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RESEARCH LETTER

An assessment of road traffic accidents in Spain: the role of tourism

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ABSTRACT
One of the principal causes of tourist deaths worldwide appears to be road accidents. However, the literature rarely addresses tourist road safety by exploring spatial variations. This paper covers the gap that exists as to how tourism can influence road safety (as a negative externality) and examines the case of Spanish NUTS-3 regions, particularly interesting due to Spain having been the world's second most-visited country for five consecutive years. Our findings show a higher traffic accident rate for foreign drivers and indicate that tourism traffic safety is a relevant topic that should be incorporated into road safety policy planning.

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Tourism; externalities; traffic safety; Spain; NUTS-3 regions

1. Introduction

Tourism activities may impact destinations both positively and negatively (Schubert, Brida, & Risso, 2011). Tourism may improve local economies through income, employment and higher tax revenue, while negative effects include increased traffic, which leads to infrastructure congestion, noise, pollution and other environmental issues that might worsen residents' quality of life.

Safety is a critical issue for tourism and road traffic accidents (RTAs) are one of the main causes of tourist deaths worldwide (Wilks, Pendergast, & Wood, 2002). Evidence broadly supports higher accident risk for non-domestic/foreign drivers (tourists) (Behrens & Carroll, 2012). Nevertheless, limitations exist due to a lack of data and of analyses that take spatial variations into account (Page, Bentley, Meyer, & Chalmers, 2001).

This paper covers the extant gap as to how tourism can influence RTAs from a spatial perspective and takes into account socio-economic, geographic and driving factors. The prior literature focuses on other negative effects of tourism, such as environmental externalities and so-called 'tourism-phobia' (anti-tourism protests), which is probably the most recent popular phenomenon and tourism-related topic. Furthermore, the mass media pay greater attention to other misfortunes that befall tourists (plane crashes, natural disasters, terrorist attacks), while RTAs are often covered in the media as simple events, and on occasion are not widely disseminated lest they damage a destination's reputation (Ball & Machin, 2006).

To our knowledge, ours is the first and only study that addresses the impact of tourism on RTAs for Spanish NUTS-3 regions. We analyze the case of Spain, the world's second most-visited country for five consecutive years, with more than 82 million visitors in 2017 but also notable differences in tourist flows in the different provinces (NUTS-3). For example, in 2016 the Balearic Islands received 10.5 tourists per resident, equating to almost 2000 tourists per km^2, while Ciudad Real only received 0.9 visitors per resident, i.e. 20 tourists per km^2, implying 99% less territorial impact on average.

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Road safety performance can be analyzed through other outcomes (fatalities, injuries). However, we have focused on RTAs because research based on accident data analysis addresses the real road traffic conditions that derive from the increased mobility triggered by tourism activities, and so may be a better guide for preventive strategies and traffic risk management.

2. Empirical framework and method

A dataset was collected from official statistics for the 50 Spanish NUTS-3 regions (provinces) for the 2000–2015 period (excluding Ceuta and Melilla because of their small size). Table 1 shows endogenous and exogenous variables, including tourism-road safety related variables.

An econometric model was applied following expression (1) for province i during period t:

$$Y_{it} = \alpha + \beta_k X_{it} + \gamma_k Z_{it} + \mu_i + \nu \mathrm{Year}_t + \varepsilon_{it} \tag{1}$$

Y_{it} is a set of endogenous safety variables; X_{it} is the vector of attributes of each province (explanatory economic and demographic; risk exposure; and geographic and meteorological characteristics); Z_{it} contains tourism-related variables; μ_i are omitted province-specific time-invariant variables; the Year_t dummy captures the common time trend in all the provinces; ε_{it} is the mean zero random error.

We estimate a panel data model averaged by population (Pop variable in Table 1), assuming negative binomial distribution justified by the non-normal distribution of the variables (see Doornik–Hansen test results in Table 2). Standard errors robust to heteroscedasticity (see Breusch–Pagan/Cook–Weisberg test results for heteroscedasticity in Table 2) have been estimated and an AR (1) correlation is assumed in the error term (see Wooldridge test results for autocorrelation in Table 2). The unit root test indicates that none of the three dependent variables present stationarity problems. We have also included province fixed effects and a linear time trend. Finally, the correlation matrix shows no significant problems apart from the logical

Table 1. Variables and descriptive statistics.

Variable (Abbreviation)	Source	Mean	Median	Std. dev.
Endogenous variables				
Total no. of traffic accidents (TOTAcc) (sum of):	Directorate General of Traffic	1861.449	1008	3065.725
• No. urban traffic accidents (UrAcc)		1023.794	348.5	2446.713
• No. interurban traffic accidents (IntAcc)		837.655	641	721.214
Exogenous variables by category				
Tourism				
Domestic tourists (10,000) (DTou)	National Statistics Institute	8.392	6.016	7.919
Foreign tourists (10,000) (FTou)		6.842	1.688	13.298
Domestic overnight stays (10,000) (DStays)		20.589	12.121	19.666
Foreign overnight stays (10,000) (FStays)		31.472	3.167	77.867
Economic and demographic				
Unemployment rate (% for 4th quarter) (UnR)	National Statistics Institute	15.591	13.940	8.121
Population (as of January 1st) (Pop)		894,820.2	600,116	1,096,338
Population capital city/Population Province (%) (PopRate)		0.326	0.310	0.131
Population average age (years) (AvAge)		42.059	41.745	2.808
Hospital density (public hospitals/km^2) (Hospdens)	Ministry of Health, Social Policy and Equality	0.625	0.568	0.284
Risk exposure				
Motorization rate (vehicles/1000 inhabitants) (Motpc)	Directorate General of Traffic	652.626	656	81.332
Driver rate (driver's licenses/1000 inhabitants) (Drivpc)		564.617	571.13	50.914
Transport fuel consumption rate (metric tons of fuel consumed by transport sector/ inhabitant) (FuConsmpc)	Ministry of Energy, Tourism and Digital Agenda	0.759	0.691	0.245
Geographic and meteorological				
Rain (mm. annual mean) (Rai)	State Meteorological Agency	475.990	397.600	285.862
Latitude (decimal degrees) (Lat)	Google Maps	39.92	40.5	3.142
Longitude (decimal degrees) (Long)		4.883	3.519	6.107
Altitude (metres) (Alt)		368.1	219.5	355.063

Table 2. Models and estimations.

Exogenous variables	(1) Endogenous variable: TOTAcc	(2) Endogenous variable: UrAcc	(3) Endogenous variable: IntAcc	(4) Endogenous variable: TOTAcc	(5) Endogenous variable: UrAcc	(6) Endogenous variable: IntAcc
DTou	0.004 (0.004)	0.000 (0.008)	0.004 (0.006)	–	–	–
FTou	0.010 (0.003)***	0.002 (0.004)	0.017 (0.005)***	–	–	–
DStays	–	–	–	−0.001 (0.003)	−0.005 (0.005)	0.000 (0.002)
FStays	–	–	–	0.003 (0.001)***	0.002 (0.001)**	0.003 (0.001)***
UnR	−0.005 (0.002)**	−0.004 (−0.004)	−0.007 (0.002)***	−0.006 (0.002)**	−0.004 (0.005)	−0.008 (0.002)***
PopRate	−0.422 (0.829)	3.035 (1.832)*	−1.520 (0.903)*	−0.694 (0.859)	2.919 (1.837)	−1.944 (0.882)**
AvAge	0.082 (0.027)***	0.162 (0.043)***	−0.004 (0.027)	0.068 (0.028)**	0.149 (0.045)***	−0.015 (0.029)
Hospdens	0.015 (0.040)	0.164 (0.119)	−0.042 (0.043)	0.022 (0.040)	0.172 (0.118)	−0.034 (0.044)
Motpc	−0.001 (0.000)*	−0.002 (0.001)**	0.000 (0.000)	−0.001 (0.000)**	−0.002 (0.001)**	0.000 (0.000)
Drivpc	0.000 (0.000)	0.000 (0.001)	0.000 (0.000)	0.000 (0.000)	0.000 (0.001)	0.000 (0.000)
FuConsmpc	0.025 (0.131)	−0.392 (0.254)	0.218 (0.134)	0.064 (0.127)	−0.334 (0.236)	0.241 (0.140)*
Rai	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Lat	1.518 (0.487)***	1.195 (0.942)	0.835 (0.577)	1.563 (0.502)***	1.162 (0.964)	0.988 (0.568)*
Long	0.059 (0.024)**	0.031 (0.047)	0.034 (0.028)	0.063 (0.024)**	0.031 (0.048)	0.043 (0.027)
Alt	0.003 (0.001)**	0.001 (0.003)	0.002 (0.001)	0.003 (0.001)**	0.001 (0.003)	0.003 (0.001)*
Linear time trend	−0.036 (0.006)***	−0.016 (0.012)	−0.039 (0.007) ***	−0.029 (0.006)***	−0.012 (0.012)	−0.032 (0.008)***
Intercept	−3.601 (18.510)	−33.463 (40.893)	35.621 (21.506)*	−16.866 (18.924)	−39.032 (40.217)	15.751 (20.338)
Province fixed effects	YES	YES	YES	YES	YES	YES
Wald test (joint significance)	1418.77***	1817.05***	714.20***	1362.20***	1623.57***	691.27***
Breusch–Pagan/Cook–Weisberg test heterogeneity (Ho: constant variance)	1480.83***	$1.7\ 10^{5}$***	5516.25***	1683.23***	33,404.24***	3787.96***
Wooldridge test –autocorrelation (Ho: No first order autocorrelation)	75.718***	29.416***	101.253***	76.725***	30.142***	100.628***
ADF test –nonstationarity (Ho: nonstationarity)	−0.213**	−0.383**	−0.249***	−0.213**	−0.383**	−0.249***
Doornik-Hansen test multivariate normality	16,894.074***	17,395.031***	17,551.106***	16,894.074***	17,395.031***	17,551.106***
No. Observations	791					
No. Provinces	50					

Note: Standard errors in parentheses. Statistical significance at 1% (***), 5% (**), 10% (*).

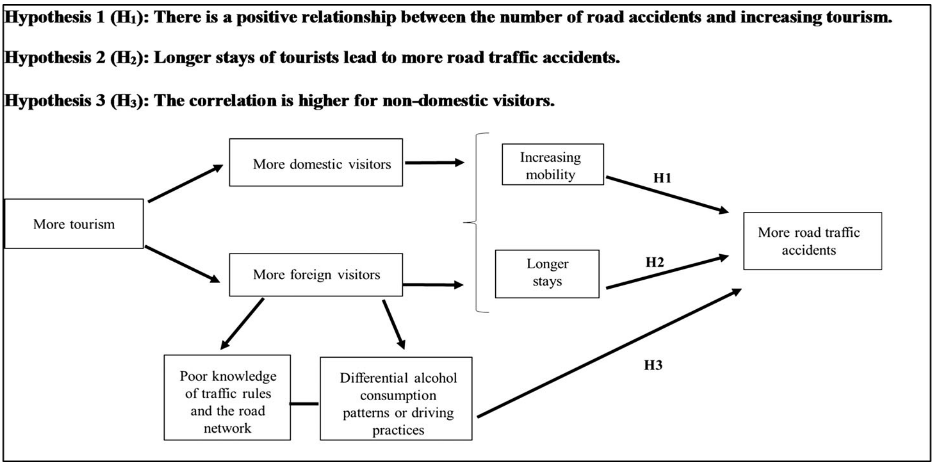

Figure 1. Diagram of research hypotheses. Source: Authors.

correlation between domestic and foreign tourists; in any event, the results are robust to their separate estimation.[1]

Taking into account the evidence in the earlier literature, our set of hypotheses is summarized below in Figure 1.

3. Results and discussion

Table 2 provides estimates for 6 models depending on the endogenous variable. As can be observed, tourist volume has a negative influence on RTAs at destinations. This is in line with previous research in general (Walker & Page, 2004) and Spanish regions such as the Balearic Islands (Rosselló & Saénz-de-Miera, 2011); however, there are clear differences depending on the tourist's place of origin.

RTAs do not seem to be influenced by the arrival of domestic tourists, while we find a statistically significant positive coefficient (at 1%) for foreign tourists. This could be explained by risk factors such as the use of rented cars (Behrens & Carroll, 2012), poor knowledge of traffic rules and of the road network (Petridou, Dessypris, Skalkidou, & Trichopoulos, 1999), and differential alcohol consumption patterns (Castillo-Manzano, Castro-Nuño, Fageda & López-Valpuesta, 2017) or driving practices (Yannis, Golias, & Papadimitriou, 2007). In terms of individual countries, Spain is visited by citizens from left-side driving countries, such as the United Kingdom (from which almost 18 million tourists arrived in 2016).

If we consider the number of foreign tourists travelling on interurban roads, it is clear that the number of accidents rises and this effect is multiplied by each additional night that they stay in the country. Nevertheless, for urban roads (equivalent to urban tourism) this effect is only linked to journey length and is not as significant (at 5%).

If tourist typology data were available, an interesting future research line might be to test our findings for the cases of rural and sun-and-sand tourists (whose destinations are resorts situated in non-urban areas far from arrival airports) or short city-break and, especially, cruise day-excursion tourists, irrespective of whether they are domestic or foreign.

Finally, with respect to the control variables used, among other results it is important to highlight the significance of the geographic variables for the road traffic accident rate, especially in the two models that do not differentiate among road types. The effects of the economic cycle measured by Unemployment Rate (UnR) and the average age of the population (AvAge) also stand out, with the first being negative and the second, positive. The variable PopRate deserves special mention:

as was to be expected, the more the population is concentrated in the provincial capital, the higher the mortality rate on urban roadways and the lower on interurban roads.

4. Concluding remarks

Our findings highlight the fact that tourist traffic safety should be a topic of concern for both public transportation and tourism authorities. More specifically, tourist cities must integrate foreign visitors as a target group into national road safety policy; and in our case study – the Spanish provinces – in particular, considering traditional tourism seasonality.

In this regard, potential educational and corrective strategies should be implemented that take into account the fact that, in the twenty-first century, the real gateways through which international tourism passes are not physical borders but airports. So, efforts should not just be concentrated in hotels and tourism resorts, but in airports too, with the handing out of informative safety messages, in collaboration with rental car agencies, for example.

Note

1. Available from authors upon request.

Disclosure statement

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