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The Adverse Impacts of Disasters In-Name-Only

Abstract

Disasters caused by natural hazards, such as earthquakes or hurricanes, have many adverse consequences associated with the physical damage they cause. Here, we show that the very name given to a disaster can also lead to adverse consequences. We argue that the name used for a disaster is significant, and is distinct from the physical event itself. Specifically, we show that the toponyms (place names) used to refer to disaster events by the media and the authorities have consequences if these toponyms do not accurately align with the disaster-affected region. Examples of inaccurate disaster toponyms abound, but the costs of these inaccurate toponyms have yet to be recognized. When a disaster damages area A and not area B, but the toponym adopted for that disaster encompasses both A and B, we show that B experiences a decline in tourism that is unrelated to the hazard event that hit only area A. We also show that once B's name has been tarnished, it becomes difficult to clear its name. Our examples are three recent Italian earthquakes for which we quantify the impact on tourism of the earthquakes themselves and of the toponyms they were given. Once an area is defined as affected, even when it was not, this designation leads to a statistically significant and economically material decline in tourism – in our examples, this amounts to an unnecessary 10-15 percent decline in tourist arrivals that endures for several years following the event. We finish by making some observations about how disasters should be named.

JEL-Codes: Q540, R110, Z390.

Keywords: earthquake, tourism, toponyms, media, panel match.

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1 What's in a name?

Disasters caused by natural hazards, such as earthquakes or hurricanes, have many adverse consequences that can last even years after the event itself. These arise because disasters hurt and even kill people, and because they destroy infrastructure and homes. All of this is well documented. This article aims to show that the very name given to a disaster can also lead to adverse consequences after that event. We argue that the name used to describe a phenomenon, such as a disaster, is significant and distinct from the physical event itself. Words matter; giving an event a 'bad name' quite literally leads to adverse outcomes.

Shakespeare's answer to Juliet's rhetorical question about Romeo's family name (in their eponymous play): 'What's in a name?' was that names are unimportant. "That which we call a rose/ By any other name would smell as sweet." The evidence we provide below suggests otherwise. We find that names do matter. Specifically, we show that the toponyms (place names) used to refer to disaster events by the media (and governments) have consequences if these toponyms do not accurately align with the region that was directly damaged by the disaster event. A toponym that becomes a 'household name' and that includes regions that were not affected by the physical hazard itself, leads to adverse consequences for these 'wrongly' included regions. In the cases we document, these regions suffer from declines in tourist arrivals even though they were unaffected by the original shock.

Though examples of inaccurate disaster toponyms abound, the costs of these inaccurate toponyms have yet to be recognized. Misleading toponyms include catastrophic events that have had global repercussions, such as the Great East Japan Earthquake (in 2011) or the Indian Ocean Tsunami (in 2004); or, more recently, catastrophes such as the Türkiye-Syria earthquake (in 2022) and the Valencia Flood (in 2024). In all of these cases, the toponym used to define the event covered a vastly different area from the one directly affected by the tsunami, the earthquake, or the flood.

When a disaster damages area A and not area B, but the toponym adopted for that disaster encompasses both A and B, we show that B experiences a decline in tourism that is unrelated to the hazard event that hit area A, only because the toponym gave it a 'bad name.' This is surprising not only because economists rarely think that a name (i.e., a nominal object) can have real consequences, but because once a name is repeated frequently enough it becomes established and is perceived to describe facts. It then becomes exceedingly difficult to change this perceived reality. Once B's name has been tarnished, it becomes difficult to clear its name.

Our case studies are from Italy. We focus on three earthquakes that occurred between 2009 and 2017 and investigate the impact of the earthquakes themselves and of the toponyms they were given on tourism, testing the hypothesis that the toponym exerted its own impact independent from the earthquake.[1] In one case, the toponym used was fairly accurate (the L'Aquila Earthquake of 2009), but in the other two (the Central Italy Earthquake of 2016 and the Ischia Earthquake of 2017), the toponym described a much bigger region than was directly impacted by these seismic events.[2] For the latter two cases, we show that area A

[1] This hypothesis was first suggested in Baiocchetti (2020).

[2] The L'Aquila and Central Italy earthquakes were the highest mortality events in Italy since 1980 - in each about 300 people were killed. The Ischia earthquake was much smaller but is the only other event for which we have data and which led to widely reported impacts. The Emilia earthquake of 2012 led to higher mortality than Ischia, and its toponym is also inaccurate, but the required tourism data for 2013 are unavailable.

(affected by the earthquake) experienced a large reduction in both domestic and international tourism, but that area B (affected only by the toponym) experienced a reduction in tourism as well.

Previously, several empirical studies investigated the effects of naming extreme weather events such as storms, heat waves, and droughts. Their focus was either on the act of naming an event or on the gender of that name. Rainear et al. (2017) analyzed storms in the U.S. and found that naming winter storms affected neither people's perceptions of their severity nor of their susceptibility to the storms' impact. Nor did naming an event affect the perceived credibility of media reports about it. In contrast, Kotroni et al. (2021) studied storm naming in the Eastern Mediterranean and found that naming did influence people's preparedness. Neither of these investigates the names in themselves, but only whether an event received an explicit name (i.e. a proper noun).

In contrast, two other sets of studies did examine the implications of the names themselves. The first focused on gendered naming conventions. A contentious Jung et al. (2014) paper argued that female-named hurricanes in the U.S. were deadlier, hypothesizing that this was because people were less cautious when female-named hurricanes were forecasted to arrive since they viewed female-named storms as more benign than male-named ones. However, a long series of published rebuttals cast doubt on this empirical claim (Bakkensen and Larson, 2014, Christensen and Christensen, 2014, Maley, 2014, Malter, 2014). A more recent paper casts further doubt on the plausibility of the Jung et al. (2014) argument. Dinh et al. (2023) examined the implications of referring to hurricanes by their gendered names in news coverage, and found that the choice of adjectives and verbs in the description of female-named hurricanes was more negative than for male ones.

Possibly, the only group of studies that is relevant to our work investigates the effects of naming infectious diseases and epidemics. Fukuda et al. (2015) describes how the World Health Organization in collaboration with the World Organisation for Animal Health, the Food and Agriculture Organization of the United Nations, and the International Classification of Diseases (ICD) developed a set of best practices for naming new infectious diseases, with the explicit aim to minimize the potential negative effects of these names.

It has long been argued that the choice of a disease's name can affect people's perceptions and attitudes about the risk it poses, and can also lead to discrimination and stigmatization associated with the labeling of diseases based on geographical locations or nationalities. This last concern has been the focus of a small literature on naming practices for what was called the 'Wuhan Virus' or the 'China Virus'; before the ICD settled on the name Corona Virus Disease 2019 (COVID-19) in February 2020.[3] Masters-Waage et al. (2020) and Xu and Liu (2021) empirically investigated the effects of using different labels for COVID-19. Masters-Waage et al. (2020) found no evidence to support the hypothesis that different naming conventions of COVID-19 affected people's risk perceptions and attitudes towards Chinese people. Xu and Liu (2021) also found that labeling COVID-19 as the 'China virus' did not increase the perception that Chinese immigrants are a threat.[4] They also found that the branding of COVID-19 as "Chinese" did not appear

[3]Oddly, the same considerations about stigmatization have not been followed with other viral diseases, like Ebola or Marburg, as both are still officially named after places. In fact, Ebola provides us with an inaccurate toponym that is still used by the World Health Organisation: The West Africa Ebola Outbreak of 2013-2016. In 2013, Ebola spread widely in three very small West African countries — Sierra Leone, Liberia, and Guinea — and a few cases were eventually also diagnosed in Italy, Mali, Nigeria, Senegal, Spain, the United Kingdom, and the United States. See: https://www.who.int/emergencies/situations/ebola-outbreak-2014-2016-West-Africa.

[4]They do find that Chinese immigrants were perceived more negatively, weakly, in a subsample of liberal respondents of their survey.

to reduce the extent to which Americans blamed their own federal government for the mismanagement of the pandemic; this branding did not work to deflect blame to China, as was in no doubt intended by very prominent proponents of the 'China' label.

In the next section, we describe how toponyms for earthquakes have been determined in Italy and how people reacted to these toponyms. Maybe unsurprisingly, we also document how toponym-only-affected areas occasionally recognized the significance of their 'wrongful' inclusion in the toponyms. In Section 3, we describe our data and empirical methodology, while in Section 4 we examine each of the three above-mentioned earthquake events. Section 5 concludes with a discussion about the importance of naming conventions, and some policy suggestions for the use of toponyms for the naming of disasters.

2 Earthquakes, misnaming and the media

2.1 Choosing earthquake toponyms in Italy

No organization or institution in Italy is officially responsible for assigning names to disaster events. Instead, the toponyms that are eventually used to identify these events typically spread through the media. These geographical labels may start to spread from journalists covering the news of the event or from statements by official bodies, such as the National Institute of Geophysics and Volcanology (INGV), which oversees seismic monitoring. Drawing on INGV archive data[5], Table 1 examines the names attributed to major earthquakes in Italy since 1900 and the types of regions they refer to.

Two key observations emerge. First, when compared to the past, historical names of regions, or names based on topographical or environmental features are now less commonly used, with administrative region names (particularly NUTS-2 and NUTS-3 levels[6]) becoming more prevalent. When historical or geo-physical region names are used—such as "Friuli" in 1976 and "Emilia" in 2012—they often partially overlap with the administrative region's name. Second, with the exception of urban areas, the scale used to identify affected locations has broadened over time. This shift culminated in 2016 with the use of a macro-regional toponym (NUTS-1) for the first time, as in the case of "Central Italy."

[5]Source: https://ingvterremoti.com/i-terremoti-in-italia/ (in Italian).

[6]NUTS are the Nomenclature of Territorial Units for Statistics adopted by the European Commission and used throughout the European Union. NUTS-1 are the macro-regions, of which Italy has five (north-west, north-east, central, south, and the islands); NUTS-2 are typically referred to as Regions (e.g., Abruzzo), of which Italy has 21, NUTS-3 are sometimes referred to as Provinces (e.g., L'Aquila), of which Italy has 67. The smallest layer are the municipalities (comuni), of which Italy has 7904 (e.g., L'Aquila City is a municipality).

Table 1: Prevailing name of the major earthquakes that occurred in Italy after 1900

Year	Earthquake name	Type of Region
1905	Calabria	NUTS-2 Administrative region
1908	Messina	Municipality and NUTS-3 administrative region
1915	Marsica	Historical and geographical region (the land of ancient Marsi)
1919	Mugello	Topographical region (a valley)
1920	Garfagnana	Historical and geographical region (a mountain valley)
1930	Irpinia e Vulture	Historical and geographical, and topographical (mountain) regions (respectively)
1962	Irpinia	Historical and geographical region (land of ancient Irpini)
1968	Belice	Topographical region (a valley)
1976	Friuli	Historical and geographical region (partly identifying a NUTS-2 administrative region)
1980	Irpinia	Historical and geographical region (land of ancient Irpini)
1997	Umbria e Marche	Two NUTS-2 administrative regions
2009	L'Aquila	Municipality and NUTS-3 region
2012	Emilia	Historical and geographical region (partly identifying a NUTS-2 administrative region)
2016	Centro Italia	NUTS-1 region
2017	Ischia	Municipality and physical region (an island)

Notes: See Gavinelli et al. (2022) for a comprehensive explanation of historical, geographical, physical, and administrative regions in Italy. Source: own elaboration based on web archives.

The event referred to as the "Central Italy" earthquake encompasses a series of seismic shocks, with their main epicenters recorded in the following locations: the municipality of Accumoli (NUTS-3 region of Rieti, NUTS-2 Lazio region) on August 24, 2016; the municipality of Visso (NUTS-3 Macerata, NUTS-2 Marche) on October 26, 2016; the municipality of Norcia (NUTS-3 Perugia, NUTS-2 Umbria) on October 30, 2016; and the municipality of Capitignano (NUTS-3 L'Aquila, NUTS-2 Abruzzo) on January 18, 2017. The toponym "Central Italy" broadly encompasses all these areas,[7] but it also includes many other areas within Central Italy that were unaffected by the earthquake. No toponym precisely identifies all these areas; perhaps the closest equivalent is "Alta Sabina", a historical-geographical region, yet it would exclude the municipalities located in the Marche region. In any case, already after the first tremor, when obviously no one knew that others would follow and where, the area affected was referred to as Central Italy in the press, as shown in Figure 1. Taking into consideration the titles on the front pages of the major Italian newspapers[8] on the day after the event (August 25, 2016), the following toponyms appear to identify the area that was hit: Central Italy (NUTS-1, 7 times); Lazio, Marche and Umbria (NUTS-2, twice); Lazio, Marche, Umbria and Abruzzo (NUTS-2, twice); Appennino (the mountain range that runs from the north to the south of the country, twice); Amatrice, Arquata and Accumoli (municipalities, twice); Lazio and Marche (NUTS-2, once); Amatrice and Accumoli (municipalities, once); Amatrice (a municipality, once).

In press releases and on its website, the INGV adopted the toponym Central Italy to identify the affected area.[9] The three municipalities where fatalities were recorded were Accumoli, Amatrice, and Arquata. The

[7] Abruzzo is classified as part of Southern Italy by the Italian National Institute of Statistics (ISTAT), but it is considered part of Central Italy in geophysical terms.

[8] We considered: Il Corriere della Sera (the best-selling Italian newspaper, reported in Figure 1), La Repubblica, La Stampa, Il Sole 24 Ore, Il Messaggero, Il Giornale, Il Foglio, Il Fatto Quotidiano, Il Manifesto, Libero, L'Unità, Il Tempo, Avvenire, L'Osservatore Romano, Il Mattino, Il Tirreno, and La Gazzetta del Mezzogiorno

[9] See https://ingv.it/stampa-e-urp/stampa/note-stampa/3025-sequenza-sismica-in-italia-centrale-aggiornamento-12-settembre-ore-11-00 (in italian).

Figure 1: Front page of the best-selling newspaper in Italy the day after the August 24, 2016 earthquake.


GIOVEDÌ 25 AGOSTO 2016

CORRIERE DELLA SERA

FONDATO NEL 1876

Come effettuare i versamenti

Il territorio

24 AGOSTO 2016

Morti e paesi cancellati

Sisma devasta il Centro Italia, oltre 150 vittime. Trappola in un albergo

three are located in a valley called Alta Valle del Tronto, an alternative toponym that could have defined better the heavily affected area. Alternative toponyms can also be suggested with reference to the other main events of the sequence. The aftershocks occurred between October 26 and October 30, 2016, and mostly hit the municipalities of Ussita, Visso, Sant'Angelo sul Nera and Norcia, all of which are part of the Monti Sibillini National Park. It also represents an alternative and more geographically concise toponym. The municipalities mostly affected by the last relevant shock that occurred on January 16, 2017, were Capitignano, Montereale and Campotosto, all of which are also located in the Alta Valle dell'Aterno area.

A similar reasoning can be applied to the Ischia case, where an earthquake was recorded on August 21, 2017. The toponym refers both to the entire island and to one of the six municipalities it is divided into. The epicenter was located in the municipality of Casamicciola Terme, where the only two fatalities were recorded. Minor damages were also reported in the bordering municipality of Lacco Ameno. We analyzed again the titles of the main Italian newspapers (listed in footnote 8) on the day following the event and found that they all refer to the area as Ischia; only one newspaper mentions Casamicciola Terme, in addition to Ischia, in its subtitle. The front page of Il Corriere della Sera, the best-selling Italian newspaper, is shown in Figure 2. As with the previous example, referring to the area as Ischia is not incorrect if referring to the island, though it can be misleading: Ischia is also the name of a municipality (the most populous of the six) that was not affected by the earthquake and, anyway, the island was affected only partly, since four municipalities out of six municipalities on the island were not damaged at all (including the municipality of Ischia).

For the L'Aquila earthquake, in contrast, the toponym is more geographically accurate. It refers to the earthquake that occurred on April 6, 2009, whose epicenter was located in the municipality of L'Aquila. The toponym refers to both the municipality and its province (NUTS-3 region),[10] most of which was affected

[10]Italian provinces (NUTS-3 regions) are almost always named after their capital.

Figure 2: Front page of Il Corriere della Sera, the best-selling newspaper in Italy, the day after the August 21, 2017 earthquake.

Quotidiano

Tiratura: 410.224
Diffusione: 316.808

MARTEDÌ 22 AGOSTO 2017 — www.corriere.it — EURO 1,50 — ANNO 142 - N. 197

CORRIERE DELLA SERA

FONDATO NEL 1876

Aveva 86 anni
Addio a Guido Rossi il giurista anti crisi
di Paola Pica e Giangiacomo Schiavi
a pagina 12

Il ritratto
Il sacerdote laico amante delle regole
di Ferruccio de Bortoli
a pagina 13

Comunità islamiche
LA REAZIONE CHE ANCORA NON C'È
di Sabino Cassese

Il terremoto Panico e gente per le strade, frazioni isolate. Va giù una palazzina abitata. Requisito un traghetto per i soccorsi

Scossa a Ischia, crolli e vittime

Sisma di magnitudo 4: un morto, se ne temono altri. Bimbi tra le macerie, si scava per salvarli

STORIE & VOLTI

LE TESTIMONIANZE
«I turisti in fuga con le valigie»
di A. Pasqualetto a pagina 3

IL MAGISTRATO
«Paghiamo il conto delle case abusive»
di Alfio Sciacca a pagina 5

LA GEOLOGA
Perché tanti danni? Quell'area è friabile
di Leonard Berberi a pagina 5

by the shock. This event garnered significant media attention: Italy had not experienced an earthquake of such magnitude for decades, and it struck a regional capital not far from Rome. Its resonance may have also stemmed from the politicization of the event by the then Prime Minister, Silvio Berlusconi (Alexander, 2018, Özerdem and Rufini, 2013). Apart from the heavily affected provincial capital (72,696 inhabitants as of January 1, 2009), all other affected municipalities in the province had populations of fewer than 5,000. The media's attention focused almost exclusively on the city of L'Aquila, the most severely affected in terms of both casualties and building collapses (Galli and Camassi, 2009). Since the L'Aquila toponym coincides quite precisely with the heavily hit area (the so-called earthquake crater), we do not discuss it in the next subsection.

2.2 Adversely affected undamaged areas - in the media

A discontent regarding the names for the Central Italy and the Ischia earthquakes emerged not long after these events. Protests came from both local institutions and tourism operators who were located in the regions described by the toponym, but which experienced no damage.

In January 2017, a few months after the events, the newspaper Il Sole 24 Ore dedicated a report to the economic consequences of the Central Italy earthquakes in areas that were perceived to have been damaged, but were in reality not directly impacted by the earthquakes themselves. They deduced that:

> The damage caused by the earthquake [...] is not limited to the dramatic destruction of buildings [...]. There are less visible but deeply impactful damages that [...] risk exacting a steep toll on one of the most lucrative industries in these regions: tourism. [...] In this quadrilateral area

> encompassing northern Lazio, Abruzzo, Marche, and Umbria, there are treasures like Valnerina (from Amatrice to Norcia), struck by the earthquake and now grappling with a 90% or total drop in tourist arrivals. Meanwhile, world-famous destinations in Umbria—such as Assisi, Spoleto, and Gubbio—though far from the earthquake's epicenter, have experienced declines ranging from 30% (in November) to 50% (in December). [11]

In May 2017, the newspaper Il Corriere della Sera dedicated an article to the "virtual earthquake", observing that:

> Not just collapsed houses. Among the rubble, there are also empty rooms—rooms that are fully functional. They once hosted tourists, who have now vanished due to fear, often unjustified. [...] Even those who were untouched by the disaster have suffered. "I consider Assisi to be the epicenter of a virtual earthquake," explains Eugenio Guarducci, the city's Tourism Councilor. "There was no rubble here. No displaced residents. But the economic consequences, unfortunately, have been very real: from October 2016 to March 2017, we observed a 50% drop in arrivals compared to the same period the previous year. And all of this happened because the media spoke vaguely about the earthquake in the province of Perugia [...]".[12]

The protests by the above-mentioned Tourism Councilor of Assisi prompted the INGV to officially change the name assigned to the seismic sequence from "Central Italy Earthquake" to "Amatrice, Norcia, and Visso Seismic Sequence".[13] This, though, happened almost one year after the events. The INGV agreed to change their communication of seismic events from that moment on by providing the name of the municipality where the epicenter is located, instead of a greater administrative unit.[14] Nonetheless, their choice of the new name is unclear, as the first significant tremor was recorded in the municipality of Accumoli, not Amatrice.

However, years after this announcement, we observed that INGV indeed adopts the criterion of indicating the municipality closest to the epicenter in the public technical database where all seismic events are listed.[15] However, on the more public-facing pages of the institutional website, this criterion does not seem to be consistently followed. This is evident, for instance, on the page that lists the major seismic sequences that have occurred in Italy in recent years, all of which caused little damage.[16] Considering those that took place after the date when the Institute announced it would improve its communication, the toponymic references vary, pointing to entire NUTS-2 administrative regions (such as "Molise 2018"), physical regions ("Tuscany-Emilia Apennines 2023"), entire NUTS-3 administrative regions ("Province of Florence 2022"), and municipalities (as in "Umbertide 2023").

[11] Source: https://www.infodata.ilsole24ore.com/2017/01/20/la-mappa-costi-economici-delle-aree-piu-colpite-dal-terremoto-del-centro-italia/. The quoted text has been translated from Italian by the authors.

[12] Source: https://viaggi.corriere.it/eventi/danni-terremoto-turismo/. The quoted text has been translated from Italian by the authors.

[13] See: https://www.ansa.it/lazio/notizie/2017/02/14/terremoto-centro-italia-cambia-nome_e2765d90-a36f-4262-afe1-ff3ec5ef66c3.html (in Italian). Other official bodies, such as the Chamber of Commerce of Perugia, also emphasized the need for better communication to avoid identifying the entire region with the area affected by the earthquake: see https://www.pg.camcom.gov.it/P42A4495C6858S0/In-Umbria-flussi-turistici-in-caduta-dopo-il-terremoto.html (in Italian).

[14] Source: https://ingv.it/stampa-e-urp/stampa/note-stampa/3083-ingv-il-sito-web-del-centro-nazionale-terremoti-migliora-l-informazione-degli-eventi-sismici.

[15] See: https://terremoti.ingv.it/

[16] See: https://ingvterremoti.com/terremoti-in-italia/

At the time, protests came also from tourist operators. One of them, interviewed in Assisi almost one year after the events, explicitly blamed the media for using an inaccurate toponym to identify the seismically-affected area:

> "Tourists no longer come; I've lost 70 percent of my business because of your labels," exclaims Paola, [...]. Labels? "The newspapers and television called it the 'Central Italy Earthquake', lumping everyone together... People got scared and now go on vacation elsewhere." [17].

Similar dissatisfaction was also expressed in Ischia. A few months after the earthquake, the president of Federalberghi Ischia (a trade association of hotel owners) said that:

> The Italian market (of tourists) has been the most problematic following the seismic event, as it was heavily influenced by the negative portrayal of the island by Italian media in the initial days. The media often disseminated false information, failing to respect and accurately represent the areas of the island most affected by the disaster. Ischia must prioritize investing in better communication strategies [...].[18]

The association also launched a social media campaign called "ischiavivapiuchemai" (translatable as: Ischia more alive than ever) to explain that:

> Ischia is not a crater; the earthquake [...] affected only two out of six municipalities. In the others, absolutely nothing happened. [...] It is therefore urgent to immediately restart the economy through transparent and comprehensive information for tourists and residents to avoid hasty departures and unwarranted panic, which risk compromising the season of an island that depends on tourism.[19]

Through an analysis of Google Trends data, we document distinct search patterns for keywords related to the Ischia earthquake. Figure B.1 in the Appendix compares web searches for "terremoto Casamicciola" ("Casamicciola earthquake," referring to the municipality at the epicenter) and "terremoto Ischia" ("Ischia earthquake," referring to the entire island). Overall, significantly more people searched for "Ischia earthquake," indicating that the earthquake was immediately associated with the island's toponym. However, "Casamicciola earthquake" garnered greater search interest within the NUTS-2 region of Campania, which was directly affected by the event. Conversely, the term "Ischia earthquake" exhibited higher search interest across other Italian regions. The maps illustrate that more precise geographical awareness was concentrated in the area where the earthquake occurred.

We conducted a similar descriptive analysis for the Central Italy earthquake, specifically comparing web searches for "Central Italy earthquake," the epicenter, and the most affected location for each of the four

[17] Source: https://www.repubblica.it/venerdi/reportage/2017/07/05/news/turisti_addio_il_nuovo_crollo_di_assisi_vers_breve_-170032915/. The quoted text has been translated from Italian by the authors.

[18] Source: https://ansabrasil.com.br/campania/notizie/2017/11/01/turismo-in-calo-a-ischia-dopo-terremoto_737c5e94-93d3-43c6-8df8-2e241e8be6ee.html. The quoted text has been translated from Italian by the authors.

[19] Source: https://www.sassilive.it/economia/lavoro/terremoto-ischia-federalberghi-aderisce-a-campagna-la-bellezza-non-teme-fatalita/. The quoted text has been translated from Italian by the authors.

shocks associated with that earthquake. Figure B.2 in the Appendix shows that, at the time of the first earthquake in August 2016, the municipality most affected by the event (Amatrice) was predominantly associated with the earthquake, as the vast majority of users searched for "Amatrice earthquake." This trend reversed for the shocks of October 2016 and January 2017, where "Central Italy earthquake" became the most searched term. A similar pattern applies to the second and third shocks, which occurred in late October 2016. Figure B.3 shows that while the epicenter and the most affected municipality of the October 30 shock (Norcia) were the most searched on the day of the earthquake, "Central Italy earthquake" became the most searched term in the following months and at the time of the final shock. Conversely, when the last earthquake occurred on January 18, 2017, "Central Italy" was the toponym most associated with the earthquake, surpassing searches for the epicenter and the most affected municipality of that shock (see Figure B.4 in the Appendix). Overall, the descriptive evidence shows that the name "Central Italy earthquake" gained increasing prominence in describing the seismic sequence, eventually becoming the official term used by the media and institutions like INGV to identify the sequence.

In the following sections, we test whether the perceptions reported in the listed quotations find support in empirical analysis, and compare them to the 2009 toponym-accurate L'Aquila earthquake.

3 Data and method

3.1 Data and sample description

The ideal setting to answer our research question - what's in a name? - would require data on tourist flows at the most granular administrative level (i.e., municipalities) over a long time span. Data on tourist arrivals and overnight stays for Italian municipalities are available from 2014 onward, so we can use this data to analyse only the Central Italy and Ischia earthquakes. We constructed two other datasets at the NUTS-3 and tourist district levels to extend the analysis to the earlier L'Aquila earthquake, as well.

For the municipal-level dataset, we measure tourist flows – tourist arrivals by place of origin (domestic or international) - from 2014 to 2018, collecting data from the Italian National Institute of Statistics (ISTAT) and regional statistical offices.[20] In addition, we collect data on several relevant characteristics of each municipality in our sample, including income per capita, the population size in logarithmic form, the share of foreigners, municipal peripherality with respect to socio-economic centers, and tourism classification.[21] Table A.1 in the Appendix reports a detailed description of the variables included in our analysis, as well as their data sources. Our final sample comprises 3,362 out of 7,904 municipalities. Figure 3 illustrates the geographical coverage of our sample.

For the L'Aquila earthquake, we sourced data on tourist flows at the NUTS-3 and district levels from ISTAT; these data correspond to the Italian provinces, while tourist districts, which are used for statistical

[20] Data on tourist flows in Italy are collected by provincial and regional offices and subsequently submitted to ISTAT. For more details, refer to https://siqual.istat.it/SIQual/lang.do?language=UK. Considering that ISTAT provides data on tourist flows for only 2,872 out of 7,901 municipalities within the time frame of our analysis, we contacted all Italian regional statistical offices to supplement the ISTAT municipal database with data from as many missing municipalities as possible.

[21] See the next section for a detailed explanation of the rationale and relevance behind the inclusion of each variable in our analysis.

Figure 3: Municipalities in the dataset

purposes to monitor tourism flows, are defined based on geographic and administrative divisions. These districts typically group contiguous municipalities sharing similar tourism characteristics, such as coastal areas, mountain regions, or towns of similar cultural interest.[22] Tourist districts are more disaggregated than provinces, covering smaller areas. In 2009, the year of the occurrence of the L'Aquila earthquake, Italy had 111 provinces and 542 tourist districts.

We measure monthly tourist arrivals for 107 out of the 111 provinces from January 2008 to March 2010, i.e., up to one year after the earthquake.[23] For tourist districts, we observe annual tourist flows from 2004 to 2011 for 474 units.[24] Table 2 provides descriptive statistics for all variables in our datasets, categorized by earthquake. For each earthquake, we provide separate statistics for units located within the crater (the area directly damaged by the earthquake) and for unaffected units inside and outside the geographical area defined by the toponym.

[22]Individual municipalities can also constitute independent tourist districts. For instance, the municipality of L'Aquila is also considered a tourist district on its own. The surrounding municipalities within the same Province of L'Aquila are grouped into another tourist district called "Other Municipalities L'Aquila".

[23]We exclude from the analysis four provinces due to missing data: Barletta-Andria-Trani, Fermo, Monza e della Brianza, and Sud Sardegna.

[24]We exclude 17 tourist districts from our analysis due to missing data. For the remaining tourist districts, we aggregated 92 of them into groups of two to four geographically contiguous districts, as ISTAT began reporting aggregate data from a certain year onwards. For example, ISTAT provided separate data for the tourist districts of "Rivisondoli" and "Other Municipalities L'Aquila" from 2004 to 2007, but combined them into a single district ("Rivisondoli and Other Municipalities L'Aquila") from 2008 onwards.

Table 2: Descriptive statistics

Central Italy earthquake (Municipal-level data, 2014-2018)	**Crater**		**Unaffected-Toponym**		**Unaffected-Control group**	
Variable	Mean	St. dev	Mean	St. dev	Mean	St.dev
Total arrivals	4,876.5	14,004.4	16,630.6	44,724.5	37,953.3	243,718.1
Arrivals - Italians	5,727.1	13,595	13,204.4	30,829.3	19,427.7	86,030.8
Arrivals - Internationals	1,126.5	2,979.4	4,760.7	19,313.8	20,490.3	174,115.6
Total overnight stays	16,962.1	45,452.4	58,864.2	150,572.3	131,564.2	706,864.7
Overnight stays - Italians	17,545.6	39,696.2	48,456.8	122,086.9	65,921.3	269,821.1
Overnight stays - Internationals	6,118.3	15,258.0	15,125.9	46,818.6	72,404.1	499,065.2
Population (log)	7.5	1.3	8.3	1.4	8.5	1.3
Share of foreigners	0.08	0.03	0.08	0.04	0.07	0.04
Income per capita	16,444.3	2,048.1	17,204.8	2600.5	19,295.4	3,903.8
Periphery score	3.6	1.0	3.7	1.0	3.5	1.1
Tourism category	8.5	2.8	7.6	3.2	7.1	3.1
Ischia earthquake (Municipal-level data, 2014-2018)	**Crater**		**Unaffected-Toponym**		**Unaffected-Control group**	
Variable	Mean	St. dev	Mean	St. dev	Mean	St.dev
Total arrivals	68,049.4	4,872.0	124,810.1	95,259.4	33,732.3	222,493.1
Arrivals - Italians	56,340.4	5,540.1	95,881.4	74,135.9	18,112.9	79,587.0
Arrivals - Internationals	11,709	1,510.1	28,928.7	23,180.2	17,819.9	159,680.7
Total overnight stays	403,881.4	32,978.9	741,480.5	556,257.4	116,686.2	645,651.4
Overnight stays - Italians	327,565.8	38,560.4	532,257.4	398,803.2	61,609.5	250,435.6
Overnight stays - Internationals	76,315.6	13,443.0	209,223.1	179,179.1	62,640.8	457,686.5
Population (log)	9.0	0.1	9.3	0.6	8.4	1.3
Share of foreigners	0.06	0.01	0.07	0.02	0.07	0.04
Income per capita	18,196.5	536.1	17,393.0	1,191.3	18,908.5	3,798.9
Periphery score	5	0	5	0	3.6	1.1
Tourism category	9	0	5.5	2.7	7.2	3.1
L'Aquila earthquake (Provincial-level data, 01.2008-03.2010)	**Crater-Toponym**		**Unaffected-Bordering provinces**		**Unaffected-Control group**	
Variable	Mean	St. dev	Mean	St. dev	Mean	St. dev
Total arrivals	35,492.6	17,387.8	21,480.7	21,881.1	74,837.6	131,531.3
Arrivals - Italians	33,345.8	17,315.6	17,181.7	17,895.4	42,198.3	58,335.3
Arrivals - Internationals	2,146.8	1,307.4	4,299.0	6,143.3	32,639.2	84,180.7
Total overnight stays	121,547	63,685.7	92,995.8	180,203	286,742	604,883.8
Overnight stays - Italians	113,515.2	62,514.7	76,365.9	157,077.5	161,157.7	311,183.2
Overnight stays - Foreigners	8,031.8	4,529.1	16,629.9	27,252.5	125,584.3	354,973.5
L'Aquila earthquake (Tourist district-level data, 2004-2011)	**Crater-Toponym**		**Unaffected-Bordering tourist districts**		**Unaffected-Control group**	
Variable	Mean	St. dev	Mean	St. dev	Mean	St. dev
Total arrivals	74,789.2	24,341.7	80,019.7	45,648.3	177,612	354,193
Arrivals - Italians	64,909.5	20,330.4	67,998.5	38,399.1	103,392.6	161,258.9
Arrivals - Internationals	9,879.7	4,031.8	12,021.2	8,610.7	74,219.5	230,498.1
Total overnight stays	189,466.1	30,969.5	307,377.5	243,446.9	710,832.3	1,351,669
Overnight stays - Italians	159,715.1	22,076.7	250,048.2	199,783	417,646.6	715,788.6
Overnight stays - Foreigners	29,751	9,550.7	57,329.3	52,833.6	293,185.7	821,740.1

3.2 Method

We perform our analysis by implementing the Imai et al. (2023) non-parametric generalization of the Difference-in-Differences (DiD) estimator. Imai et al. (2023) introduces a matching method specifically designed for time-series cross-sectional data, offering a flexible approach to estimate both the short- and long-term average treatment effects on the treated (ATT), even with a limited number of pre-treatment time points. We first describe the methodology with specific reference to our municipal dataset, followed by its application to the datasets at the NUTS-3 and tourist district levels.

For each unit (municipality) $i = 1, ..., N$ and year $t = 2014, ..., 2018$ we observe our outcome variables of interest - tourist arrivals and overnight stays - Y_{it}, a vector of time-varying covariates Z_{it}, a vector of time-invariant municipal characteristics V_i, and a treatment dummy variable X_{it}. According to the primary hypothesis underlying our analysis, inaccurate descriptions of the geographical areas affected by earthquakes (toponyms) can negatively impact tourist arrivals in municipalities that did not experience any direct damage. Consequently, we expect to observe a negative impact on tourist arrivals in toponym areas outside the crater zone for the Central Italy and Ischia earthquakes. Conversely, the impact of the L'Aquila

earthquake is expected to be limited to L'Aquila itself, with no significant effects on the surrounding areas. For our municipal dataset, we create a set of treatment variables X_{it} to estimate the effects of interest separately:

i) Two dummy variables identifying municipalities located in the crater of Central Italy or Ischia, respectively. These allow us to estimate the effect of the two earthquakes on tourist arrivals.

ii) A dummy variable identifying municipalities within the geographical area of Central Italy but not hit by the Central Italy earthquake.[25] This allows us to estimate the effect of the Central Italy earthquake toponym for municipalities beyond the crater.

iii) A dummy variable for municipalities located in the island of Ischia but not affected by the Ischia earthquake. This allows us to estimate the effect of the Ischia earthquake toponym for municipalities beyond the crater.

Additionally, we set the number of pre-treatment and post-treatment periods - lags L and leads F, respectively - exploiting all the time points in our municipal dataset. Specifically, we set $L = 2$ and $F = 2$ for the Central Italy earthquake, and $L = 3$ and $F = 1$ for the Ischia earthquake. Following Imai et al. (2023), we estimate the ATT as:

$$\begin{aligned}\delta(F, L) = E\Big\{ & Y_{i,t+F}(X_{it} = 1, X_{i,t-1} = 0, \{X_{i,t-l}\}_{l=2}^{L}) \\ & - Y_{i,t+F}(X_{it} = 0, X_{i,t-1} = 0, \{X_{i,t-l}\}_{l=2}^{L}) | X_{it} = 1, X_{i,t-1} = 0 \Big\}\end{aligned} \tag{1}$$

where $Y_{i,t+F}(X_{it} = 1, X_{i,t-1} = 0, \{X_{i,t-l}\}_{l=2}^{L})$ is the potential outcome in case of treatment, and $Y_{i,t+F}(X_{it} = 0, X_{i,t-1} = 0, \{X_{i,t-l}\}_{l=2}^{L})$ is the potential outcome in absence of treatment. $\{X_{i,t-l}\}_{l=2}^{L}$ represents the realized history. Applying this methodology involves three stages:

1. For each treated unit we apply a matching method to create a matched set, M_{it}, of control units. This is particularly important in our context due to the high degree of heterogeneity in outcomes and covariate histories between the treated and control groups.[26] We first perform an exact matching based on municipalities' time-invariant characteristics V_i, i.e. the tourism category and the periphery score. By implementing this exact matching, we restrict the comparison to municipalities with the same degree of tourist attractiveness, as the variation in tourism activity is largely influenced by the presence and quality of specific local natural and cultural features (Faber and Gaubert, 2019). We then refine each matched set M_{it} by computing the Mahalanobis distance, i.e. given a control unit in M_{it}, we calculate the standardized distance using the time-varying covariates Zit and then average it over the pre-treatment periods considered. Refining the matched set with income per capita and the population is particularly relevant, as areas with higher wages and population size tend to generate larger multipliers (Moretti, 2010). Additionally, a higher share of foreigners can attract more

[25] We adopted several geographical specifications for what we define as Central Italy, resulting in treatment variables taking the value of 1 for narrower or wider areas. See the next section for a detailed explanation of the geographical coverage of each treatment variable.

[26] For example, in the year preceding the Central Italy earthquake, municipalities within the affected area (the crater) had significantly fewer tourist arrivals on average compared to the control group (5,526.8 vs. 33,545.9), as well as a smaller population (4,895.9 vs. 13,826.8).

international tourists (Kuznetsov and Sabel, 2006). This refinement method allows us to account for past outcomes and time-varying covariates without relying on strict parametric assumptions. The algorithm matches each treated unit with the 5 most similar control units based on the Mahalanobis distance, assigning equal weight to each unit in the refined matched set M_{it}.

2. After refining the matched set, we estimate the counterfactual post-treatment outcome for the treated units by calculating the weighted average of the control units in the refined matched set.
3. Lastly, we implement the DiD estimator to calculate the treatment effect for each treated unit by computing the difference between the actual and counterfactual changes in outcomes. Following equation 1, we then derive the ATT by averaging the treatment effect across all treated observations[27].

We use datasets at the NUTS-3 and tourist district levels to apply the same methodology to the L'Aquila earthquake. In this case, we create two treatment variables. The first identifies the province/tourist district of L'Aquila, allowing us to estimate the earthquake's impact on tourist arrivals. The second identifies provinces/tourist districts bordering L'Aquila, to determine whether tourist arrivals in the surrounding areas were also affected. We set $L = 14$ and $F = 12$ for the monthly provincial data, and $L = 5$ and $F = 2$ for the tourist district data. We decided to corroborate our analysis using both data sources for two main reasons. First, we do not have the same territorial granularity as municipal-level data. In the case of provincial data, the province of L'Aquila also includes the areas surrounding the crater, possibly introducing a downward bias in our estimates. Tourist districts are smaller areas, allowing us to better capture the effect of interest. Second, we do not have any Z_{it} for the monthly provincial data, so we create a matched set only with the outcome history for both datasets. Nonetheless, we have enough pre-treatment periods to robustly estimate the ATT using these data sources.

One advantage of this methodology compared to regression methods is that it allows for assessment of the covariate balance between treated and matched control observations, making it possible to evaluate whether the treated and matched control groups are comparable with respect to observed confounders. Additionally, the identifying assumptions of this method - limited carryover effects, the absence of interference, and the parallel trend assumption[28] - are milder than most common methods, such as the DiD estimator, linear regressions with fixed effects, and dynamic models (Imai et al., 2023, Xu, 2024).

4 Results

We begin this section by presenting the results for the Central Italy earthquake, followed by a discussion of the findings for the Ischia earthquake, and conclude with the estimates for the L'Aquila earthquake.

[27] Standard errors are computed using a block-bootstrap approach built for matching analysis in time-series cross-sectional settings (Otsu and Rai, 2017).

[28] The assumption of limited carryover effects makes the post-treatment potential outcome not dependent on previous earthquakes. This assumption is satisfied as the affected areas did not experience any huge earthquakes in the previous years (Cerqua et al., 2023). The absence of interference is met as untreated municipalities are not affected by the earthquake occurring in the treated ones. To avoid any estimation bias, we exclude from the control group the municipalities within the crater when specifying the treatment variable as in (ii) and (iii). The same applies to the provincial and tourist district level datasets. The parallel trend assumption is given after conditioning on M_{it} and the treatment and outcome history.

4.1 Central Italy earthquake

For the Central Italy earthquake, we have data for 114 out of 138 municipalities belonging to the earthquake's crater.[29] Table 3 presents the earthquake's impact on tourist arrivals and overnight stays for those municipalities. We report the ATT for each post-treatment year—2016, 2017, and 2018. Overall, the estimates indicate a negative impact on tourist arrivals, statistically significant at the 5% level in 2016 and at the 1% level in the following years. Estimates for overnight stays show a similar trend, with a negative statistically significant impact in 2017 (5% level) and 2018 (1% level). The lack of statistical significance in 2016 is likely due to the timing of the earthquake, a seismic sequence comprising four major tremors occurring from late August 2016 through early 2017. The first tremor struck near the end of the summer season, after most tourist inflows had already been recorded.

Table 3: Impact of the Central Italy earthquake on tourist arrivals and overnight stays

Total arrivals		
t (2016)	t+1 (2017)	t+2 (2018)
-569.4**	-2,211.0***	-1,466.7***
(231.6)	(678.4)	(564.0)
Total overnight stays		
t (2016)	t+1 (2017)	t+2 (2018)
-1,907.8	-5,999.0**	-6,247.5***
(1,297.1)	(3,107.2)	(2,115.2)

Notes: Treated municipalities are those located in the crater of the Central Italy earthquake. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

As discussed in previous sections, "Central Italy" encompasses a much broader geographical area than the crater itself. To examine whether the earthquake's toponym influenced tourist inflows in municipalities unaffected by the earthquake, we assign treatment to municipalities located within the same NUTS-3 regions as the crater in the estimates presented in Table 4.[30] Figure 4 provides a graphical representation of the municipalities classified as treated and Figure 5 shows the covariate balancing. The balancing remains stable across the two pre-treatment time points and fully within the (-1, 1) range of standardized mean differences. The imbalance level for the lagged values of our primary dependent variable, tourist arrivals, remains consistent throughout the pre-treatment period, supporting the plausibility of the parallel trend assumption for the proposed estimator.

The results in Table 4 indicate that municipalities untouched by the earthquake but within the Central Italy toponym experienced a statistically significant reduction in tourist arrivals at the 1% level for 2016, 2017, and 2018. The same pattern of Table 3, but at the 1% level of significance, is observed for overnight stays. When considering the mean number of arrivals in 2015, the year prior to the earthquake, the substantial decline observed in 2017 corresponds to approximately 40% fewer tourists for municipalities in the crater area and 12.5% fewer for unaffected municipalities within the toponym area but not in the crater. Based on official ISTAT statistics for the average daily expenditure of tourists (both domestic and international)[31] in 2017, we estimate that the observed reduction in tourist arrivals in 2017 corresponds to an economic loss of approximately 590,000 € in each municipality unaffected by the earthquake but located in Central Italy

[29] see https://sisma2016data.it/report-page/ for reports containing the full list of municipalities included in the crater.
[30] For this analysis, municipalities within the Central Italy earthquake's crater are excluded from the control group.
[31] The average national daily expenditure per trip was 94 € in 2017 and 91 € in 2018.

for that year, rising to around 810,000 € in 2018.

Table 4: Impact of the Central Italy earthquake's toponym on tourist arrivals and overnight stays

Total arrivals		
t (2016)	t+1 (2017)	t+2 (2018)
-499.9***	-2,128.2***	-1,263.5***
(187.3)	(352.2)	(437.4)
Total overnight stays		
t (2016)	t+1 (2017)	t+2 (2018)
-757.1	-6,317.3***	-8,903.8***
(916.6)	(1,502.8)	(2,187.5)

Notes: Treated municipalities are those unaffected by the earthquake but inside the geographical area of the toponym. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Figure 4: Unaffected municipalities within the geographical area of the toponym

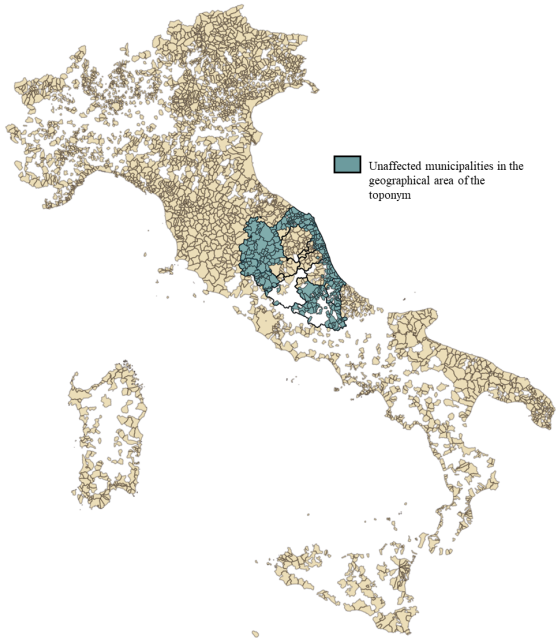
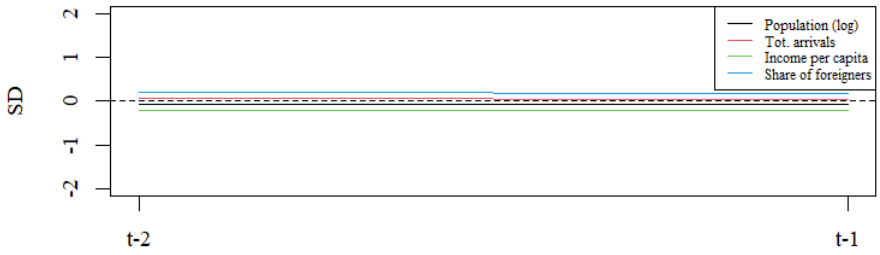


Figure 5: Covariate balancing for the Central Italy earthquake



We replicate the estimation by expanding the definition of treated municipalities to include a broader geographical area than that depicted in Figure 4. Specifically, we consider as treated those municipalities unaffected by the earthquake but located within the same NUTS-2 regions as the crater area[32], as illustrated in Figure B.5 in the Appendix. Results, reported in Table A.2 in the Appendix, are in line with the ones of Table 4.[33][34]

We also investigate whether (i) the distance from the crater and (ii) tourists' place of origin influence the observed decline in tourist arrivals. Regarding (i) the distance from the crater, in the case of the Central Italy earthquake, the statistically significant reduction in tourist arrivals and overnight stays may be associated with unaffected municipalities located closer to the crater, rather than with the toponym itself. Table A.3 in the Appendix reports the results of estimations conducted for municipalities grouped by their distance from the crater's border. Specifically, we estimate effects for municipalities within 10km, between 11km and 20km, between 21km and 30km, between 31km and 40km, and between 41km and 50km from the border. In these analyses, municipalities within the crater and those outside the treated group but located within 50km of the border are excluded from the control group. Figure B.6 in the Appendix provides a visual representation of these distance-based groupings. Results in Table A.3 in the Appendix indicate that the negative effect on tourist arrivals persists even for municipalities situated 41-50km away from the crater.

Regarding tourists' place of origin, media outlets vary in the scope and depth of their earthquake coverage (Quarantelli, 1990), potentially shaping perceptions of the crater's size — an effect that may be even more pronounced in international news reporting since both the reporting media and its audience may be less informed about Italian geography. Table A.4 in the Appendix shows that the reduction in tourist arrivals and overnight stays in unaffected municipalities within the toponym is statistically significant both for Italian and international tourists. Notably, for international tourists, the decline in arrivals is significant at the 5% level in 2016 and at the 1% level in both 2017 and 2018. For Italian tourists, the reduction is significant at the 1% level in 2017, only at the 10% level in 2018, and not significant in 2016.

Lastly, we provide evidence of the robustness of our estimates using as an alternative estimator the Synthetic Difference in Differences (SDID) (Arkhangelsky et al., 2021). The SDID combines features of Synthetic Control (Abadie et al., 2010, Abadie and Gardeazabal, 2003) and the Difference in Differences, estimating the ATT through a two-way fixed effect regression with optimally chosen unit and time weights.[35] When applying the SDID method, we include only our time-varying covariates, as conditioning on time-invariant covariates is not allowed (Clarke et al., 2023). Table A.11 in the Appendix shows that results align closely with our main estimates in Table 3 and Table 4. Furthermore, although having a highly skewed depen-

[32] We exclude Rome from the analysis.

[33] Two municipalities, Foligno and Narni, which are formally outside the list of municipalities within the crater, experienced damage from the earthquake. According to the Modified Mercalli Intensity (MMI) scale (Wood and Neumann, 1931), they recorded intensities of VI (Narni) and VII (Foligno), corresponding to light to moderate damage in well-constructed ordinary structures. We exclude these municipalities from the analysis and re-calculate the estimates reported in Table 4 and Table A.2. Results do not change.

[34] Even though we are interested in analyzing the short-term effect on tourist arrivals, we repeated the estimates for both the municipalities within the crater and those included in the toponym, adding a post-treatment year, i.e. 2019. The main reason for not including 2019 in the main estimates is that we lose 70 municipalities due to missing data. The reduction in arrivals remains statistically significant even for 2019, both for municipalities within the crater (point estimate: -1,156.3; standard error: 552.4) and for municipalities not affected by the earthquake but located in the geographical area of the toponym (for the municipalities reported in Figure 4: point estimate: -1,444.9; standard error: 495.3; for the municipalities reported in Figure B.5: point estimate: -1,696.5; standard error: 899.5).

[35] See Arkhangelsky et al. (2021) and Clarke et al. (2023) for a detailed description of the method.

dent variable is not a primary concern for our empirical strategy, we also re-estimate the model using the logarithm of tourist arrivals as the outcome variable. These results, also presented in Table A.11 in the Appendix, further confirm our findings.

4.2 Ischia earthquake

We have data for all 6 municipalities on Ischia Island. One of those municipalities, Casamicciola Terme, represents the crater. Following the approach used for the Central Italy earthquake, we conduct separate estimations for the crater and the other municipalities on the island to identify both the direct earthquake effect and the toponym effect. Table 5 presents the estimated impact of the earthquake on tourist arrivals and overnight stays for the crater. The results indicate a significant decline in both tourist arrivals and overnight stays, with estimates significant at the 1% level for each post-treatment year.

Table 5: Impact of the Ischia earthquake on tourist arrivals and overnight stays

Total arrivals	
t (2017)	t+1 (2018)
-14,493.6***	-14,958.0***
(3,006.0)	(2,811.4)
Total overnight stays	
t (2017)	t+1 (2018)
-58,989.8***	-67,054.2***
(13,176.6)	(7,105.5)

Notes: The treated municipality is Casamicciola Terme, crater of the Ischia earthquake. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

We then estimate the effect on tourist arrivals and overnight stays for unaffected municipalities located on the island. Figure 6 shows that the pre-treatment balancing of covariates falls within the standardized mean difference range of (-1, 1). Table 6 shows that the toponym effect also leads to a significant decline in tourist arrivals and overnight stays in the case of the Ischia earthquake. Using the mean number of arrivals in the year before the earthquake as a reference, the observed decline in 2017 corresponds to approximately an 11.5% reduction in tourists among unaffected municipalities within the toponym. The reduction in tourist arrivals is statistically significant at the 5% level for both 2017 and 2018. For overnight stays, the decline is significant at the 5% level in 2017 and at the 10% level in 2018.[36] Based on our results, the estimated decrease in total overnight stays in 2017 corresponds to an economic loss of approximately 6.5 € million in each municipality located in the island but untouched by the earthquake for that year[37].

Although standard errors for the point estimates in 2018 are of similar magnitude to the coefficients, they are reported as statistically significant due to the point estimates not being perfectly centered within the confidence intervals, which tend to skew toward negative values. For instance, the 95% confidence interval for total arrivals is (-35,028.9, -1,861.6). This outcome is primarily driven by the high heterogeneity in

[36] Although Casamicciola Terme is the only municipality where significant damage occurred in the inhabited area and the area damaged by the earthquake is very limited, as specified by the Italian Civil Protection (see https://emergenze.protezionecivile.gov.it/en/seismic/ischia-earthquake-2017/), a small portion of the territory within the municipality of Lacco Ameno reported minor damage to local infrastructure. We repeat estimates in Table 6 excluding Lacco Ameno. The results, reported in Table A.5 in the Appendix, do not change.

[37] Calculation based on official Istat statistics.

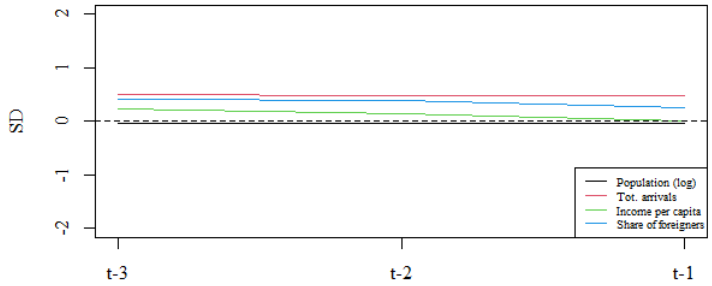
arrivals across treated units.[38]

Table 6: Impact of the Ischia earthquake's toponym on tourist arrivals and overnight stays

Total arrivals	
t (2017)	t+1 (2018)
-12,540.5**	-8,575.1**
(5,568.3)	(8,572.5)
Total overnight stays	
t (2017)	t+1 (2018)
-69,193.3**	-20,620.2*
(29,762.1)	(24,825.9)

Notes: Treated municipalities are those unaffected by the earthquake but inside the geographical area of the toponym. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Figure 6: Covariate balancing for the Ischia earthquake



We further examine the toponym effect by disaggregating the estimates based on tourists' place of origin. Table A.6 presents separate results for Italian and international tourists. Notably, only Italian tourists exhibit a significant reduction in arrivals and overnight stays. This pattern may be attributed to the limited media coverage of the Ischia earthquake in international outlets as this was a more minor earthquake. Unlike the Central Italy earthquake, which garnered widespread attention from both media and institutions due to its severity and high number of fatalities, the Ischia earthquake received less coverage due to its lower intensity and more localized impact. Interestingly, estimates divided by tourist place of origin reflect anecdotal evidence reported in Section 2.2 in which the president of Federalberghi Ischia states that "the Italian market of tourist has been the most problematic [...] as it was heavily influenced by the negative portrayal of the island by the Italian media." (see subsection 2.2).

To assess the robustness of our estimates, we performed the same additional analyses as those conducted for the Central Italy earthquake.[39] In the case of the Ischia earthquake, when applying the SDID estimator, we use placebo standard errors instead of block-bootstrapped ones because a small number of treated units

[38] In the year before the earthquake, the five unaffected municipalities on the island had a mean number of arrivals of 108,622.2, with a standard deviation of 105,826.7. The municipality of Barano d'Ischia recorded the lowest number of arrivals, 18,708, while the municipality of Ischia reported the highest, at 235,484.

[39] As with the Central Italy earthquake, we also repeated the estimates by adding 2019. In this case, as well, tourist arrivals decreased both for Casamicciola Terme and for the other municipalities on the island.

can render the estimated variance and confidence intervals less reliable (Arkhangelsky et al., 2021, Clarke et al., 2023). Additionally, while our main estimates remain robust even when a single unit is treated, we further analyze the effect on tourist arrivals for Casamicciola Terme (the municipality in the crater) using the Synthetic Control method, which is specifically designed for such cases. The results, reported in Table A.12 in the Appendix, are consistent with our main findings.[40]

4.3 L'Aquila earthquake

For the L'Aquila earthquake, we present estimates at the tourist district level in the main text, complemented by additional estimates at the provincial level provided in the Appendix. Table 7 reports the impact of the earthquake on tourist arrivals and overnight stays in the tourist district of L'Aquila, which includes only the municipality of L'Aquila. The earthquake led to a statistically significant reduction at the 1% level in both tourist arrivals and overnight stays in each post-treatment year. While the city of L'Aquila became the primary symbol of the earthquake in media and institutional narratives due to the extensive damage and the tragic loss of hundreds of lives, the tourist district of L'Aquila does not encompass other municipalities within the province of L'Aquila that also sustained damage from the earthquake[41]. These additional municipalities form part of both the crater and the toponym of the earthquake. Table A.7 in the Appendix shows estimates including the tourist district "Other municipalities of L'Aquila" as treated. The results are consistent with those reported in Table 7.

Table 7: Impact of the L'Aquila earthquake on tourist arrivals and overnight stays - tourist district of L'Aquila

Total arrivals		
t (2009)	t+1 (2010)	t+2 (2011)
-55,783.0***	-43,831.4***	-35,108.8***
(2,143.3)	(3,550.8)	(4,156.3)
Total overnight stays		
t (2009)	t+1 (2010)	t+2 (2011)
-46,560.0***	-55,314.0***	-88,171.6***
(6,185.7)	(6,445.7)	(9,764.5)

Notes: Estimates refer to tourist district-level data. The treated unit is the tourist district of L'Aquila, representing both the crater and the toponym of the earthquake. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Among our case studies, the L'Aquila earthquake is the only instance where some municipalities were affected—albeit mildly—by the earthquake but were not included within the geographical area defined by the earthquake's toponym. Specifically, 18 municipalities in the province of Teramo, 29 in the province of Pescara, 2 in the province of Chieti, and 14 in the province of Rieti sustained light damage. These municipalities are all part of tourist districts bordering the district of L'Aquila. To test whether these bordering areas experienced a decline in tourist arrivals despite not being part of the earthquake's toponym, we assign them treatment status. For this analysis, we exclude tourist districts within the province of L'Aquila from the control group. Table 8 shows that when the crater is fully aligned with the earthquake's toponym, bordering areas, even when they did sustain some damage from the earthquake, do not experience a decline in tourist inflows. A narrowly defined toponym can thus shield mildly affected areas from the adverse indirect impact of the earthquake, as long as these areas are excluded from the toponym.

[40] Consistent with our main estimates, the 95% confidence interval for total arrivals in logarithmic form at t+1 is (-0.78, 0.03)

[41] Out of 108 municipalities in the province of L'Aquila, only 35 were unaffected by the earthquake.

Table 8: Impact of the L'Aquila earthquake on tourist arrivals and overnight stays - tourist districts bordering the crater

Total arrivals		
t (2009)	t+1 (2010)	t+2 (2011)
-2,474.7	-998.4	166.1
(3,453.7)	(4,665.7)	(5,957.9)
Total overnight stays		
t (2009)	t+1 (2010)	t+2 (2011)
-1,490.4	-11,131.1	-20,695
(14,511.6)	(23,187.4)	(24,041.5)

Notes: Estimates refer to tourist district-level data. Treated units are those tourist districts bordering the one of L'Aquila. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

This finding remains consistent when we conduct our analysis using monthly data at the provincial level. Table A.8 and Table A.9 in the Appendix present the estimates for the province of L'Aquila and its bordering provinces, respectively.[42] While the province of L'Aquila shows a significant decline in tourist arrivals across all post-treatment time points, no significant reductions are observed for bordering provinces, even in the immediate months following the event.[43] This lack of a significant effect for bordering provinces is consistent for both Italian and international tourists, as shown in Table A.10 in the Appendix.

To further assess the robustness of our estimates for the L'Aquila earthquake, we replicate the additional analyses performed for the Ischia earthquake, including the SDID estimator and the Synthetic Control method. The results, detailed in Table A.13 in the Appendix, remain consistent with our main estimates.

5 Conclusion

Inaccurate toponyms for disasters matter. Once an area was defined as affected, even when it was not, the designation led to a statistically significant and economically material decline in tourism that appears easily preventable. In our examples, this amounts to a 10-15 percent decline in tourist arrivals that endures for several years following the event.

We focused on tourism, but this is most likely not the only economic sector that is adversely affected by these toponym errors. Many other economic sectors are also affected by perceptions of economic actors about the availability of services and infrastructure, about current safety, and about future risk in locations where economic activity occurs. For example, disasters also affect supply chains; see Carvalho et al. (2020). While we do not have the granular data required to show it, it is likely that suppliers located in inaccurate-toponym-affected areas also see declines in the demand for their products and services. All else equal, their customers further down the chain are likely to prefer suppliers from areas that are perceived as less risk-prone to disruptions that might severe these supply links and thus disrupt their own businesses.

Investment is often also dependent on the perceptions of future risks, both because the profitability of this future investment depends on this future risk, and because there may be risk of damage to physical assets. Future risk is very often assessed based on the most salient risks from the recent past - a classic example of

[42] The province of Rome is excluded from the analysis.

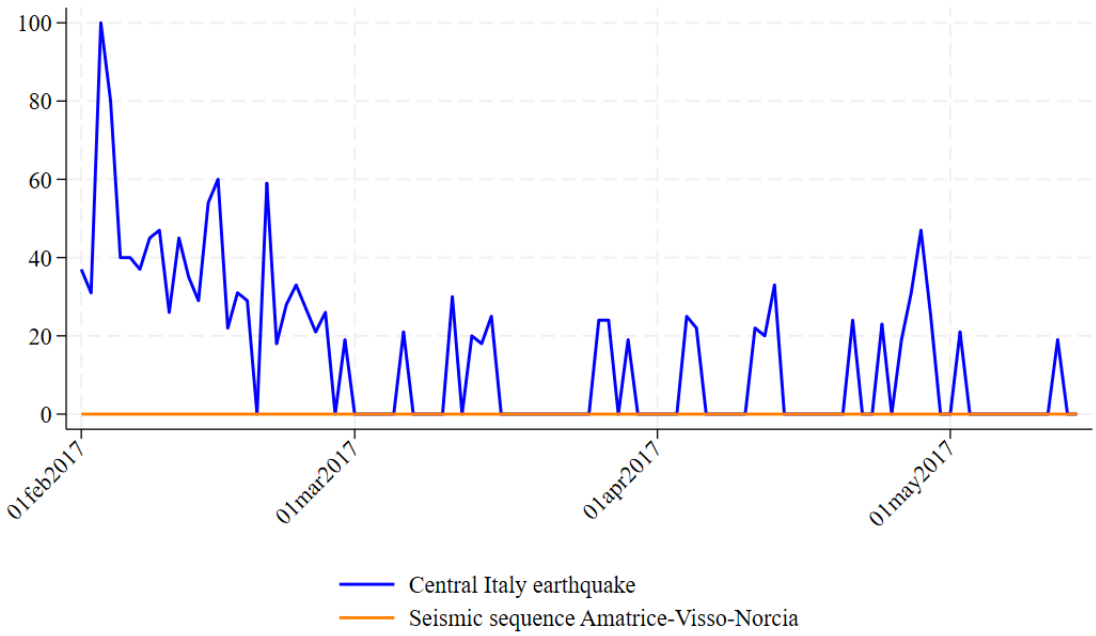
[43] We repeated the estimation by extending the post-treatment time points to the last available year for tourist districts, which is 2013. By doing so, we included 2 additional years for the tourist districts and 36 additional months for the provincial data. In both cases, the geographical areas neighboring the crater never experience a significant reduction in tourist arrivals.

the availability heuristic of Tversky and Kahneman (1973). As such, investors may be scared off by these disasters, even though these disasters are, unknowingly, in-name-only (e.g., Dessaint and Matray (2017)). Other sectors, such as local hospitality or tertiary education can also be vulnerable to this misnaming (Basile (2024)).

To make matters worse, it is difficult to change a name, once it has been born and used by the media and in official communications. One month after the fourth earthquake in the 'Central Italy' sequence described earlier, the INGV decided to rename the Central Italy earthquake with a new and supposedly more geographically precise name: the "Amatrice-Visso-Norcia Seismic Sequence."[44] The new name lacks a clear rationale, but in any case, it did not catch on.[45] The Central Italy toponym had already stuck and, even within government, reports still refer to the earthquake as the "Central Italy earthquake."[46]

The name continued to haunt not only government reports, but also people's memories of the events. Figure 8 shows Google searches for the old and new earthquake names after the new name had been changed. Despite the official INGV name change, it had no discernible impact on the public, as people continued to search exclusively for the previous Central Italy name.

Figure 7: Comparison of Google searches for "Central Italy Earthquake" and its new official name



Notes: Data from Google Trends. The Y-axis ranges from 0 to 100 and represents the search interest relative to the highest point on the graph within the considered time frame. A value of 100 indicates the highest search frequency for the term, 50 represents half of the searches, while a score of 0 means that there was insufficient data detected for the term.

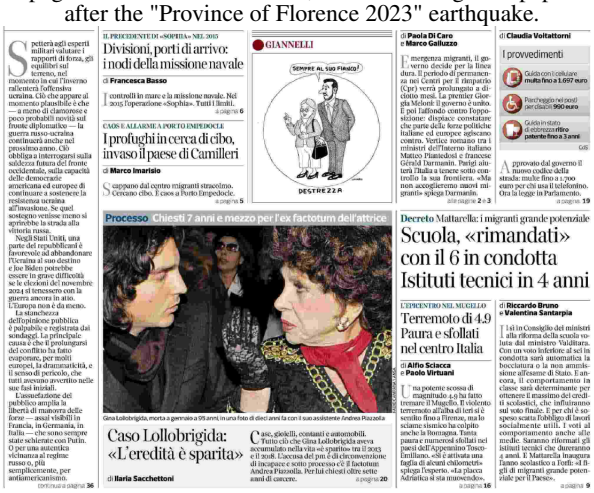
[44] See https://www.ansa.it/sito/notizie/cronaca/2017/02/14/terremoto-del-centro-italia-cambia-nome-in-sequenza-amatrice-norcia-visso_e26406b6-7928-4e09-819c-3639b6ed4c1c.html (in Italian).

[45] The new name includes the municipality most affected by the first earthquake (Amatrice) along with the epicenters of the earthquakes that occurred in late October (Visso and Norcia), but not the 2017 event.

[46] see the official reports on the reconstruction at the following page https://sisma2016data.it/report-page/ (in Italian).

The INGV practice of misidentifying toponyms has not abated over time, unfortunately. In 2023, a small earthquake occurred in the province of Florence (NUTS-3), according to the INGV; though the impacted area was much smaller. The image below is taken from Corriere della Sera the day after the earthquake. Worryingly, the newspaper enlarged the toponym even more, and called it Central Italy once again.[47]

Figure 8: Front page of Il Corriere della Sera, the best-selling newspaper in Italy, the day after the "Province of Florence 2023" earthquake.


Divisioni, porti di arrivo: i nodi della missione navale

I profughi in cerca di cibo, invaso il paese di Camilleri

GIANNELLI

Caso Lollobrigida: «L'eredità è sparita»

Terremoto di 4.9 Paura e sfollati nel centro Italia

Scuola, «rimandati» con il 6 in condotta Istituti tecnici in 4 anni

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[47] A 2018 earthquake in the region of Molise (NUTS-2) offers another example. The earthquake caused some damage in 21 municipalities out of the 136 municipalities that constitute the region. Nonetheless, both on INGV and the Corriere della Sera (August 17, 2018), adopted a toponym for the earthquake based on the entire region (Molise).

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Appendix A

A.1 List of Tables

Table A.1: Description of variables in our datasets

Variable	Description	Municipalities; years	Provinces; months	Tourist Districts; years	Data source
Total arrivals	Number of guests, both Italian and international, accommodated in lodging facilities	3,362; 2014-2018	107; 01.2008-03.2010	474; 2004-2011	ISTAT
Arrivals - Italians	Number of Italian guests accommodated in lodging facilities	3,052; 2014-2018	107; 01.2008-03.2010	474; 2004-2011	ISTAT
Arrivals - Internationals	Number of international guests accommodated in lodging facilities	3,044; 2014-2018	107; 01.2008-03.2010	474; 2004-2011	ISTAT
Total overnight stays	Number of nights spent by guests, both Italian and international, in lodging facilities	3,362; 2014-2018	107; 01.2008-03.2010	474; 2004-2011	ISTAT
Overnight stays - Italians	Number of nights spent by Italian guests in lodging facilities	3,052; 2014-2018	107; 01.2008-03.2010	474; 2004-2011	ISTAT
Overnight stays - Internationals	Number of nights spent by international guests in lodging facilities	3,044; 2014-2018	107; 01.2008-03.2010	474; 2004-2011	ISTAT
Population (log)	Municipal resident population in logarithmic form	3,362; 2014-2018			ISTAT
Share of foreigners	Percentage of foreign-born municipal population over total population	3,362; 2014-2018			ISTAT
Income per capita	Average income earned per person	3,362; 2014-2018			Ministry of Economy and Finance
Periphery score	Municipal peripherality with respect to socio-economic focal centers. See this link for more information (in italian)	3,362; Time-invariant			ISTAT
Tourism category	Variable with 11 categories describing the municipality's potential for tourism. See this link for more information (in italian)	3,362; Time-invariant			ISTAT

Table A.2: Impact of the Central Italy earthquake's toponym on tourist arrivals and overnight stays - wider definition of the area

Total arrivals		
t (2016)	t+1 (2017)	t+2 (2018)
-413.1	-2,040.6***	-1,338.3*
(355.5)	(500.2)	(730.9)
Total overnight stays		
t (2016)	t+1 (2017)	t+2 (2018)
-2,545.2	-7,337.4***	-10,085.7***
(1,935.3)	(2,661.9)	(3,799.3)

Notes: Treated municipalities are those unaffected by the earthquake but inside the geographical area of the toponym. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Table A.3: Impact of the Central Italy earthquake's toponym on tourist arrivals and overnight stays - distance to the crater

Total arrivals			
Distance to the crater	t (2016)	t+1 (2017)	t+2 (2018)
0-10km	-215.5	-2,025.7***	-1,467.6**
	(213.3)	(503.5)	(592.8)
11-20km	-189.4	-1,538.5**	-261.7
	(377.0)	(622.4)	(920.2)
21-30km	-156.9	-1,887.9*	-169.3
	(650.2)	(1,026.4)	(1,280.7)
31-40km	-118.4	-1,090.7*	-1,305.4**
(excluding Rome)	(480.4)	(624.4)	(724.3)
31-40km	4,245.4	2,266.1	12,394.2
(including Rome)	(4,599.3)	(8,096.9)	(20,553.3)
41-50km	-602.3	-1,540.7***	-931.0
	(500.2)	(533.4)	(893.7)
Total overnight stays			
Distance to the crater	t (2016)	t+1 (2017)	t+2 (2018)
0-10km	1,580.4	-5,132.9**	-9,560.8**
	(1,155.4)	(2,272.7)	(3,717.3)
11-20km	-2,990.7	-6,924.3**	-10,870.0**
	(2,450.8)	(3,634.3)	(4,687.0)
21-30km	-671.7	-5,777.2**	-1,357.5
	(1,362.7)	(2,592.6)	(2,692.4)
31-40km	-55.1	926.7	-4,711.3
(excluding Rome)	(2,116.7)	(3,603.5)	(3,943.2)
31-40km	6,521.9	27,094.0	49,938.9
(including Rome)	(7,249.5)	(36,501.1)	(70,998.3)
41-50km	2,071.4	-4,873.0**	-4,618.2**
	(4,360.0)	(2,706.4)	(2,352.4)

Notes: Treated municipalities are those unaffected by the earthquake but inside the geographical area of the toponym. Municipalities are divided by their distance to the crater. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Table A.4: Impact of the Central Italy earthquake's toponym on tourist arrivals and overnight stays by tourists' place of origin

Arrivals - Italians		
t (2016)	t+1 (2017)	t+2 (2018)
-272.7	-1,535.1***	-587.5*
(181.8)	(315.7)	(346.9)
Arrivals - Internationals		
t (2016)	t+1 (2017)	t+2 (2018)
-235.8**	-783.1***	-725.1***
(102.1)	(131.7)	(171.5)
Overnight stays - Italians		
t (2016)	t+1 (2017)	t+2 (2018)
-396.8	-4,293.5***	-6,024.7***
(889.9)	(1,365.3)	(2,068.0)
Overnight stays - Internationals		
t (2016)	t+1 (2017)	t+2 (2018)
-1,109.5**	-2,855.9***	-3,553.8***
(503.7)	(672.0)	(742.1)

Notes: Treated municipalities are those unaffected by the earthquake but inside the geographical area of the toponym. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Table A.5: Impact of the Ischia earthquake's toponym on tourist arrivals and overnight stays - Municipality of Lacco Ameno excluded from the analysis

Total arrivals	
t (2017)	t+1 (2018)
-11,806.7**	-7,984.9**
(6,610.0)	(10,435.8)
Total overnight stays	
t (2017)	t+1 (2018)
-65,954.5**	-29,832.7**
(37,713.6)	(31,252.4)

Notes: Treated municipalities are those unaffected by the earthquake but inside the geographical area of the toponym. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Table A.6: Impact of the Ischia earthquake's toponym on tourist arrivals and overnight stays by tourists' place of origin

Arrivals - Italians	
t (2017)	t+1 (2018)
-11,754.1**	-6,725.1**
(4,689.5)	(4,632.6)
Arrivals - Internationals	
t (2017)	t+1 (2018)
-507.5	874.2
(1,644.4)	(2,390.8)
Overnight stays - Italians	
t (2017)	t+1 (2018)
-58,731.0**	-11,945.2
(22,978.1)	(15,547.2)
Overnight stays - Internationals	
t (2017)	t+1 (2018)
-2,686.5	-376.6
(10,735.2)	(14,745.2)

Notes: Treated municipalities are those unaffected by the earthquake but inside the geographical area of the toponym. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Table A.7: Impact of the L'Aquila earthquake on tourist arrivals and overnight stays - tourist districts included in the province of L'Aquila

Total arrivals		
t (2009)	t+1 (2010)	t+2 (2011)
-40,573.0***	-39,018.5***	-32,022.8**
(13,768.8)	(10,982.3)	(15,303.3)
Total overnight stays		
t (2009)	t+1 (2010)	t+2 (2011)
-9,911.2	-56,280.4***	-80,914.1***
(27,333.1)	(15,580.0)	(19,293.4)

Notes: Estimates refer to tourist district-level data. Treated units are the tourist districts included in the province of L'Aquila, representing both the crater and the toponym of the earthquake. Specifically, they are two tourist districts: L'Aquila; Rivisondoli and other municipalities of L'Aquila. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Table A.8: Impact of the L'Aquila earthquake on tourist arrivals and overnight stays - province of L'Aquila

Total arrivals	
Time	ATT
t (03.2009)	-24,878.6***
	(2,417.0)
t+1 (04.2009)	-49,772.8***
	(8,222.2)
t+2 (05.2009)	-52,534.6***
	(12037.9)
t+3 (06.2009)	-34,777.0***
	(8,512.3)
t+4 (07.2009)	-39,985.8***
	(8687.7)
t+5 (08.2009)	-33,673.8***
	(12,951.8)
t+6 (09.2009)	-47,762.0***
	(10,603.6)
t+7 (10.2009)	-47,657.6***
	(10,416.6)
t+8 (11.2009)	-34,692.2***
	(10154.8)
t+9 (12.2009)	-21,799.2***
	(1629.3)
t+10 (01.2010)	-6,869.0***
	(2481.8)
t+11 (02.2010)	-2,717.2**
	(1,091.7)
t+12 (03.2010)	-28,325.8***
	(2,050.1)
Total overnight stays	
Time	ATT
t (03.2009)	-58,373.2***
	(4,187.4)
t+1 (04.2009)	-139,607.6***
	(6,644.3)
t+2 (05.2009)	-141,218.0***
	(9,660.1)
t+3 (06.2009)	-114,886.6***
	(12,726.6)
t+4 (07.2009)	-90,038.8**
	(37,356.4)
t+5 (08.2009)	-24,516.2
	(40,741.8)
t+6 (09.2009)	-95,034.0***
	(16,669.6)
t+7 (10.2009)	-129,775.2***
	(11,233.2)
t+8 (11.2009)	-111,256.2***
	(4,453.2)
t+9 (12.2009)	-54,894.8***
	(4,454.7)
t+10 (01.2010)	3,953.0
	(8,812.7)
t+11 (02.2010)	4,190.2
	(6,750.7)
t+12 (03.2010)	-68,794.8***
	(6,188.9)

Notes: Estimates refer to provincial-level data. The treated unit is the province of L'Aquila, representing both the crater and the toponym of the earthquake. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Table A.9: Impact of the L'Aquila earthquake on tourist arrivals and overnight stays - provinces bordering the crater

Total arrivals	
Time	ATT
t (03.2009)	681.6
	(3,517.9)
t+1 (04.2009)	-4,148.8
	(10,103.1)
t+2 (05.2009)	-6,395.9
	(17,099.2)
t+3 (06.2009)	-2,249.5
	(18,141.8)
t+4 (07.2009)	-4,364.7
	(26,955.7)
t+5 (08.2009)	-3,483.1
	(34,529.9)
t+6 (09.2009)	-4,119.9
	(13,724.2)
t+7 (10.2009)	-1,986.7
	(6,998.3)
t+8 (11.2009)	-925.2
	(1,287.8)
t+9 (12.2009)	-702.7
	(1,334.6)
t+10 (01.2010)	205.9
	(2,082.3)
t+11 (02.2010)	-21.7
	(831.7)
t+12 (03.2010)	842.8
	(3,497.8)
Total overnight stays	
Time	ATT
t (03.2009)	-1,634.5
	(9,000.3)
t+1 (04.2009)	-9,172.1
	(25,657.4)
t+2 (05.2009)	-12,892.6
	(52,386.2)
t+3 (06.2009)	-8,589.3
	(129,840.5)
t+4 (07.2009)	-170,63.8
	(251,311.2)
t+5 (08.2009)	-42,036.9
	(343,406.6)
t+6 (09.2009)	-17,719.7
	(103,271.6)
t+7 (10.2009)	5,145.2
	(21,981.4)
t+8 (11.2009)	9,045.4
	(6,244.8)
t+9 (12.2009)	9,204.1
	(6,347.9)
t+10 (01.2010)	8,840.4
	(6,565.4)
t+11 (02.2010)	7,677.1
	(5,308.0)
t+12 (03.2010)	6,667.9
	(7,127.1)

Notes: Estimates refer to provincial-level data. Treated units are those provinces bordering the one of L'Aquila. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Table A.10: Impact of the L'Aquila earthquake on tourist arrivals and overnight stays by tourists' place of origin - provinces bordering the crater

	Arrivals - Italians	**Arrivals - Internationals**
Time	ATT	ATT
t (03.2009)	-428.7	1,642.3
	(1,383.9)	(2,408.8)
t+1 (04.2009)	-2,517.6	-4.8
	(4,309.4)	(4,153.3)
t+2 (05.2009)	-3,819.9	-576.9
	(9,080.6)	(5,159.0)
t+3 (06.2009)	-1,290.0	-968.0
	(13,309.6)	(3,938.4)
t+4 (07.2009)	-1,642.2	-1,926.6
	(19,005.6)	(5,713.4)
t+5 (08.2009)	-218.1	-2,465.2
	26,900.5	(5,207.2)
t+6 (09.2009)	-1,750.3	-2,005.7
	(7,411.1)	(5,048.2)
t+7 (10.2009)	-543.0	-1,313.9
	(3,660.2)	(3,010.7)
t+8 (11.2009)	-324.9	-817.8
	(1,006.1)	(858.0)
t+9 (12.2009)	57.3	-736.4
	(1,218.9)	(894.5)
t+10 (01.2010)	361.5	-549.5
	(1,346.3)	(811.9)
t+11 (02.2010)	32.5	-254.8
	(636.0)	(289.1)
t+12 (03.2010)	-513.7	1,609.1
	(1,362.0)	(2,344.9)
	Overnight stays - Italians	**Overnight stays - Internationals**
Time	ATT	ATT
t (03.2009)	-2,991.3	3,179.1
	(4,417,7)	(4,444.3)
t+1 (04.2009)	-8,717.0	387.4
	(15,684.1)	(10,183.8)
t+2 (05.2009)	-10,004.7	-1,816.5
	(33,629,0)	(15,793.9)
t+3 (06.2009)	-4,674.8	-771.3
	(96,103.6)	(20,957.0)
t+4 (07.2009)	-4,866.3	-4,515.0
	(184,865.6)	(38,089.0)
t+5 (08.2009)	-31,392.1	-11,415.9
	(274,089.3)	(34,055.1)
t+6 (09.2009)	-7,309.8	-3,912.0
	(68,181.2)	(22,511.1)
t+7 (10.2009)	-9,205.1	-143.3
	(11,393.3)	(8,158.2)
t+8 (11.2009)	9,577.0	-27.0
	(4,971.4)	(1,716.8)
t+9 (12.2009)	9,565.0	57.7
	4,983.3	(1,927.7)
t+10 (01.2010)	8,745.6	301.6
	4,559.7	(1,641.3)
t+11 (02.2010)	6,862.1	423.6
	(3,825.7)	(751.8)
t+12 (03.2010)	2,912.3	3,578.8
	(4,412.1)	(4,377.6)

Notes: Estimates refer to provincial-level data. Treated units are those provinces bordering the one of L'Aquila. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses.

Table A.11: Central Italy earthquake and toponym - additional estimates

Alternative outcome: Logarithm of Arrivals - Crater		
t (2016)	t+1 (2017)	t+2 (2018)
-0.07	-0.49***	-0.37***
(0.06)	(0.11)	(0.12)
Alternative outcome: Logarithm of Arrivals - Unaffected (Toponym)		
t (2016)	t+1 (2017)	t+2 (2018)
-0.03	-0.20***	-0.14***
(0.03)	(0.04)	(0.05)
Alternative estimator: Synthetic Difference in Differences - Crater		
t (2016)	t+1 (2017)	t+2 (2018)
-547.2**	-2,812.8***	-2,313.8***
(265.1)	(728.6)	(608.9)
Alternative estimator: Synthetic Difference in Differences - Unaffected (Toponym)		
t (2016)	t+1 (2017)	t+2 (2018)
-727.3***	-3,282.7***	-2,709.5***
(230.8)	(467.8)	(514.7)

Notes: ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses. Time-varying covariates are included following Kranz (2022).

Table A.12: Ischia earthquake and toponym - additional estimates

Alternative outcome: Logarithm of Arrivals - Crater	
t (2017)	t+1 (2018)
-0.19***	-0.19***
(0.05)	(0.03)
Alternative outcome: Logarithm of Arrivals - Unaffected (Toponym)	
t (2017)	t+1 (2018)
-0.20**	-0.14**
(0.11)	(0.17)
Alternative estimator: Synthetic Difference in Differences - Crater	
t (2017)	t+1 (2018)
-11,876.9***	-12,182.9**
(3,273.3)	(5,868.7)
Alternative estimator: Synthetic Control - Crater	
t (2017)	t+1 (2018)
-20,264*	-48,956.8**
(10,673.4)	(16,160.2)
Alternative estimator: Synthetic Difference in Differences - Unaffected (Toponym)	
t (2017)	t+1 (2018)
-11,149.6***	-6,950.5*
(2,425.3)	(3,672.1)

Notes: ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses in the estimation with the alternative outcome. When performing the estimation with the Synthetic Difference in Differences (and the synthetic control method), as the number of treated units is small and estimated variance and confidence intervals may be unreliable (Arkhangelsky et al., 2021, Clarke et al., 2023), we report placebo standard errors in parentheses. Time-varying covariates are included following Kranz (2022).

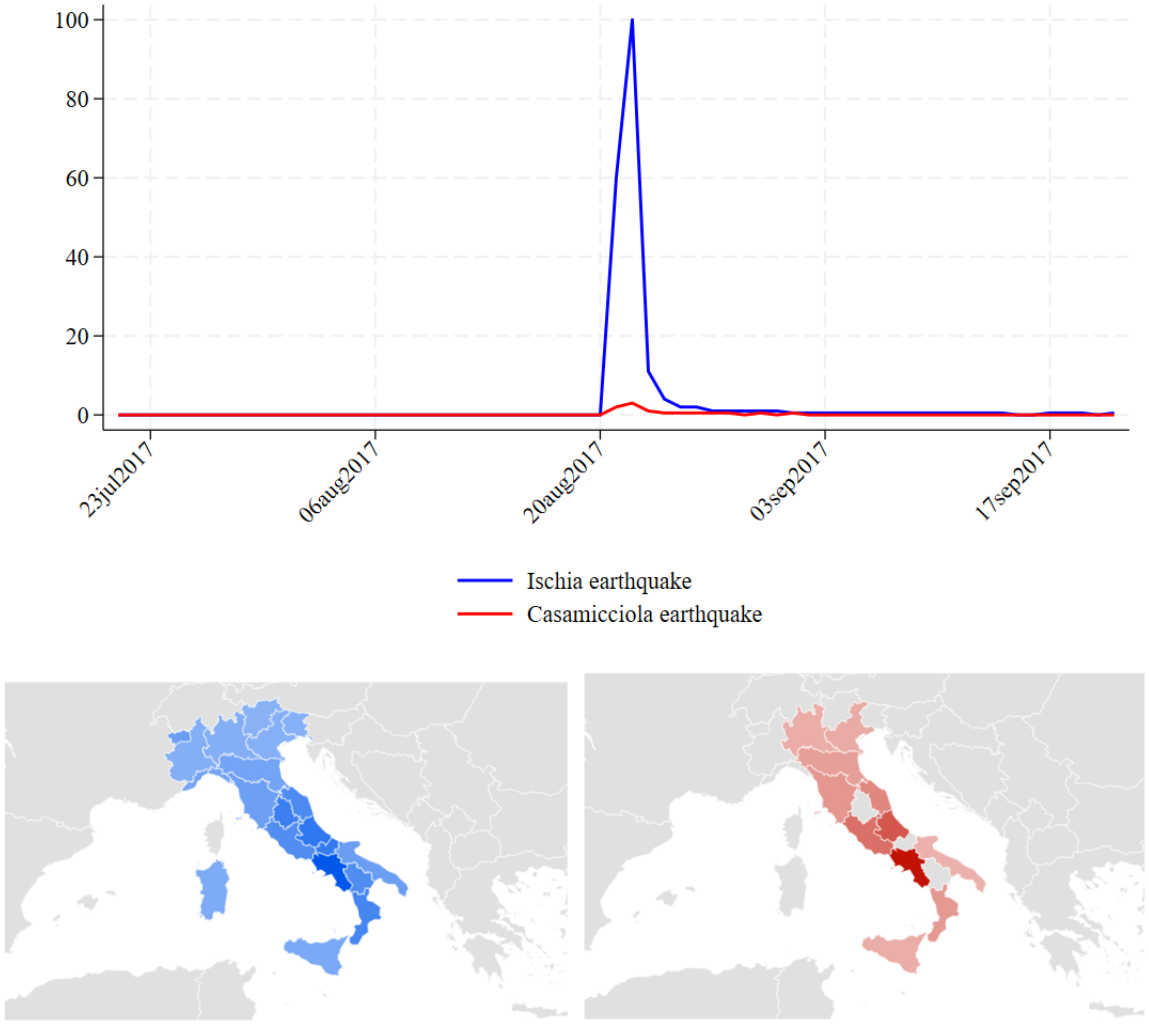
Table A.13: L'Aquila earthquake and bordering units -additional estimates

Alternative outcome: Logarithm of Arrivals - Crater		
t (2009)	t+1 (2010)	t+2 (2011)
-0.93***	-0.66***	-0.48***
(0.02)	(0.04)	(0.05)
Alternative outcome: Logarithm of Arrivals - Unaffected (Bordering units)		
t (2009)	t+1 (2010)	t+2 (2011)
0.01	0.03	0.06
(0.06)	(0.12)	(0.12)
Alternative estimator: Synthetic Difference in Differences - Crater		
t (2009)	t+1 (2010)	t+2 (2011)
-58,651.3***	-50,627.2***	-45,563.2**
(17,243.3)	(18,998.1)	(21,615.3)
Alternative estimator: Synthetic Control - Crater		
t (2009)	t+1 (2010)	t+2 (2011)
-61,717.4***	-58,033.8***	-56,232.0***
(18,061.2)	(17,619.6)	(20,342.7)
Alternative estimator: Synthetic Difference in Differences - Unaffected (Bordering units)		
t (2009)	t+1 (2010)	t+2 (2011)
-7,107.2	-4,756.7	-7,489.9
(8,150.7)	(15,218.9)	(18,664.1)

Notes: ***, **, * denote significance at the 1, 5, and 10% level, respectively. Block-bootstrapped standard errors are reported in parentheses in the estimation with the alternative outcome. When performing the estimation with the Synthetic Difference in Differences (and the synthetic control method), as the number of treated units is small and estimated variance and confidence intervals may be unreliable (Arkhangelsky et al., 2021, Clarke et al., 2023), we report placebo standard errors in parentheses.

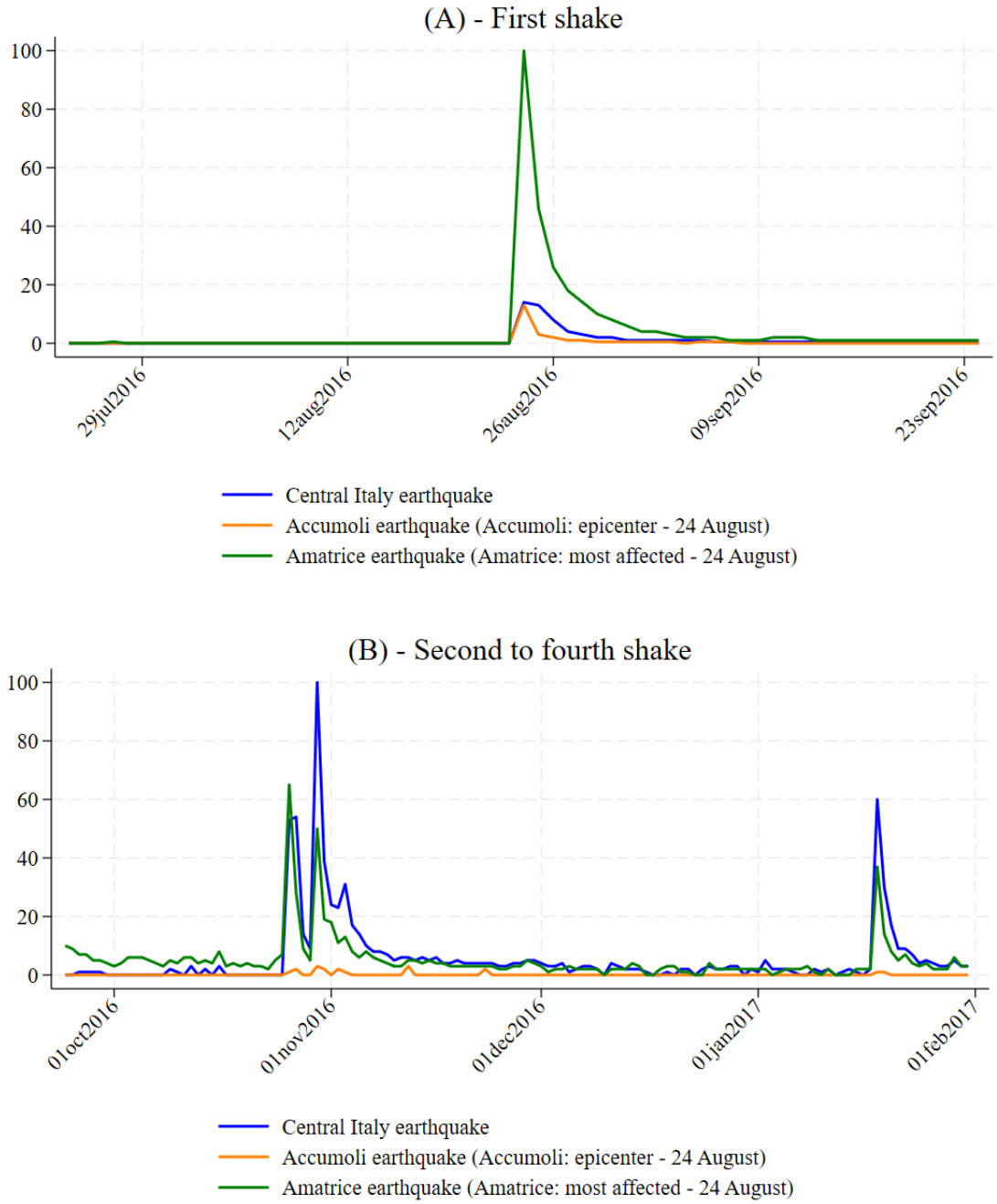
Appendix B List of Figures

Figure B.1: Comparison of web searches for "Ischia Earthquake" and "Casamicciola Earthquake" on Google Trends



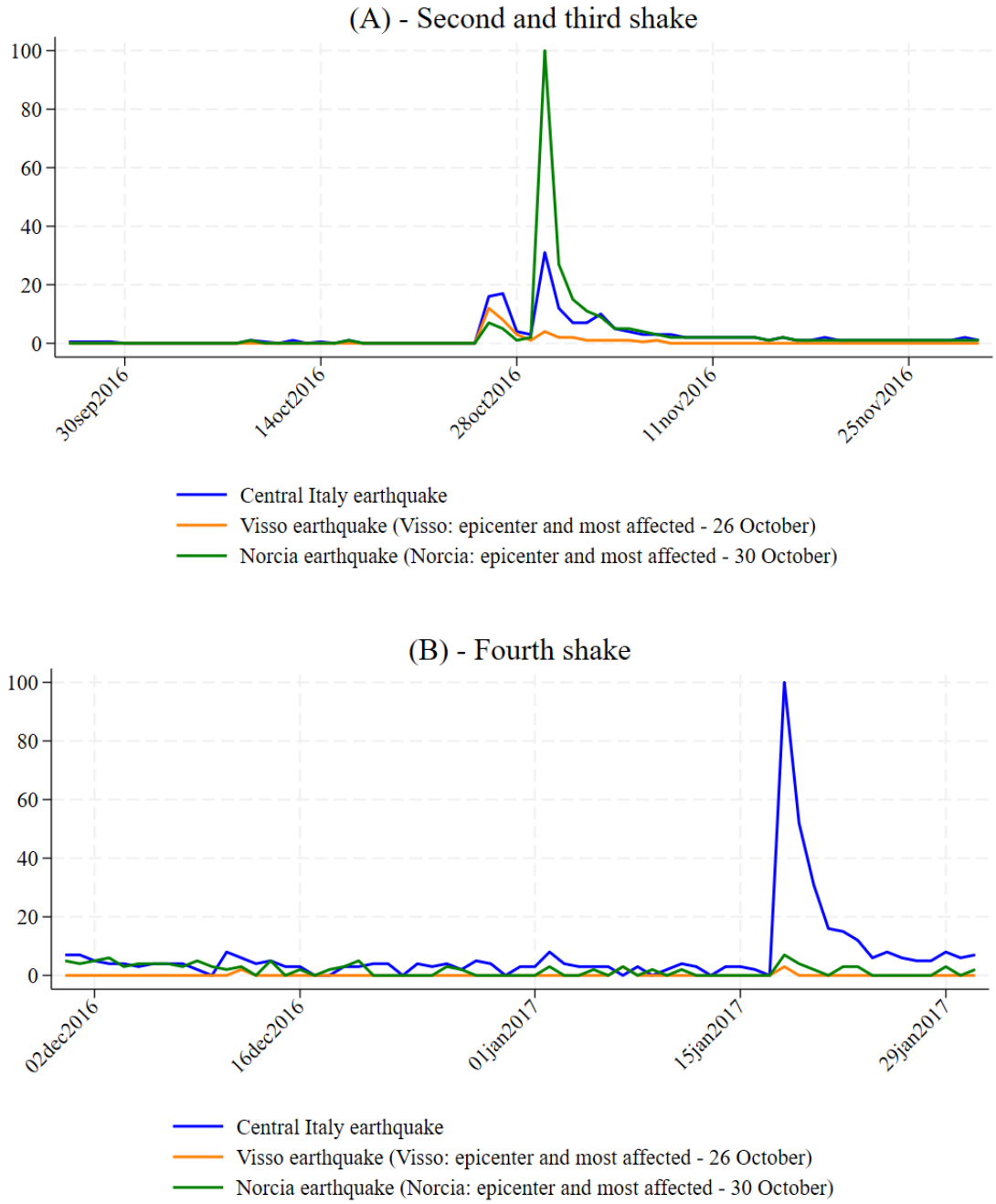
Notes: The Y-axis ranges from 0 to 100 and represents the search interest relative to the highest point on the graph within the considered time frame. A value of 100 indicates the highest search frequency for the term, 50 represents half of the searches, while a score of 0 means that there was insufficient data detected for the term.

Figure B.2: Comparison of web searches for "Central Italy Earthquake", "Amatrice Earthquake" and "Accumoli Earthquake" on Google Trends



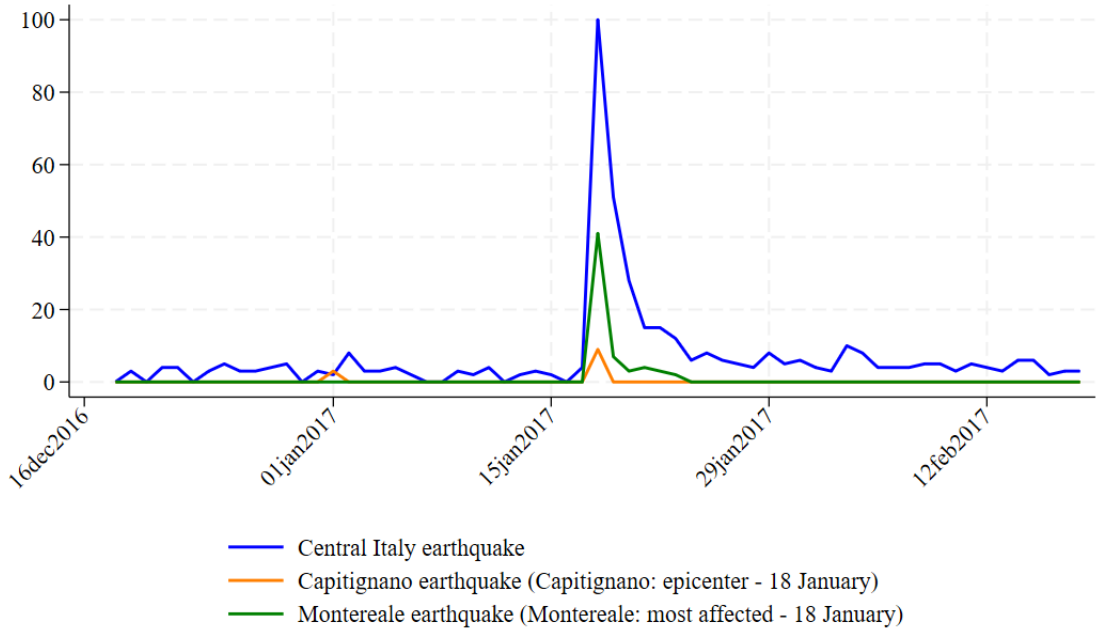
Notes: The Y-axis ranges from 0 to 100 and represents the search interest relative to the highest point on the graph within the considered time frame. A value of 100 indicates the highest search frequency for the term, 50 represents half of the searches, while a score of 0 means that there was insufficient data detected for the term.

Figure B.3: Comparison of web searches for "Central Italy Earthquake", "Visso Earthquake" and "Norcia Earthquake" on Google Trends



Notes: The Y-axis ranges from 0 to 100 and represents the search interest relative to the highest point on the graph within the considered time frame. A value of 100 indicates the highest search frequency for the term, 50 represents half of the searches, while a score of 0 means that there was insufficient data detected for the term.

Figure B.4: Comparison of web searches for "Central Italy Earthquake", "Capitignano Earthquake" and "Montereale Earthquake" on Google Trends



Notes: The Y-axis ranges from 0 to 100 and represents the search interest relative to the highest point on the graph within the considered time frame. A value of 100 indicates the highest search frequency for the term, 50 represents half of the searches, while a score of 0 means that there was insufficient data detected for the term.

Figure B.5: Unaffected municipalities within the geographical area of the toponym - wider definition of the area

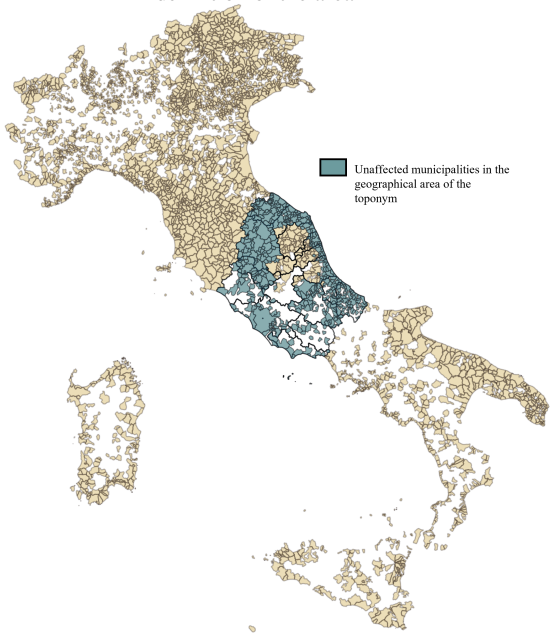


Figure B.6: Unaffected municipalities within the geographical area of the toponym - distance to the crater