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ORIGINAL PAPER

The impact of COVID-19 on tourism, employment, and population of the Azores islands

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Abstract
Tourism is a very important economic sector and, for many regions, the main economic activity. Tourism was one of the main sectors affected by the COVID-19 pandemic. This paper aims to evaluate the impact of COVID-19 on tourism, employment, and the population of the Azores, highlighting the resilience of the different islands and the sustainability of their tourism. To do that, we estimate an economic base model for the Azores islands that relates total employment per island with performance indicators of the basic activities (hosts, milk production, fish captures, external public support, and the service of the public debt). The results show that employment on the islands was reduced by around 7% because of the reduction in tourism activities. The analyses also revealed that the western small islands of Flores and Corvo, which had fewer COVID-19 cases in 2020, increased their specialization in tourism and Terceira island showed a relative touristic attractiveness at the expense of the nearby Graciosa and São Jorge. We also estimated a model that relates employment with the population to evaluate the potential impact of job losses in the population change in the Azores. The results show the loss of jobs did not affect significantly the population movement in the short run.

Keywords Tourism · COVID-19 · Azores islands · Resilience

JEL Classification R11 · R58 · Z32

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1 Introduction

Tourism alludes to the minds of regional developers when they assume that the solution to any development constraint in developing or decaying places can be overcome with tourism. The fact is that, on the one hand, not all regions can successfully specialize and develop through tourism due to strong competition between touristic places (Kappert 2000; Edgell 2016; Dentinho 2021) and, on the other hand, tourism is a very sensitive activity in face of global crises (Ritchie 2004), like the financial crisis of 2008 or Covid-19 (Gössling et al. 2020).

Since the COVID-19 pandemic spread in 2020, many researchers started to analyze its impact on tourism activity. The interest in this theme can be seen by searching the keywords "impact COVID-19 tourism" in the Web of Science database. There were 474 papers in the research area of Business Economics and 758 in Social Science and other topics published from 2020 until September 2023.

A systematized literature review of the early literature on COVID-19 and tourism (Yang et al. 2021) found 249 papers whose analysis revealed five key themes: (1) psychological effects and behavior; (2) responses, strategies, and resilience; (3) sustainable futures; (4) impact monitoring, valuation, and forecasting; and (5) technology adoption. Furthermore, there is normative literature on sustainability that looks at the opportunity of the crisis to promote sustainable tourism: Cooper and Alderman (2020) propose more sustainable tourism based on better management events and (Higgins-Desbiolles 2020; Tomassini and Cavagnaro 2020) defend the participation of the community. What is known is that in Europe tourism arrivals declined by 70% in 2020 (UNWTO 2021) due to COVID-19 and recovered in 2022.

One example of a study that looks at the impact of COVID-19 on tourism is (Kumudumali 2020), which tried to estimate the impact of COVID-19 on the global tourism industry in the early stages of the crisis just to say that the impact on tourism would be high. One year later, Arbulú et al. (2021) published a study that proposed different crisis scenarios for the Balearic island. In the same year, Silva Lopes et al. (2021) looked at risk perceptions by tourists in Portugal. There are also some other studies on the impacts of more localized pandemics on tourism: McAleer et al. (2010) studied the impact of SARS on Asian tourism; Mizrachi and Fuchs (2016), also focused on tourist perception and analyzed the impact of Ebola on the tourism industry in Western African countries.

Analyzing the effects of COVID-19 on tourism activity allows for evaluating the resilience of tourist areas to exogenous shocks. The resilience of tourist places relates to the capacity of a system to be reorganized or moved to a new state after a chock or disturbance keeping the community's overall quality of life at desirable levels (Lew and Cheer 2017). Cochrane (2010) states that understanding the vulnerability and resilience of places makes it easier to identify interventions that guarantee a system maintains its essential functions without passing into another domain. After an exogenous shock, tourism destinations do not disappear but find new markets or develop a different product (Cochrane 2010).

A second issue is to perceive the resilience of touristic destinies over time regarding their competitors meaning keeping their performance relative to other islands acknowledging that touristic sustainability, associated with its natural and cultural environments (Butler 1999), refers not only to its territory but also to the surrounding areas influenced by spread and backwash effects (Dentinho 2021).

To address those issues, we look at the nine islands of the Azores. First, we estimate a regional economic base model for the islands highlighting the role of tourism and the impact of the tourist break associated with COVID-19 in 2020; then we analyze the role of employment on population changes. The results can help the identification of the island as more susceptible to exogenous shock and allow a discussion on the resilience of tourism activities in the Azores.

2 Methodology

2.1 Area of study

The Azores is an archipelago of nine islands and it is an autonomous territory of Portugal in the Atlantic Ocean, a distance of around 1450 km from Lisbon. The main features of the islands are their green fields and volcanic landscape, which attract many tourists. Figure 1 shows the location.

In terms of population, the biggest island is São Miguel (SMI), where almost 56% of the Azores population lives, followed by Terceira (TER) with around 23%, and Faial with 6.1% (SREA 2023). The smallest is Corvo (COR) with only 464 inhabitants.

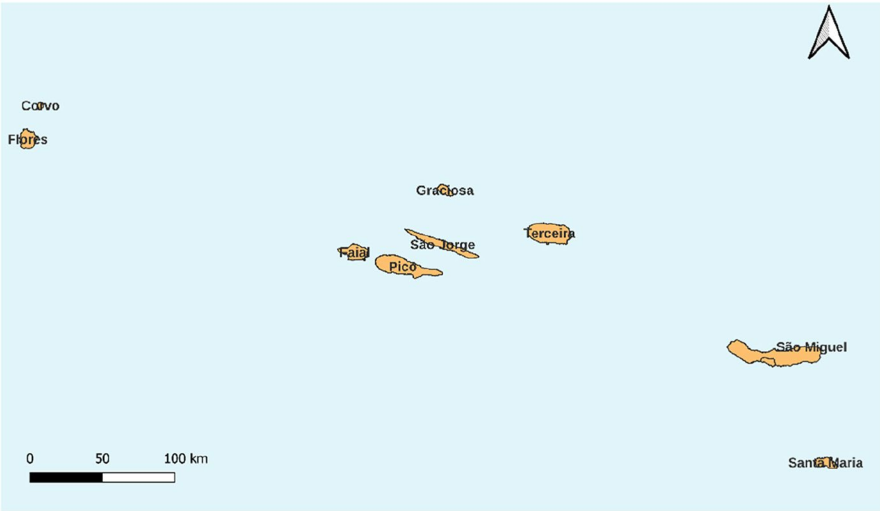

Fig. 1 The Azores islands. *Source* Serviço Regional de Estatística dos Açores (SREA 2023)

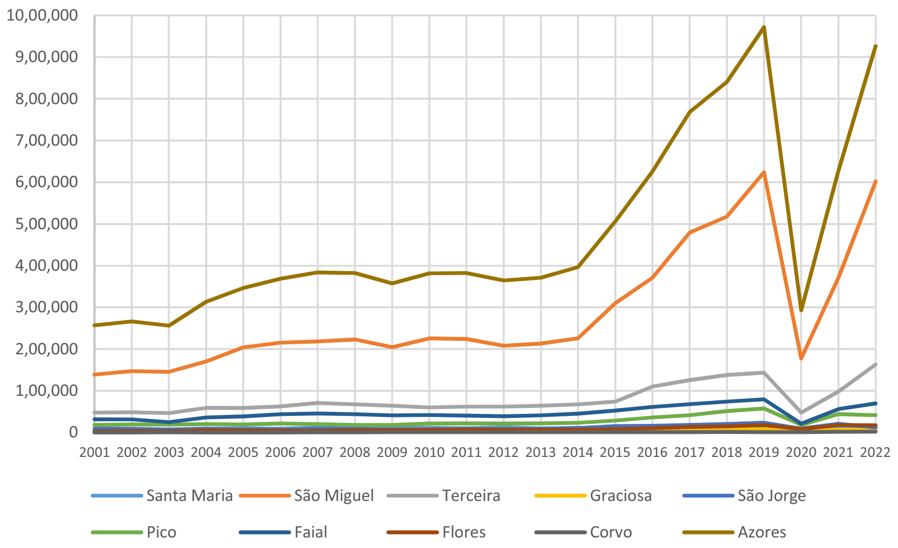

Fig. 2 The evolution of hosts in the Azores Islands. *Source* Serviço Regional de Estatística dos Açores (SREA 2023)

The basic activities in the Azores are agricultural and agro-industrial exports and are strongly linked to the milk value chain, tourism, public transfers from abroad, and fishing (Fortuna and Vieira 2007; Haddad et al. 2015).

Tourism is quite new in the Azores and has become one of the main drivers of the economy. As shown in Fig. 2, tourism took off in the São Miguel and Terceira islands after 2014. This was a result of the liberalization of air flights to São Miguel island in 2014 and Terceira in 2015.

On the other hand, Fig. 2 also shows the strong impacts of COVID-19 on tourism flows. It fell from 971,794 hosts in 2019 to 292,892 in 2020 in all the islands. The tourism flows decreased by 61% in Santa Maria, 71.5% in São Miguel, 66.8% in Terceira, 59% in Graciosa, 59.7% in São Jorge, 68.1% in Pico, 73.5% in Faial, 54.2% in Flores and only 25.8% in Corvo. These percentages are similar to the reduction in the world (UNWTO 2021).

The reduction of tourism flow directly affects income generation on the island. Brilhante and Rocha (2022) showed that in São Miguel the income drops around 78.7% in the local accommodation sector, 74.7% in the traditional hotel sector, and 58.5% in the restaurant sector.

2.2 Econometric specification

To evaluate the importance of tourism for employment generation and the role that employment plays in determining the population size of each island we used two regression models. Both models are estimated using data from 2003 to 2020, the

Table 1 Average of the variables used in the models, 2003–2019

Cod Iland	Island	Population	Employment	Hosts (1000)	Milk production (10,000 L)	Tranfers (1000 euros)	Tranfers before 2007 (1000 euros)	Debt (1000 euros)
SMA	Santa Maria	5609	1713	112	0	4881	1084	610,399
SMI	São Miguel	137,043	43,185	2754	36,041	181,836	49,193	610,399
TER	Terceira	56,159	16,820	770	14,050	51,603	11,098	610,399
GRA	Graciosa	4416	1171	50	758	4566	1062	610,399
SJO	São Jorge	8950	2870	112	2894	12,455	2930	610,399
PIC	Pico	14,108	4260	267	761	19,865	5616	610,399
FAI	Faial	14,893	5491	465	1276	15,017	3657	610,399
FLO	Flores	3781	1182	79	103	5554	1159	610,399
COR	Corvo	440	186	6	4	428	0	610,399

Source Serviço Regional de Estatística dos Açores (SREA 2023)

The debt is the value of the Azores Region, it is not divided among the islands period when all the variables are available. Table 1 shows the variables used in the models; the data source is Serviço Regional de Estatística dos Açores (SREA 2023).

In the first regression Eq. (1), total employment per island is the dependent variable. The explanatory variable of interest is the number of hosts, used as an indicator of tourism activity.

The control variables are representations of other activities from the economic base model: milk production (thousand liters), used as a proxy for agricultural and agro-industrial exports; public transfers before and after 2007–to capture the change in the Finance Law of the Autonomous Regions (one thousand euros); and the amount of public debt from the previous year (one thousand euros). Transfers data and public debt are only available for the total of the Azores. Thus, we used the spending on public education and the population size to calculate the share of each island on transfers.

The model also includes a dummy variable for the presence of the military base in Terceira, which used to generate several jobs before it was closed in 2014; and a dummy variable equal to 1 to the year 2020 and 0 otherwise, to capture the effects of the pandemic.

$$\begin{aligned} emp_{it} &= \beta_1 hosts_{it} + \beta_2 milk_{it} + \beta_3 trans_{it} + \beta_4 trans2007_{it} \\ &\quad + \beta_5 debt_{it} + \beta_6 \Delta debt_{it} + \beta_7 Base + \beta_8 Pandemic + v_{it} \\ v_{it} &= c_i + \varepsilon_{it} \end{aligned} \tag{1}$$

where the subscript i refers to the island and t to the year; emp_{it} is the total employment; $hosts_{it}$ is the number of tourists visiting the islands; $milk_{it}$ is the milk production; $trans_{it}$ is the transferees from the state; $trans2007_{it}$ is the transference before 2007; $debt_{it}$ is the debt from the previous year; v_{it} is a term that includes the island fixed effect (c_i) and the residuals (ε_{it}); and $\beta_{1,8}$ are the coefficients to be estimated. We estimated the fixed effect panel data with the within estimator (statistical tests are in Appendix 1).

In the second model, the analysis consists of estimating the effect of employment on the population of the islands. The dependent variable is the population; the explanatory variable is the employment multiplied by an iland dummy. We estimated this model also using fixed effect data, following the statistical tests (Appendix 1). Equation (2) presents the model.

$$\begin{aligned} population_{it} &= \delta_1 employment_{i,t-2} + v_{it} \\ v_{it} &= c_i + \varepsilon_{it} \end{aligned} \tag{2}$$

3 Results

The results of the first model are in Table 2. We estimated it using the variable in level (model 1) and logarithm (model 2) and the fixed effect model, which according to the Hausman test (Appendix 1) fits better to the data. The model in level explained better the evolution of employment in the Azores Island (see the R-squared), so we are focusing on the discussion of its results.

Table 2 Employment model for the Azores Island

Variables	(1) Employment	(2) Ln_employment
Host	1.056***	0.0631*
	(0.204)	(0.0324)
Milk production	0.112	0.0879**
	(0.0762)	(0.0430)
Tranfers	0.0476***	0.0819***
	(0.00524)	(0.0253)
Transfers until 2007	0.00425	−0.000114
	(0.00278)	(0.00163)
Debt	−0.00196**	−0.142***
	(0.000776)	(0.0365)
Debt (variation)	3.815***	0.000278***
	(1.448)	(6.02e-05)
Military base in Tercera	1338***	0.0293
	(379.8)	(0.0288)
Pandemic	2720***	0.134**
	(905.5)	(0.0563)
Constant	6921***	8.486***
	(653.1)	(0.598)
Observations	144	126
R-squared within	0.539	0.364

Standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$

The determinant factors of employment in the Azores are the tourist activity, represented by the number of hosts, transfers from the State, the public debt with a negative sign, variation of public debt with a positive sign, the presence of the US military base in Tercera and the COVID-19 pandemic.

For every 100 additional guests, around 1 direct, indirect, and induced job is created, values close to those presented by Dentinho and Fortuna (2019). The closing of the military base in Tercera led to a loss of 1338 jobs in the Azores.

Table 3 Change in the number of hosts and employment

Island	Host (Δ% 2019–2020)	Impact on employment (estimated Δ%)	Host (Δ% 2019–2022)
Santa Maria	−61	−6	−9
São Miguel	−72	−10	3
Terceira	−67	−5	17
Graciosa	−59	−4	−10
São Jorge	−59	−5	2
Pico	−68	−10	5
Faial	−74	−10	4
Flores	−59	−10	12
Corvo	−26	−2	125

The pandemic coefficient (a dummy for the year 2020) has a positive value of 2,720. This effect is because fewer people were leaving the Islands in 2020 due to COVID-19 restrictions. Concerning State activity, every million euros allocated generates around four jobs.

Using the data from the variation of the host between 2019 and 2020 and the coefficient from regression 1, and considering all other variables constant, we can estimate the impact of the decline in the host on employment in all the Azores Islands (Table 3). The islands of Faial, São Miguel, and Terceira were the ones that had a larger decline in visitors. The impact on total employment is smaller in the island that receives fewer tourists, such as Corvo and Graciosa. In Terceira, the impact on employment is also one of the smallest because the number of hosts there is about 22% of the number from São Miguel and its economy is less dependent on tourism.

Möller and Amcof (2018) showed that tourism has a positive effect on population change in rural areas, concerning both the size and structure of the population.

Table 4 Population change model for the Azores Island

Variables	(1) Pop	(2) ln_pop
Employment (t-2)		
SMA	−0.0614	−0.0162
	(1.102)	(0.121)
SMI	0.102**	0.0311
	(0.0463)	(0.127)
TER	0.169*	0.0498
	(0.0968)	(0.103)
GRA	−0.811	−0.222*
	(1.713)	(0.131)
SJO	1.164***	0.375***
	(0.421)	(0.0772)
PIC	0.330	0.100
	(0.591)	(0.161)
FAI	0.274	0.0996
	(0.315)	(0.110)
FLO	0.255	0.0833
	(1.298)	(0.0994)
COR	−0.0153	−0.000808
	(4.581)	(0.0600)
Constant	25,878***	8.662***
	(588.7)	(0.318)
Observations	144	144
R-squared	0.118	0.186
Number of cod	9	9

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Tourmis can increase employment opportunities which is an important reason for migration (Boyle et al. 1998). Thus, we used Eq. (2) to evaluate if employment has an effect on population size in the Azores. We estimate one regression with the variables at level and in logarithm form. The employment variable interacts with an island dummy to control for the island-specific effect of employment.). The fixed effect also controls for unobservable effects in each island that may influence their demographical changes. The results are in Table 4.

The coefficient associated with employment in both regression models demonstrates statistical significance solely when the change in employment over the two preceding years is incorporated into the model. With a predetermined level of statistical significance set at 5%, regression (1) highlights the potential influence of employment on the populations of São Miguel (SMI) and São Jorge (SJO) islands. In contrast, regression (2) only validates the effect in the case of São Jorge. Consequently, based on these results, we cannot assert that employment exerts a significant and immediate impact on the population of the Azores.

During the period spanning from 2014 to 2019, characterized as a tourism boom in the islands (as illustrated in Fig. 2), job opportunities surged by 22%, while the population experienced a 1% decline. So, the mere creation of employment prospects does not suffice to deter individuals, particularly the younger demographic, from leaving the islands or to attract people from other places. Similarly, it is plausible that job losses during crises, such as the COVID-19 pandemic, did not significantly influence the decision to remain on the island. Other factors, including familial and community ties as well as cultural considerations, may play pivotal roles in determining island residency. This is an issue that can be better explored in future studies, by using microdata from population census records.

4 Conclusion

This paper evaluated the impact of COVID-19 on tourism and employment. The novelty of the exercise comes from the availability of recent data on tourism and an adequate way to evaluate its impact on employment of nearby islands' competition between themselves as touristic destinies. We also investigated if employment changes could influence the population size in the islands.

Although tourism activities were severely affected by the pandemic and its restrictions, the loss of jobs might not affect significantly the population movement in the short run. The reasons behind this population resilience may be related to government and familiar support. A deeper analysis of these factors is beyond the scope of this work and can be addressed in further studies.

The analysis also showed that places less dependent on tourism like Terceira and São Jorge, and less affected by COVID-19, such as Corvo, were more resilient to the crisis. This means they recover faster and even increase their number of hosts compared to the pre-pandemic period. Results also show that the threat and opportunities of the COVID-19 crisis reinforced the potential of remote destinies (Flores and Corvo) and the backwash effects that more entrepreneurial places of Faial, Terceira, and São Miguel exert respectively in Pico, Graciosa, and São

Jorge and Santa Maria. The crisis speeds up the concentration of tourism in the winning places of an emerging tourist sector in the islands the same way as, over time, Funchal, Albufeira, Lisbon, Nazaré, Fátima, Porto, Castelo de Vide, and Gerês become winners of Portugal touristic landscape (Dentinho 2021).

Appendix 1: Statistical tests

See Tables 5, 6 and 7.

Table 5 Fisher-type unit-root test based on augmented Dickey–Fuller tests

Variable	Inverse chi-squared(18)	*P*-value
Population	32.4232	0.0196
Employment	58.1068	0.0000
Hosts	61.2867	0.0000
Milk production	55.6384	0.0000
Debt (variation)	32.1837	0.0209
Tranfers	59.7549	0.0000
Tranfers 2007	45.26	0.0001

AR parameter: Panel-specific, panel means and drift term included

Table 6 Hausman test FE × RE, Eq. (1)

Coefficients	(b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E
Regression (1)–level				
Host	1.056	1.067	−0.011	0.190
Milk production	0.112	0.627	−0.515	0.117
Tranfers	0.048	0.085	−0.038	0.006
Transfers until 2007	0.004	0.020	−0.016	0.003
Debt	−0.002	−0.001	−0.001	0.000
Debt (variation)	3.815	2.180	1.635	0.260
Military base in Tercera	1338.262	2552.220	−1213.957	342.822
Pandemic	2720.275	1869.496	850.778	319.642
chi2(8) = 68.7, Prob > chi2 = 0.0000				
Regression (2)–ln				
Host	0.063	0.454	−0.391	0.053
Milk production	0.088	0.197	−0.110	0.081
Tranfers	0.082	0.243	−0.161	0.028
Transfers until 2007	0.000	0.005	−0.005	0.001
Debt	−0.142	−0.383	0.241	0.040
Debt (variation)	0.000	0.000	0.000	0.000
Military base in Tercera	0.029	0.043	−0.014	0.023
Pandemic	0.134	0.651	−0.517	0.075
chi2(8) = 87.68, Prob > chi2 = 0.0000				

Table 7 Hausman test FE × RE, Eq. (2)

Coefficients	(b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E
Regression (1)–level				
Employment t-2				
SMA	−0.061	−6.602	6.541	6.278
SMI	0.102	2.814	−2.713	0.265
TER	0.169	2.352	−2.183	0.543
GRA	−0.811	−10.604	9.792	9.809
SJO	1.164	−2.763	3.927	2.270
PIC	0.330	−0.678	1.007	3.420
FAI	0.274	−0.376	0.651	1.781
FLO	0.255	−11.082	11.337	7.252
COR	−0.015	−87.404	87.388	21.983
chi2(8) = 130.39, Prob > chi2 = 0.0000				
Regression (2)–ln				
Employment t-2				
SMA	−0.016	0.192	−0.209	0.135
SMI	0.031	0.434	−0.403	0.145
TER	0.050	0.384	−0.335	0.116
GRA	−0.222	0.168	−0.389	0.147
SJO	0.375	0.237	0.138	0.083
PIC	0.100	0.281	−0.181	0.183
FAI	0.100	0.280	−0.180	0.123
FLO	0.083	0.146	−0.063	0.109
COR	−0.001	−0.213	0.212	0.049
chi2(8) = 39.34, Prob > chi2 = 0.0000				

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