
Molise	**1**	108	**345**	0.1103	**1.67%**	**918071**
Basilicata	**1**	238	**490**	0.1221	**1.76%**	**969701**
Calabria	**1**	840	**1995**	0.1418	**2.70%**	**1484807**
Sardinia	**1**	913	**3351**	0.1087	**2.55%**	**1400818**

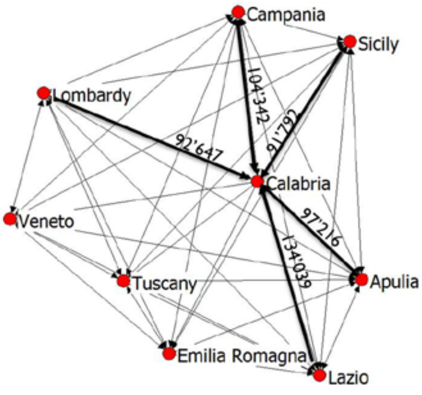
From a graphical point of view, the modifications in the determinants yield changes in the *weights* of the linkage structure of the network. For convenience, refer to an *ego network*, consisting of a focal node (*ego*) and the nodes (*others*) whom ego is directly connected to plus the ties, if any, among the others. Fig.2(a) displays the ego network of Calabria before the simulation, while Fig.2(b) shows the same network after the simulation. A cut-off of 50’000 units, below which the link is not included in the network, was adopted for both figures. The number of tourist arrivals (that represents the *weight* of the link) from a given region is shown for each entering link of Calabria. The sum of the weights of all entering links is called *in*-degree of the node and indicated by *I*. The graph shows that Campania, Apulia, Lombardy, Lazio and Sicily are the nodes from which tourists arrive in Calabria. Hence, given the estimated travel-in rate y_j=0.027 (Table 3), the new *in*-degree of Calabria $\hat{I}_j$ can be assessed as:

$$\hat{I}_j = \frac{\hat{y}_j \cdot I_j}{(TIR)_j} = \; 0.027(1264836)/0.023 \qquad (5)$$

where *j* indicates Calabria. The weight of its links increased from 1264836 to 1484807: the level of criticality of Calabria decreases.

In conclusion, in the context of tourism strategies planning, this study set out to provide some technical tools to assess the extent to which possible modifications in some determinants of tourism flows can affect people’s destination preferences. Beta regression model appears to be a valid technique to predict the evolution of a system whose critical points are characterized in terms of a normalized indicator ranging from zero to one. It also provides a natural guide to future research: for example, it could be interesting to study whether and how the technique can be extended and applied to international tourism inflows.

a)



b)

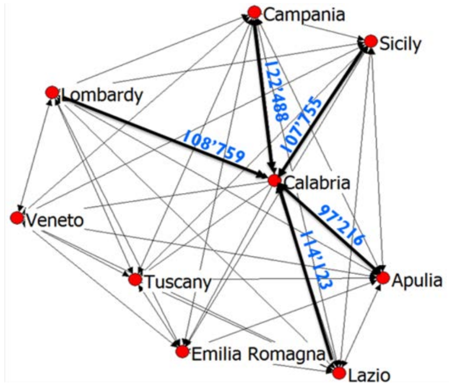


Fig.2 - Ego network of Calabria, before (a) and after simulation studies (b)

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