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DO WILDFIRES BURN TOURISM INTENTIONS? THE CASE OF PORTUGAL

Do wildfires burn tourism intentions? The case of Portugal

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ABSTRACT

Fire intensity and size incite visitation decrease and recreational losses, relevant tourism variables for European economies. As a result of climate change, this reality is becoming more evident. Due to significant gaps in analyzing the relationship between wildfires and tourism demand, this paper aims to explain how tourism demand reacts to wildfires in Portugal. We use a novel approach in these studies and estimate a spatial econometric model to analyze the relationship between total burned areas and overnight stays in a touristic establishment in a given municipality and its neighbouring municipalities. Our results show that wildfires negatively affect the overnight stays in the same location but also cause spillover effects in neighbouring municipalities. Also, the wildfire occurrences are positively related to the number of overnight stays after three months, suggesting a delay in tourism activities,

Keywords: tourism, wildfires, spatial econometrics,

JEL Codes

O13: Agriculture • Natural Resources • Energy • Environment • Other Primary Products

Q54: Climate • Natural Disasters and Their Management • Global Warming

Q56: Environment and Development • Environment and Trade • Sustainability • Environmental Accounts and Accounting • Environmental Equity • Population Growth

L83: Sports • Gambling • Restaurants • Recreation • Tourism

1 INTRODUCTION

Climate change relates to shifts in the mean climate and variations in the frequency and intensity of extreme weather events. The increased frequency and intensity of extreme precipitation, droughts, tropical cyclones, and compound extremes, including fire weather, are evident, as shown in the IPCC 6th Assessment Report (IPCC 2021). In particular, the recurrence and duration of wildfires, as a result of climate change, has increased in many countries all over the world, including Greece, Spain, and Portugal (Giannakopoulos, Kostopoulou et al. 2011, Hall, Scott et al. 2011, Marques, Borges et al. 2011, Doerr and Santín 2016). Consequently, economic activities, specialization, and other economic geography variables are also predicted to shift in the coming years (Yohe and Schlesinger 2002, Conte, Desmet et al. 2021). A region that is expected to be severely affected by climate change and fires is the Mediterranean.

The Mediterranean region is a European area composed of lands around the Mediterranean Sea with a similar "Mediterranean climate", with rainy winters ranging from mild to cool and dry summers from warm to hot. The region comprises countries such as Portugal, Spain, France, Greece, Italy, Malta, Croatia, and Cyprus, with typical Mediterranean forests, woodlands, and scrub vegetation, especially vulnerable to wildfires due to its sensitivity to drought and rising temperatures. Forest fire risk, one of the main threats for Mediterranean ecosystems and societies, is expected to grow due to climate change (Giannakopoulos, Kostopoulou et al. 2011, IPCC 2021), causing local vital socio-economic sectors, such as agriculture and tourism, to be adversely affected (Arabadzhyan, Figini et al. 2021).

In the Mediterranean, tourism constitutes a significant economic activity, totalizing 217 billion euros in international tourism receipts, 23% of the world total, in 2014. The Mediterranean reported 342 million international tourist arrivals in 2014, mainly in France, Spain, Italy, Greece, and Portugal, representing almost one-third of worldwide arrivals (UNWTO 2015). The Mediterranean climate is the principal element tourists consider regarding travel planning, especially relevant for summer tourism (Giannakopoulos, Kostopoulou et al. 2011, Roson and Sartori 2014). Hence, the dependence of tourism activities on climate resources makes the industry one of the most vulnerable to climate change (Dogru, Bulut et al. 2016, Dogru, Marchio et al. 2019). For instance, in Spain, Molina, González-Cabán et al. (2019) detected a high visitation susceptibility concerning vegetation flammability and spread fire conditions, concluding that fire intensity and size would significantly influence visitation decrease and recreational losses.

In short, climate change has substantive impacts on rural and urban geographical distribution, local communities, the regions' ecosystem services, and biodiversity, which, in the end, affect the tourism supply and demand (Dogru, Marchio et al. 2019). For these reasons, the Mediterranean region is also classified by the World Tourism Organization (UNWTO 2015) as one of the hot spots in the world in need of climate change adaptation.

Portugal, as a Mediterranean country, has historical wildfires. Natural ignitions in the European Mediterranean basin, such as lightning, are standard where the atmospheric conditions feature low humidity and little or no precipitation. However, the modified socio-economic, environment and land patterns, in Portugal, as well as in other European Mediterranean countries, led to changes in the traditional causes of fire ignition in recent decades, whose origins have predominantly become anthropogenic instead of natural (Pereira, Trigo et al. 2005, de Zea Bermudez, Mendes et al. 2009). Currently, Portugal has the highest incidence of wildfire events in the Mediterranean basin and the whole of Europe, which have also become larger and more intense (Meira Castro, Nunes et al. 2020). Until the 1980s, wildfires in Portugal never exceeded 150,000ha of total burnt area. However, afterwards, forest fires with more than 150,000 ha per year started to be registered. In the 2000s, the extent of large forest fires increased. In 2003 a large wildfire was observed, totalizing 471,750 ha of burnt area, culminating in the most significant and catastrophic ones in Portugal, where 539,921 ha was burnt in 2017 (ICNF 2021).

As in other similar regions, wildfires in Portugal are more prone to occur in the summer, when high temperatures and relative air humidity are low. In the same period, tourism activities are at their highest, and studies already look to patterns of seasonality and global warming implications in summer tourism (Vergori 2017, Koutroulis, Grillakis et al. 2018). The tourist accommodation sector registered 2.5 million guests and 7.5 million overnight stays in August 2021 in Portugal, versus 1.5 million guests and 3.6 million overnight stays in November 2021. This summer tourism peak is responsible for a seasonal increase in the income of associated economic sectors, such as food and hospitality. The average daily rate (ADR) amounted to EUR 115.8 in August, and EUR 98.7 in July, versus EUR 47.1 in February (INE 2021).

In the described climate change setting, since 2000, the occurrence of wildfires in Portugal, their patterns and causes have been extensively analyzed. Some examples include Pereira, Trigo et al. (2005), which look at synoptic patterns of large summer forest fires, and Pereira, Caramelo et al. (2015) that further develop the work on a space-time clustering analysis of wildfires. Meira Castro, Nunes et al. (2020) spatially explore the causes of forest fires between 1996 and 2015 at the district level. Other studies look to heatwaves, specific fires, and other events (Gomes 2006, Gomes and Radovanovic 2008, Parente, Pereira et al. 2018, Viegas 2018). Towards our purpose, the characterization of wildfires in Portugal by Marques, Borges et al. (2011) stands out. The study merges geographic information systems and statistical analysis techniques, within a weighted generalized linear model, showing a significant increase in the number of very large fires, and that socioeconomic features impact the probability of fires occurrence.

Markedly, only very few studies look at socioeconomic wildfires impacts, mainly focusing on wood production and forest sustainability (Rego, Louro et al. 2013, Gómez-González, Ojeda et al. 2018). Costs of wildfires are related to the loss *per se* and other longer-term dimensions such as rehabilitation of ecosystems health and recreational and touristic activities (Lynch 2004). Tourism demand may vary due to the occurrence of forest fires, given tourists' concern about health risks, the importance of the destination's image and its deterioration, and the possibility of reductions in biodiversity and landscape values.

Although the broad impacts of climate change in tourism have been analyzed (Scott, Gössling et al. 2012, Kaján and Saarinen 2013, Dogru, Marchio et al. 2019, Scott, Hall et al. 2019), more specific studies only focus on tourism activities that will suffer most immediately from climate change, expectedly, the decrease in snow and skiing activities (Dawson and Scott 2013, Gilaberte-Búrdalo, López-Martín et al. 2014, Steiger, Scott et al. 2019). Some of these studies use simplified regression models to evaluate the effect on ski tourism variables resulting from increased temperatures (Demiroglu, Kučerová et al. 2015, Damm, Greuell et al. 2017).

Fewer studies exist on climate change and tourism analysis in the Mediterranean region. Dogru, Bulut et al. (2016), using a vulnerability theoretical framework, show that exposure and sensitivity to climate change negatively affect tourism demand. In contrast, adaptive capacity, as the ability to manage extreme consequences of potential impacts, positively affects tourism income in the long run. However, in a later study, within a dynamic panel data model analysis measuring the impacts in tourism receipts and gross domestic product, Dogru, Marchio et al. (2019) conclude that the industry is highly vulnerable to climate change and shows some resilience.

Studies on wildfire impacts in tourism are even in more remarkable absence, as noted by Arabadzhyan, Figini et al. (2021) in a review on coastal tourism. Such may be explained both by the difficulty in collecting and treating data and coordinating analysis between two vastly different scientific areas and by the fact that the tourism *boom* is still very recent in some wildfire-prone regions, such as Portugal. Additionally, the years of the pandemic and substantial restrictions on travel further hinder the collection of information, although new analyses are emerging (Marques, Guedes et al. 2021). Existing analyses include Sánchez, Baerenklau et al. (2016) that develop a Kuhn–Tucker model of recreation demand, with survey data, to look to relationships between wildfires and wilderness access, looking to the effects on visits, showing significant potential welfare loss. Molina, González-Cabán et al. (2019) use the travel cost method to explore relationships between fire intensity and net value change on recreation value in a Spanish-protected area. The authors found that the fire intensity and fire size would significantly influence visitation decrease and recreational losses, translating to a critical negative effect on the local economy. In Portugal, Otrachshenko and Nunes (2022) use yearly data in a two-level analysis in a panel regression model with fixed effects to reveal that burned areas negatively impact the number of tourist arrivals.

As evidenced, the literature presents significant gaps in analyzing the relationship between wildfires and tourism demand. In the context of climate change, with perspectives of future worsening of extreme events in the Mediterranean region, and with the growing importance of the tourism sector for regional socio-economic development, it becomes critical to understand how tourists change their journeys in the evidence of those events.

This paper aims to understand how tourism demand reacts to wildfires and how tourists adjust their destination / monthly travel intentions within monthly time lags. Do tourists postpone their trips for a few months when faced with the evidence of the fires? Will they change their intentions to visit at similar times in the following years? Analyzing these questions requires knowledge of the details of tourism demand in limited geographic and time dimensions. This study builds on previous analysis and develops a model to address these questions. Looking at all mentioned works, we conclude that regression analyses, adequately tuned to the variables in question, can produce valuable results. We apply spatial econometric techniques not yet used in this field to develop a novel spatial regression model that considers the possibility of spillovers in time and space, contributing to the economic geography literature on climate change impacts. The model analyses wildfires over monthly time units and municipalities, capturing their effects on the variation in the distribution of tourism along with the municipalities mentioned above.

Our paper proceeds as follows. Section 2 presents the collected data and model design, namely the characterization of wildfires, tourism, and model development. In section 3, the model results are presented, emphasising the impact of wildfires in neighbouring municipalities. Finally, section 4 presents the conclusions, caveats and recommendations for further work.

2 DATA AND METHODOLOGY

2.1 Data

This study uses wildfires data provided by the Portuguese Institute for Conservation of Nature and Forests (ICNF) (ICNF 2021). The database includes monthly distributed data on the burned area in hectares by municipalities from 2017 to 2020. The total burned area includes forests and shrubs lands and rural areas. The percentage of wildfires events during summers increased severely from 49% to 70% from 2019 to 2020. Table 1 presents the different dimensions of wildfires in the country's municipalities during summer, in 2019 and 2020.

Table 1 – Wildfire events in continental Portugal, per wildfire area, 2019-2020

Summer (Jul / Aug / Sep)					
Wildfire area *(ha)*	**Year**	**Municipalities** *(n.)*	*(ha)*	**Burned area** *(ha)*	(%)
< 10	2019	139	3172900	364	0.01
	2020	145	3900725	363	0.01
10-49	2019	66	2635760	1627	0.06
	2020	57	2439578	1385	0.06
50 - 99	2019	22	1033555	1593	0.15
	2020	12	283947	848	0.30
100 - 499	2019	33	1484249	6626	0.45
	2020	36	1249021	9346	0.75
500 - 1499	2019	14	476433	12047	2.53
	2020	15	611911	11874	1.94
> 1500	2019	1	19155	9249	48.28
	2020	9	388927	36683	9.43
Total	2019	275	8822052	488494	5.54
	2020	274	8874109	623800	7.03

Source: (ICNF 2021)

As a proxy for tourism demand, the municipality's number of tourist guests and monthly overnight stays were obtained from the Statistics Portugal website (INE) from 2020 to August 2021 (INE 2021b, INE 2021c). Table 2 exhibits the number of overnight stays and guests from 2020 and 2021 until August, revealing that most tourism demand occurs in the summer period. Counted local accommodations have ten or more beds.

Table 2 – Tourism demand in continental Portugal, 2020-2021

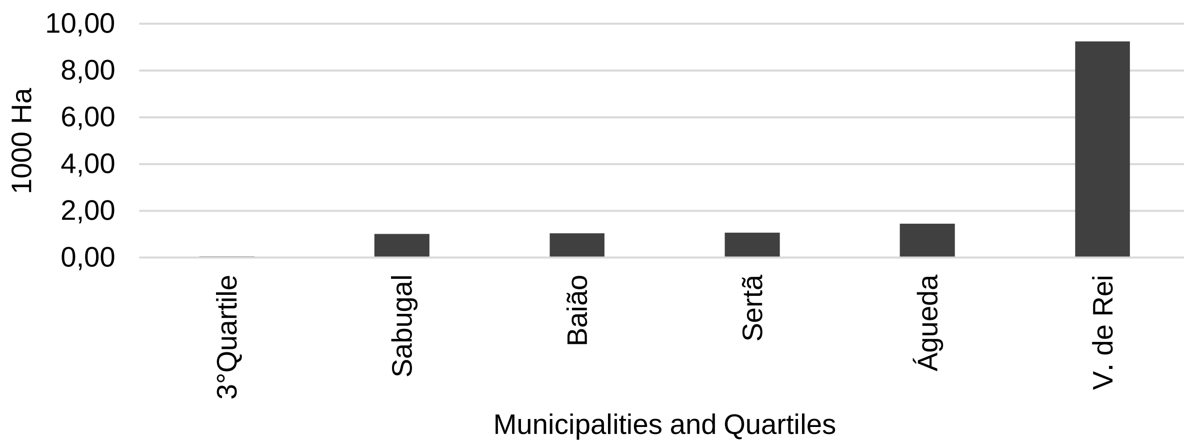
		Overnight stays**		Guests	
	Units	**2020**	**2021**	**2020**	**2021**
Summer*	*(10^6 n.)*	10.3	10.1	4.0	3.7
Year	*(10^6 n.)*	22.4	17.0	9.5	6.9
Summer/Year	*(%)*	46%	60%	42%	54%
NA	*(%)*	21%	27%	23%	23%

Source: INE (2021b); INE (2021c)

* Data up to August 2021; ** Overnight stays are the permanence of an individual in an establishment that provides accommodation for a period between noon of one day and noon of the following day (INE, 2021).

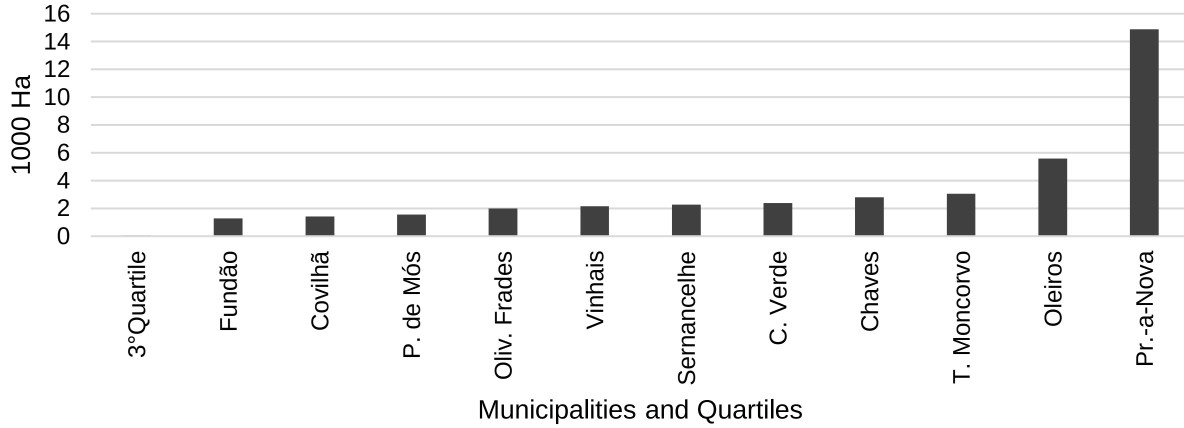
Figure 1 and 2 shows the occurrence of wildfires of more than 1000ha in continental Portugal during summers 2019 and 2020, respectively. Comparing figure 2 with tourism demand, in 2020 and 2021 summers (Figure 3), it is possible to see the lowest tourism records in the same municipalities with the most significant fires. In Proença-a-Nova (Pr-a-Nova in Figure 2), for example, had the most significant wildfire in 2020 summer (Figure 2), and this municipality registered the lowest tourism demand rate in 2020 and 2021 (Figure 3). This data shows possible wildfires interfering in summer tourism demand in the same year and one year later after the wildfire event.

Figure 1 - Burned areas per Municipalities of the 4th Quartile, summer 2019.



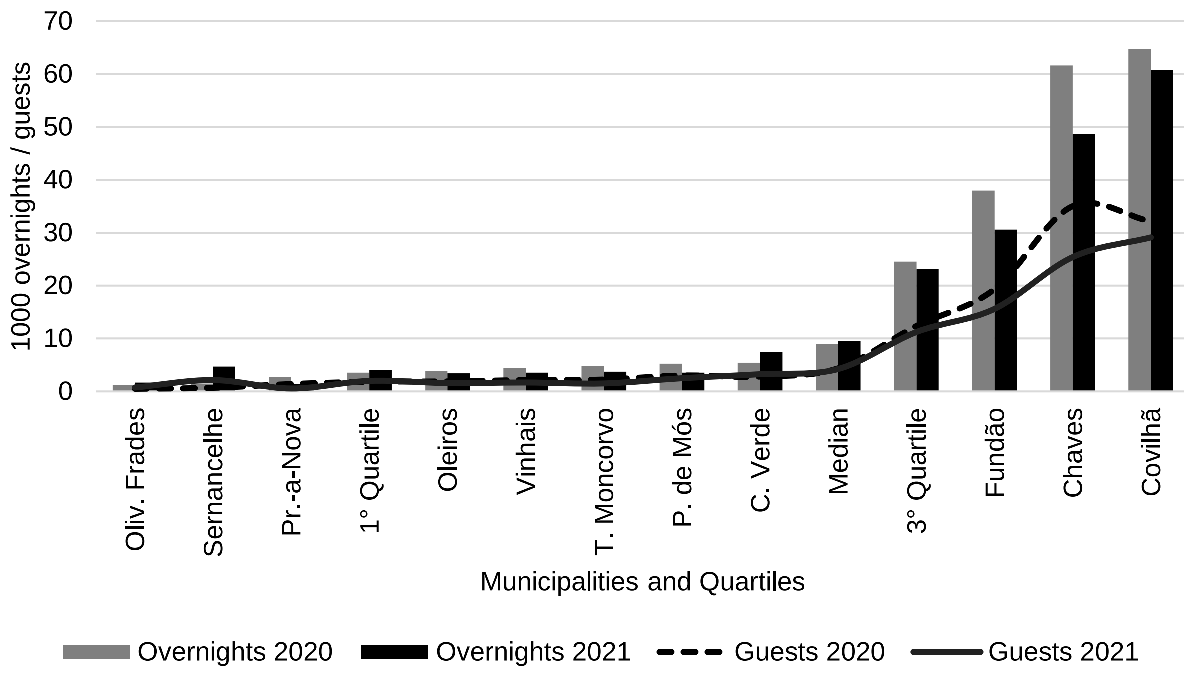
Source: (ICNF 2021)

Figure 2 – Burned areas per Municipalities of the 4th Quartile, summer 2020.



Source: (ICNF 2021)

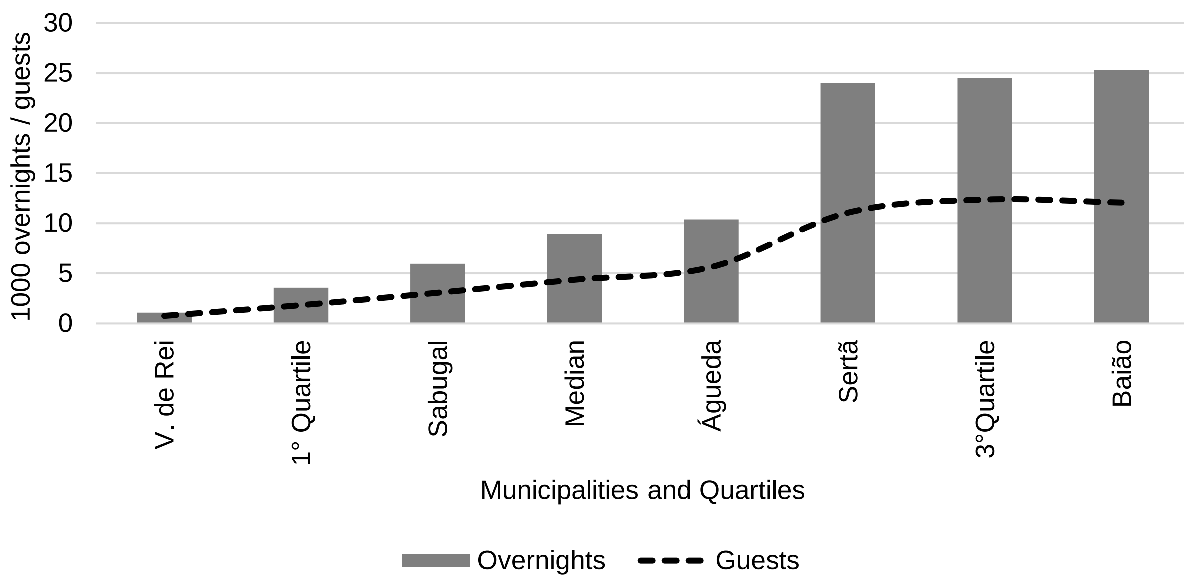
Figure 3 – Tourism demand, per representative Municipalities with wildfires in 2020 - summers 2020 and 2021.



Source: Source: INE (2021b); INE (2021c)

In the same way, a similar effect appeared when comparing figure 4 with the tourism demand in 2020 summer for the same municipalities illustrated in figure 1. For example, Vila de Rei municipality, wherein 2019 had the most significant wildfire registered during summer (Figure 1), and in the next year (2020) had the lowest summer tourism demand recorded (Figure 4), showing a one-year later effect.

Figure 4 – Tourism demand, summer 2020, per Municipalities with wildfires in 2019.



Source: Source: INE (2021b); INE (2021c)

From the wildfires data, as shown in figures 1 and 2, it is essential to notice more extensive wildfire episodes in different municipalities in 2019 and 2020. Due to the need for forest regeneration after a major fire, it is rare for two major fire events to occur in the same area.

2.2 Methodology

In this paper, we use a spatial econometric regression to look at the effects on neighbour regions. We estimate the relationship between total burned areas and overnight stays in a touristic establishment in a given municipality by month. The main equation has the following specification;

$$Stays_{i,m,y} = \beta_0 + \beta_1 Burned\_Area_{i,m,y} + \theta_i + month_m + year_y + \varepsilon_{ii,y}$$

where $Stays_{i,m,y}$ is the number of overnight stays, considered in relation to each person, by municipality, $Burned_{i,m,y}$ stands for the total area of burned forest, agriculture land, and shrub. The terms θ_i, $month_m$, and $year_y$, are the municipality, month and year fixed effects, respectively.

The municipality fixed effects control for time-invariant unobserved local characteristics that may affect the number of overnight stays, such as the area of the municipality, the landscape, the location or the supply of cultural and environmental amenities that do not vary in 2020 and 2021. Monthly and yearly fixed effects control for any common changes across municipalities and for the seasonal nature of the touristic demand as well as COVID19 restrictions implemented nationally wide.

The coefficient of interest is β_1 which measures the change in the number of overnight stays due to an increase in one hectare in burned area.

The model is estimated with contemporaneous information for overnight stays and burned area, but the β_1 estimator potentially suffers from omitted variable bias, if there are other factors that affect tourist demand and the burned area simultaneously. One example higher temperature or low level of precipitation that induce higher tourist arrivals but also increase the probability of forest or shrub fires. In order to prevent this bias, we estimate five more models with the burned area lagged by one, three, six, nine and twelve months. These models try to measure the non-contemporary effect of wildfires on tourism demand.

Wildfires in one given municipality can also affect tourism demand in neighbouring municipalities. In order to control for that, we estimate a set of models including a spatial lag of the burned area in other municipalities, weighted by a spatial weight matrix. This matrix is row-standardized and is based on the power functional form as follows:

$$w_{ij} \begin{cases} \frac{d_{ij}^{-2}}{\sum_{j=1}^{n} d_{ij}^{-2}}, & i \neq j \\ 0, & \end{cases}$$

The model with spatially lagged burned area has the following specification:

$$Stays_{i,m,y} = \beta_0 + \beta_1 Burned\_Area_{i,m,y} + \beta_2 WBurned\_Area_{i,m,y} + \theta_i + month_m + year_y + \varepsilon_{ii,y},$$

where $WBurned_{i,m,y}$ denotes the spatial lag of $Burned_{i,m,y}$.

3 RESULTS

The analysis of effects on the number of overnights spent by tourists resulting from wildfires is presented below in Table 3. The model comprises 1, 3, 6, 9 and 12 monthly temporal lags, identified with *"L#"*, to capture the changes in intentions. For each temporal lag, a spatial lag, noted with *"W",* is also considered, showing the effects of wildfires on neighbouring municipalities in local tourism demandable. These results are presented in Table 4.

According to Table 3, burned area is positively related to the number of overnight stays after three months. This can be the result of postponed reservations or the decrease in prices that might occur if wildfires reduce the attractiveness of the municipality in the following days. The negative effect appears to be statistically significant after twelve months of the wildfires. On average, one hectare of burning area reduces overnight stays in almost 3 units.

Table 3 - Results of the spatial regression model with time lags.

	(1) Overnights	(2) Overnights	(3) Overnights	(4) Overnights	(5) Overnights	(6) Overnights
Burned Area	-0.535					
	(0.382)					
L. Burned Area		-0.251				
		(0.434)				
L3. Burned Area			0.887**			
			(0.404)			
L6. Burned Area				0.0662		
				(0.439)		
L9. Burned Area					0.598	
					(0.524)	
L12. Burned Area						-2.953*
						(1.637)
Mun. fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	2636	2815	3137	3783	4259	4259
R^2	0.055	0.054	0.056	0.034	0.048	0.048
adj. R^2	0.051	0.049	0.052	0.031	0.045	0.045

Table 4 presents the results of the model with the temporal and spatially lags of the burned area. The negative effects of the burned area on overnight stays are now statistically significant on the contemporaneous month of the wildfire, as well as on the twelve months lag. A novel result is the impact of wildfires in neighbouring municipalities. The magnitudes are much higher than the magnitude of the coefficient for the same location. For example, one hectare of burned area in the municipality is related with a decrease in 0,7 overnight stays, while the effect of the neighbouring wildfires is 29 overnight stays less per hectare of burned area in the contemporaneous month. The positive effect after three months is also significant, as in Table 3, as well as the effect of the neighbouring wildfires.

Table 4 - Results of the spatial regression model with time and space lags.

	(1) Overnights	(2) Overnights	(3) Overnights	(4) Overnights	(5) Overnights	(6) Overnights
Burned Area	-0.706*					
	(0.407)					
W_Burned Area	-28.96**					
	(13.06)					
L. Burned Area		-0.252				
		(0.424)				
L.WBurned Area		-0.227				
		(4.428)				
L3. Burned Area			0.728**			
			(0.324)			
L3.W_Burned Area			27.98**			
			(12.80)			
L6. Burned Area				0.0958		
				(0.427)		
L6.W_Burned Area				-7.286		
				(5.082)		

L9. Burned Area					0.612	
					(0.507)	
L9.W_Burned Area					7.707	
					(7.254)	
L12. Burned Area						-2.623*
						(1.477)
L12.W_Burned Area						-26.11***
						(8.929)
Mun. fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	2636	2815	3137	3783	4259	4259
R^2	0.055	0.054	0.056	0.034	0.048	0.048
adj. R^2	0.051	0.049	0.052	0.031	0.045	0.045

4 FINAL REMARKS

This study demonstrated the relationship between wildfires and tourism demand in local wildfire municipalities and neighbouring municipalities. We found a positive relationship between wildfires and the number of overnight stays after three months, resulting from postponed reservations that faced wildfires implications. This discovery is suitable for economic purposes since it demonstrated that wildfires impact local economies, changing regional tourism demand.

Still in the regional analysis, and possibly the most expressive result of this study was to verify that tourism demand of the wildfires neighbouring municipalities is also negatively impacted by them. This analysis demonstrates that the wildfires have a negative spillover on neighbouring tourism demand, more significant than in the municipality. As tourism is an essential activity for the regional and national economy, these results show the need to develop policies to fight wildfires and adapt to climate changes that transcend municipal and, possibly, national borders.

Going beyond the regional analysis, we also used the temporal effect of fires on tourist demand. Wildfires have not only immediate local effects but also one year after they occur. This effect can show that tourists use weather data such as local fire occurrences to determine their next visit, changing their intentions to visit sites that burned a year later. These results show one more reason for developing climate adaptation measures to fight forest fires.

We construct the model considering fixed effects from external variables, such as climate temperature and the occurrence of COVID 19. However, a further analysis that may be carried out is to consider the effect of COVID 19 on the tourism demand in Portugal. In addition, we hope to analyze further the effects of wildfires on tourism revenues and their impact on regional and national GDP.

5 REFERENCES

Arabadzhyan, A., P. Figini, C. García, M. M. González, Y. E. Lam-González and C. J. León (2021). "Climate change, coastal tourism, and impact chains – a literature review." Current Issues in Tourism **24**(16): 2233-2268.

Conte, B., K. Desmet, D. K. Nagy and E. Rossi-Hansberg (2021). "Local sectoral specialization in a warming world." Journal of Economic Geography **21**(4): 493-530.

Damm, A., W. Greuell, O. Landgren and F. Prettenthaler (2017). "Impacts of +2°C global warming on winter tourism demand in Europe." Climate Services **7**: 31-46.

Dawson, J. and D. Scott (2013). "Managing for climate change in the alpine ski sector." Tourism Management **35**: 244-254.

de Zea Bermudez, P., J. Mendes, J. Pereira, K. Turkman and M. Vasconcelos (2009). "Spatial and temporal extremes of wildfire sizes in Portugal (1984–2004)." International Journal of Wildland Fire **18**(8): 983-991.

Demiroglu, O. C., J. Kučerová and O. Ozcelebi (2015). "Snow reliability and climate elasticity: case of a Slovak ski resort." Tourism Review **70**(1): 1-12.

Doerr, S. H. and C. Santín (2016). "Global trends in wildfire and its impacts: perceptions versus realities in a changing world." Philosophical Transactions of the Royal Society B: Biological Sciences **371**(1696): 20150345.

Dogru, T., U. Bulut and E. Sirakaya-Turk (2016). "Theory of vulnerability and remarkable resilience of tourism demand to climate change: Evidence from the Mediterranean Basin." Tourism Analysis **21**(6): 645-660.

Dogru, T., E. A. Marchio, U. Bulut and C. Suess (2019). "Climate change: Vulnerability and resilience of tourism and the entire economy." Tourism Management **72**: 292-305.

Giannakopoulos, C., E. Kostopoulou, K. V. Varotsos, K. Tziotziou and A. Plitharas (2011). "An integrated assessment of climate change impacts for Greece in the near future." Regional Environmental Change **11**(4): 829-843.

Gilaberte-Búrdalo, M., F. López-Martín, M. R. Pino-Otín and J. I. López-Moreno (2014). "Impacts of climate change on ski industry." Environmental Science & Policy **44**: 51-61.

Gomes, J. F. P. (2006). "Forest fires in Portugal: how they happen and why they happen." International Journal of Environmental Studies **63**(2): 109-119.

Gomes, J. F. P. and M. Radovanovic (2008). "Solar activity as a possible cause of large forest fires — A case study: Analysis of the Portuguese forest fires." Science of The Total Environment **394**(1): 197-205.
Gómez-González, S., F. Ojeda and P. M. Fernandes (2018). "Portugal and Chile: Longing for sustainable forestry while rising from the ashes." Environmental Science & Policy **81**: 104-107.
Hall, C. M., D. Scott and S. Gössling (2011). "Forests, climate change and tourism." Journal of Heritage Tourism **6**(4): 353-363.
ICNF. (2021). "Informação sobre áreas ardidas e ocorrências de 2001 a 2021 - Relatórios de Incêndios rurais." accessed 2022-01-31, from http://www2.icnf.pt/portal/florestas/dfci/relat/rel-if.
INE. (2021). "Survey on Guests Stays on Hotel Establishments and Other Accommodations: Global results.", accessed 2022-01-31, from https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_destaques&DESTAQUESdest_boui=472730931&DESTAQUESmodo=2.
INE. (2021b). "Nights (No.) in tourist accommodation establishments by Geographic localization and Place of residence; Annual.", accessed 2022-01-31, from https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&contecto=pi&indOcorrCod=0009183&selTab=tab0.
INE. (2021c). "Guests (No.) in tourist accommodation establishments by Geographic localization (NUTS - 2013) and Type (tourist accommodation establishment); Monthly." accessed 2022-01-31, from https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&contecto=pi&indOcorrCod=0009812&selTab=tab0.
IPCC (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. V. Masson-Delmotte, P. Zhai, A. Pirani, S.L., Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou.
Kaján, E. and J. Saarinen (2013). "Tourism, climate change and adaptation: a review." Current Issues in Tourism **16**(2): 167-195.
Koutroulis, A. G., M. G. Grillakis, I. K. Tsanis and D. Jacob (2018). "Mapping the vulnerability of European summer tourism under 2 °C global warming." Climatic Change **151**(2): 157-171.
Lynch, D. L. (2004). "What Do Forest Fires Really Cost?" Journal of Forestry **102**(6): 42-49.
Marques, C. P., A. Guedes and R. Bento (2021). "Rural tourism recovery between two COVID-19 waves: the case of Portugal." Current Issues in Tourism: 1-7.
Marques, S., J. G. Borges, J. Garcia-Gonzalo, F. Moreira, J. M. B. Carreiras, M. M. Oliveira, A. Cantarinha, B. Botequim and J. M. C. Pereira (2011). "Characterization of wildfires in Portugal." European Journal of Forest Research **130**(5): 775-784.
Meira Castro, A. C., A. Nunes, A. Sousa and L. Lourenço (2020). "Mapping the Causes of Forest Fires in Portugal by Clustering Analysis." Geosciences **10**(2): 53.
Molina, J. R., A. González-Cabán and F. Rodríguez y Silva (2019). "Wildfires impact on the economic susceptibility of recreation activities: Application in a Mediterranean protected area." Journal of Environmental Management **245**: 454-463.
Otrachshenko, V. and L. C. Nunes (2022). "Fire takes no vacation: impact of fires on tourism." Environment and Development Economics **27**(1): 86-101.
Parente, J., M. G. Pereira, M. Amraoui and E. M. Fischer (2018). "Heat waves in Portugal: Current regime, changes in future climate and impacts on extreme wildfires." Science of The Total Environment **631-632**: 534-549.
Pereira, M. G., L. Caramelo, C. V. Orozco, R. Costa and M. Tonini (2015). "Space-time clustering analysis performance of an aggregated dataset: The case of wildfires in Portugal." Environmental Modelling & Software **72**: 239-249.

Pereira, M. G., R. M. Trigo, C. C. da Camara, J. M. C. Pereira and S. M. Leite (2005). "Synoptic patterns associated with large summer forest fires in Portugal." Agricultural and Forest Meteorology **129**(1): 11-25.
Rego, F., G. Louro and L. Constantino (2013). "The impact of changing wildfire regimes on wood availability from Portuguese forests." Forest Policy and Economics **29**: 56-61.
Roson, R. and M. Sartori (2014). "Climate change, tourism and water resources in the Mediterranean." International Journal of Climate Change Strategies and Management **6**(2): 212-228.
Sánchez, J. J., K. Baerenklau and A. González-Cabán (2016). "Valuing hypothetical wildfire impacts with a Kuhn–Tucker model of recreation demand." Forest Policy and Economics **71**: 63-70.
Scott, D., S. Gössling and C. M. Hall (2012). "International tourism and climate change." WIREs Climate Change **3**(3): 213-232.
Scott, D., C. M. Hall and S. Gössling (2019). "Global tourism vulnerability to climate change." Annals of Tourism Research **77**: 49-61.
Steiger, R., D. Scott, B. Abegg, M. Pons and C. Aall (2019). "A critical review of climate change risk for ski tourism." Current Issues in Tourism **22**(11): 1343-1379.
UNWTO (2015). UNWTO Mediterranean Tourism Trends, 2015 edition. UNWTO Tourism Trends Snapshot. W. T. Organization.
Vergori, A. S. (2017). "Patterns of seasonality and tourism demand forecasting." Tourism Economics **23**(5): 1011-1027.
Viegas, D. X. (2018). "Wildfires in Portugal." Fire Research **2**(1).
Yohe, G. and M. Schlesinger (2002). "The economic geography of the impacts of climate change." Journal of Economic Geography **2**(3): 311-341.

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