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## War of the Waves: Radio and Resistance during World War II<sup>†</sup>

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*We analyze the role of the media in coordinating and mobilizing insurgency against an authoritarian regime, in the context of the Nazi-fascist occupation of Italy during WWII. We study the effect of BBC radio on the intensity of internal resistance. By exploiting variations in monthly sunspot activity that affect the sky-wave propagation of BBC broadcasting toward Italy, we show that BBC radio had a strong impact on political violence. We provide further evidence to document that BBC radio played an important role in coordinating resistance activities but had no lasting role in motivating the population against the Nazi-fascist regime. (JEL D74, L82, N44)*

**D**uring any war, the transmission of information to troops on the ground is an essential weapon. Information is needed to transmit orders, to coordinate and direct military operations, to warn soldiers of imminent dangers, and also to motivate the troops, letting them know that they are not alone and that they are fighting for a worthy cause. Information is especially important during civil wars or when civilians resist a foreign occupation. In such circumstances, military organizations are looser and less hierarchical, and the need for coordination is accordingly greater; moreover, information about the chances of victory, propaganda, and spreading of

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emotions can play an important role in mobilizing and motivating the insurgency (or in preventing this from happening). Hence, the media are particularly important actors during a civil war or when fighting a foreign occupation.

This paper studies the effects of BBC radio (Radio Londra) during the German occupation of Italy in 1943–1945 and the associated civil war between fascists and partisan forces. Partisan resistance played an important role in the Italian liberation and was violently opposed by the Nazi-fascist forces, resulting in more than 75,000 Italian casualties. The BBC was deeply engaged in encouraging opposition to the German occupation throughout Europe, and was a particularly important source of reliable information during the Italian Civil War. Its strategy was to target individuals and organizations that were already inclined toward an active resistance, besides providing information and counterpropaganda for the masses. Specifically, the BBC provided accurate and reliable information on the Allied Forces' military campaigns and on resistance activities. It also diffused counterpropaganda messages against the fascist regime. Finally, it conveyed coded messages to the partisan brigades, in order to direct and coordinate them.

One of the contributions of this paper is a novel identification strategy that exploits exogenous time and geographic variation in the BBC signal strength across Italian municipalities, induced by sunspot activity. Unlike other local radios, BBC radio broadcast from the United Kingdom and relied on the ionospheric propagation of shortwaves and medium waves (BBC 1944). Ionospheric propagation, and the resulting signal strength, changes over time because of seasonal variations in daylight time and, more interestingly for our purposes, because of sunspot activity. At the same time, ionospheric propagation is affected by the distance between receiving locations and BBC transmitters (which did not change throughout the civil war period). Finally, the interaction between geographical and time variations in the ionosphere propagation (due to seasonal and sunspot variations) induces additional heterogeneous variation in the reflection and, consequently, in the reception of the signal across municipalities over time. By using the Voice of America Coverage Analysis Program (VoACAP), we simulate the strength of BBC signal across Italian municipalities for each month. We then study the effect of these predicted monthly changes in the BBC signal strength on indicators of insurgency against the Nazi-fascist occupation in different Italian municipalities. As historical records do not provide a direct municipal-level, time-varying measure on the intensity of resistance, as an indirect proxy we use the number of episodes of violence perpetrated by the Nazi-fascists in response to partisan or civilian resistance (e.g., Nazi-fascists retaliations).

After controlling for municipality and year-month fixed effects, to account for any direct geographical, seasonal, and time effect on insurgent activities, we find that BBC signal strength is positively associated with the intensity of resistance. Specifically, a one standard deviation increase in signal strength increases the number of episodes of Nazi-fascist violence related to partisan and civilian resistance by almost three times, relative to the monthly average. This is a large effect, which is possibly explained by the role of BBC messages. As we discuss in Section I, the Italian BBC program provided counterpropaganda targeted to the Italian population at large, but it also conveyed information and coded messages to resistance fighters.

For instance, Radio Londra was used by the Allies to deliver coded messages about the timing and locations of air-drops, of bombings by the Allied Air Forces, and about the ground movements of the Nazi-fascist and Allied troops. A change in the BBC signal quality could determine whether or not partisan brigades would receive such key information and, therefore, be able to undertake their resistance activities.

Additional evidence reinforces the interpretation that BBC broadcasts affected the intensity of partisan activities mainly through improved coordination. First, the effect of the BBC on the intensity of resistance was stronger in the proximity of a city liberation, i.e., when military activity was more intense and the marginal value for the Allies of an attack by the partisan brigades was probably larger. Furthermore, the effect that we estimate is simultaneous to the change in the BBC signal strength, and does not depend on the quality of transmissions in previous months. The lack of a long-lasting effect suggests that the main mechanism at work was operational coordination of allied and resistance activities rather than propaganda or persuasion. This interpretation is confirmed by the finding that the competing fascist radio EIAR (Ente Italiano Audizioni Radiofoniche) and the Allied Forces radio (broadcasting from liberated cities in the South of Italy) had no observable effects. The aim of both these radio stations was mainly propaganda. Moreover, we find that the effect of the BBC was weaker during the bombings of German unmovable targets by the Allied Forces, suggesting that the BBC informed partisans and kept them away from bombing areas. Finally, the cumulative BBC signal strength between 1943 and 1945 is not correlated with the outcomes of the first postwar elections in 1946. Although in this case the identification strategy is less compelling, this evidence too does not support a motivation or propaganda channel. All in all, we infer that the BBC radio played an important role in coordinating resistance activities against the foreign occupation, but had a minor role in mobilizing the civilian population against the Nazi-fascist regime.

A rapidly growing literature studies the role of the media in the context of political protests (Enikolopov et al. 2016, Manacorda and Tesei 2016, Acemoglu et al. 2018).<sup>1</sup> Differently from existing contributions, we focus on military insurgencies in times of war rather than on protest participation. This allows us to measure the impact of the media in a context of more radical conflict and organized violence, where several human lives are at stake.<sup>2</sup> While the literature has focused on the effect of media in favoring spontaneous coordination of participants to protests (Enikolopov et al. 2016, Manacorda and Tesei 2016), we analyze a setting where media work via centralized or external coordination. Relatedly, by emphasizing the role of the media in facilitating forms of direct foreign intervention during war episodes, we speak more directly to an important aspect of modern conflicts that

<sup>1</sup>Enikolopov et al. (2016) show that social media diffusion increased protest participation in Russia, mainly through improved coordination. Manacorda and Tesei (2016) show that mobile phones increased the responsiveness of mass protests to economic downturns in Africa, through both enhanced information and better coordination. Acemoglu et al. (2018) show that social media may have played an important role in mobilizing protests in Egypt during the Arab spring.

<sup>2</sup>Kern and Hainmueller (2009) find a positive impact of West German television on the support for East Germany's authoritarian regime, mostly due to the entertaining nature of West German television. In a similar context, Bursztyn and Cantoni (2016) show that the exposure to West German television affected the composition, but not the aggregate level of consumption, in East Germany.

has received little attention in the literature (Shapiro and Weidmann 2015). Our results show that critical information provided to insurgents by the BBC increased the intensity of resistance against the Nazi-fascist regime, helping the Allies to liberate Italy.<sup>3</sup>

More generally, by studying a setting where media provide both propaganda and tactical information, we can compare the efficacy of these two instruments. Contrary to the previous literature (DellaVigna et al. 2014; Yanagizawa-Drott 2014; Adena et al. 2015, 2017; Armand et al. 2017), in this historical setting radio exposure did not seem to operate through propaganda. This is despite the BBC's high perceived credibility and its deliberate aim at motivating civilians to rise up against the regime (Briggs 1970, Papa 1978, Piccialuti Caprioli 1979).<sup>4</sup> One possible explanation is that the emergence of organized military brigades catalyzed most of the opposition to the Nazi-fascist regime. These brigades largely benefited from tactical information about military activities rather than from propaganda. Finally, by also looking at the opposite propaganda by the fascist regime (EIAR), we can also study the effect of the response of an autocratic regime to the presence of foreign media. This is a relevant point, as the observed effect of media on protest activities is jointly determined by their interaction with the demand for regime change and with the response of autocratic regimes (Qin et al. 2017).

The paper is organized as follows. Section I illustrates the historical background. Section II describes the data. Section III explains our empirical strategy. Section IV presents the main empirical results, while Section V discusses possible mechanisms at work. Section VI concludes. Tables and Figures reports additional results, which we also discuss in the main text. For the interested reader, the online Appendix presents illustrative examples of BBC messages and of episodes of violence perpetrated by the Nazi-fascists. It also contains detailed background information on several aspects concerning the BBC radio signal.

## I. Background

### A. *The Italian Civil War and the Resistance*

The Allied troops landed in and liberated Sicily in July 1943. They advanced quickly in the South of Italy and liberated it by the end of September 1943. The Allied troops were then halted by Germans between Naples and Rome (along the

<sup>3</sup>More generally, our paper is also related to the literature on foreign intervention in weakly institutionalized environments. Dell and Querubin (2018) find that US bombings exacerbated Vietnamese insurgency and weakened local governance, while Garcia-Arenas (2016) finds a positive effect of US radio counterpropaganda during the 1991 Russian presidential elections on the support to Yeltsin.

<sup>4</sup>DellaVigna et al. (2014) find sizable effects of exposure to Serbian public radio on Croatian nationalism. Yanagizawa-Drott (2014) shows that a popular radio broadcasting had a large effect on violence against minorities in the Rwandan genocide, where persuasion and imitation by neighboring villages were the main mechanisms. In the context of Nazi Germany, Adena et al. (2015) study the effects of radio propaganda, finding positive effects on Nazi popularity, while Adena et al. (2017) show that bombing by the Allies increases the likelihood of treason (e.g., work slowdown) and that the exposure to BBC counterpropaganda tends to amplify such effects. Notice that, differently from the German context analyzed by Adena et al. (2017) with uncoordinated acts of defection mostly from members of the government or the army, in Italy there was an organized resistance composed by members of the general population.

so-called “Gustav line”) until the Spring of 1944. From there, the battlefield moved quickly to another German line of defense, the so-called “Gothic line,” that cut Italy from East to West between Florence and Bologna. The battles by the “Gothic line” took place between the summer of 1944 and April 1945. Germans surrendered in May 1945.

The war in Italy was not just fought by the Allies against the Germans, but it was also a civil war: in the areas under German occupation, the Nazis were supported by Italian military forces loyal to Mussolini, but opposed by an active resistance movement (the *Resistenza*, literally the Resistance). The partisan movement was largely a bottom-up phenomenon that grew spontaneously from a few thousands active individuals in the fall of 1943 to tens of thousands one year later. About 30,000 partisan insurgents were killed by the Nazi-fascists during this period, mainly from the summer 1944 onward (Gentile 2015). Although the partisan leadership played a key role in the design of the postwar Italian political system, partisan organizations did not have actual recognition by the Allies during the war and, unlike in other European countries, they were not represented in the Allies command structures (Spriano 1975). Partisan forces were organized in small brigades, and the coordination of their activities remained a major challenge throughout the civil war.

### *B. The Italian Service of the BBC*

The Italian Service of the BBC started in the autumn of 1939 with a 15 minute daily broadcasting. It soon became widely known in Italy simply as Radio Londra (Piccialuti Caprioli 1979). Its length and scope expanded over time: after September 1943 it reached 4 hours and 15 minutes of daily broadcasting (BBC 1945).<sup>5</sup> During the Italian Civil War (October 1943–May 1945), the Italian program of the BBC was structured in three main sections: (i) News bulletins broadcast hourly, at half past the hour, from the afternoon until 11:30 PM (BBC 1944). Importantly, the news bulletins were often followed by coded “special messages” conveying logistic and military information to resistance fighters (see Section IC); (ii) “London Calling Italy,” which was 30 minutes long (Piccialuti Caprioli 1976) and broadcast at 4:30 PM and 10:30 PM; (iii) The “Fighters and Workers Program,” 15 minutes long and broadcast at 6:30 AM and 5:30 PM (Piccialuti Caprioli 1976). It provided news on the Italian military campaign along with encouragement and advice to the resistance movements (Piccialuti Caprioli 1976; BBC 1944).

While it is clearly difficult to have a precise estimate of the number of people listening to (and trusting) the BBC in Italy at that time, there are several indicators suggesting that it had a relatively high level of credibility and a large audience among the Italian population. The only available data are from the “Survey of Public Opinion Held in Sicily,” conducted by a group of social scientists on behalf of the Psychological Warfare Branch (henceforth, PWB) and of the Allied Force Headquarters (henceforth, AFHQ) in the fall of 1943 in Sicily. According to this survey, 61 percent of the respondents listened to the BBC on average 18 times a

<sup>5</sup>The program always started with four Morse codes identifying the “V” letter according to the Churchill’s V-for-Victory campaign.

month; 47 percent considered “Radio Palermo” (i.e., the radio station of the Allied Forces broadcasting from the former EIAR facilities in the city of Palermo) as the most credible radio; 22 percent said that the BBC was the most credible, while 42 percent considered EIAR and German radios as the least credible. Among those who listened to either the EIAR or the German radio, 66 percent was interested in music and only 7 percent in the news (Holt and Van de Velde 1960, 132).

Most importantly, historians tend to share the view that the BBC was perceived as a reliable source of information by Italians during the Second World War and had a high level of diffusion among the Italian population (Briggs 1970, Papa 1978, Piccialuti Caprioli 1979).

Historians attribute this perceived credibility to the unbiased account of the war events given by the BBC, the result of the British editorial principle of separation between facts and opinion and, most importantly, of a specific strategic choice of the British counterpropaganda.<sup>6</sup>

The number of radio subscribers (which was relatively low compared to other western European countries of the time) underestimates the actual number of people listening to the radio. Historians report that in Italy there was extensive collective listenership, also in several clandestine centers. In addition, anti-fascist activists mentioned the presence of homemade receivers. This created the so-called “mass clandestine listenership” (Papa 1978, Piccialuti Caprioli 1979).

An indirect measure of success of the BBC is given by the effort of the fascist regime to contrast it. The regime introduced laws to discourage people from listening to the BBC. In 1941 the penalty for listening to the BBC was two months in jail and a pecuniary fine of 1,000 liras, plus the confiscation of the radio.

A report issued by the “Guardia Nazionale Repubblicana”—a military police corp created by the fascist government—stresses how widespread the propaganda by “Radio Londra” was among the Italian population, and calls for the “confiscation of radio receivers” or expresses the desire that they are “forced to receive a single Italian Station” (Bussoni 2017, 79). A second indirect measure of success of the BBC is represented by the many attempts of the fascist regime to sabotage its broadcasting through jamming devices.<sup>7</sup>

### C. *The BBC and the Resistance*

Besides engaging in counter-propaganda, the BBC also supported resistance movements throughout Europe. On June 18, 1940, on the eve of the French armistice with the Nazi invaders, Charles de Gaulle delivered a famous speech at the BBC in London rallying the French to support the Resistance. Later on, André Philip, who had escaped from France to take part in de Gaulle’s government, claimed that “If there is resistance in France, it is due to the BBC” (Briggs 1970, 7).

<sup>6</sup>“Remember: The Italian are now starved of the truth from day to day. The truth to them has been systematically twisted during the last seventeen years. Therefore, first and foremost give them facts. And secondly give them illuminating background” (*Directive of British Propaganda to Italy*, September 20, 1940).

<sup>7</sup>In 1940 the fascist regime allocated a special fund of 60 million liras to create some jamming stations in the main Italian municipalities (Cannistraro 1975).

Aside from motivating civilians to engage in the resistance against the Nazi-fascists, the BBC also played an important role in coordinating the resistance groups. “As resistance fighters in Europe tried to strike back against their occupiers, the BBC European Services would broadcast secret messages to them. These would be apparently meaningless phrases, whose significance was known only to specific resistance groups and their British handlers in the Special Operations Executive (SOE).<sup>8</sup> Hearing the words would tell the resistance fighters if an operation was to go ahead, or canceled; or if people or documents had arrived safely” (BBC 2007). According to Bussoni (2017, 78), during the Italian Civil War, the BBC sent coded information to the partisans concerning air-drops of weapons and supplies or the setting-up of “improvised airfields.” It also gave precise information on Nazi-fascist targets to sabotage, and forewarned the areas that were going to be interested by upcoming Allied attacks. To the best of our knowledge, there is no evidence that these messages were deciphered by the Nazis (Sinagra 1970, Piccialuti Caprioli 1976). The online Appendix provides additional details and examples of the coded messages that were sent.<sup>9</sup>

More generally, as exemplified by Davison (1963, 35), during the Second World War: “The BBC initially promoted the formation of resistance movements by letting individuals on the continent know that they were not alone—that there were others who shared their opinions. It urged all those who were resistance-minded to get together and form groups. It then attempted to provide political and technical information that would be useful to these groups. It gave them news that was relevant to their activities and that was likely to support their morale. It also let them know about techniques that had been used successfully to interfere with Nazi military operations. In this case, a foreign source provided not only external communications to a group of organizations but in some cases provided internal communications as well. That is, it enabled members of groups that had no reliable internal channels to keep in touch with each other.”

#### D. EIAR and Allied Forces Broadcasting

The EIAR (Ente Italiano Audizioni Radiofoniche) was the official radio of the fascist regime. It was active since the end of 1924 (first station in Rome). Throughout the years, the fascist regime increased the extent of propaganda

<sup>8</sup>The Allies also assisted the resistance movement by means of the Special Operations Executive (SOE), a secret organization. In particular, sometimes airdrops were organized with the help of SOE radio operators on the ground, in connection with partisan groups. These radio operators were themselves parachuted along with small radio handset transmitters (the so-called “parasets,” Pidgeon 2003) that were used to send messages or requests to the Allied headquarters in Monopoli (Apulia) until January 1945, and then to the ones in Siena (Tuscany) from February 1945 onward (Stafford 2011). For the sake of our exercise, it is important to notice that SOE communications could not overlap with the BBC signal, as they had different points of transmission and reception. Moreover, the frequency of transmission and the power of these “parasets” were quite different from those of the BBC antenna transmitters located in the United Kingdom (Pidgeon 2003). Nevertheless, by relying on the same software that we use for the BBC radio (see Section IIA), we simulated the within municipality variation in the signal strength of SOE radios, which turned out to be uncorrelated with the BBC signal. Also, our results are robust to controlling for the signal strength of SOE radios (these estimates reported in column 1 of online Appendix Table A.2).

<sup>9</sup>“*My beard is blond,*” “*The hen laid an egg,*” or “*The parrot is read*” are a few examples of “*special messages*” sent under the strictest military secrecy to resistance fighters or to undercover Allied corps in Italy (Bussoni 2017, 78). It is also important to remark that, as shown by Piffer (2010), the Allies did not discriminate among partisan groups with different political ideologies. Therefore, they did not target their supplies to specific partisan groups.



broadcast by the EIAR. In 1931, 22 percent of EIAR radio programs had clear propaganda content. This percentage increased to 33 percent in 1938 (Cannistraro 1975). The fascist regime also tried to boost radio penetration throughout Italy by introducing, in April 1937, a radio device called “Radio Balilla,” which had a relatively low cost and was payable in 18 rates (Cannistraro 1975, 243).

As the Allied Forces advanced in the south of Italy and freed Italian cities from the Nazi-fascists, they took control over former EIAR transmitters located there and used them to broadcast counterpropaganda from within Italy. For example on August 6, 1943, soon after the Allies landed in and liberated Sicily, “Radio Palermo” started broadcasting four hours per day. The hours of daily broadcasts had increased to nine by September of the same year (Isola 1996). The same happened with “Radio Bari” and “Radio Napoli” that started broadcasting soon after the Armistice of September 1943, and “Radio Roma” that started after the liberation of Rome. The most famous program broadcast by these radios was “Italia Combatte,” which mostly delivered news on the partisan resistance movement (Monteleone 1995). Since all of these radios were under the control of the Allied Forces, from now on we will refer to them simply as “AF Radio.”

## II. Data

### A. Radio Exposure

Our analysis focuses on one radio broadcasting from abroad (BBC) and two competing radio stations broadcasting from within Italy (EIAR and the AF Radio). Unfortunately, the information on how many people listened to these radios in each month-municipality is not available. Hence, we cannot estimate the relationship between signal strength and number of people listening to these radios. Following Enikolopov et al. (2011) and Durante et al. (2015) we, therefore, exploit continuous variation in signal strength and proxy radio exposure in each municipality by a time-varying indicator of its signal quality.

Broadcasting relied on different technologies for different radio stations. As we discuss in the next subsections, we use two different sets of information and software for the prediction of the radio signal: one to calculate the strength of the EIAR and Allied Forces radio signals and another one for the BBC signal.

*Radio Signal Prediction: EIAR and AF Radio.*—We calculate the radio signal strength of the EIAR radio in each Italian municipality by using information on transmitters’ location, frequency, and power every month from 1925 up to 1945. We gather this information from the historical archives of the weekly digests of the Ente Italiano Audizioni Radiofoniche (1925–1929) and Ente Italiano Audizioni Radiofoniche (1930–1945).<sup>10</sup> We cross-checked this information with that in Papa (1978), Monteleone (1995), and Isola (1996). Similarly, for the Allied Forces radio

<sup>10</sup>The digests *Radiorario* (1925–1929) and *Radiocorriere* (1930–1945), published by the Ente Italiano Audizioni Radiofoniche, provide information on the broadcasting programs and, most importantly, on the location, frequency, and power of the EIAR radio stations. Digital copies are available at [www.radiocorriere.teche.rai.it/](http://www.radiocorriere.teche.rai.it/).

we exploit data on EIAR transmitters along with information provided by Fontana et al. (2017) on when a city (where a radio station was located) was liberated by the Allied Forces. Moreover, we cross-checked this information with that in Papa (1978), Monteleone (1980), and Isola (1996) to account for the transmitters destroyed by the Allied bombing.

Exploiting this data, we calculate the predicted EIAR and Allied Forces radio signal strength for all Italian municipalities in each year using the Irregular Terrain Model (ITM) (Hufford 2002), which combines data on the radio transmitters with the orographic characteristics of the terrain. This methodology is also used in Olken (2009), Enikolopov et al. (2011), DellaVigna et al. (2014), Yanagizawa-Drott (2014), Adena et al. (2015), Durante et al. (2015), Adena et al. (2017) and Armand et al. (2017). By exploiting this software, we are able to compute the signal loss caused by physical distance and topography between the transmitting and receiving locations. Our measure of the EIAR/Allied Forces radios signal strength for each municipality-month is the maximum of the signal powers across all transmitters. As in Durante et al. (2015), we compute the radio signal strength in decibels (dB) at the centroid of each Italian municipality. Moreover, to account for the potential endogeneity of the transmitter locations, we also compute (and control for) the theoretical radio signal intensity in absence of any geomorphological obstacle (i.e., by assuming that the terrain between the transmitter and the receiver is flat), as in Olken (2009) and Durante et al. (2015) (see also the discussion in Section III).

*Radio Signal Prediction: BBC.*—The BBC broadcast from the United Kingdom toward Italy using medium waves and shortwave radio transmission. We collect data on the location, frequency and power of British medium wave transmitters from the “Directory of Long and Medium Wave Usage in the United Kingdom, 1922–2007” by Watkins (2008). We also cross-checked it with Broadcasting Publications (1943–1945)<sup>11</sup> and Pawley (1972). The latter two sources were also used to collect information on shortwave transmitters, together with the information contained in National Publishing (1943–1945).<sup>12</sup> Nevertheless, as we explain in great detail in the online technical Appendix, our analysis focuses on medium wave transmissions for two main reasons. The first one concerns the characteristics of Italian radio handsets during the WWII period. In particular, only “luxury” handsets were able to receive shortwave broadcasting. The most popular receivers, such as “Radio Balilla,” were able to receive only medium wave signals (RAI 2012). Hence, it is reasonable to assume that only a negligible share of the Italian population and partisans were able to receive BBC shortwave radio broadcasting. In addition, during our sample period shortwave transmissions, unlike medium wave transmissions, used multiple frequencies on any given day. Therefore it is not possible to recover a reliable estimate

<sup>11</sup>Digital copies of the “Broadcasting Yearbook,” published by Broadcasting Publications, are available at [https://www.americanradiohistory.com/Broadcasting\\_Yearbook\\_Summary\\_of\\_Editions\\_Page.htm](https://www.americanradiohistory.com/Broadcasting_Yearbook_Summary_of_Editions_Page.htm).

<sup>12</sup>Digital copies of the *Stevenson's Radio Bulletin*, originally printed by National Publishing, are available at <https://www.americanradiohistory.com/Archive-Radio-Logbooks/Archive-Stevenson-Burgess-Others/>.

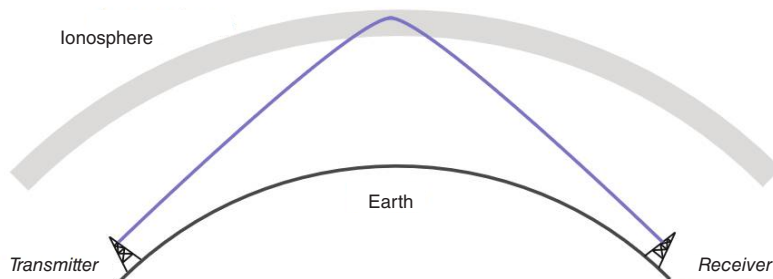


FIGURE 1. SKY-WAVE IONOSPHERIC PROPAGATION

*Note:* The figure illustrates the sky-wave ionospheric propagation of radio signal broadcasting.

of the quality of BBC shortwave signal reception across Italian municipalities in a given year-month.<sup>13</sup>

The medium (and short) wave broadcasting by the BBC made it possible to reach very distant locations by exploiting the so-called “sky-wave” or ionospheric radio propagation, which is illustrated in Figure 1.

To calculate the BBC signal strength in each Italian municipality, we make use of the Voice of America Coverage Analysis Program (VoACAP).<sup>14</sup> Similarly to the ITM, VoACAP exploits information on transmitter locations, frequency, and power and on the latitude and longitude of the receiving locations (e.g., municipalities). Yet, differently from local radio stations (e.g., EIAR and AF Radio), the sky-wave propagation in the ionosphere is not influenced by orographic characteristics. It is, instead, heavily affected by solar activity, i.e., by the number of sunspots (see the discussion below). Accordingly, we collect data on the monthly average number of sunspots from the solar weather historical archives of the WDC-SILSO, Royal Observatory of Belgium, Brussels.<sup>15</sup> After inputting the information on BBC transmitters and on monthly sunspots, VoACAP provides a prediction of the BBC radio signal strength in terms of Signal-to-Noise Ratio (SNR), expressed in decibel. Specifically, it provides a predicted SNR for each BBC transmitter-frequency-power combination in each Italian municipality and month at every half hour. Because the BBC used medium waves broadcasting toward Italy only during night hours (BBC 1944), we focus on the average strength of the BBC signal from 9:30 PM to 11:30 PM. Analogously to what was done with the EIAR and the Allied Forces radio

<sup>13</sup> As we explain in detail in the online technical Appendix, the BBC itself had no technical instruments to obtain reliable predictions on how a given change in shortwave (or medium wave) transmission frequency could have affected the quality of the signal in a specific location. Therefore, by not taking into account the BBC shortwave signal, we simply introduce a classical measurement error in our analysis. It is also important to stress that the first computer software for the prediction of the ionospheric radio propagation was released after the end of the WWII.

<sup>14</sup> For an overview of VoACAP, see <https://www.voacap.com/>. See also Guest and Guest (2013), Lane (2001), Lockheed-Martin (2010a, b), and the documentation in OAML-SDD-96 (2010). An executable version of the software is available for download at <http://www.greg-hand.com/hfwin32.html>.

<sup>15</sup> See <http://sidc.be/silso/infosnmtot>.

stations, our measure of the BBC signal strength for each municipality-month is the maximum of the signal strength across all BBC transmitters.<sup>16</sup>

Changes in solar activity affect the ionosphere and, consequently, the propagation of medium (and short) waves. In particular, the solar energy has the effect of loading the atoms present in the higher layers of Earth's atmosphere. When a radio electromagnetic wave comes in contact with the loaded atmospheric layers, its path is altered and the wave is reflected/refracted toward the ground. Importantly, such radio propagation is characterized by hops and skip zones.<sup>17</sup> In this context, sunspots play an essential role because they alter the ionosphere composition and consequently act on the sky-wave propagation.

Beside solar activity, time variation in the ionosphere is also induced by seasonal changes in daylight, such that the average predicted BBC signal is stronger during months with fewer hours of daylight (see Figure T.10 in the online Appendix). Since medium wave transmitter locations, frequency, and power are constant during our sample period, variation in the predicted BBC signal within a municipality (i.e., once taking into account the location of the receiver) is solely induced by: (i) the monthly variation in sunspots; and (ii) seasonal variation in the ionosphere induced by changes in daylight. The variation induced by sunspots is illustrated in Figure 2, which plots the monthly variation of total sunspots and the average residual of the predicted BBC medium wave signal (after controlling for calendar month and municipality fixed effects), to show that the quality BBC medium wave signal is higher during periods of low solar activity.

However, time variation in the ionosphere does not just affect the within-municipality variation in the BBC signal over time, but it also affects its variation across space. In fact, while geographical heterogeneity in signal reception is mainly driven by the distance from the transmitters (such that closer municipalities tend to receive on average a stronger signal), a decrease (increase) in the number of sunspots tends to improve (worsen) the overall quality of BBC signal in all Italian municipalities, but such improvement (deterioration) will be heterogeneous across municipalities because of a differential reflection over the ionosphere. The same argument applies to the heterogeneous impact on the ionosphere propagation induced by seasonal daylight variations. This means that there is an interaction between geographical heterogeneity and common trends in the signal strength that leads to additional heterogeneous variation in quality reception across receiving locations. This variability is illustrated in Figure 3, which shows the within municipality and within calendar-month variation in the quality of BBC medium wave

<sup>16</sup> See the online Appendix for more details about the sky-wave propagation mechanism, VoACAP, and the technical aspects of predicting the BBC radio signal.

<sup>17</sup> A hop occurs when the electromagnetic radiation that is refracted toward the ground, reaches the surface, and is reflected back upward with the same angle. The best signal levels are typically experienced within the first hop. However, if conditions are favorable, e.g., at low frequencies/at night/with a powerful transmitter and a sensitive receiver, it is possible to transmit a reliable signal even after several jumps. The regions between two hops are called areas of skip. In these regions, the radio signal is generally weak or nonexistent. Transmissions in the first jump area are particularly weak. On the contrary, the upper skip areas (second, third, etc.) may have stronger signals of the first zone of skip, because the reflected beams in the next hops tend to be easily diffracted and then fill these areas of shadow. See the online Appendix for further details.

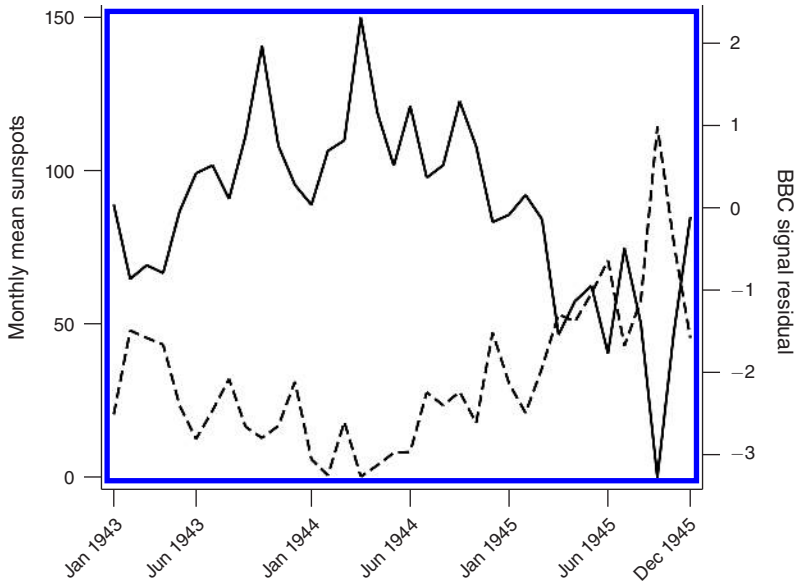


FIGURE 2. BBC SIGNAL RESIDUAL AND SUNSPOTS OVER TIME

*Notes:* The figure illustrates the variation over time in the number of monthly mean sunspots (dashed line) and in the average residual of the predicted BBC signal once taking into account calendar month and municipality fixed effects (solid line). The number of monthly mean sunspots is obtained by taking the arithmetic mean of the daily number of sunspots over all days of each calendar month.

signal across Italian municipalities by comparing March 1943 with March 1944 (left panel), and March 1944 with March 1945 (right panel).

In this respect, the variation in radio signal that we exploit is quite different from the one of local radio signals obtained via ITM (i.e., the standard in the existing literature, and that we also use for the EIAR and AF Radio).<sup>18</sup> The radio signal strength calculated via ITM depends on the interaction among transmitters' frequency and power and the topography of the transmitter and receiver locations as well as of the area between them. Accordingly, a variation in the radio signal strength within a receiver's location (e.g., a municipality) may only be induced by potentially endogenous variations in the transmitters characteristics (e.g., location, frequency). Instead, the BBC radio signal strength calculated via VoACAP depends on the interaction among the transmitters' frequency, power, and location with the receiver's location and the sunspots.

<sup>18</sup>Garcia-Arenas (2016) also exploits the variation in ionospheric radio propagation. However, he only uses the average level of ionization at the midpoint between the point of transmission (i.e., the location of *Radio Liberty* transmitters) and the point of reception (i.e., Russian districts) as a proxy of the quality of radio reception. Our approach, instead, also uses information on the transmitters' power and frequency, which are key inputs in predicting the quality of the radio signal at the point of reception. Most importantly, differently from Garcia-Arenas (2016), we exploit time variation in sunspot activity inducing within municipality variation in signal quality rather than just focusing on average differences across different geographical areas.

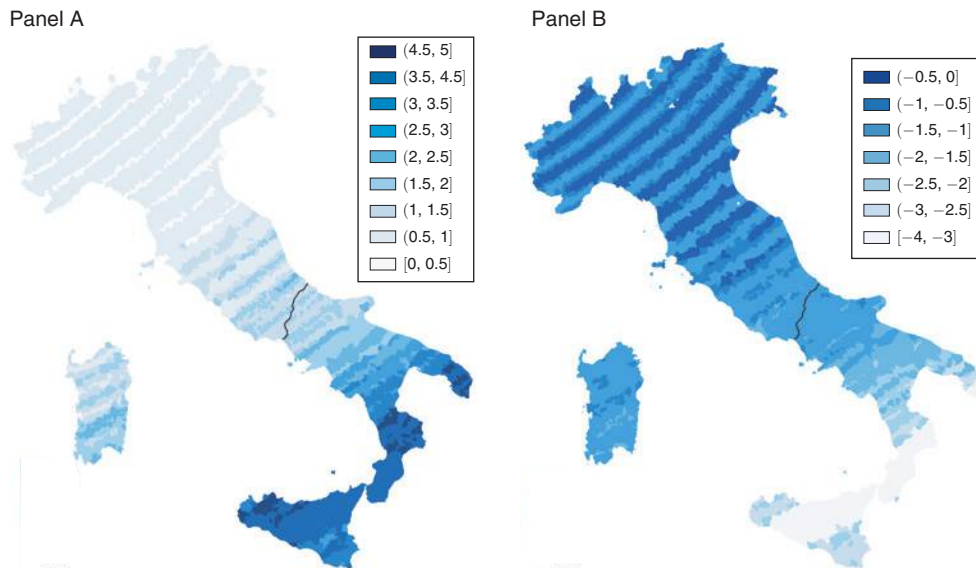


FIGURE 3. WITHIN-MUNICIPALITY VARIATION IN BBC SIGNAL

*Notes:* The figure illustrates two examples of within-municipality variation in the BBC signal throughout Italy looking at the difference in the predicted strength of the BBC signal in March 1944 with respect to March 1943 (left panel) and in March 1945 with respect to March 1944 (right panel). The black line represents the “Gustav line.”

Note that we were not able to recover the threshold in the SNR above which the BBC signal was “good enough” to allow for reception. At that time, indeed, the radio signal was analog, i.e., the quality of the signal was continuous, ranging from extremely noisy to extremely clear. The lower quality of radio receivers of the time (working against a good signal reception) and the lower noise in the surrounding environment (working in favor of a good signal reception) undermine the applicability of thresholds considered good proxies for reliable signal reception in today’s similar radio transmissions. Yet, in a validation exercise (i.e., column 4 of Table 4) we show that our results are robust to setting the threshold of good radio service in modern transmissions at the level indicated by Lane (1997) (i.e., a SNR above 48), who was one of the main developers of VoACAP.

### B. Intensity of Resistance

In principle, we would like to measure the intensity of resistance (i.e., the activity of partisan brigades) in each month-municipality observation. Because this measure is not available, we rely on an indirect indicator of intensity of the insurgency against the Nazi-fascists, namely the number of episodes of violence perpetrated by the Nazi-fascists against civilians or partisans in each month in a given municipality in response to partisan or civilian resistance (an episode is classified as violent if there was at least one Italian victim). The data are from the “Atlas of Nazi-fascist Massacres” (Anpi-Insml 2016). This Atlas provides a comprehensive census of all Nazi-fascist episodes of violence taking place between the landing of the Allies

in Sicily in July 1943 and the German surrender of Italy in May 1945.<sup>19</sup> Overall, the Atlas identifies more than 5,500 episodes of Nazi-fascist violence for a total of 23,000 victims and specifies their date of occurrence and location. The dataset also provides information on the type of victim and on the motivation or type of violence. In particular, the Atlas classifies victims as civilians or partisans and allows identification of victims of Nazi-fascist violence related to partisan or civil resistance (i.e., retaliations, round-ups, punitive expeditions, territorial control and desertification). We proxy the intensity of resistance, in a given municipality-month with the number of episodes of such types of Nazi-fascist violence.<sup>20</sup> The Atlas also provides information on victims of Nazi-fascist violence less connected to the resistance activity (e.g., due to military retreat, or victims of racial or gender motivated violence) that we exploit to validate our baseline results. The online Appendix describes some examples of episodes of Nazi violence in retaliation for partisan activities, included in our dataset.

We also have information on whether partisan brigades were ever active in a given municipality during the war. The primary source of this information is Baldissara (2000), who provides detailed maps of the areas of activity of partisan groups describing only the area of operation but not the period in which the brigades were active, nor how intensive their activity was. The information from these maps was then elaborated by Fontana et al. (2017).

### C. Sample

As discussed in Section I, the Allied troops liberated the South of Italy (i.e., the territory below the “Gustav line”) by the end of September 1943, and the Germans surrendered in May 1945. Accordingly, our sample covers the period October 1943–May 1945 and focuses only on municipalities above the “Gustav line,” since partisan activities were rather sporadic south of it.<sup>21</sup> This amounts to excluding 77 percent of municipalities in Campania and all municipalities in Apulia, Basilicata, Calabria, Sicily, and Sardinia. We also exclude all municipalities in the region of Valle d’Aosta, for which no data on victims are recorded. We are thus left with 5,873 municipalities out of the initial 8,011.<sup>22</sup>

Figure 4 shows that the Nazi-fascist violence episodes were mainly concentrated in the proximity of the front line. As the Allied troops advanced northward, the

<sup>19</sup>The Atlas is the result of a joint research project (2009–2016) of Italian and German historians sponsored by the Italian and the German governments. Information on the episodes of Nazi-fascist violence is available at <http://www.straginazifasciste.it/?lang=en>.

<sup>20</sup>We do not focus on a specific subcategory of Nazi-fascist violence (e.g., retaliations), as the distinction among these categories is blurred. Indeed, as pointed out by Gentile (2015, 148) “Many of the civilians were killed as a result of a [Nazi-fascist] response to a partisan attack, even though sometimes such response lacked the formal characteristics of a retaliation, as the reprisal was enacted after a few hours or even days from the originating episode.” Nevertheless, in a robustness check (column 2 in Table 4), we show that our baseline results are robust to focusing on a subset of violent episodes more formally related to partisan attacks (i.e., retaliations).

<sup>21</sup>Given the fuzziness of the “Gustav line” (which, for example, moved from September to December), we also include the municipality whose centroid lies within 50 kilometers south of the “Gustav line.” Results are robust to choosing different cut-offs.

<sup>22</sup>Since a few municipalities appeared or disappeared in the decades after the WWII, we use municipal administrative entities as of 1995, for which we managed to collect a homogeneous set of prewar and postwar available characteristics.

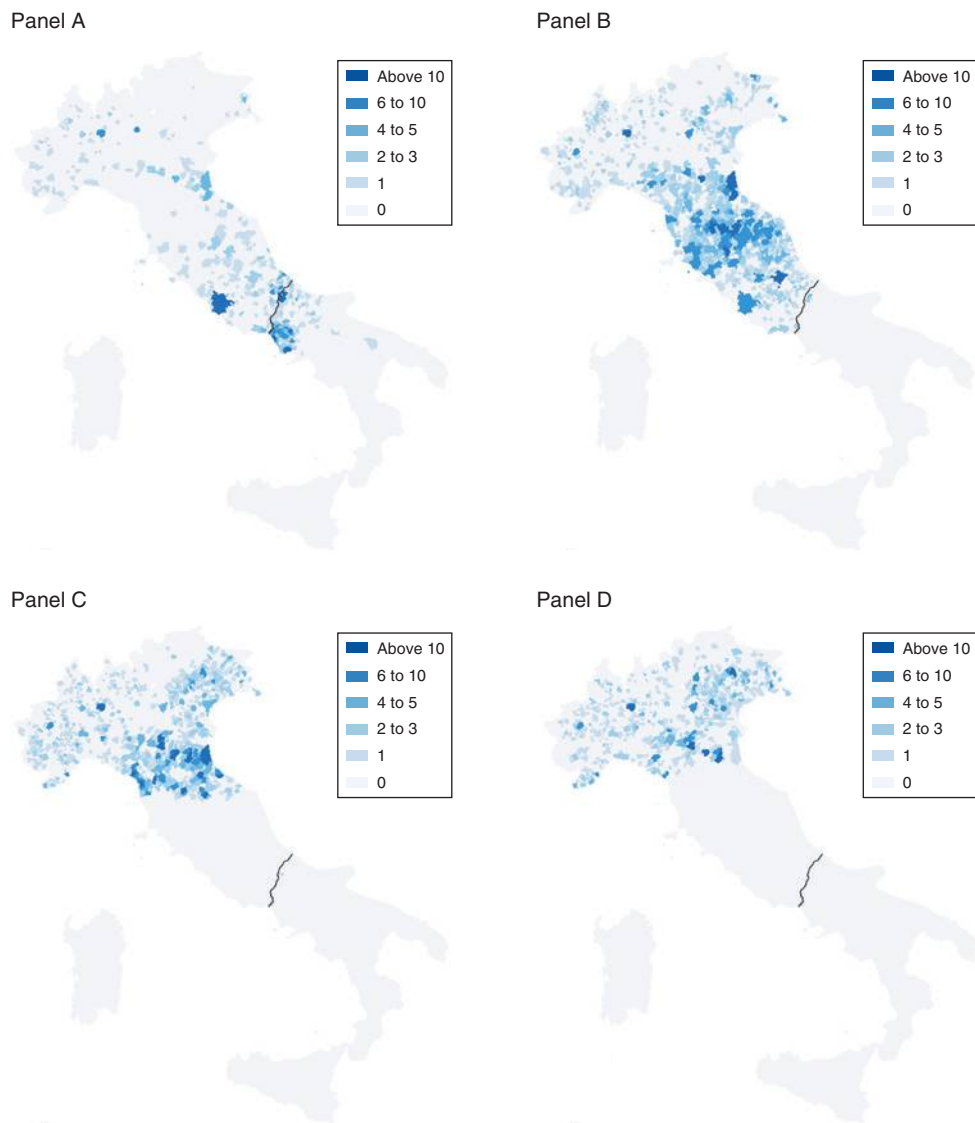


FIGURE 4. GEOGRAPHICAL DISTRIBUTION OF EPISODES OF NAZI-FASCIST VIOLENCE OVER TIME

*Notes:* The figure illustrates the geographical distribution of episodes of Nazi-fascist violence, related to partisan or civilian resistance, throughout Italy in the periods October 1943–February 1944 (top-left), March 1944–July 1944 (top-right), August 1944–December 1944 (bottom-left), and January 1945–May 1945 (bottom-right). The black line represents the “Gustav line.”

intensity of the conflict between partisans and Nazi-fascists increased. This is due to several reasons. On the one hand, as documented by Gentile (2015), the German troops were more aggressive near the battlefront, both because of the greater stress and due to their composition. On the other hand, it is likely that partisan brigades were also more active near the battlefront because their actions could have a greater marginal impact on the enemy. If we were to include in our sample all municipality-month observations between October 1943 and May 1945, we would



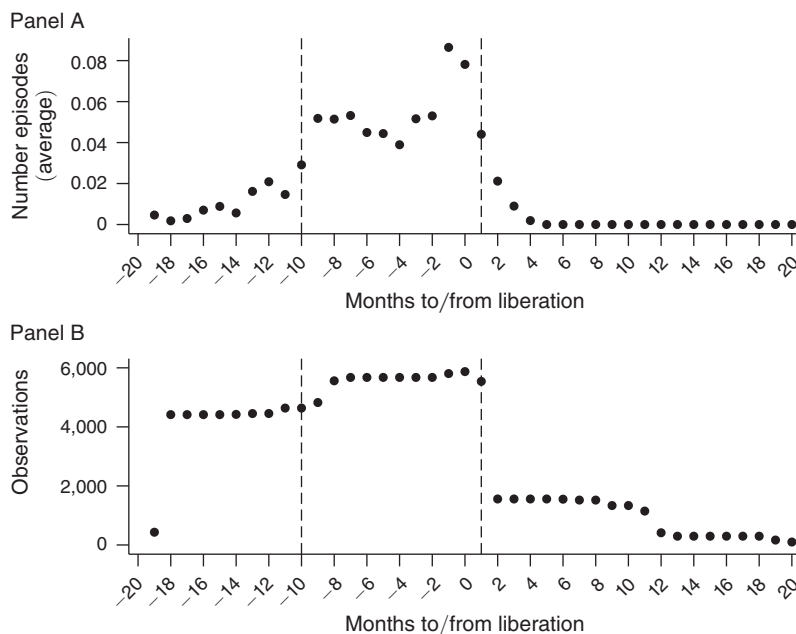


FIGURE 5. EPISODES OF NAZI-FASCIST VIOLENCE AND OBSERVATIONS BY MONTHS TO/FROM LIBERATION

*Notes:* The figure illustrates the distribution of the average number of monthly episodes of Nazi-fascist violence related to partisan or civilian resistance (top) and the overall number of municipality-month observations (bottom) with respect to the liberation of the provincial capital. Dotted lines delimit the baseline sample used in the analysis.

face two issues. First, we would include municipalities also in months when they were no longer under Nazi-fascist occupation and, thus, not exposed to Nazi-fascist violence. Second, we would include occupied municipalities in months when they were far from the frontline, and thus not so heavily involved in the Italian Civil War (e.g., northern municipalities were not so exposed to Nazi-fascist violence in the early periods of the occupation). Also, we only know the exact date of liberation of the provincial capital.<sup>23</sup> This explains why, as the top panel of Figure 5 documents, we still observe a significant number of episodes of Nazi-fascist violence taking place one month after the assumed liberation of a municipality. For all these considerations, we restrict the sampling period from ten months before to one month after the liberation of the province capital (for a total of a 12-month window). As the top panel in Figure 5 shows, by restricting the sample in this way, we are focusing on a time interval characterized by a higher intensity of partisan insurgency and, consequently, of Nazi-fascist violence. The bottom panel of the same figure illustrates that, in this way, we are also able to run our estimates on a rather balanced panel of municipalities observed over a period of similar length around their liberation date. In the online Appendix we provide a robustness check, where we control for the

<sup>23</sup>For several hundreds of municipalities near the two major front lines, however, we know the exact month of liberation. These are the municipalities near the “Gothic line” (a line of German defense that cuts through Northern-Central Italy), and those near the “Gustav line” (that cuts through Southern-Central Italy). The dates of liberation were geo-coded by Fontana et al. (2017). Note that the German retreat was quite fast, except near the two front lines, implying that measurement error concerning the exact date at the municipal level is unlikely to be large.

(time) distance from the date of liberation of the closest provincial capital, and we also report estimates obtained by using the entire sample.

Table 1 reports the summary statistics for the final sample. As our sample includes only municipalities above the “Gustav line,” 80 percent of our observations are located in the North of Italy and 15.7 percent in the center. The average number of episodes with victims is 0.05, distributed quite evenly between those with civilian and partisan victims. Figure 6 illustrates the distribution of municipalities in the sample according to the range of standard deviation in the BBC signal and according to the number of episodes of Nazi-fascist violence.<sup>24</sup> As far as the radio signals of the BBC, EIAR, and AF Radio are concerned, although interpreting their levels is not straightforward (see the discussion in Section IIA), it is important to stress that in all three cases a higher value corresponds to a better signal reception.

### III. Empirical Strategy

To identify the effect of the BBC signal over episodes of Nazi-fascist violence, we estimate the following model:

$$(1) \quad y_{it} = \alpha + \beta BBC_{it} + \gamma X_{it} + \rho_i + \delta_t + \epsilon_{it}.$$

Here,  $y_{it}$  is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance and observed in a municipality  $i$  in a given month  $t$  (see Section IIB).<sup>25</sup> As episodes of Nazi-fascist violence that occur at the beginning of a month are likely to be influenced by the BBC signal in the previous month, we define  $BBC_{it}$  as the average medium wave BBC signal (SNR) taken over the current and previous month, i.e.,  $t$  and  $t - 1$ .<sup>26</sup> The variable  $X_{it}$  is a vector of time-varying municipal level climate covariates that may have a direct effect over the episodes of Nazi-fascist violence and more broadly over the resistance activity. Specifically, we include average monthly rainfalls (in millimeters), average cloud intensity (percentage cover) and monthly average temperatures in Celsius degree.<sup>27</sup> Standard errors are clustered at the province level.

<sup>24</sup>Notice that the 64 percent of municipalities in our sample never experience any episode of Nazi-fascist violence.

<sup>25</sup>We could use the actual number of victims instead of the number of episodes, but the former is more likely to suffer from measurement error. In Section IVB we experiment with this alternative dependent variable.

<sup>26</sup>Our results are robust to separating the BBC signal strength in month  $t$  and  $t - 1$ . See also the lead-lag analysis we provide in the following section.

<sup>27</sup>Source: *Tyndall Center for Climate Change Research* (version CRU TS 1.2). In column 2 of online Appendix Table A.2, we present a robustness specification where we also include a set of “endogenous” controls. Namely: (i) the number of days a municipality experienced bombing attacks carried out by the Allied Forces in a given month (with German and non-German targets) from the *Theater History of Operations Reports* (T.H.O.R. Lt Col Robertson et al. 2013); (ii) the municipality’s (absolute) distance in months to/from the liberation date of its provincial capital (see the discussion in Section IIC), which also captures any eventual backlash of Nazi-fascist troops in the immediacy of liberation; (iii) a dummy for the presence of any SS or H. Goering Nazi troop (or both) within 15 kilometers from a municipality. These were special Nazi troops composed of young and highly ideological soldiers who were involved in previous massacres in Eastern Europe and in the Balkans. According to Gentile (2015), two elite Nazi divisions were responsible of particularly heinous episodes of violence: the 16th SS-Panzer-Grenadier-Division “Reichsfuhrer-SS” and the “Hermann Goering” division. We take this information from Fontana et al. (2017), who, in turn, codes it from data originally supplied by Gentile (2015) and obtained from the German war archives.

TABLE 1—DESCRIPTIVE STATISTICS

	Mean	SD	Min	Median	Max
North	0.800	0.400	0	1	1
Center	0.157	0.364	0	0	1
South	0.043	0.203	0	0	1
Episodes with victims	0.051	0.332	0	0	17
Episodes with civilian victims	0.024	0.231	0	0	17
Episodes with partisan victims	0.024	0.199	0	0	11
BBC	59.388	5.399	41	59.500	70
EIAR	131.557	31.242	47.313	129.371	228.604
AF Radio	227.293	33.011	121.505	224.722	391.902
Rain precipitations	71.955	64.060	0	55.400	382.500
Cloud coverage	57.258	8.745	31.300	58.700	77.500
Temperatures	11.658	8.072	-12.600	11.700	26.500
Number of months to/from liberation (abs.)	4.513	3.163	0	4	10
Presence of SS and H. Goering troops	0.006	0.079	0	0	1
Number of municipality-months			66,197		
Number of municipalities			5,873		

Notes: *BBC* is the BBC signal (SNR) in the month. *EIAR* and *AF Radio* is the effective signal intensity in the month of EIAR and Allied Forces radio, respectively. *Rain precipitations* is the monthly average rainfall in millimeters. *Cloud coverage* is the monthly average cloud coverage. *Temperatures* is the monthly average temperature. *Observations months to/from liberation (abs.)* is the absolute value of the distance (in months) to the liberation of the provincial capital. *Presence of SS and H. Goering troops* is a dummy variable that takes value one if either the SS or the H. Goering troops are present in the municipality.

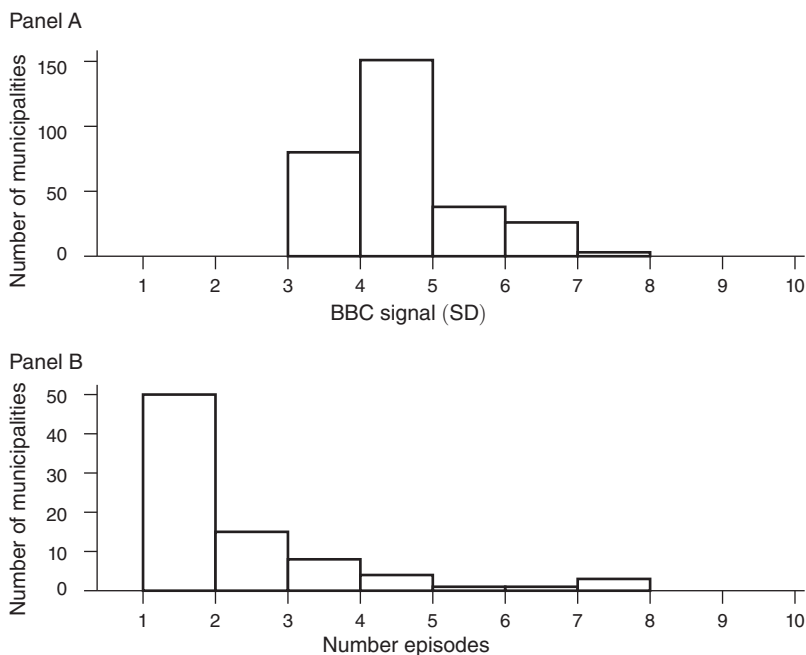


FIGURE 6. DISTRIBUTION OF BBC SIGNAL AND EPISODES OF NAZI-FASCIST VIOLENCE

Notes: The figure illustrates the distribution of municipalities in the sample according to the range of standard deviation in the BBC signal (top panel) and according to the number of episodes of Nazi-fascist violence related to partisan or civilian resistance (bottom panel).

Following the discussion in Section IIA, we know that variations in  $BBC_{it}$  across time come from seasonal daylight effects and sunspot activity, while variations across space come from the relative location of receiving municipalities with respect to transmitters. In addition to these, we also know that the reflection mechanism across the ionosphere induces additional variation across time and space through the interaction between the geographical location of receiving municipalities and ionosphere changes. If so, the identification of the causal effect of the strength of the BBC signal on Nazi-fascist violence is conditional on controlling for any endogenous determinant of the BBC signal, i.e., municipality ( $\rho_i$ ) and calendar month ( $\delta_t$ ) fixed effects. In fact, time-invariant municipal characteristics could simultaneously determine the strength of the radio signal and the intensity of partisan activities. For instance, northern municipalities were closer to the BBC transmitters and received, on average, a better BBC signal, but also had orographic characteristics that could affect the intensity of the insurgents' activity.<sup>28</sup> At the same time, the quality of the BBC signal is affected by seasonal changes in daylight, which in turn might also be correlated with insurgent activities, as one could expect lower insurgent activity in the winter months.

To additionally account for unobserved patterns in the war events, we further specify  $\delta_t$  as year-month (i.e., date in months) instead of calendar month fixed effects.<sup>29</sup> Ultimately, our claim is that after controlling for municipality and year-month fixed effects (which absorb the geographical heterogeneity and common trends in signal reception), any residual variation in the BBC signal is only due to the heterogeneous impact of the ionosphere variations on the BBC radio signal across municipalities induced by sunspot activity and seasonal effects.<sup>30, 31</sup>

Before moving to the results, it is important to discuss the identification of the effect of other competing radio stations. In Section V, in fact, we also account for broadcasting by radios other than the BBC by including in equation (1) two variables that measure the signal quality of the fascist radio EIAR and of the AF Radio, as computed via ITM (see Section IIA). The identification of the effect of these two radios exploits within-municipality variation in the radio signal due to changes over time in the location, frequency, and power of transmitters. From October 1943 to May 1945, this variation was caused by: (i) the Allied bombings and destruction of EIAR transmitters, (ii) the installation of new transmitters, or (iii) the change of the transmitters' radio frequency operated by the fascists or the Allied Forces. Moreover, when a municipal-

<sup>28</sup> According to Gentile (2015, 48), the Italian geography with its mountainous areas in the center and in the north of the country did not help the deployment of large insurgent groups.

<sup>29</sup> In column 3 of online Appendix Table A.2, we estimate a specification where we control for calendar month and year fixed effects. Results are substantially unchanged.

<sup>30</sup> Another potential concern is that the information conveyed by the BBC could easily spread toward neighboring municipalities. If this was true, some municipalities with a relatively worse BBC signal could still have received the information, and our estimate would still represent a lower bound of the true effect. In Section VC we investigate spatial interactions in the BBC signal reception.

<sup>31</sup> We cannot exclude that local weather conditions affected the actual reception of the BBC signal (and, of course, local weather could also influence partisan activities on the ground). However, this is not a threat to our identification strategy because our variable of interest is the predicted signal strength, not the actual reception. To the best of our knowledge, there is no conclusive evidence on the effects of solar weather on terrestrial weather (Lindsay 2003, Thompson 2012). Nevertheless, we always control for monthly rainfalls, cloud coverage, and temperatures.

TABLE 2—BBC AND NAZI-FASCIST VIOLENCE

	Any (1)	Civilian (2)	Partisan (3)
BBC	0.029 (0.008)	0.020 (0.006)	0.009 (0.003)
Municipality fixed effects	Yes	Yes	Yes
Year-month fixed effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Average outcome	0.0507	0.0241	0.0244
Number of municipality–months	66,197	66,197	66,197

*Notes:* The dependent variable is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance. *BBC* is the average BBC signal (SNR) between month  $t$  and month  $t - 1$ . Controls include the average rain precipitations, the average cloud coverage, and the average temperature in the month. Standard errors robust to clustering at province level.

ity hosting a transmitter was freed from the Nazi-fascists, transmitters switched from broadcasting fascist propaganda to anti-fascist counterpropaganda. As explained in Section IIA, to account for the potential endogeneity of the EIAR and AF Radio transmitters location, we also control for the theoretical radio signal intensity in absence of any geomorphological obstacle. After accounting for this hypothetical free space signal, the residual variation in signal intensity within a municipality is due to the interaction between the orographic characteristics of the Italian terrain and the variation in the transmitters location over time.

## IV. Results

### A. Main Estimates

Table 2 reports baseline estimates of the effect of BBC signal strength on the number of episodes of violence—related to partisan or civilian resistance—perpetrated by the Nazi-fascists. We only display the coefficient of interest omitting to report the remaining covariates. In column 1 the dependent variable is the number of episodes with any type of victims, while in columns 2 and 3 we consider the number of episodes where victims are civilians or partisans, respectively.

The coefficient reported in column 1 is positive and statistically significant, and it implies that a one standard deviation increase in the signal strength (5.399) is associated with an increase in the number of episodes with any type of victims of about three times ( $5.399 \times 0.029/0.051 = 3.070$ ), relative to its average.<sup>32</sup> The estimated coefficients in the remaining two columns of Table 2, where we separate episodes with

<sup>32</sup> As shown in online Appendix Table A.1, the effect of the strength of the BBC signal on Nazi-fascist violence turns out to be positive in column 3, where we control for both year-month and municipality fixed effects. However, the estimate of the coefficient of interest is negative in columns 1 and 2, where we do not include municipality fixed effects. This is because omitting to control for municipal characteristics causes a significant downward bias in the estimated effect of the BBC signal. On average, the BBC signal is of better quality in the northern areas of Italy (as they are closer to the United Kingdom), while much of the action by the partisans occurs near the battle front (i.e., in the center and, only later on, in the center-north of the country). Also, the most northern areas of Italy, such as the Alps, almost never experienced large scale partisan action (see Figure 4). Finally, it is worth mentioning that adding, as we do in column 4, a full set of our control variables does not have a significant impact on our coefficient of interest.

civilian and partisan victims when constructing our dependent variable, are also positive and statistically significant. Here, the effect of a one standard deviation increase in the quality of the signal strength is considerably larger (almost five times its average) in column 2 where we consider episodes with civilian victims, compared to column 3 where we consider partisan victims (almost two times its average). This difference can be explained by taking into account that partisans adopted guerrilla-like strategies (i.e., attack and hide), which implies that Nazi-fascist army units typically retaliated against unarmed civilian populations (Battistelli and Crociani 2015).<sup>33</sup>

The large effect that we estimate of an improvement in the quality of the BBC signal on the intensity of resistance can be explained by considering the nature of BBC messages. As we document in Section I, the Italian program of the BBC provided counterpropaganda targeted to the overall Italian population. At the same time, the BBC delivered information and coded messages to Resistance fighters (see the online Appendix for more details). The Allied Forces, for example, used Radio Londra to send precise instructions to the insurgents on the timing and location of air-drops of military and logistic supplies. Perturbations to the quality of the BBC signal determined whether or not partisans could receive these supplies and, hence, conduct their insurgency actions. These initial findings suggest that the BBC could have affected the intensity of partisan resistance through the coordination of the actors involved in the Italian Civil War. We further investigate this hypothesis in the following sections.

To make our analysis more transparent and to further corroborate the validity of our identification strategy, in what follows we analyze how episodes of Nazi-fascist violence change with respect to leads and lags from the BBC signal received at time  $t$ . In this way we can test for the potential presence of pretrends in episodes of Nazi-fascist violence and, at the same time, study the dynamic impact of variations in the quality of the BBC signal on our dependent variable.

Before commenting on these figures, it is important to point out that, in the spirit of a placebo test, we should expect to find no effect on current episodes of Nazi-fascist violence of the quality of the BBC signal at time  $t + \tau$ , as this could not possibly convey any useful information for insurgency activities at time  $t$ . Nevertheless, BBC signal quality is serially correlated across months: after controlling for year-month and municipality fixed effects, the residual correlation between the BBC signal at time  $t$  and  $t + 1$  is 0.49. This is due to the intrinsic smoothness in the ionosphere variation, which in turn is due to the gradual variation in daylight hours across calendar months and to a certain degree of serial correlation in the monthly sunspots.<sup>34</sup> Thus, even if BBC messages only have a contemporaneous causal effect on the intensity of resistance, we could estimate a positive anticipated effect in the immediately preceding months due to the positive serial correlation in signal quality.

With this caveat in mind, in Figure 7 we report estimates from a specification where we augment the model in equation (1) by including up to five lags and five leads of  $BBC_{it}$ . Importantly, variations in the quality of BBC signal at time  $t$  do not have any significant impact on past episodes of Nazi-fascist violence, at least

<sup>33</sup> See also the online Appendix for an illustrative description of retaliations undertaken by the Nazi-fascists.

<sup>34</sup> In our sample period (October 1943–May 1945), the correlation between the number of sunspots in year-month  $t$  and the one at  $t + 1$  is 0.66.

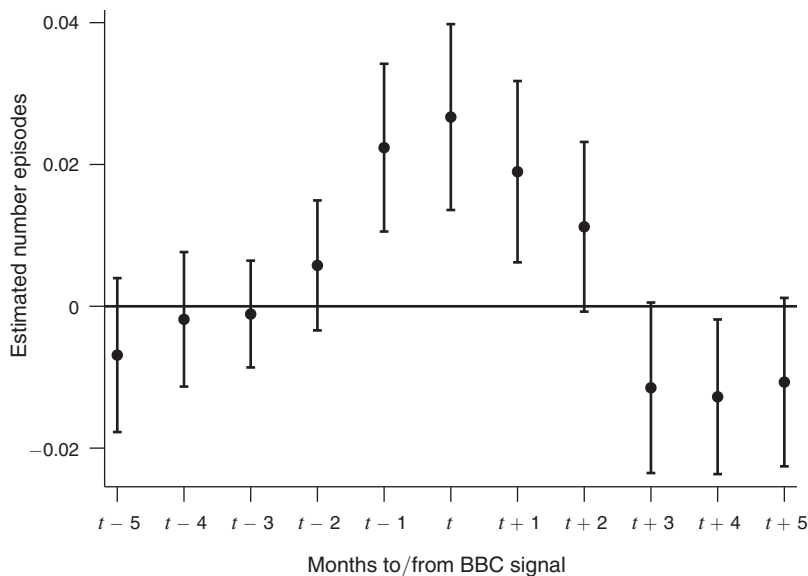


FIGURE 7. LEADS AND LAGS

Notes: The figure illustrates the estimated number of episodes of Nazi-fascist violence related to partisan or civilian resistance at different leads (left) and lags (right) from the BBC signal in a certain month. Ninety-five percent confidence intervals reported.

up to time  $t - 1$ . As explained above, the positive correlation between episodes of violence at time  $t - 1$  with the BBC signal at time  $t$  can be explained by the degree of serial correlation in the quality of the BBC signal. Moreover, a variation in the quality of BBC signal at time  $t$  has a positive and significant impact on episodes of Nazi-fascists violence both at time  $t$  and  $t + 1$ , while it does not have much of an impact in later months. We also observe a weak and negative impact of the quality of the BBC signal on violence at time  $t + 3$  and  $t + 4$ . This could be possibly explained by a crowding out effect of past episodes of Nazi-fascist violence on future ones, for example, because of capacity constraints faced by the insurgents. In Section VB we provide further discussion of the effect of past exposure to BBC on our outcome variable. What is important to highlight here is that Figure 7 documents the absence of pretrends in our dependent variable, and shows that the strongest and most significant impact of a variation in the quality of the BBC signal on the episodes of Nazi-fascists violence is the contemporaneous one.

### B. Robustness

In this section we report estimates from a variety of exercises that we implement to assess the robustness of our results. For the sake of exposition, from now on we only focus on the number of episodes of Nazi-fascist violence against both civilians and partisans as dependent variable.<sup>35</sup> Estimates are reported in Table 3.

<sup>35</sup> Almost all the following results hold when we distinguish between civilian and partisan victims in constructing our dependent variable. These estimates are available upon request.

TABLE 3—BBC AND NAZI-FASCIST VIOLENCE—ROBUSTNESS

	Conley SE (1)	Two-way clustering (2)	Add municipalities below Gustav (3)	Add provincial trends (4)	Poisson (5)	Number of victims (6)
BBC in the month	0.029 (0.008)	0.029 (0.013)	0.029 (0.008)	0.021 (0.008)	0.308 (0.055)	0.198 (0.073)
Municipality fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Province trend	No	No	No	Yes	No	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Average outcome	0.0507	0.0507	0.0506	0.0507	0.877	0.224
Number of municipality-months	66,197	66,197	66,569	66,197	66,197	66,197

*Notes:* In columns 1 to 5 the dependent variable is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance, while in column 6 it is the number of victims. *BBC* is the average BBC signal (SNR) between month  $t$  and month  $t - 1$ . *Controls* include the average rain precipitations, the average cloud coverage, and the average temperature in the month. Standard errors robust to clustering at province level, except in column 1, where we allow for spatial correlation among municipalities that fall within 100 kilometers of each other and in column 2 where we allow for two-way clustering at province and year-month level. In column 3 we also include municipalities below the “Gustav line.” In column 4 we include province-specific (linear) time trends. In column 5 we report Incidence Rate Ratios from a Poisson model.

In column 1, as suggested in Conley (1999) we report estimates with standard errors corrected for spatial correlation among municipalities that fall within 100 kilometers from each other, and for serial correlation up to 5 months.<sup>36</sup> The coefficient of interest remains statistically significant at the 1 percent level.<sup>37</sup> In column 2 we cluster the standard errors over two dimensions, as suggested in Cameron et al. (2011): at provincial and year-month level. The standard error increases with respect to the baseline estimates, but the coefficient remains significant at the 5 percent level.

In column 3 we display the estimates that we obtain when we include in the sample also municipalities below the “Gustav line.” The estimated coefficient of interest remains quantitatively the same and statistically significant at the 1 percent level. To strengthen the causal interpretation of our findings, in column 4 we also control for the presence of unobservable linear trends at provincial level that could affect the timing of both the BBC broadcast and the Nazi-fascist violence. Reassuringly, the coefficient of the BBC signal strength is still similar in magnitude and statistically significant.

Next, we address the point that our main dependent variable is indeed count data, i.e., there are many municipality-month observations with zero episodes of violence (see Table 1). For this purpose, in column 5 we report the Incidence Rate Ratio from a Poisson model. After accounting for the right skewness, we find that a one standard deviation increase in the strength of the BBC signal increases the number of episodes of Nazi-fascist violence by almost two times ( $5.399 \times 0.361 = 1.949$ ), which

<sup>36</sup>The routine we rely on for these estimates builds upon Hsiang (2010) and Fetzer (2014).

<sup>37</sup>We obtain very similar estimates by considering a radius of 200, 300, and 400 kilometers. We also clustered standard errors at the regional level, and results were substantially similar (see column 4 in online Appendix Table A.2).



is smaller than the magnitude of the effects estimated through OLS (three times) but still substantially large. Finally, in column 6 we check whether using the number of victims, rather than the number of episodes of Nazi-fascist violence, leads to different results. The effect of broadcasting by the BBC remains almost unchanged: a one standard deviation increase in the BBC signal strength leads to an increase in the number of victims of about 4.5 times, relative to its average ( $5.399 \times 0.198/0.224 = 4.773$ ).<sup>38</sup>

Finally, we perform a randomized inference test, in the spirit of Young (2019) and Dell and Olken (forthcoming). To do so, we collect data on the monthly average number of sunspots from January 1947 to December 2017, which we then use to simulate a placebo BBC signal in each year-month in this 70 year range. We then construct 1,000 counterfactual distributions of the BBC signal by randomly assigning to each year-month in the sample range (October 1943–May 1945) a corresponding future BBC signal in a year-month of the placebo simulation (January 1947–December 2017). To preserve the seasonal pattern of the BBC signal, we constrain the BBC signal in each counterfactual to correspond to the same month of the year of the actual signal. That is, in each estimate we randomly assign to the actual BBC signal in month  $k$  of year  $t \in [1943, 1945]$  a corresponding BBC signal in the same month  $k$  of year  $t \in [1947, 2017]$ . Figure 8 shows the distribution of counterfactual estimates of our baseline specification (equation (1)), and compares it to the coefficient from the actual BBC signal (vertical line). The comparison to the distribution of estimated counterfactual effects implies a  $p$ -value of 0.001, where the  $p$ -value measures the fraction of the absolute value counterfactual coefficients to the right of the absolute value of the actual coefficient.

### C. Validation

In Table 4 we provide additional evidence to corroborate the interpretation that BBC broadcasts fostered insurgency against the Nazi-fascists. First, if the BBC had any effect on the intensity of the resistance movement, we should expect its impact to be stronger in municipalities with active partisan brigades. In column 1 of Table 4, we empirically test this prediction by interacting the quality of the BBC signal with a dummy variable from Fontana et al. (2017), which takes the value of one if a partisan brigade was active within the boundaries of a municipality. The coefficient of the interaction term is positive and statistically significant, implying that the effect of an improvement in the quality of the BBC signal was larger in municipalities in which partisan groups were active.

Second, we should also expect to find a positive effect of the BBC signal strength on categories of Nazi-fascist violence that are closely related to the occurrence of partisan attacks (i.e., retaliations), while there should be no significant impact on forms of violence (i.e., due to military retreat or racial and gender motivated ones) that were perpetrated for reasons not immediately related to the activity of partisan groups. Columns 2 and 3 report these estimates. Indeed, the effect on retaliations

<sup>38</sup>Results are qualitatively similar when we use as the dependent variable a dummy for the occurrence of any episode of Nazi-fascist violence (see column 5 in online Appendix Table A.2).

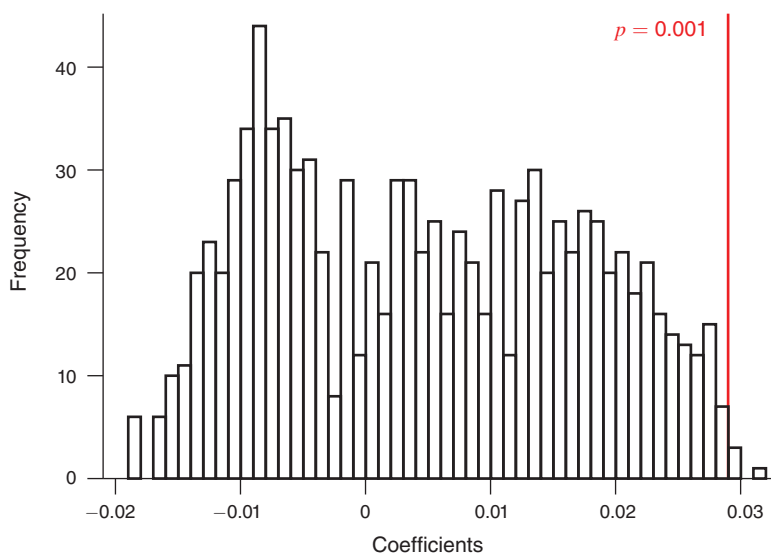


FIGURE 8. COUNTERFACTUALS

*Notes:* The figure plots histograms of absolute coefficients from a regression of the main outcome variable (number of episodes of Nazi-fascist violence related to partisan or civilian resistance) on counterfactual BBC signal, estimated using the baseline specification (1). Each counterfactual was selected at random by assigning each year-month of the BBC signal in the sample period (October 1943–May 1945) to a corresponding BBC signal in the month of a year ranging from 1947 to 2017. This procedure was repeated to construct 1,000 counterfactual coefficients. The coefficient for the real BBC signal is shown as the red vertical line. The  $p$ -value measures the fraction of the absolute value counterfactual coefficients to the right of the absolute value of the actual coefficient.

TABLE 4—BBC AND NAZI-FASCIST VIOLENCE—VALIDATION

	Interaction brigades (1)	Only retaliations (2)	Unrelated to resistance (3)	Good reception (4)
BBC	0.028 (0.008)	0.005 (0.002)	0.004 (0.003)	
BBC × Partisan brigades	0.002 (0.001)			
Good BBC reception				0.241 (0.058)
Municipality fixed effects	Yes	Yes	Yes	Yes
Year-month fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Average outcome	0.0507	0.0117	0.0104	0.0507
Number of municipality–months	66,197	66,197	66,197	66,197

*Notes:* The dependent variable is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance. In column 2 the dependent variable includes only Nazi-fascist retaliations against partisan attacks. In column 3 the dependent variable includes only episodes of Nazi-fascist violence unrelated to partisan or civilian resistance (military retreat, gender, or racial violence). *BBC* is the average BBC signal (SNR) between month  $t$  and month  $t - 1$ . *Controls* include the average rain precipitations, the average cloud coverage and the average temperature in the month. *Partisan brigades* is a dummy for whether a partisan brigade was ever active in the municipality. *Good BBC reception* is a dummy for whether the BBC signal is above the threshold for good radio service (SNR above 48) according to Lane (1997). Standard errors robust to clustering at province level.

committed by Nazi-fascists is positive and large, compared to its average ( $5.399 \times 0.005/0.0117 = 2.307$ ), while it is not statistically different from zero on the number of episodes of violence unrelated to the resistance. These findings are consistent with our hypothesis that the BBC broadcasting led to a higher number of episodes of Nazi-fascist violence due to an increase in the intensity of resistance activities, rather than to a more general backlash of Nazi-fascist forces to the increased counterpropaganda.

As a final validation test, we rely on the threshold for good radio service indicated by Lane (1997) to construct a dummy variable that takes value one if the strength of the BBC signal in a given municipality-month is above a SNR of 48. Column 4 shows that our results hold both in size and magnitude when we classify municipalities according to whether the strength of the BBC signal is above or below this good service threshold in a given month (a five-fold increase in episodes when the signal is good), which is reassuring against any misspecification in the radio signal.<sup>39</sup>

## V. Mechanism

In this section we investigate the potential mechanisms behind the estimated effect presented in Table 2. Specifically, we provide additional evidence to better understand if the BBC broadcasting was mainly a coordination tool between partisans and Allied forces, or whether it also had any enduring effect in motivating the Italian population against the Nazi-fascist occupation.

### A. Time to Liberation

In Figure 5 we showed that the intensity of the conflict was mostly concentrated in a 12-month window around the liberation of the municipality's provincial capital. In column 1 of Table 5 we dig deeper along this dimension and test whether the impact of the BBC was stronger in a narrower time interval around the liberation, i.e., exactly when the intensity of confrontation between Nazi-fascist troops and partisan brigades was expected to be higher. To this end, we interact the BBC signal with a dummy that takes the value of one for municipalities that are in a six-month window around the liberation date of their provincial capital (i.e., from four months before to one after). The interaction term is positive and statistically significant, with the effect of the BBC signal that almost doubles if the municipality is about to be liberated. This is suggestive that BBC was used to coordinate partisan attacks particularly when and where the Allies offensive was more intense, and hence the support of partisan brigades more useful and effective.<sup>40</sup>

<sup>39</sup>To further document that the variability identified in our data is capturing meaningful variations in the BBC signal quality, we investigate the presence of nonlinearities in the effect of the BBC signal strength. We find that an improvement in the BBC signal was particularly effective when more needed, i.e., in the bottom quartile of the signal distribution (a SNR between 38 and 55). These results are available upon request to the authors.

<sup>40</sup>See also column 6 in online Appendix Table A.2, where we also include in our sample municipality-month observations that, by being far from the battlefield, are characterized by a lower incidence of military operations. In line with expectations on a coordinating role played by the BBC, which becomes more relevant in closer proximity of the battlefield, the estimated effect of the BBC signal strength is still positive but no longer statistically significant. It is also smaller in magnitude than that reported in column 1 of Table 2.

TABLE 5—BBC AND NAZI-FASCIST VIOLENCE—MECHANISM (1)

	Close window (1)	Lag effects (2 months) (2)	Lag effects (4 months) (3)
BBC	0.021 (0.006)	0.030 (0.08)	0.029 (0.008)
BBC × Close window	0.014 (0.004)		
Average BBC previous 2 months		−0.003 (0.008)	
Average BBC previous 4 months			−0.003 (0.008)
Municipality fixed effects	Yes	Yes	Yes
Year-month fixed effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Average outcome	0.0507	0.0507	0.0507
Number of municipality-months	66,197	66,197	66,197

*Notes.* The dependent variable is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance. *BBC* is the average BBC signal (SNR) between month  $t$  and month  $t - 1$ . *Controls* include the average rain precipitations, the average cloud coverage and the average temperature in the month. *Close window* is a dummy for being in a six-month window around the liberation date of the provincial capital (from four months before to one month after). Standard errors robust to clustering at province level.

### B. Past Exposure

On the one hand, if the BBC enhanced coordination among insurgents by providing them with operational orders or news on the approach of the Allied Forces, we should mainly detect a contemporaneous (i.e., in a given time  $t$ ) effect of the BBC signal strength on the number of episodes of Nazi-fascist violence. On the other hand, if the BBC also motivated partisan insurgents or the same civilian population to engage in insurgency activities to fight against the Nazi-fascists or to undertake actions of disobedience, then we should observe a significant lagged effect of the quality of the BBC signal on our dependent variable.

We investigate this issue in columns 2 and 3 of Table 5, where we include in equation (1) a measure of the average quality of the BBC signal in the previous two and four months, respectively. This specification should be able to capture the effect of a prolonged exposure to BBC broadcast. Similarly to what we found in Figure 7, results confirm the importance of the effect of contemporaneous broadcasting by the BBC, while the coefficients of the variables referring to the quality of the BBC signal over the previous months are not statistically different from zero.<sup>41</sup> We interpret this evidence as suggestive that the BBC played a relevant role in coordinating operational activities of the resistance movement, but had a lesser role in motivating and mobilizing civilians to join and support the movement.

<sup>41</sup> Similar results could be obtained by looking at the average BBC signal in the previous six months (estimates available upon request).

TABLE 6—BBC AND NAZI-FASCIST VIOLENCE—MECHANISM (2)

	Spatial spillovers (1)	Spatial spillovers (2)	Spatial spillovers (3)
Average BBC neighbor	0.030 (0.008)	0.021 (0.011)	0.049 (0.017)
BBC		0.010 (0.009)	0.061 (0.022)
BBC × average BBC neighbor			−0.001 (0.000)
Municipality fixed effects	Yes	Yes	Yes
Year-month fixed effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Average outcome	0.0507	0.0507	0.0507
Number of municipality–months	66,197	66,197	66,197

*Notes:* The dependent variable is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance. *BBC* is the average BBC signal (SNR) between month  $t$  and month  $t - 1$ . *Average BBC neighbor* is the average BBC signal (SNR), between month  $t$  and month  $t - 1$ , in all the municipalities sharing a border with a given municipality  $i$ . *Controls* include the average rain precipitations, the average cloud coverage and the average temperature in the month. Standard errors are computed by accounting for spatial correlation among municipalities that fall within 100 kilometers of each other (Conley 1999).

### C. Spatial Spillovers

As we explained before, in a typical month the BBC broadcasts could include tactical information sent to partisan troops on the ground. Clearly, some of these broadcasts were targeted at specific municipalities, while some others were targeted at broader areas. Although we do not have any information on the messages, including the eventual geographical targeting, we could still learn something on the extent of coordination across areas by looking at whether there is any evidence of spatial spillovers in insurgent activities depending on the quality of the BBC signal across neighboring municipalities (i.e., municipalities sharing a border with a given municipality  $i$ ).

Specifically, we follow Yanagizawa-Drott (2014) and estimate spillovers by calculating the population-weighted average of the BBC signal in all neighboring municipalities.

In column 1 of Table 6 we report the coefficient on the average BBC signal in neighboring municipalities which is positive and significant.<sup>42</sup> After rescaling the coefficient to account for the population size in neighboring municipalities, the magnitude is around 1/12 of the baseline coefficient of Table 2.<sup>43</sup> In column 2 we

<sup>42</sup>To account for the spatial autocorrelation in the BBC signal, as we do in column 1 of Table 3, we report estimates with standard errors corrected for spatial correlation among municipalities that fall within 100 kilometers from each other, as suggested in Conley (1999).

<sup>43</sup>The total population size in neighboring municipalities is around 53,356, while the one in the average municipality is equal to 5,565. Hence, the population exposed to the BBC signal in neighboring municipalities is on average 9.6 times larger than the one in the average municipality. Accordingly, when rescaling the spillover effect by the relative average population, the marginal effect of an increase in the population having access to a better BBC signal in neighboring municipalities is approximately  $0.049/9.6 = 0.005$ , which is around 1/12 of an increase in the share of population experiencing an improvement in the BBC signal in municipality  $i$ .

include both the average BBC signal in neighboring municipalities and in municipality  $i$ . When doing so, both the significance and the size of the coefficients drop. This points at the presence of a certain degree of spatial autocorrelation in the BBC signal, as also suggested by Figure 3.

Yet, once we allow for potential complementarity/substitutability by introducing an interaction between the two signals, the coefficient on the main two terms becomes statistically significant again. This shows that there is indeed a direct effect of BBC signal in neighboring municipalities on the number of episodes of Nazi-fascist violence in municipality  $i$ , beyond possible spurious effects due to spatial autocorrelation. Moreover, the coefficient on the interaction term is negative and statistically significant, pointing at the presence of some degree of substitutability.

There are two plausible and not mutually exclusive interpretations of these findings. First, when neighboring municipalities receive a better signal, they are able to communicate the information received to partisans in municipality  $i$ , who also become more active and hence induce more local retaliation. In other words, the positive direct effect of the signal received by the neighboring municipality is evidence of communication on the ground. Second, it is also possible that when neighboring municipalities are more aggressive, because they receive a better signal, some of the German retaliation also falls on municipality  $i$  (without necessarily going through direct communication on the ground). The negative interaction term suggests that the quality of the BBC signal in municipality  $i$  is less important when other surrounding municipalities also receive a good signal. This too can be interpreted as either evidence of a substitution between the effort exerted by partisans in neighboring municipalities, or as evidence that the retaliation by the Germans on municipality  $i$  is diluted when its neighboring municipalities become more active at the same time.

#### D. *Competing Radios*

What role did other competing radios play in these war years? As explained in Section II, besides the BBC there were at least other two main radio stations actively involved in the “war of the waves” at that time. They were the official radio of the fascist regime (EIAR) and the radio of the Allied Forces (AF Radio). Differently from the BBC, both radios were exclusively engaged in promoting propaganda.<sup>44</sup>

Columns 1 and 2 of Table 7 report estimates from specifications where we include, respectively, a measure of quality of the EIAR and of the AF Radio signal besides the BBC signal strength. As explained in Section III, to deal with the potential endogeneity of the transmitters location, as in Olken (2009) and Durante et al. (2015), the theoretical radio signal intensity in the absence of any geomorphological obstacles is also included in these specifications. The estimated coefficient of the BBC signal strength is still positive and statistically significant in both columns.

<sup>44</sup> In those years, another important radio broadcasting in Italy on both medium waves and shortwaves was Radio Moscow, the official international broadcasting station of the Union of Soviet Socialist Republics. Unfortunately, we do not have any information on its transmissions, although it is important to stress that the goal of this radio was never to support resistance activities on the ground.

TABLE 7—BBC AND NAZI-FASCIST VIOLENCE—MECHANISM (3)

	EIAR (1)	AF Radio (2)	Bombings (3)	Bombings (infr. versus non-infr.) (4)
BBC	0.029 (0.008)	0.027 (0.008)	0.030 (0.008)	0.029 (0.008)
EIAR	0.001 (0.000)			
AF Radio		0.001 (0.000)		
Days bombings (German targets)			0.411 (0.206)	
Days bombings (non-German targets)			0.044 (0.149)	0.065 (0.146)
Days bombings (German targets–infr.)				1.021 (0.412)
Days bombings (German targets–non infr.)				0.091 (0.222)
BBC × Days bombings (German targets)			–0.007 (0.003)	
BBC × Days bombings (non-German targets)			–0.001 (0.002)	–0.001 (0.002)
BBC × Days bombings (German targets–infr.)				–0.018 (0.007)
BBC × Days bombings (German targets–non infr.)				–0.001 (0.004)
Municipality fixed effects	Yes	Yes	Yes	Yes
Year-month fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Average outcome	0.0542	0.0507	0.0507	0.0507
Number of municipality–months	61,782	66,197	66,197	66,197

*Notes:* The dependent variable is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance. *BBC* is the average BBC signal (SNR) between month  $t$  and month  $t - 1$ . *EIAR* and *AF Radio* is the effective signal intensity in month  $t$  of EIAR and Allied Forces radio, respectively. *Days bombings (German)* represents the number of days in month  $t$  with bombing attacks by the Allies over the municipality with German targets. *Days bombings (German–infr.)* represents the number of days in month  $t$  with bombing attacks by the Allies over the municipality with German (infrastructures, i.e., nonmovable) targets. *Controls* include the average rain precipitations, the average cloud coverage, and the average temperature in the month. In columns 1 and 2 we also control for the theoretical radio signal intensity in the absence of orographic obstacles of EIAR and Allied Forces Radio, respectively. Standard errors robust to clustering at province level.

More importantly, the coefficients of the EIAR and of the Allied Forces radio signal are both positive, but only marginally significant.

Our interpretation is that broadcasts by the fascist radio EIAR could have provided some motivation to act against resistance groups or, vice-versa, may have had a backfiring effect and pushed people to rebel against the Nazi-fascist regime (see Adena et al. 2015). However, our evidence seems to suggest that the BBC played a more relevant role than the fascist or Allied Forces radio in the war events, possibly because it was also engaged in coordinating insurgency activities on the ground.<sup>45</sup>

<sup>45</sup> A caveat is in order, however: the monthly variation in the signal of these two radio stations is smaller than for the BBC, and this can limit the power of our econometric exercise.

### E. Allied Bombings

In this section we investigate whether there was any interplay between the BBC radio service, the Allied bombing over Italy and the occurrence of Nazi-fascist violence. The Allied bombing of Italy intensified toward the end of 1942 and continued until the end of the war. It had two main purposes: breaking the morale of the Nazi-fascist troops and destroying military targets.

We gather data on bombing attacks carried out by the Allied Forces in Italy during the WWII from the Theater History of Operations Reports (T.H.O.R. Lt Col Robertson et al. 2013). Following Bianchi and Giorcelli (2018), we classify bombing attacks according to whether they had a German target (e.g., air strikes executed in support of ground operations against the German troops) or not.<sup>46</sup> We measure the intensity of bombings over a municipality by the number of days in a month in which a municipality was under Allied bombing attack (with both German and non-German targets), and we then interact it with the BBC signal strength.<sup>47</sup>

Of course, this exercise must take into consideration that unobserved determinants of military activities on the ground could be correlated with the timing and location of bombing strikes. Given that we only exploit within-municipality variation, and that the Allied Forces could not predict the quality of BBC signal in a given municipality and month, reverse causation (from partisan activities to bombings) is less of a concern, at least with regard to bombing of preexisting infrastructures.<sup>48</sup> Therefore, the identifying assumption is that the timing and the number of the bombings over a certain municipality were orthogonal to the timing of the partisan activities on the ground. For unmovable targets (e.g., armaments' production facilities that had to be destroyed no matter what), this entails assuming that the Allies could not communicate with local partisan brigades other than through BBC messages, which is not an implausible hypothesis. The assumption that bombings are exogenous and uncorrelated with unobserved determinants of German retaliation is more restrictive when it comes to movable targets, however. The reason is that the passage of a movable target in the proximity of locality  $i$  could trigger both bombings and partisan attacks, inducing a correlation between bombings and the error term of our regression. Moreover, bombings or partisan attacks could affect the location of these movable targets. For this reason, we not only classify targets as German and non-German but, among the former ones, we also distinguish those that are infrastructures from those that are not.

Estimates in column 3 of Table 7 show that an increase in the number of days of Allied bombing of German targets is positively correlated with the occurrence of Nazi-fascist violence in a given municipality. Column 4 suggests that such correlation is mainly driven by the bombing of infrastructures under German control.

<sup>46</sup>Specifically, a bombing attack is classified as having a German target if it falls in one of the following categories: direct cooperation with ground forces; troop concentrations; radar installations; gun emplacements; weapon launching sites; tactical targets; supply dumps; tracks and marshaling yards; moving trains; highways and vehicles; and transportation facilities (Bianchi and Giorcelli 2018, 10).

<sup>47</sup>In our sample, on average, a municipality experiences in a month, 0.019 days of bombing attacks with German targets and 0.35 days of attacks with non-German targets.

<sup>48</sup>The online Appendix provides a detailed discussion on the (non)predictability of the BBC radio signal at that time.



A plausible interpretation is that German troops are more violent when under stress, and hence more likely to retaliate against the local population. Note that the estimated coefficient of the BBC signal quality remains positive and statistically significant in both column 3 and 4. More interestingly, the estimate of the interaction between BBC signal strength and the bombing of German targets (in particular, infrastructures) is negative and statistically significant. This evidence suggests that an improvement in the BBC signal helped partisans to coordinate with the military effort carried out by the Allied Forces, and partisan attacks were held off during months of more intensive bombings by the Allies.

#### F. *Postwar Electoral Outcomes*

As a last test to assess whether the main mechanism at work is coordination of insurgent activities rather than motivation, we analyze the effect of the exposure to BBC broadcasts on postwar electoral outcomes. If the BBC radio service had any impact on insurgency through propaganda and motivation, it might have influenced also political behavior in the immediate postwar elections.<sup>49</sup> We report estimates from cross-sectional regressions where the dependent variables are the percentages of votes obtained by Communists (Italian communist party and other minor extreme left parties) and Socialists in the 1946 elections to the Constitutional Assembly (Table 8) and in the 1953 elections to Parliament (Tables 10 and 11). In Table 9 we only report estimates relative to the “extreme left” group as the main Communist and Socialist parties merged into a single party in the 1948 parliamentary elections. In these tables we also report the estimates of the effect of radios on the percentage of votes to the Christian Democrats, the Monarchic party, and the extreme right (the neofascist party). The explanatory variable of main interest is the average BBC signal strength between 1943 and 1945. We also include in our econometric specifications the average signal strength of the EIAR and AF Radio stations. Their estimated coefficients are reported in Tables 8–11 as well.

We are well aware that these estimates represent only correlations and do not provide evidence of any causal effect because, for instance, we are omitting potentially relevant explanatory variables. To address this concern we include in our econometric specifications province fixed effects and several control variables that account for municipal-level characteristics such as geography (altitude, area, latitude, and longitude), demographics (resident population, share of women, and share of illiterates as from the 1951 census), and past political behavior (vote shares of different parties in the last three free elections held in 1919, 1921, and 1924). For each dependent variable we also report estimates from a specification in which we include a set of control variables related to the Italian Civil War (the number of episodes of Nazi-fascist violence related to partisan or civilian resistance; the number of months in which the municipality was under Nazi-fascist occupation, and in which SS and H. Goering troops were present in the municipality; the

<sup>49</sup>Fontana et al. (2017) study how postwar election outcomes were affected by episodes of violence and the duration of the German occupation. They find that a longer occupation and harsher Nazi violence shifted votes toward the Communists (that were more active in the Resistance movement) and away from the Christian Democrats.

TABLE 8—BBC AND POSTWAR ELECTORAL OUTCOMES—1946 ELECTIONS

	Communists (1)	Communists (2)	Socialists (3)	Socialists (4)	Christian Democrats (5)	Christian Democrats (6)	Monarchists (7)	Monarchists (8)
BBC	0.331 (2.785)	0.499 (2.802)	2.105 (2.560)	2.355 (2.606)	0.651 (2.594)	0.585 (2.730)	-0.459 (0.385)	-0.495 (0.399)
EIAR	-0.017 (0.016)	-0.017 (0.016)	0.042 (0.017)	0.041 (0.017)	-0.023 (0.024)	-0.023 (0.024)	-0.008 (0.007)	-0.007 (0.006)
AF Radio	0.040 (0.015)	0.039 (0.015)	-0.027 (0.020)	-0.027 (0.020)	0.023 (0.024)	0.023 (0.024)	0.007 (0.010)	0.007 (0.010)
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Civil War controls	No	Yes	No	Yes	No	Yes	No	Yes
Average outcome	17.01	17.01	24.60	24.60	41.69	41.69	1.122	1.122
Number municipalities	5,011	5,011	5,011	5,011	5,011	5,011	5,011	5,011

*Notes:* *BBC*, *EIAR*, and *AF Radio* represent the average signal (over the period 1943–1945) of BBC, EIAR, and Allied Forces radio (respectively) in the municipality. *Communist* is the percentage of votes to the communist and other extreme left parties in the 1946 constitutional assembly elections. *Socialists* is the percentage of votes to the socialist parties in the 1946 constitutional assembly elections. *Christian Democrats* is the percentage of votes to the Christian-Democratic (DC) party in the 1946 constitutional assembly elections. *Monarchists* is the percentage of votes to the monarchic party in the 1946 constitutional assembly elections. *Controls* include altitude, area, latitude and longitude, resident population, share of women and share of illiterates as from the 1951 census, the vote shares of different parties in the last three free elections before the war (1919, 1921, and 1924). The controls also include the average theoretical radio signal intensity in the municipality (over the period 1943–1945) in the absence of orographic obstacles of EIAR and Allied Forces radio. In columns 2, 4, 6, and 8 we also include *Civil War controls*, i.e., the total number (calculated for the period between October 1943 and May 1945) of: (i) episodes of Nazi-fascist violence related to partisan or civilian resistance in the municipality; (ii) months in which the municipality was under Nazi-fascist occupation; (iii) months in which SS and H. Goering troops were present in the municipality; (iv) days with bombing attacks by the Allies with German and non-German targets, at municipality level; and (v) partisan brigades operating in the municipality. Standard errors robust to clustering at province level.

number of days with bombing attacks by the Allies; the number of partisan brigades operating in the municipality). By doing so, we account for the possibility that insurgent activities rather than the BBC propaganda had any effect on postwar electoral outcomes.

Importantly, the estimated coefficient of the BBC signal is never statistically significant. This evidence suggests that the BBC broadcasts did not have any lasting motivating effect, by affecting, for instance, the electoral behavior of the population at large in the first postwar free elections.<sup>50</sup>

## VI. Concluding Remarks

This paper provides evidence that broadcasts by a foreign mass media influenced the activities of insurgent groups opposing an oppressive military regime. We show that at the end of World War II, improvements in the quality of reception of the BBC, due to exogenous variations in sunspot activities, led to a significant increase in the

<sup>50</sup>The estimates also show a positive and statistically significant correlation between the strength of EIAR and AF Radio and the percentage of votes to socialists and communists, respectively, in the 1946 and 1953 elections. Again, this may reflect the propaganda-only nature of such radios in comparison to the BBC.

TABLE 9—BBC AND POSTWAR ELECTORAL OUTCOMES—1948 ELECTIONS

	Extreme left (1)	Extreme left (2)	Christian Democrats (3)	Christian Democrats (4)	Monarchists (5)	Monarchists (6)	Extreme right (7)	Extreme right (8)
BBC	−1.180 (5.463)	−0.816 (5.530)	0.030 (3.893)	−0.197 (3.958)	0.307 (0.325)	0.396 (0.328)	0.358 (0.271)	0.402 (0.294)
EIAR	0.019 (0.023)	0.018 (0.023)	−0.023 (0.022)	−0.022 (0.022)	0.004 (0.004)	0.004 (0.004)	0.003 (0.004)	0.002 (0.004)
AF Radio	0.020 (0.029)	0.018 (0.029)	0.014 (0.023)	0.015 (0.023)	−0.017 (0.008)	−0.016 (0.008)	−0.007 (0.004)	−0.007 (0.004)
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Civil War controls	No	Yes	No	Yes	No	Yes	No	Yes
Average outcome	37.41	37.41	54.25	54.25	1.007	1.007	1.126	1.126
Number of municipalities	5,011	5,011	5,011	5,011	5,011	5,011	5,011	5,011

*Notes:* BBC, EIAR, and AF Radio represent the the average signal (over the period 1943–1945) of BBC, EIAR, and Allied Forces radio (respectively) in the municipality. *Extreme left* is the percentage of votes to the communist, socialist, and other extreme left parties in the 1948 parliamentary elections. *Christian Democrats* is the percentage of votes to the Christian-Democratic (DC) party in the 1948 parliamentary elections. *Monarchists* is the percentage of votes to the monarchic party in the 1948 parliamentary elections. *Extreme right* is the percentage of votes to the neo-fascist party in the 1948 parliamentary elections. *Controls* include altitude, area, latitude and longitude, resident population, share of women and share of illiterates as from the 1951 census, and the vote shares of different parties in the last three free elections before the war (1919, 1921, and 1924). The controls also include the average theoretical radio signal intensity in the municipality (over the period 1943–1945) in the absence of orographic obstacles of EIAR and Allied Forces radio. In columns 2, 4, 6, and 8 we also include *Civil War controls*, i.e., the total number (calculated for the period between October 1943 and May 1945) of: (i) episodes of Nazi-fascist violence related to partisan or civilian resistance in the municipality; (ii) months in which the municipality was under Nazi-fascist occupation; (iii) months in which SS and H. Goering troops were present in the municipality; (iv) days with bombing attacks by the Allies with German and non-German targets, at municipality level; and (v) partisan brigades operating in the municipality. Standard errors robust to clustering at province level.

number of violent episodes perpetrated by the Nazi-fascists in Italian municipalities in response to partisan or civilian resistance.

The evidence also suggests that the BBC played an important role in coordinating resistance activities against the foreign occupation, but probably had a minor role in mobilizing the civilian population against the fascist regime. This is somehow in contrast to other papers that have studied the role of the radio in disseminating political propaganda (Yanagizawa-Drott 2014; Adena et al. 2015; DellaVigna et al. 2014; Garcia-Arenas 2016). A possible explanation is that, in our context, most of the opposition to the Nazi-fascist regime was catalyzed by the emergence of formally organized brigades, which largely benefited from tactical information on the Allied military activities rather than from counterpropaganda. Indeed, resistance to an oppressive military regime or to an organized occupying force typically faces severe coordination problems. This was certainly true in Italy during the Nazi-fascist occupation: partisan brigades often enjoyed the support of the local civilian population, but operated undercover and with few directions from their national leaders. In these circumstances, organizational and coordination challenges were of paramount importance, and external directions and assistance through the radio or other media could significantly increase the effectiveness of resistance activities. The BBC fulfilled this role by providing information about

TABLE 10—BBC AND POSTWAR ELECTORAL OUTCOMES—1953 ELECTIONS (1)

	Communists (1)	Communists (2)	Socialists (3)	Socialists (4)	Christian Democrats (5)	Christian Democrats (6)
BBC	−2.920 (3.291)	−2.553 (3.382)	−1.584 (1.696)	−1.518 (1.760)	0.754 (1.802)	0.762 (1.819)
EIAR	−0.010 (0.017)	−0.010 (0.017)	0.037 (0.013)	0.036 (0.013)	−0.020 (0.026)	−0.019 (0.026)
AF Radio	0.036 (0.018)	0.035 (0.018)	−0.024 (0.015)	−0.025 (0.015)	0.029 (0.025)	0.029 (0.026)
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Civil War controls	No	Yes	No	Yes	No	Yes
Average outcome	18.70	18.70	19.48	19.48	47.60	47.60
Number of municipalities	5,011	5,011	5,011	5,011	5,011	5,011

*Notes:* *BBC*, *EIAR*, and *AF Radio* represent the average signal (over the period 1943–1945) of BBC, EIAR, and Allied Forces radio (respectively) in the municipality. *Communist* is the percentage of votes to the communist and other extreme left parties in the 1953 parliamentary elections. *Socialists* is the percentage of votes to socialist parties in the 1953 parliamentary elections. *Christian Democrats* is the percentage of votes to the Christian-Democratic (DC) party in the 1953 parliamentary elections. *Controls* include altitude, area, latitude and longitude, resident population, share of women and share of illiterates as from the 1951 census, and the vote shares of different parties in the last three free elections before the war (1919, 1921, and 1924). The controls also include the average theoretical radio signal intensity in the municipality (over the period 1943–1945) in the absence of orographic obstacles of EIAR and Allied Forces radio. In columns 2, 4, and 6 we also include *Civil War controls*, i.e., the total number (calculated for the period between October 1943 and May 1945) of: (i) episodes of Nazi-fascist violence related to partisan or civilian resistance in the municipality; (ii) months in which the municipality was under Nazi-fascist occupation; (iii) months in which SS and H. Goering troops were present in the municipality; (iv) days with bombing attacks by the Allies with German and non-German targets, at municipality level; and (v) partisan brigades operating in the municipality. Standard errors robust to clustering at province level.

military targets and the movement of enemy troops, and also by letting the insurgents know that they were not alone and that their acts of insurgency were deemed strategically important by the Allies.

Our findings also suggest that the BBC strategy was effective. The BBC deliberately targeted groups and individuals who were already active or engaged in the resistance activities, beyond speaking to the masses (Davison 1963). The German violent reaction associated with an improved BBC signal strength is a confirmation that the partisan activities induced by the BBC were right on target, and that the military and strategic goals of the resistance movement were met.

TABLE 11—BBC AND POSTWAR ELECTORAL OUTCOMES—1953 ELECTIONS (2)

	Monarchists (1)	Monarchists (2)	Extreme right (3)	Extreme right (4)
BBC	2.415 (1.627)	2.207 (1.557)	1.029 (0.998)	1.006 (1.026)
EIAR	0.006 (0.010)	0.006 (0.010)	−0.004 (0.005)	−0.004 (0.005)
AF Radio	−0.029 (0.014)	−0.029 (0.013)	−0.007 (0.007)	−0.007 (0.007)
Province fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Civil War controls	No	Yes	No	Yes
Average outcome	4.538	4.538	3.626	3.626
Number of municipalities	5,011	5,011	5,011	5,011

*Notes:* BBC, EIAR, and AF Radio represent the average signal (over the period 1943–1945) of BBC, EIAR, and Allied Forces radio (respectively) in the municipality. *Monarchists* is the percentage of votes to the monarchic party in the 1953 parliamentary elections. *Extreme right* is the percentage of votes to the neo-fascist party in the 1953 parliamentary elections. *Controls* include altitude, area, latitude and longitude, resident population, share of women and share of illiterates as from the 1951 census, and the vote shares of different parties in the last three free elections before the war (1919, 1921 and 1924). The controls also include the average theoretical radio signal intensity in the municipality (over the period 1943–1945) in the absence of orographic obstacles of EIAR and Allied Forces radio. In columns 2 and 4 we also include *Civil War controls*, i.e., the total number (calculated for the period between October 1943 and May 1945) of (i) episodes of Nazi-fascist violence related to partisan or civilian resistance in the municipality; (ii) months in which the municipality was under Nazi-fascist occupation; (iii) months in which SS and H. Goering troops were present in the municipality; (iv) days with bombing attacks by the Allies with German and non-German targets, at municipality level; and (v) partisan brigades operating in the municipality. Standard errors robust to clustering at province level.

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