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THE IMPACT OF COVID-19 ON THE TOURISM SECTOR IN ITALY: A REGIONAL SPATIAL PERSPECTIVE

Maria Giovanna Brandano
Alessandra Faggian
Adriana Carolina Pinate

WORKING PAPERS

2023/09

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CRENoS – CAGLIARI
VIA SAN GIORGIO 12, I-09124 CAGLIARI, ITALIA
TEL. +39-070-6756397; FAX +39-070- 6756402

CRENoS - SASSARI
VIA MURONI 25, I-07100 SASSARI, ITALIA
TEL. +39-079-213511

Title: THE IMPACT OF COVID-19 ON THE TOURISM SECTOR IN ITALY: A REGIONAL SPATIAL PERSPECTIVE

Prima Edizione: Luglio 2023
ISBN: 978 88 68514 716

Viale Bonaria 98 - 09125 Cagliari
Tel. 070/6848663 - info@arkadiaeditore.it
www.arkadiaeditore.it

The impact of COVID-19 on the tourism sector in Italy: a regional spatial perspective

Maria Giovanna Brandano[*]
Gran Sasso Science Institute, L'Aquila & CRENoS
Alessandra Faggian
Gran Sasso Science Institute
Adriana C. Pinate
Gran Sasso Science Institute

Abstract

The recent COVID-19 pandemic crisis affected all economic sectors, but in particular tourism. In fact, it is now almost unquestionable that the tourism sector was hit the hardest. However, the resilience of domestic and international tourism, and its capacity to rebound from crises, has also been recognized. In this context, the aim of this paper is twofold. First, to analyze the impact of COVID-19 on tourism flows in Italy, by looking at NUTS-3 level data on national and international tourism arrivals. Second, to understand whether, and to what extent, some "alternative" destinations benefited during the pandemic. Spatial and geostatistical analyses are used to capture the determinants of the variation in tourism flows in 2020 and 2021 compared with the pre-pandemic year (2019). Results show different scenarios in the two periods analyzed, demonstrating that tourist behaviors started to change, and they are still evolving.

Keywords: COVID-19 pandemic, Spatial analysis, tourism flows, Italy, short-term resilience.
Jel Classification: I18, C31, L83, Z32; R10.

[*] Corresponding author. E-mail: mariagiovanna.brandano@gssi.it

1. Introduction

The effect of infectious diseases on tourism demand has been widely investigated in the literature. In the past, some cases, such as Ebola or SARS, caused a decrease in tourism arrivals, while others, such as yellow fever and malaria, seem unrelated to this phenomenon[1]. However, diseases are not the only shocks that can affect tourism. According to Ritchie and Jiang (2019), shocks are regular occurrences in tourism. Events like cyclones, bushfires, earthquakes, and terrorist attacks are frequent, and destinations have developed different strategies to mitigate the risk and be more resilient. Even in the face of this, COVID-19 was an unprecedented shock for the tourism sector. Dolnicar and Zare (2020) call COVID-19 a "super-shock" for at least three reasons. First, "*the economic shock and the consequent travel decline is global"*. Second, "*the economic shock is more dramatic, with reductions to economic growth twice as big as those caused by regular shocks"*. Finally, *"the shock has the potential to trigger structural changes in certain sectors of the industry"* (Dolnicar and Zare, 2020, p. 1). As a matter of fact, UNWTO confirmed a reduction of international tourist arrivals by 73% in 2020 (UNWTO, 2022), although with marked regional differences. To gauge the magnitude of this, the 2008 economic crisis caused a decrease in international tourists worldwide by only 4% in 2009. Moreover, the intensity of social contacts is different by sectors and hence so is the economic impact of lockdowns. Sectors such as tourism and cultural and creative industries (CCIs), public transport, and general services are expected to experience the most significant negative impact of lockdowns and mobility restrictions (Immordino *et al.,* 2021).

Before the pandemic, the tourism sector directly contributed 4.4% of GDP, 6.9% of employment, and 21.5% of service exports in the OECD countries. For example, the tourism contribution to GDP was 11.8% in Spain, 8.7% in Mexico, 8% in Portugal, 7.4% in France, and 6.8% in Greece (OECD, 2020). In Italy, the third European country for international arrivals, this contribution was 5.6% (WEF, 2019). Despite the contribution to GDP not so relevant as in Spain, the sector showed a positive performance in terms of accommodation supply, employment and tourist arrivals. According to Eurostat data, in 2018, Italy was third after Germany and Spain for employees in mainly tourism-related activities, second after Germany for employees in partially tourism-related activities and second after Spain for the number of accommodation services, travel agencies, and tour operators[2]. Italy was able to attract 13.3% of tourist arrivals in the EU, only surpassed by Spain and France.

In the backdrop of this positive scenario, COVID-19 (and its restrictions) struck. On 30 January 2020, COVID-19 was declared by the World Health Organization (WHO) a "Public Health Emergency of International Concern" and a pandemic on 11 March 2020. In April and May 2020, travel restrictions were introduced by 100% of destinations. Only in June 2020 did tourism-related activities re-open but with several sanitary and health measures imposed. During the lockdown, but also after, travel restrictions and changes in tourism behaviors affected the tourism sector in unprecedented ways. However, domestic and international demand reacted to the shock in different ways. Internal tourism -among regions of the same

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[1] See Falk *et al.* (2022, b) for a complete review of this topic.

[2] In absolute terms: 348,280 persons employed in mainly tourism-related activities; 1,310,549 persons employed in partially tourism-related activities; 289,137 accommodation services, 40,052 travel agencies and tour operator activities (Marques Santos *et al.*, 2020).

country- and "slow" tourism gained interest, while international travel saw the most substantial decline.

Studies exploring the links between the incidence of infections and domestic tourism at the regional level are rare (Falk *et al.*, 2022, a, p. 2), because, on the one hand, data show it was international tourism to suffer the most and, on the other hand, reliable data on internal flows were more difficult to find. As such, it is still being determined what kind of regions has been positively affected by the growth in domestic flows. For these reasons, following the first hints suggested by OECD (2020), Istat (2020), and Falk *et al.* (2022, a and b) this paper intends to empirically analyze tourism demand in Italy at the provincial level (NUTS-3) and investigate the following main hypotheses.

H1: tourism demand shows different patterns across Italian provinces after COVID-19;

H2: domestic and international tourists have different patterns;

H3: the short-term resilience depends on the characteristics of the destination.

The validity of these hypotheses is tested using spatial analysis techniques and data at NUTS-3 level for the years 2020 and 2021 compared with the pre-pandemic 2019. This paper provides a first quantitative investigation into how COVID-19 affected tourism arrivals in Italy at the provincial level. As far as we know, currently, there is no research on the application of these spatial geostatistical analyses to the understanding of the regional variation in the tourism flows during the first two years of the pandemic.

The paper is structured as follows. Section 2 analyses the literature review on tourism and the effect of COVID-19, dividing theoretical and empirical studies. Section 3 presents data. Section 4 describes the methodology. Section 5 discusses the main results, while Section 6 concludes providing limitations future development of the present research.

2. Literature review

Some months after the onset of the pandemic crisis, two international institutions – the OECD and the European Commission - provided the first statistics on the impact of COVID-19 on the tourism sector. OECD (2020) showed how the COVID-19 crisis hit the tourism economy hard, with unprecedented effects on jobs and businesses. The OECD forecasted a fall of around 80% in international tourism in 2020, a percentage that UNWTO confirmed with official data on tourist flows a few months later. According to the European Commission, the magnitude of the effect is related to the sectorial specialization of countries and regions.

We can classify the effects of COVID-19 on the tourism industry into four categories (Figure 1): 1. A "substitution" effect on the demand side (both destinations and tourists). 2. An "income" effect on the demand side. 3. A "substitution" effect on the supply side (in the long run). 4. An "income" effect on the supply side related to the risk of closure for firms (in the short run). The most recent literature on the topic covers all four aspects, although with different intensities.

Figure 1. Matrix of COVID-19 effects

	Demand side	Supply side
"Substitution" effect	• Tourists: Domestic vs International • Destinations: change in preferences	• Accommodation supply might change in the long run
"Income" effect	• Loss of jobs or reduction on working hours	• Closure of some tourism-related activities • Fall in revenue in travel and tourism industries • Change in hotels' pricing strategies

2.1 The "substitution" effect on the demand side

From the very beginning of the pandemic crisis, it became clear that both psychological factors (e.g. fear of contamination) and economic factors (i.e., reduction of income because of job loss or reduction of working hours) would result in a significant change in tourist preferences and destinations. Marques Santos *et al.* (2020) forecasted that the most affected territories would have been those with a very high concentration of tourists in the Summer (mostly seaside destinations) and/or urban destinations. Confirming this, recent surveys (DNA, 2020; Interface Tourisme, 2020; VVF, 2020) found that in 2020 tourists preferred low-density destinations and destinations far from big cities (with outdoor activities). For some less affected rural areas, COVID-19 became an opportunity to boost their local economy, because perceived as safer and hence more attractive. This "substitution" of destinations went hand-in-hand with changes in the type of clientele to be served. In fact, because of all the travel restrictions and the uncertainty associated with them, domestic tourism became the most important source of income for the industry, providing the much-needed boost to help sustain many tourism destinations and businesses, and playing a key role in the short- and medium-run recovery.

However, this "substitution" effect, in terms of destinations and tourists, impacted regions differently. For instance, different regional effects are found in Spain (Arbulù *et al.*, 2021) and Turkey (Altuntas and Gok, 2021). Specifically, domestic flows in Spain are analyzed, and the smallest losses in terms of overnight stays are predicted for Andalusia and Aragon (35.1% in both) and Madrid (35.3%). The regions with the highest expected losses are the Canary Islands (-59.4%) and Castille-and-Leon (58.8%). Reasons that explain these uneven behaviors are: i) the different historical attractiveness of these regions, ii) the dependence on air and sea transportation for the islands, and iii) the capacity to attract new segments of domestic demand. In the case of Turkey, the authors included quarantine decisions among the determinants of the different effects of COVID-19 on domestic tourism. The higher the restrictions imposed on the population, the smaller the spread of contagious, and therefore higher the probability that the region with a low level of COVID-19 cases could be considered safe for tourists.

Following the studies mentioned above, regions in four countries in Middle Europe - Austria, the Czech Republic, Germany, and Switzerland - are studied to understand the short-run impact of COVID-19 in July and August of the first pandemic summer of 2020 (Falk *et al.*, 2022, a). For the first time, this analysis empirically demonstrated that COVID-19 negatively impacted domestic tourism demand in densely populated areas. In contrast, areas with a low population density increased such flows. In the same vein, Falk *et al.* (2022, b) examined 305 NUTS-3 regions in six other European countries - Denmark, Finland, France, Italy, Spain, and Sweden. The novelty of this paper is the use of the five categories suggested by the OECD to measure the urban/rural dichotomy considering not only the density of the population, but also accessibility and connectivity [3]. The authors found that large metropolitan regions suffered a sizeable decrease in demand while rural and remote areas an increase. Significant variations were identified between Northern and Southern regions. In fact, only in the North a substitution effect in demand, between metropolitan and remote areas, was observed. This result has also been confirmed by Silva (2021), who empirically demonstrated how rural tourism in Portugal did not benefit from the pandemic crisis as did, for instance, in France and Czechia. More recently, some authors explored the COVID-19 effect in more details for specific countries. Falk *et al.* (2022c) focused on France, while Falk *et al.* (2022d) on Germany. The analyses, conducted at a very granular level (i.e., 96 French regions in the first case and 2,029 villages in Bavaria in the second one), revealed for the first time the importance of spatial spillover effects and hence the need to use of spatial analysis in this context. Falk *et al.* 2022 (d) also examined the recovery of domestic tourism demand in the summer of 2021. Notwithstanding the study's limitations, given by only using data on two months per year, this work represents the first attempt to understand better what happened over a more extended period of time.

Italy, one of the hardest hit countries in the first wave of the pandemic, has only partially been investigated so far. Osti and Nava (2020) and Del Chiappa *et al.* (2021) tried to understand tourists' perceptions and behaviors collecting primary data through surveys in the first period of COVID-19. Both contributions found that Italian residents changed their travel preferences, moving more towards less crowded destinations, such as rural areas, mountains or less famous beaches. These new destinations made them feel safer than the traditional destinations (seaside towns or art cities).

Another relevant aspect analysed by the literature is the recovery of the sector after the COVID-19 shock. Provenzano and Volo (2021) focused on the impact of the pandemic in Lombardy, the most affected Italian region in the first wave. Independently by the three scenarios hypothesized – *Covid no more*, *Covid exponential decay,* and *Covid new wave* – the most interesting result is that domestic and international tourism are expected to follow a very different recovery path. Domestic tourists are expected to recover faster. A focus on

[3] According to this typology regions are classified as 'metropolitan' if more than half of their population lives in one or more functional urban area (FUA) of at least 250 thousand inhabitants and as 'non-metropolitan' otherwise. Then, metropolitan regions are divided into 1) large metro and 2) metro regions based on the population size of the FUAs located within those regions. Non-metropolitan regions are divided into 3) with access to a metro, 4) with access to a small/medium city, 5) remote based on their level of access to a FUA with a population above a predetermined threshold (see Fadic *et al.,* 2019).

international tourism is provided by the Bank of Italy (2021), which analyzes mobile phone data until February 2021. The main findings are that provinces hit the most are characterized by i) specialization in art and cultural tourism, ii) hotel prevalence, and iii) accessibility by plane.

2.2 The "income" effect on the demand side

The many restrictions imposed because of COVID-19 also affected other sectors of the economy with an unprecedented "domino" effect. This resulted in a contraction of the spending power of people, at least in the short run. Again, this favoured more local destinations rather than international ones. There are not very many contributions on this yet. However, Mariolis *et al.* (2021) find that in Greece, total employment is expected to decrease between -2.1% and -6.4% because of the pandemic. This decline would mainly impact the Hotels and Restaurants, Land Transport, Agriculture, and Real Estate sectors. As for the case of Spain, a survey showed that 42% of respondents planned to spend less, much less, or even nothing on tourism activities after the end of the pandemic (EY, 2020). In Italy, Spain, France, and the Netherlands, results of another survey conducted in May 2020 showed that respondents intended to reduce their travel budget between 10% and 30% compared to 2019 (Interface Tourism, 2020).

2.3 The "substitution" effect on the supply side

The impact on the supply side was also considered. However, because of the lack of official data and the impossibility of forecasting the end of the crisis, scholars initially tried to identify not only the short-term impact on the supply side, but also some possible medium- to long-term benefits for the tourism sector[4]. For instance, Brouder (2020) highlighted the importance of a tourism transformation on both the demand and supply sides. He adds that *the present situation opens the doors to transformative change in tourism* (Brouder, 2020, p. 488). In the same vein, Hall *et al.* (2020) stated that COVID-19 may push individuals to change their habits in terms of tourism and travel, opening up the opportunity for a real transformation of the overall tourism system. Despite the nexus between this last pandemic and tourism being still under investigated, the capacity of tourism to recover after a crisis is well-known. For this reason, a complete reorientation of tourism must be considered with caution. More appreciated is the possibility - or opportunity - to make tourism more sustainable. According to Romagosa (2020), the pandemic could be seen as an opportunity to change the direction of tourism development into more sustainable tourism, in line with the Sustainable Development Goals (Gossling *et al.,* 2020), going towards greener and more balanced tourism (Ioannides and Gyimòthy, 2020) or focusing more on innovation (both demand and supply sides; Brouder, 2020).

Dolnicar and Zare (2020) investigate the effect of COVID-19 on short-term accommodations rented via online platforms, such as Airbnb. They hypothesize two main consequences. One is that COVID-19 will lead to a re-emergence of the original Airbnb spirit and hence this accommodation will be shared among ordinary citizens. The second one is that Airbnb – and other online platforms – will recover, but not to pre-pandemic levels, since, according to

[4] For a complete overview of this perspective see the Special Issue published by Tourism Geographies 22 (3) titled "Visions of Travel and Tourism after the Global COVID-19 Transformation of 2020".

DuBois (2020), the pandemic and consequent travel restrictions caused a 96% drop in Airbnb bookings.

2.4 The "income" effect on the supply side

The OECD forecasted that not all companies would survive the crisis and predicted a loss of jobs. In July 2020, ISTAT estimated that about 38.8% of Italian businesses (equal to 28.8% total employment and 22.5% GDP) were "at risk" of closing down and that the risk was higher, the smaller the companies (going from 18.8% for large companies to 40.6% for micro-businesses).

One of the first studies empirically analyzing the relationship between COVID-19 and tourism supply found a negative relationship between this pandemic and tourism industry returns (Lee and Chen, 2020). However, daily data for the 65 countries under analysis show different results for the three variables (i.e., confirmed cases, deaths, and recovered cases). The same dependent variable was examined by Sharma and Nicolau (2020), who focused on returns in specific tourist sectors (i.e., airlines, hotels, cruise lines, and rental cars) in the United States. Results demonstrate that the cruise industry was the most affected. Moreover, the COVID-19 multiplier effect of tourism on GDP is estimated to decrease between 2% and 6% in Greece (Mariolis *et al.*, 2021). Another effect of COVID-19 on the supply side and specifically on the hotels' management is the change in the behaviors of operators during the pandemic. Guizzardi *et al.* (2022), by analyzing 100 hotels in Milan (Italy), found that hotels pursued price-discount strategies during that period. At the same time, the "advance booking" strategy had lost its relevance, favoring the "last-minute" one.

The main limitation of these first contributions is that they only explore data over a short period which necessarily gives a partial picture of the phenomenon. Moreover, they focus on countries, rather than regions, but as COVID-19 impacted regions very differently, a country level analysis is sometimes not very meaningful.

Despite the large number of contributions on COVID-19, the analysis of the effect on tourism is still in its embryonal phase. Many gaps can be identified. Most studies analyze domestic tourism (except Fotiadis *et al.*, 2021, Provenzano and Volo, 2021, and Bank of Italy, 2021); all of the papers focus on the first wave or the first year (except Falk *et al.,* 2022, d). As for the case of Italy, no publication empirically analyzes the relationship between COVID-19 and domestic and international demand for the period 2020 and 2021. The present paper aims to fill these gaps by contributing to the existing literature in different ways. First, considering the previous and original classification of the effects of COVID-19, we focus on the "substitution" effect on the demand side. Specifically, we investigate the heterogeneous impact of COVID-19 in Italian provinces by dividing total tourists into domestic and international components. Second, the paper analyses the variations in tourism arrivals in the first, but also in the second year post COVID-19. Finally, we use a spatial analysis that allows us to account for spatial spillover effects between neighboring provinces.

3. Data and variables

The focus of the study is on both domestic and international tourist arrivals in the 107 Italian provinces (NUTS-3) in the two post COVID-19 years (2020-2021). We compare them to the pre COVID-19 year of 2019 to judge the bouncing back ability of the different places.

The analysis is carried out at the provincial level, as this is the finest geographical scale, at which COVID-19 cases data (from the Italian Ministry of Health) are available (and reliable). At the same time, this level of analysis is precise enough to account for the significant variation in how COVID-19 struck within regions (Ascani *et al.* 2021). As for data on tourism flows, these come from the Italian National Statistics Institute (Istat).

3.1. Domestic tourism flows

Figure 2[a-b-c] shows the geographical distribution of domestic (i.e., of Italian residents) tourist arrivals in the destination province of the pre-pandemic 2019 year and the 2020-2021 pandemic years, respectively. Figure 2[a] displays a homogeneous distribution with a stronger concentration of arrivals in the North, Centre, and some provinces of the South. Figure 2[b] shows a strong decrease in tourist arrivals in almost all provinces in 2020 compared to pre-pandemic 2019. Some exceptions are the Northeast provinces, especially those near the border and some in the Center along the Adriatic coast[5]. Regional capitals, such as Milan and Turin recorded a decrease of more than 60%, while Florence and Rome more than 50% (see Table A.1b in the Appendix).

During the second pandemic year (Figure 2c), the Northern and Southern provinces recovered more than the Southern ones[6]. Even where there has been a recovery, the province with the highest number of arrivals in 2021 (Rimini), was one million below the level of the top province in 2019 (Rome) (see Table A.1a in the Appendix for the top 10 provinces in the different years).

To check the change in the geographical distribution of domestic arrivals with respect to the local economy, we map the ratio between arrivals and total employees in the destination province. Figure 2[d-e-f] shows this new variable in the three years 2019-2021. In pre-pandemic 2019 (Figure 2d), the number of tourists was higher in places with more employees (in all sectors). In the first year of the pandemic (Figure 2e), the impact of tourism on the local economy was significantly lower than it had been the year before the epidemic, which resulted in a significant decline in tourists as measured by lower percentages on an unchanged employee base[7]. Again, the border and central coastal provinces present some exceptions. On the other hand, a recovery in the weight of tourism on the local economy is seen in the second year of the pandemic (Figure 2f), particularly in the central provinces and Sardinia Island. The North-West part is the one with the slower recovery.

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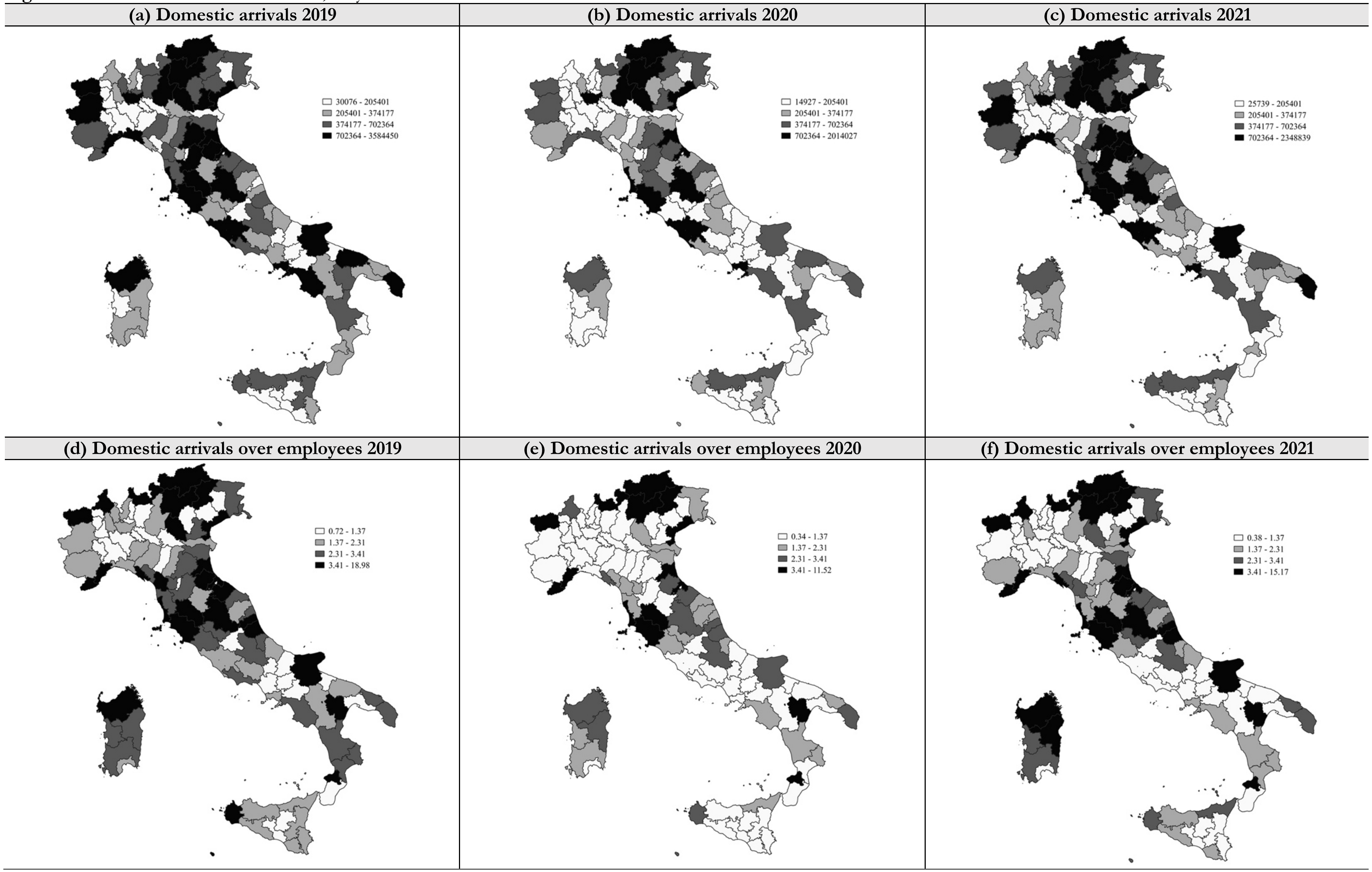
[5] Ravenna, Rimini, Livorno, and Grosseto.

[6] Except Naples, Foggia and Lecce.

[7] During the first lockdown, the majority of companies activated smart working and the Italian government established laws to avoid lay-offs by giving economic aid, which is why this percentage is lower.

Figure 2. Domestic arrivals. NUTS-3 level, Italy



Note: Domestic arrivals (a-c) and domestic arrivals over total employees (d-f) in 2019, 2020, and 2021 at the provincial level (NUTS-3) -equal quantile-.

3.2. *International tourism flows*

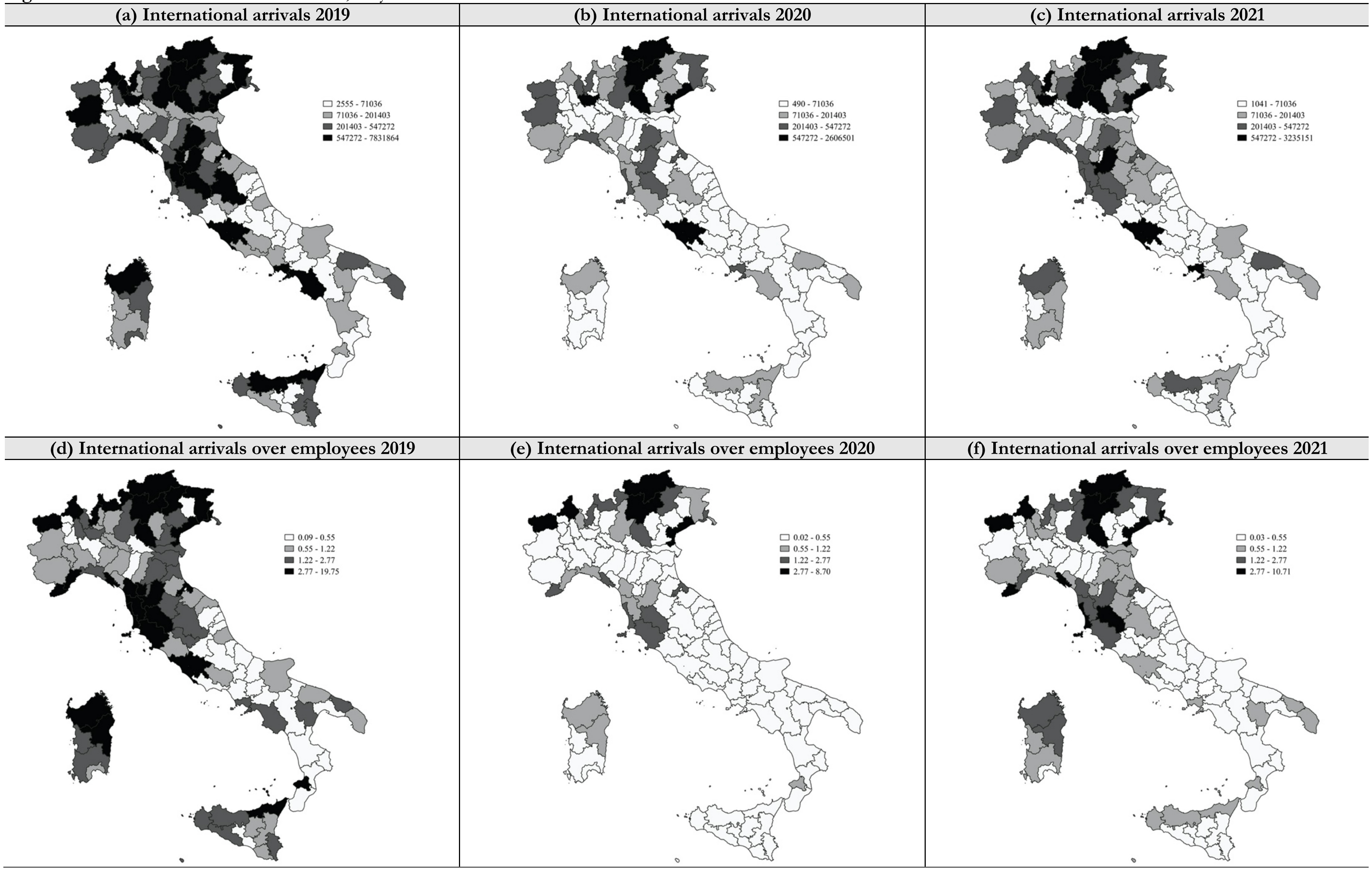
Figure 3[a-b-c] shows the geographical distribution of international tourist arrivals in the destination province of the pre-pandemic 2019 year and the 202-2021 pandemic years, respectively. Figure 3[a] displays a concentration of arrivals mainly in the North, Centre, and Islands. Figure 3[b] shows a very strong decrease during the first wave of the pandemic, which is still evident in the second year (Figure 3c). Some exceptions are represented by provinces in the North[8] and Rome in 2020. While a little recovery is evident in Tuscany, Sardinia, Sicily and some provinces in Apulia in 2021.

The loss of tourism arrivals is very evident with values ranging from -49% to -90% in 2020 and from -24% to -90% in 202 (see top ten provinces international arrivals Table A.1a in the Appendix). In fact, unlike domestic tourism, international flows had little variation between the first and second year of the pandemic; this can be explained in part by the travel restrictions on international flights imposed by the Italian government but also at the European and global level, where travelers needed to compiling with a series of requisites to enter the country (such as being vaccinated, showing a negative test within 48 hours of the flight until the interdiction of direct flights with some countries).

To check the change in the geographical distribution of international arrivals with respect to the local economy, we map the ratio between arrivals and total employees in the destination province. Figure 3[d-e-f] shows this new variable in the three years 2019-2021. In pre-pandemic 2019 (Fig. 3d), the arrivals were higher in the North, Centre and Islands, in provinces with more employees (in all sectors). In the first year of the pandemic (Figure 3e), international arrivals decreased more sharply than domestic ones. This led to lower percentages of weight being placed on an unchanged employee base almost everywhere in the country, with some exceptions on the bordering provinces, the coasts of Liguria and Tuscany, and the north of Sardinia Island. In the second year of the pandemic (Figure 2f), a recovery in the weight of tourism on the local economy is visible in the Centre and in the entire Sardinia Island, with a slight improvement in some provinces of the Apulia region and Sicily Island.

[8] This is especially true for those close to the borders (i.e, Bolzano, Udine, Gorizia, Trieste, Aosta, and Turin).

Figure 3. International arrivals. NUTS-3 level, Italy



Note: International arrivals (a-c) and domestic arrivals over total employees (d-f) in 2019, 2020, and 2021 at the provincial level (NUTS-3) -equal quantile-.

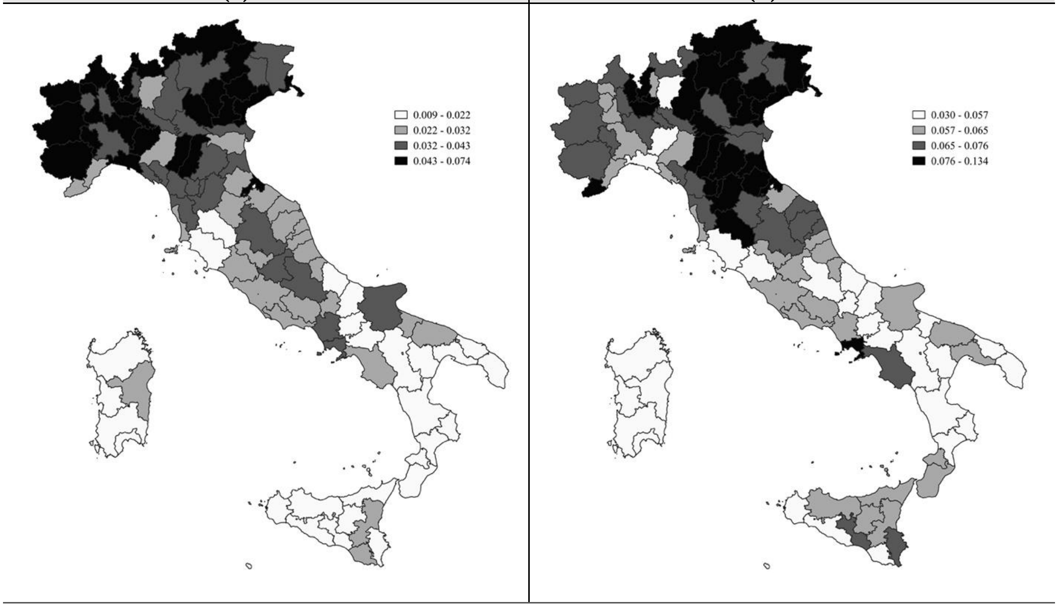
3.3. COVID-19 cases

Recent contributions have investigated the spread of COVID-19 at the regional level [9]. Figure 4 shows the annual COVID-19 confirmed cases per capita for the first and the second year. The maps reveal a geographical pattern that persists between the two periods, with the North of the country being the most affected. This result confirms and extends to the second year of the pandemic the findings obtained by Amdaoud *et al.* (2021) and Ascani *et al.* (2021), which found a consistent geographical pattern of COVID-19 spread in the first pandemic period [10].

After a first visual examination, by comparing the geographical distribution of the change in tourism arrivals with the spread of COVID-19, it seems that the two variables are correlated but just for 2020. Conversely, the international arrivals seem to be diametric to the COVID-19 cases, with a high loss for the South of the country (see Figure 3[b-c] and Table A.1 in the Appendix).

Figure 4. COVID-19 cases per capita. NUTS-3 level, Italy

(a) 2020	**(b) 2021**



Note: Covid cases per capita in 2020 and 2021 years at the provincial level (NUTS-3) -equal quantile-.

[9] A comprehensive per days analysis in Italy at NUTS-3 level during the first wave is provided by Ascani *et al.* (2021).

[10] Authors as Amdaoud *et al.* (2021) focused on the spatial spread of the pandemic at regional level in 12 European countries, found a distinctive heterogeneous geographical pattering of mortality rate that remains consistent across regions within the same country. In the particular case of Italy, Ascani *et al.* (2021) analysed the regional determinants of first wave of COVID-19, suggesting that the disease hit harder economic core provinces.

4. Empirical strategy

The present analysis assumes that the spread of COVID-19 influences the change in tourism arrivals. Recent scholars have demonstrated how during the first wave (2020) the spread of this virus was heterogeneous among regions within the same country (Amdaoud *et al.* 2021; Ascani *et al.* 2021), and the previous section has shown a heterogeneous spatial distribution in tourism arrivals in the first and in second years after COVID-19 started spreading.

In this regard, the spatial dimension introduced in this empirical analysis aims to capture this spatial distribution and the possible short-term resilience of tourism. To account for spillover effects between neighboring provinces, it is necessary to study the spatial dependence of the variation in domestic and international arrivals, then examine the various factors that explain the differences between provinces' demand. In this regard, two complementary approaches are adopted. First, we perform a spatial autocorrelation analysis of Moran's index (global and local) to test for the existence of spatial dependence of tourism destinations in space. Secondly, we run a spatial regression model to capture the role of the spread of COVID-19, and some other important factors, in determining the growth rate of tourist flows in destinations. This empirical approach of spatial and geostatistical technique has been used in tourism competitiveness studies (Romão and Nijkamp, 2019) and, more recently, in explaining the spread and dynamics of COVID-19 in regions (Amdaoud *et al.*, 2021). However, this approach is not yet in studies on the variation of tourist arrivals during the first and second years of the pandemic.

4.1. Spatial autocorrelation

First, the global Moran's I test is computed to detect the spatial association between the growth of tourist flows across the country. This measure is one of the most used in literature to test the existence of spatial dependency on several phenomena (Guillain and le Gallo, 2010). Recently, some authors have applied similar techniques in tourism studies (e.g., Adamiak *et al.,* 2019; Majewska, 2015; Sarrión-Gavilán *et al.*, 2015; Zhang *et al.*, 2011). The global spatial autocorrelation (i.e., spatial dependency), helps us to understand the change in the arrivals in each province compared with that of its neighbors and that of more distant areas (Amdaoud *et al.*, 2021). The Moran I's of univariate can be calculated as follows (Wrigley *et al.,* 1982):

$$I = \frac{n}{\Sigma_i^n \Sigma_j^n w_{ij}} \frac{\Sigma_i^n \Sigma_j^n w_{ij}\left(y_i - \underline{y}\right)\left(y_j - \underline{y}\right)}{\Sigma_i^n \left(y_i - \underline{y}\right)^2} \quad (1)$$

where n equals the number of spatial units, w_{ij} is the weight[11] between locations *i* and *j*, y represents the variable of interest, in this case, the change in the tourism flows, and $\underline{y}$ denotes

[11] There are several ways to define the weight matrix. In this analysis is used a spatial contiguity weight matrix, that identifies the neighbour province as any contiguous polygon, and it is applied the Queen criterion, where province is considered contiguous if has either a common border or vertex. The Queen's matrix is based in on the concept of binary contiguity (expressed by values 0–1) according to which the proximity structure is considered contiguous if has either a common border or vertexes. The

the average over all locations of the variable (i.e., the mean of y). If the global Moran I value is higher than 0 it indicates positive spatial autocorrelation.

The second step consists of controlling the spatial autocorrelation at the local level by implementing the LISA (Local Indicators of Spatial Association) computed through a local Moran Index (Anselin, 2010; Crociata *et al.*, 2022). This represents a measure of spatial autocorrelation that compares the gaps between values of the reference variable, in this case, the change in the tourism arrivals, based on a contiguity criterion (the same used in the global Moran I). The local version of the Moran in spatial entity *i*, I_i is defined (Anselin, 1995; Sarrión-Gavilán *et al.*, 2015):

$$I_i = \frac{n(y_i - \underline{y})}{\sum_i^n (y_i - \underline{y})^2} \sum_j^n w_{ij} \left(y_j - \underline{y}\right) \qquad (2)$$

To geographically plot the significant local Moran statistics, the results of the LISA can be reported on a map that distinguishes the spatial entities (in our case provinces) with the different types of clustering correlation: positive/similar values (either high or low, HH or LL) and negative/dissimilar values (High-Low HL, Low–High LH). The LISA maps help us identify potential neighboring effects on domestic and international tourism flow growth. In other words, it highlights whether provinces with high (low) tourism growth are surrounded by provinces with low (high) growth.

4.2. Spatial regression analysis

The change in domestic and international tourist arrivals is modeled as a function of the spread of COVID-19 and a set of control variables in the destination province. Following Falk *et al.* (2022, d), the pre-pandemic year is used as the base to calculate the change in domestic and international tourism arrivals for the 2020 and 2021 years. Hence, the model is specified as follows:

$$\Delta Y_{i,j,2020-2019} = \beta_0 + \beta_1 COVIDcases_{j,2020} + \beta_n X_{n,j,2020} + \varepsilon \qquad (3)$$

$$\Delta Y_{i,j,2021-2019} = \beta_0 + \beta_1 COVIDcases_{j,2021} + \beta_n X_{n,j,2021} + \varepsilon \qquad (4)$$

where *i* refers to the type of tourism flow (i.e., domestic or international), and *j*= 1,2,…,107 indicates the destination province. The dependent variables ΔY represents the growth in the inflow of tourism *i* in province *j* for 2020 and 2021 years with respect to the pre-pandemic year 2019. β_0 is the intercept, and $COVIDcases_j$ is our variable of interest and measures the number of per capita cases in province *j*. $X_{n,j}$ is a vector of additional *n=1..N* control variables, β is the vector of parameters to be estimated and ε is the error term. Table 1 provides a description of all variables (the correlation matrix is plotted in Table A.3 in the Appendix).

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weight matrix (wij) is set equal to 1 if the pair shares either a common edge or a vertex (considered contiguous) and 0 otherwise (Anselin and Rey, 2014). Results appear also robust if the Rook contiguity weight matrix (wij is set to 1 if the pair shares a common edge and 0 otherwise) is implemented.

To avoid biased OLS, we must consider possible spatial autocorrelation, especially from the perspective of analyzing the regional change in tourist flows during the COVID-19 pandemic, which, as we have already seen in the previous maps seems to show a spatial association. Spatial regression strategy, with different territorial scales, is commonly implemented in regional analysis of travel flows (e.g., Alvarez-Díaz *et al.*, 2017; Majewska, 2015; Romão and Nijkamp, 2019), and has been recently extended to analyses the change in tourism flows during the pandemic (Falk *et al.,* 2022, c; Falk *et al.* 2022, d). In the context of spatial econometrics, different approaches can be used for the choice of models (Le Gallo, 2022). Giving we are working with linear models separated by years (Eq. 3-4), we adopted the so-called "*from Specific-to-General*" approach, which consists of starting whit a simple non-spatial model (OLS) that is extended depending on the result of spatial dependency diagnostics (Ángulo and Mur, 2011)[12]. The Lagrange Multipliers test (LM, Anselin *et al.,* 1996) and its analog robust (i.e., Robust LM), are used to examine if moving through a Spatial Lag Model (SAR), a Spatial Error Model (SEM) or a non-spatial model[13]. In our case, the LM tests suggest the SAR model as the most appropriate to capture spatial dependency on the changes in tourism arrivals among neighboring provinces[14]. Therefore, equations 3 and 4 are rewritten as follows:

$$\Delta Y_{i,j,2020} = \beta_0 + \rho W \Delta Y_{i,j,2020} + \beta_1 COVIDcases_{j,2020} + \beta_n X_{n,j,2020} + \varepsilon \quad (5)$$

$$\Delta Y_{i,j,2021} = \beta_0 + \rho W \Delta Y_{i,j,2021} + \beta_1 COVIDcases_{j,2021} + \beta_n X_{n,j,2021} + \varepsilon \quad (6)$$

where $W\Delta Y$ is the lagged dependent variable from the spatial continuity weight matrix W, and ρ is the autoregressive parameter representing the intensity of the interaction between the observations of ΔY. The SAR model allows us to consider spatial dependency in the explanatory variable, in our case, the number of COVID-19 per capita cases on the variation of the tourism arrivals between neighboring provinces. The incorporation of the weighted $W\Delta Y$ dependent variable in the right side of the equation allows us to consider the degree of spatial dependence while the other variables are controlled (Anselin *et al.,* 1996).

In this regard, domestic and international tourism flows also depend on a set of variables that control for the different characteristics of destinations in demographic, socio-economic, and territorial terms. The demographical dimension of local destinations is controlled by the POPULATION DENSITY. This variable is also considered a measure of local agglomeration economies. On the socioeconomic determinants, GDP PER CAPITA is used as a control for

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[12] This strategy has been implemented in studies dedicated to tourism (for instance see Alvarez-Díaz *et al.,* 2017; Yang and Fik, 2014) and most recently by Amdaoud *et al.* (2021) to study the spread and dynamics of COVID-19 in European regions.

[13] Since we are not working with time-series or cross-sectional model, we decide to do not use a general spatial Durbin model (SDM). However, for a robustness of our analysis we regress the SDM and test if the spatial lag of the X variable is not significant, $H0$: $\eta = 0$ (Ángulo and Mur 2011). We were not able to reject the null in any of the models, so the evidence points to a spatial autoregressive model (SAR) or to static spatial error model (SEM). In our case, the LM test suggest as bet fit the SAR model.

[14] With the exception of the model referring to the change in domestic arrivals 2020-2019 (column a, Table 2), where the tests indicate the non-spatial OLS as the most appropriate regression to be used (none of the LMrobust tests -lag or error- appear to be significant).

the income level of residents in the target province. Several empirical pieces of evidence show that regions with a higher GDP level have a higher demand for tourism (Pérez-Rodríguez *et al.,* 2015; Arslanturk *et al.*, 2011). At the same time, it is relevant to notice that the present analysis focuses on the two years in which the disease hit the core economic Italian regions hardest (Ascani *et al.,* 2021). The quality of institutions is also included and measured throughout the indicator RULE OF LAW provided by Nifo and Vecchione (2014). Various empirical studies conducted in recent years have shown that countries with 'higher quality' governance institutions can attract more international tourists (Adedoyin *et al.*, 2022; Kim *et al.* 2018). On the track of institutions, we also include a policy response continuous RISK SCENARIO variable that is based on the time change restrictions imposed by the central government between and within regions (see detailed description in Table 1 and Appendix A.4).

Moreover, an important set of controls included in the model are those related to the territorial features, considered by recent empirical studies as key factors in the context of tourism demand resilience and, according to Falk *et al.* (2022a), of relevance during the COVID-19 pandemic to withstand the shock on domestic tourism demand. With this premise, a first indicator of the degree of rurality of the destination provinces has been included (i.e., less than half of its residents can drive to the center of a city of at least 50,000 inhabitants within 45 minutes.). The REMOTENESS indicator is of paramount importance both for the period under analysis and because we are studying domestic tourism, since, as recent studies claim, tourists from densely populated areas 'try to escape' to remote areas during the pandemic (Florida *et al.*, 2021; Zenker and Kock, 2020). On the other side, even though resident tourists tend to go to remote areas, international tourists tend to visit capital cities as they contain many artistic and cultural attractions. These have been the provinces hit the hardest (Bank of Italy, 2021).

Finally, considering the limitations of movement both within the national territory and internationally, three indicators of the level of accessibility were included: AIRPORTS, PORTS, and BORDERS. This last indicator was added based on the result obtained from the geographical distribution of the international tourist, where it was possible to note that the bordering provinces of the Northeast of the country are among those least affected by the loss of tourists (see Figures 2-3[b-c]). The covariance matrix suggests that there are no autocorrelation problems between the variables (see correlation matrix Table A.3 in the Appendix).

Table 1. Variables descriptions and descriptive statistics

Variable	Description	Mean	Std.Dev	Source
Dependent variables				
Domestic arrivals	Growth rate of domestic arrivals (e.g., Italian residents) in 2020 as compared to 2019	-0.395	0.116	Istat
	Growth rate of domestic arrivals (e.g., Italian residents) in 2021 as compared to 2019	-0.194	0.132	Istat
International arrival	Growth rate of international arrivals in 2020 as compared to 2019	-0.740	0.087	Istat

	Growth rate of international arrivals in 2021 as compared to 2019	-0.550	0.142	Istat
Variable of interest				
COVID cases per capita	Total number of COVID-19 confirmed cases over population in 2020, in 2021	0.003 0.066	0.013 0.018	Italian Ministry of Health
Control variables				
Demographic				
Population density	Number of individuals per square kilometer in 2020, in 2021	284.880 283.185	430.678 429.320	Istat
Socioeconomic				
GDP per capita	Share of Gross Domestic Product at current prices in PPS (millions of euros) over population (%) in 2020, in 2021	2.545 2.786	0.709 0.769	ARDECO
Rule of law [a]	The rule of law is an Institutional Quality Index that summarizes data on crime against persons or property, magistrate productivity, trial times, tax evasion and shadow economy (2019)	0.567	0.243	Nifo and Vecchione (2014)
Risk Scenario [b]	Continuous variable measuring the number of times a province has turned orange or red in 2020, in 2021	1.449 3.748	1.126 1.082	Own elaboration
Territorial				
Remoteness	Dummy variable that takes values 1 when a province is considered predominantly rural i.e., less than half of its residents can drive to the center of a city of at least 50,000 inhabitants within 45 minutes; 0 otherwise	0.065	0.248	Eurostat
Regional Capital	Dummy variable that values 1 if the province is a regional capital; 0 otherwise	0.187	0.392	Istat
Airport	Dummy variable that values 1 if in the province is located an airport; 0 otherwise	0.271	0.447	Own elaboration
Port	Dummy variable that values 1 if in the province is located a port; 0 otherwise	0.178	0.384	Own elaboration
Border	Dummy variable that values 1 if the province is located along land borders, or the province has at least 50% of their population in areas of 25 km width along a land border; 0 otherwise	0.131	0.339	Eurostat

Note: All the variables refer to the province of destination. The number of observations for all variables are 107 and corresponds to the number of provinces.

[a] The variable *rule of law* is available until the pre-pandemic year 2019.

[b] The Italian government set up the so-called 'risk scenarios' active from 06 November 2020 until 17 May 2022. The classification distinguished among four scenarios: low (white), low-moderate (yellow), moderate (orange), and high (red), based on the incidence of cases and the percentage of patients in intensive care and the medical area. The Laws establish the region's level and what type of restriction needs to be implemented, changing over time. See Appendix A.4 for a more detailed explanation.

5. Empirical results

This section describes the main results of spatial autocorrelation and spatial regression analyses[15]. To be consistent with the previous methodological section, the two parts of analysis and related findings are split into two sub-sections.

5.1 Spatial autocorrelation

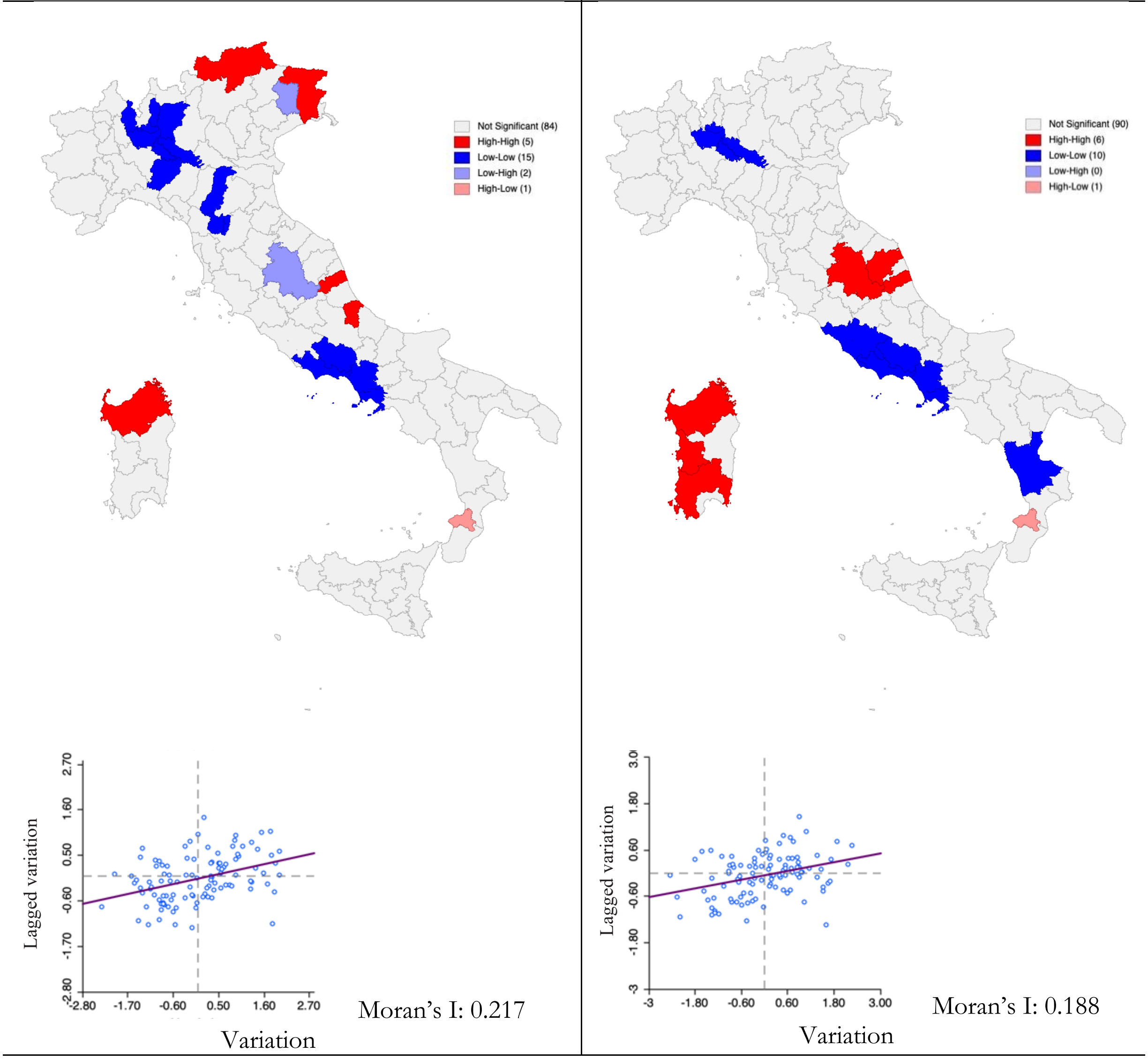
Figure 5 shows that Moran's I value for the domestic component is highly significant (p-value < 0.001) [16] and indicates spatial autocorrelation in both years. This means that provinces with similar growth rate values tend to cluster (i.e., to be located next to each other). Besides, Moran I's decreases from 0.217 in 2020 to 0.188 in the 2021 year. This trend may suggest the degree of spatial clustering of similar values, especially the low-low ones that have the most negative trends (from 15 in 2020 to 10 in 2021), which might indicate a rebound of the positive trend to a more homogeneous pre-pandemic distribution of domestic tourism among the territories. The LISA map identifies those geographical units, in our case provinces, that are similar in the growth rate of domestic arrivals. The cartographic represents the results obtained at a 95% significance level of spatial concentration. The first year of the pandemic (Figure 5a), reveals positive spatial autocorrelation observed in the Northwest and Southwest of the country, in areas labeled low-low (a low rate of growth [higher variation/loss] in a province surrounded by a low weighted average rate for the neighboring provinces), and high-high areas (i.e., high rate of growth [lower variation/loss] in a province surrounded by neighboring provinces with also a high weighted average rate) in the Northeast, in the Centre and on the North of the Sardinia Island. Dissimilar negative associations are also observed, to a lesser extent, in areas labeled low-high and high-low[17].

The map of the second year of the pandemic (Figure 5b) reveals a couple of distinctive geographical patterning of low-low clusters consistent with the first year in the Northeast and Southeast of the country. On the other hand, an increase in clustering labeled high-high can be observed in Sardinia Island and the Centre of the country, suggesting a positive spill-over on the increase of domestic tourists in these areas.

[15] Geoda (Anselin *et al.*, 2006) and Stata16SE software are used to perform the spatial and geostatistical analyses.
[16] To estimate the significance of the coefficient *I,* we implemented a randomised simulation based on a permutation approach (with 999 permutations). For each randomised value of the data the Moran's I is calculated, then the observed value of I is compared with the distribution of I values derived from the randomised data (Amdaoud *et al.*, 2021). In our analysis, the p-values in the permutations are significant for all the I calculated.
[17] Dissimilar association can be read in the same way we read the similar areas: low-high (i.e. a low rate [higher variation/loss] in a province surrounded by a high weighted average rate [lower variation/loss] for the neighbouring regions), and high-low (i.e. a high rate [lower variation/loss] in a province surrounded by a low weighted average rate [higher variation/loss] for the neighbouring regions).

Figure 5. LISA cluster maps of the variation of domestic arrivals

(a) Domestic 2020-2019	**(b) Domestic 2021-2019**



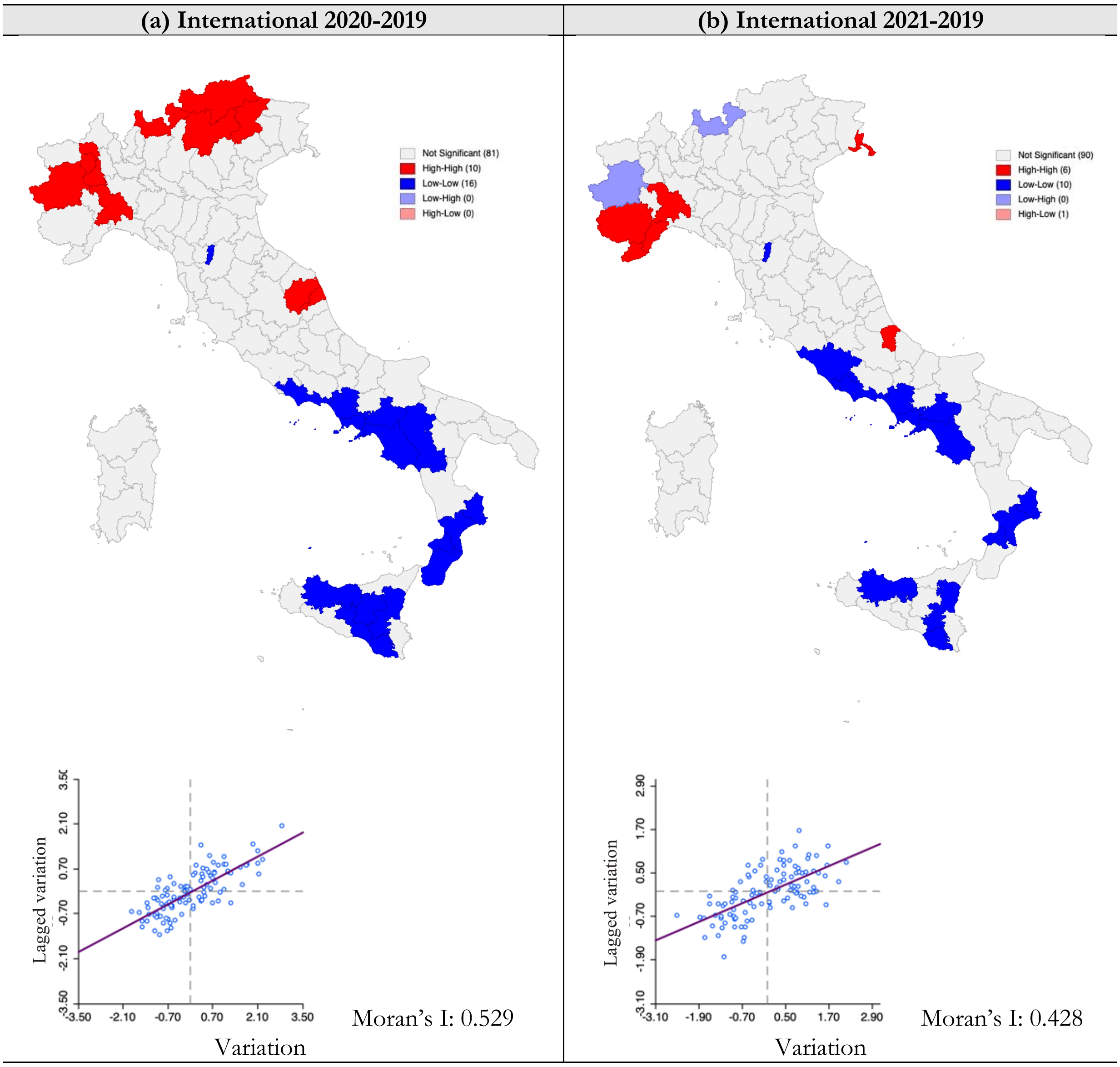
Note: Local and global indicator of spatial association -continuity weight matrix- of the variation of domestic arrivals at the provincial level (NUTS-3)

Figure 6 shows a higher spatial dependence for international arrivals with respect to domestic ones. Moran's I value is also significant (p-value < 0.001) with a very high degree of spatial autocorrelation of 0.529 in the first year of the pandemic and 0.428 in the second period. As in the case of domestic tourism, the growth rate of international arrivals confirms a higher spatial dependence in the first year of the pandemic than in the second. The LISA map of the first year indicates a strong North-South cluster pattern and an exclusive spatial dependence between provinces with similar values: high-high in the North and low-low in the South.

The spatial clusters between provinces with a high growth rate surrounded by provinces with a high weighted average rate can be found especially in those Northern provinces that are border-crossing and have been shown to have a lower loss of international arrivals (see Figure 3b-c). A result that we can assume is due to international tourism from frontier European countries that most likely travel by car and during the pandemic have lower entry restrictions than airplane travelers. This spatial cluster of areas labeled high-high is also identifiable, to a lesser extent, in the provinces of Macerata and Fermo in the Centre of the country. This is due to the attractiveness of the Marche region during this pandemic period when slow tourism and green destinations have been the most appealing.

On the other hand, the South of the country shows a geographical patterning of only low-low clusters, corresponding to provinces with a higher decrease in international arrivals (see Table A.1 in the Appendix). This spatial dependency of similarly low values is present in the Southeast of the country and in Sicily. Finally, moving to the second year, a pattern of spatial dependency shows a change in the Northwest of the country, with few areas still high-high and some others becoming low-high, while in the South the spatial dependency among provinces labelled low-low are still many.

Figure 6. LISA cluster maps of the variation of international arrivals



Note: Local and global indicator of spatial association -continuity weight matrix- of the variation of international arrivals at the provincial level (NUTS-3)

To conclude, visually comparing the LISA maps of both types of tourism (Figures 5 and 6) it is possible to notice differences in the clustering patterns, with international arrivals that display stronger spatial dependency and a more North/South split, but also some similitudes. A lower degree of clustering in the second year of the pandemic, and a similar low-low spatial pattern in the Southern Mediterranean provinces.

In fact, comparing the spatial dependence with the geographic distribution of arrivals (Section 3), it can be seen that the South of the country, except for the provinces of Abruzzo and Molise, continues to have high rates of tourist loss in the second period compared to, for example, those in the North-East of the country, despite being notoriously less affected by the pandemic (see Figure 5). These figures seem to indicate greater difficulty in recovery by the Southern Mediterranean provinces. Two possible reasons can explain this result. First, government restrictions during the pandemic were largely stretched along the territory. Although there were distinctions between risk zones (see Appendix A.4), there was predominantly movement both among and between high-risk and less-risk regions, and generally for international arrivals. The second would seem to be related to the institutional quality of the Southern regions which have lower performance than the Central-Northern.

5.2 Spatial regression analysis

As indicated in Section 4.2, we adopted a strategy that starts with a simple linear OLS model and then decides to switch to a spatial model depending on the diagnostic tests[18]. Table 2 summarizes the result of this approach and shows that the SAR model is the most appropriate to use, except for the model referring to the change in domestic arrivals 2020-2019.

Table 2. Summary of estimated models

	Dependent variable	**OLS**	**Spatial lag**
Model 1	Growth rate of domestic arrivals (2020/2019)	Yes	Robust LM is not significant
Model 2	Growth rate of international arrivals (2020/2019)	Biased	Yes
Model 3	Growth rate of domestic arrivals (2021/2019)	Biased	Yes
Model 4	Growth rate of international arrivals (2021/2019)	Biased	Yes

Table 3 reports the best-fitted regression models (columns 1, 2, and 3, that correspond to eq. 3, 5, and 6). The spatially weighted dependent variable indicates that the flow of tourists increases if the area in question is surrounded by neighbors with the same growth rate of arrivals. The spread of COVID-19 appears to have a negative effect on the growth of both types of tourists, but only limited to the first wave, as an increase of 1 unit per thousand cases results in an average decrease of 2.38 units in domestic arrivals and 1.18 units in international arrivals. Therefore, a high prevalence of COVID-19 cases in one province and neighboring appears to increase the incidence on tourism arrivals.

[18] The Breusch–Pagan test reveals that for all specifications heteroskedasticity is not a problem. This result indicates that over the 107 provinces no structural diverging error terms in classes of provinces (regimes) are present. We test for spatial dependencies in our OLS results using Moran's I, LM and the robust Lagrange Multiplier tests (lag - error). In our test, the null hypothesis of no spatial effects is rejected in the lag models (Table 3, columns 2, 3 and 4). For spatial autocorrelation we use Morans' I. In all models the spatial autocorrelation was statistically detected, however, in column 1 (Table 3) the null hypothesis at the Lagrange Multiplier test is not rejected, so we retain the OLS. Following Anselin (2005), if neither LM is significant, we keep the OLS, whereas if one of the two robust LMs (lag or error) is significant, we choose to use that spatial model.

Population density does not significantly affect the growth rate of tourist flows, unlike the result obtained by Falk *et al.* (2022, c) which found how dense population provinces influence domestic tourism demand during the first wave of the pandemic. In fact, no significance was found for those provinces that are *regional capital*. On the other hand, the *remoteness* variable shows an expected positive correlation. During the COVID-19 pandemic, tourists tended to move to more remote areas since it was easier to avoid crowding (Florida *et al.* 2021; Zenker and Kock 2020; Falk *et al.* 2022, c). A result that coincides with the ones obtained by Duro *et al.* (2022) and Falk *et al.* (2022, c), which has revealed how, during the first summer of the pandemic, remote regions were the most resilient and recorded an increased -less loss- of domestic tourism, which partly compensates for losses in large metropolitan regions.

On the socio-economic controls, the coefficient of *GDP per capita* shows the expected signs but without any significance. This result corroborates and extends to the second year of the pandemic, the one obtained by Falk *et al.* (2022, c), who found a weak GDP correlation for Southern European countries during the first summer of 2020. Contrary, we can see a continuum positive effect on time and for both types of tourism of the *rule of law*. This result helps to explain those obtained in the spatial analyses (see Figures 2, 4, 5, and 6). They show that the Northern provinces, which have a better national performance in terms of the quality of institutions, had a better recovery than the Southern ones.

On the other hand, the *risk scenario* variable used to measure national policies to contain the spread positively affects international tourism flows, but only for the second year of the pandemic. This is an apparently contradictory result, which, as with institutional quality, can be explained by looking at the distribution maps (Figure 2c) and the spatial dependence (Figure 5b). As we have already seen, the Northern provinces have had a greater concentration of international arrivals -a smaller loss- in the second period, especially the ones in the borders, which correspond to those provinces with the greatest number of cases and, therefore, the greatest number of restrictions.

On the remaining territorial variables, the presence of *airports* and *ports* has a significant negative and positive impact for both periods and exclusively on domestic arrivals. This dichotomy in the impact and thus the use of infrastructures by domestic tourists is fascinating as it suggests how people have stopped traveling by airplane within the territory, preferring to travel and reach their destination by car where possible, using mainly ferries in the summer season to reach destinations such as Sardinia Island which show a spatial clustering of high values of growth (see Figure 3) [19]. Finally, the *border* provinces positively impacted domestic arrivals (at 5%) and international arrivals (at 1%), but only in the first period of the pandemic. This high correlation was also found in the spatial analyses (Figures 5a, and 6a).

Overall, the results indicate similarities and differences between the two types of tourism and the two periods compared to pre-pandemic. We can see that the provinces that withstood the shock in terms of tourist demand are those located in or surrounded by remote areas, and where the quality of institutions better performed. Provinces with airports - presumably the capital regions - lost more in terms of domestic tourism, while those with ports had a smaller loss always in terms of domestic tourists. The variables that impacted the tourism demand, visible only in the first year, were the number of COVID-19 cases per capita (negatively) or being a province close to the border (positively).

[19] According to ISTAT estimates, the only traffic to have increased during the summer holidays is that of private vehicles accompanying passengers boarding ferries. With prices rising compared to pre-pandemic times.

Table 3. Estimation results: Growth of domestic and international arrivals

	Domestic 2020 (1)	International 2020 (2)	Domestic 2021 (3)	International 2021 (4)
WY		0.611***	0.283***	0.559***
		0.073	0.108	0.081
COVIDcases per capita	-2.379**	-1.176*	-0.082	-0.202
	[1.102]	0.651	0.809	0.762
Population density	0.000	0.000	0.000	0.000
	[0.000]	0.000	0.000	0.000
GDP per capita	-0.003	0.014	-0.014	-0.021
	[0.026]	0.014	0.026	0.025
Rule of law $_{2019}$	0.127*	0.0823**	0.131*	0.199***
	[0.069]	0.037	0.072	0.069
Risk scenario	-0.006	0.002	0.012	0.019*
	[0.007]	0.005	0.010	0.010
Remoteness	0.154***	0.052**	0.116**	0.114***
	[0.035]	0.022	0.046	0.044
Regional Capital	-0.026	-0.009	-0.048	-0.037
	[0.027]	0.016	0.033	0.031
Airport	-0.082***	-0.014	-0.066**	-0.002
	[0.024]	0.015	0.031	0.029
Port	0.100***	0.015	0.111***	0.029
	[0.029]	0.017	0.034	0.032
Border	0.057**	0.066***	-0.030	0.009
	[0.028]	0.019	0.035	0.033
Constant	-0.373***	-0.337***	-0.202***	-0.358***
	[0.046]	0.068	0.069	0.083
Obs.	107	107	107	107
R2	0.372	0.437	0.261	0.262
Adjusted R2	0.307	0.378	0.184	0.185
Log likelihood ratio	104.547	140.275	81.687	73.979
Breusch-Pagan test	2.069 (0.996)	7.155 (0.711)	9.63 (0.474)	8.478 (0.582)
Moran's I	2.995 (0.003)	4.450 (0.000)	2.164 (0.030)	4.097 (0.000)
Lagrange Multiplier (lag)	6.700 (0.010)	23.544 (0.000)	5.231 (0.022)	22.286 (0.000)
Lagrange Multiplier (error)	5.959 (0.015)	14.64 (0.000)	2.693 (0.101)	12.061 (0.001)
Robust LM (lag)	0.948 (0.330)	9.638 (0.002)	3.721 (0.040)	14.060 (0.000)
Robust LM (error)	0.207 (0.650)	0.732 (0.392)	1.183 (0.277)	8.838 (0.051)

Note: Each column displays the best fit model. Column (1) corresponds to the OLS model, Columns 2, 3 and 4 to the Spatial LAG (SAR) model. P-values are in parentheses for Lagrange Multiplier test (LM) statistics and Breusch–Pagan test statistics. Standard errors are in brackets. Estimations are at the province level (NUTS-3) for Italy. See Table 1 for the variables' definition. *** p<0.01, ** p<0.05, * p<0.01.

6. Conclusion and discussion

Travel controls, limitations on internal movements, and border closures have been the first restrictions used by governments to limit the spread of the virus. There are no doubts about these effects on tourism; the impact on tourists' behaviors in the short run needs much attention and analysis. The short-term resilience of tourism demand has been analyzed up to now only considering the summer of 2020, but not in the entire period, when restrictions become less relevant and when the population benefitted from the vaccination campaigns worldwide.

This paper uses spatial and geostatistical techniques to shed light on the geographical heterogeneity of the variation in tourist arrivals in 2020 and 2021 compared to 2019 in Italy and empirically examine the effect of COVID-19 cases on the variation in tourist arrivals. The distribution of arrivals of both types of tourism shows a significant path of spatial dependence that was stronger in the first period with respect to the second, with international arrivals showing a more divisive distribution between North and South than domestic arrivals. Although the Northern provinces were the ones where COVID-19 cases per capita were significantly higher than the average, the spatial analysis seems to indicate a faster recovery in tourism arrivals for these provinces and a greater difficulty for the Southern provinces. Since the two components of the demand react differently to shock, domestic and international tourist arrivals are distinctly analyzed. Results of the analysis show that the number of COVID-19 cases is negatively related to the variation of arrivals, meaning that the higher the presence of COVID-19 in a province, the higher the variation of arrivals recorded between 2020 and 2019. This is not observed in 2021 when the variation of arrivals seems not correlated with the spread of the virus. The rule of law, remoteness, the presence of the port, and being within the borders are the most relevant variables explaining the variation in tourist arrivals during 2020 and 2021 with respect to 2019. In particular, the presence of a port in a province better explains changes in the behaviors of domestic tourists. While being within the borders of the country is a factor that influences domestic and international tourists in 2020. The empirical analysis can confirm the three main hypotheses of this work. Indeed, tourism demand shows different patterns across Italian provinces after COVID-19; domestic and international tourists have different patterns; finally, the short-term resilience depends on the characteristics of the destination.

Several limitations of the work can be listed. First, the study uses the variation in tourist arrivals in the first and second years after the pandemic as dependent variables. Other variables can be used as a robustness check, such as, for instance, nights of stay and the average length of stay. Second, the analysis period can be extended to the previous years before the pandemic and after 2021, when data can be available. This last point can be included in further developments of this research. This extension of the analysis can help understand if the spatial autocorrelation found in this analysis is different or similar in other years. In particular, from the policymakers' perspective, it could be interesting to know if the new trends of the demand that emerged in 2020 and, in some cases, continued in 2021 are still valid or not in the following years. Another relevant point not analyzed in the present work and open to future research is the seasonality of tourism demand. Indeed, also seasonality may have been influenced by COVID-19, and this aspect needs more attention.

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APPENDIX

Table A.1a Top-10 provinces domestic and international tourist arrivals

(a) Domestic 2019			**(b) Domestic 2020**			**(c) Domestic 2021**		
Province			Province			Province		
Rome	centre	3,584,450	Bolzano	northE	2,014,027	Rimini	northE	2,348,839
Milan	northW	3,462,554	Trento	northE	1,972,273	Venice	northE	2,332,623
Rimini	northE	2,991,764	Venice	northE	1,834,680	Rome	centre	2,284,469
Trento	northE	2,744,847	Rimini	northE	1,774,788	Bolzano	northE	2,130,817
Bolzano	northE	2,575,198	Rome	centre	1,506,849	Trento	northE	2,070,343
Venice	northE	2,331,019	Milan	northW	1,165,096	Milan	northW	1,754,340
Naples	south	1,923,035	Naples	south	1,029,638	Naples	south	1,432,668
Turin	northW	1,837,658	Verona	northE	958,797	Verona	northE	1,397,049
Verona	northE	1,824,399	Perugia	centre	829,373	Perugia	centre	1,184,110
Florence	centre	1,571,507	Livorno	centre	827,651	Florence	centre	1,139,596
(d) International 2019			**(e) International 2020**			**(f) International 2021**		
Province			Province			Province		
Rome	centre	7,831,864	Bolzano	northE	2,606,501	Bolzano	northE	3,235,151
Venice	northE	7,648,761	Venice	northE	1,864,584	Venice	northE	3,226,126
Bolzano	northE	5,118,892	Rome	centre	1,106,802	Verona	northE	1,834,968
Milan	northW	4,554,299	Verona	northE	1,008,320	Rome	centre	1,568,488
Florence	centre	3,745,832	Trento	northE	789,788	Milan	northW	1,258,102
Verona	northE	3,306,029	Milan	northW	773,286	Florence	centre	973,585
Naples	south	2,236,596	Florence	centre	541,573	Brescia	northW	967,353
Trento	northE	1,783,332	Brescia	northW	499,166	Trento	northE	920,407
Brescia	northW	1,535,295	Como	northW	296,926	Naples	south	579,109
Siena	centre	1,092,483	Naples	south	288,447	Como	northW	552,481

Note: Data corresponds to the number of domestic and international tourist arrivals in 2019, 2020, and 2021 years

Table A.1-b Top-10 provinces with higher changes in domestic and international arrivals

(a) Domestic 2020-2019			(b) Domestic 2021-2019		
Province		Variation	Province		Variation
Milan	northW	-0.66	Benevento	south	-0.52
Turin	northW	-0.63	Milan	northW	-0.49
Rome	centre	-0.58	Latina	centre	-0.48
Florence	centre	-0.57	Reggio di Calabria	south	-0.43
Benevento	south	-0.57	Turin	northW	-0.41
Mantua	northW	-0.56	Matera	south	-0.40
Latina	centre	-0.56	Varese	north	-0.39
Reggio di Calabria	south	-0.56	Monza	northW	-0.38
Trieste	northE	-0.55	Trieste	northE	-0.38
Bologna	northE	-0.55	Frosinone	centre	-0.37
(c) International 2020-2019			**(b) International 2021-2019**		
Pistoia	centre	-0.90	Frosinone	centre	-0.90
Frosinone	centre	-0.88	Pistoia	centre	-0.81
Naples	south	-0.87	Rome	centre	-0.80
Salerno	south	-0.87	Prato	centre	-0.79
Rome	centre	-0.86	Benevento	south	-0.78
Florence	centre	-0.86	Lodi	northW	-0.78
Catanzaro	south	-0.86	Reggio di Calabria	south	-0.77
Syracuse	south	-0.85	Syracuse	south	-0.75
Reggio di Calabria	south	-0.84	Florence	centre	-0.74
Lodi	north	-0.84	Naples	south	-0.74

Note: Data corresponds to the growth rate of domestic and international arrivals in 2020 and 2021 compared to the pre-pandemic 2019 year

Table A.2 Top-10 provinces with higher number of annual COVID-19 cases per capita

COVID cases per capita 2020			COVID cases per capita 2021		
Province			Province		
Belluno	north	73.81	Turin	north	71.48
Varese	north	58.70	Vercelli	north	59.05
Treviso	north	57.37	Novara	north	65.28
Como	north	57.09	Cuneo	north	75.16
Valle d'Aosta	north	56.17	Asti	north	66.92
Bolzano	north	55.88	Alessandria	north	59.21
Monza	north	55.70	Aosta	north	66.60
Verona	north	55.03	Imperia	north	86.21
Milan	north	53.54	Savona	north	62.42
Piacenza	north	52.54	Genoa	north	47.30

Note: Data corresponds to the number of annual COVID-19 cases per 1000 inhabitants for the 2020 and 2021 years

Table A.3-a Correlation Matrix. Year 2020

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Growth Domestic $_{2020\text{-}2019}$	1.000											
(2) Growth International $_{2020\text{-}2019}$	0.522	1.000										
(3) COVIDcases $_{\text{per capita}}$	-0.138	0.340	1.000									
(4) Population density	-0.264	-0.199	0.064	1.000								
(5) GDP $_{\text{per capita}}$	-0.207	0.335	0.683	0.225	1.000							
(6) Rule of law	0.069	0.529	0.670	-0.151	0.686	1.000						
(7) Risk scenario	-0.046	0.002	-0.217	0.012	-0.145	-0.109	1.000					
(8) Remoteness	0.362	0.099	-0.075	-0.091	-0.173	-0.094	-0.140	1.000				
(9) Regional Capital	-0.160	-0.035	0.042	0.182	0.291	0.020	0.001	-0.030	1.000			
(10) Airport	-0.322	-0.143	0.009	0.291	0.230	-0.073	-0.056	-0.161	0.409	1.000		
(11) Port	0.105	-0.137	-0.264	0.100	-0.183	-0.221	0.010	-0.123	0.279	0.432	1.000	
(12) Border	0.077	0.471	0.488	0.010	0.266	0.356	0.043	0.009	0.027	-0.050	-0.180	1.000

Note: the VIF of the estimations is 1.88 (Table 3, column 1-2)

Table A.3-b Correlation Matrix. Year 2021

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Growth Domestic $_{2021\text{-}2019}$	1.000											
(2) Growth International $_{2021\text{-}2019}$	0.559	1.000										
(3) COVIDcases $_{\text{per capita}}$	-0.147	0.046	1.000									
(4) Population density	-0.233	-0.172	0.101	1.000								
(5) GDP $_{\text{per capita}}$	-0.149	0.128	0.588	0.224	1.000							
(6) Rule of law	0.099	0.366	0.462	-0.149	0.685	1.000						
(7) Risk scenario	0.044	0.048	0.037	0.169	-0.018	-0.130	1.000					
(8) Remoteness	0.228	0.188	-0.269	-0.091	-0.170	-0.094	-0.149	1.000				
(9) Regional Capital	-0.174	-0.105	0.026	0.181	0.294	0.020	0.112	-0.030	1.000			
(10) Airport	-0.223	-0.097	0.183	0.291	0.232	-0.073	0.026	-0.161	0.409	1.000		
(11) Port	0.157	-0.016	-0.173	0.098	-0.182	-0.221	0.109	-0.123	0.279	0.432	1.000	
(12) Border	-0.067	0.202	0.360	0.011	0.264	0.356	-0.089	0.009	0.027	-0.050	-0.180	1.000

Note: the VIF of the estimations is 1.77 (Table 3, column 3-4)

Appendix A.4 Risk Scenarios during the COVID-19 pandemic in Italy

Restrictive measures to deal with the epidemic have been phased in time and territories. Some measures have been taken at the national level regardless of the 'risk', such as the obligation to use protective equipment such as masks in both open and enclosed spaces or the closure of non-exempt activities or movement between regions. Schools were closed nationally at the start of the pandemic and replaced with distance learning, only to reopen in September 2020 with some restrictions between regions.

Considering that the pandemic incidence varied territorially, with more cases in the Northern regions, about nine months after the first confirmed case of COVID-19 (**November 2020**), the government set up so-called 'risk scenarios' active until 17 May 2022. The "risk scenarios" classification distinguished the regions (NUTS-2 level) based on the incidence of cases and the percentage of COVID-19 patients in intensive care and the medical area. It distinguished among four scenarios: low (white color), low-moderate (yellow color), moderate (orange color), and high (red color). The restrictions and identification of the areas are modified over time by decree-laws (DL) and Decree of the President of the Council of Ministers (DPCM). The Laws establish at what level the region is and what type of restriction needs to be implemented, ranging from the " low-moderate " yellow zones, such as the closure of museums at weekends, to the harsher ones, such as curfews, distance learning for high schools and the closure of all non-essential activities, to the "moderate to high" by leaving only supermarkets and pharmacies open, with prohibitions on conventions, conferences, and celebrations.

November 2021 sees the introduction of the Green Pass in Europe, which otherwise applies nationwide. To have it you need to have 3 doses or a cure in less than 6 months. Until 1 April 2022 compulsory: to go to work, access restaurants, banks, and post offices, collect pensions, travel, and board public transport.

Table A.5 Estimations results: OLS

	International 2020 (2)	Domestic 2021 (3)	International 2021 (4)
COVIDcases per capita	-1.374*	-0.215	-0.847
	[0.820]	[0.734]	[0.855]
Population density	0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]
GDP per capita	0.029	-0.014	-0.006
	[0.020]	[0.025]	[0.027]
Rule of law 2019	0.137***	0.151**	0.266***
	[0.046]	[0.076]	[0.082]
Risk scenatio	0.002	0.014	0.023**
	[0.006]	[0.011]	[0.010]
Remoteness	0.050**	0.130**	0.131**
	[0.021]	[0.050]	[0.056]
Regional Capital	-0.016	-0.051	-0.055*
	[0.021]	[0.033]	[0.032]
Airport	-0.019	-0.058**	0.011
	[0.019]	[0.024]	[0.030]
Port	0.022	0.118***	0.048
	[0.024]	[0.031]	[0.040]
Border	0.100***	-0.027	0.055
	[0.020]	[0.034]	[0.046]
Constant	-0.854***	-0.268***	-0.721***
	[0.032]	[0.066]	[0.063]
Obs.	107	107	107
R2	0.437	0.261	0.262

Note: Estimations are at province level (NUTS-3) for Italy. See Table 1 for variables definition. Standard errors are in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.01$.

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ISBN 9788868514716