

War of the Waves: Radio and Resistance During World War II*

Stefano Gagliarducci[†] Massimiliano Gaetano Onorato[‡]
Francesco Sobbrío[§] Guido Tabellini[¶]

November, 2018

Abstract

What is the role of the media in coordinating and mobilizing insurgency against a foreign military occupation? We analyze this question in the context of the Nazi-fascist occupation of Italy during WWII. We study the effect of BBC radio (*Radio Londra*) on the intensity of internal resistance to the Nazi-fascist regime. By exploiting variations in monthly sunspot activity that affect the sky-wave propagation of BBC broadcasting towards 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 fascist regime.

Keywords: Media, BBC, Insurgency, Violence, WWII, Sunspots.

JEL Classification: D74, L82, N44.

*We thank Bruno Caprettini, Mirko Draca, Marco Manacorda, Paolo Morandotti, Tommaso Nannicini, Maria Petrova, Giulio Seccia, Andrea Tesei, Joachim Voth and seminar participants at the Catholic University of Milan, Tor Vergata University, Università Politecnica delle Marche, University of Exeter, EPCS 2018, 15th Media Economics Workshop, 1st Political Economy of Development Conference, 2nd Economics of Media Bias Workshop, 2nd Marco Fanno Alumni Workshop, Petralia Sottana Workshop 2017, and ICEEE 2017 for many helpful suggestions. We also thank Fabrizio Murè and Fabio Principe for the development of the *RadioPropagAnDA* software, and Filippo Sinagra for his precious insights on cryptography during the Resistance. We are grateful to Ben Olken for providing the software necessary for *ITM* calculation, Ruben Enikolopov for his help with the *ITM* software and Martin Watkins for sharing his data on BBC transmitters. Riccardo Bianchi Vimercati, Igor Cerasa, Viola Corradini and Nicola Fontana provided an outstanding research assistance.

[†]Department of Economics and Finance and CEIS, University of Rome Tor Vergata; EIEF; IZA; Dondena.

[‡]Department of Economics and Finance, Università Cattolica del Sacro Cuore.

[§]Department of Economics and Finance, LUISS “G. Carli”; CESifo.

[¶]Department of Economics and IGIER, Bocconi University; CIFAR; CEPR; CESifo.

1 Introduction

During 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 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 about 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 towards an active resistance, besides providing information and counter-propaganda for the masses. Specifically, the BBC provided accurate and reliable information on the Allied Forces' military campaigns and on resistance activities. It also diffused counter-propaganda 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 UK and relied on the ionospheric propagation of short and medium-waves (BBC, 1944). Time variation in signal strength within municipalities was induced by seasonal changes in daylight time and by monthly variation in sunspot activity. At the same time, different geographic areas in Italy

were differently affected, depending on their location relative to BBC transmitters (which did not change throughout the civil war period). 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).

Our main result is that BBC signal strength is positively associated with the intensity of resistance. A 10% increase in signal strength (corresponding to almost one standard deviation) increases the number of episodes of Nazi-fascist violence related to partisan and civilian resistance by almost four 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 2, the Italian BBC program provided counter-propaganda 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 is stronger in the proximity of the liberation, when military activity was more intense and the marginal value for the Allies of attacks 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 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 post-war 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).¹ 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.² 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, which 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.³

¹Enikolopov *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.

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

³More generally, our paper is also related to the literature on foreign intervention in weakly institutionalized

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), 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).⁴ 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 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 2 illustrates the historical background. Section 3 describes the data. Section 4 explains our empirical strategy. Section 5 presents the main empirical results, while Section 6 discusses possible mechanisms at work. Section 7 concludes. 7 reports additional results which we also discuss in the main text. For the interested reader, the on-line 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.

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 counter-propaganda during the 1991 Russian presidential elections on the support to Yeltsin.

⁴DellaVigna *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 counter-propaganda 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.

2 Background

2.1 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 so called Gustav line) until the Spring of 1944. From there, the battlefield moved quickly to another German line of defense, the 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.

2.2 The Italian Service of the BBC

The Italian Service of the BBC started in the autumn of 1939 with a 15 minutes 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 four hours and fif-

teen minutes of daily broadcasting ([BBC, 1945](#)).⁵ During the Italian Civil War (October 1943 - May 1945), the Italian program of the BBC was structured in three main sections: 1) News bulletins broadcast hourly, at half past the hour, from the afternoon until 11.30pm ([BBC, 1944](#)). Importantly, the news bulletins were often followed by coded “special messages” conveying logistic and military information to resistance fighters (see Section 2.3); 2) “London Calling Italy” which was 30 minutes long ([Piccialuti-Caprioli, 1976](#)) and broadcast at 4.30pm and 10.30pm; 3) The “Fighters and Workers Program”, fifteen minutes long and broadcast at 6.30am and 5.30pm ([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 (PWB, henceforth) and of the Allied Force Headquarters (AFHQ, henceforth) in the Fall of 1943 in Sicily. According to this survey, 61% of the respondents listened to the BBC on average 18 times a month; 47% 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% said that the BBC was the most credible, while 42% considered EIAR and German radios as the least credible. Among those who listened to either the EIAR or the German radio, 66% was interested in music and only 7% in the news ([Holt and Van de Velde 1960](#), p. 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 that was the result of the British editorial principle of separation between facts and opinion and,

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

most importantly, of a specific strategic choice of the British Counter-Propaganda.⁶

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 home-made 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 one thousand 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, p. 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.⁷

2.3 The BBC and the Resistance

Besides engaging in counter-propaganda, the BBC also supported resistance movements throughout Europe. On June 18th 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, Andre’ 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, p. 7).

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

⁶“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*, 20 September 1940).

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

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).⁸ 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, p. 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 on-line appendix provides additional details and examples of the coded messages that were sent.⁹

More generally, as exemplified by Davison (1963, p. 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

⁸The 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 handsets 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 UK (Pidgeon, 2003). Nevertheless, by relying on the same software that we use for the BBC radio (see Section 3.1.2), 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 main results are robust to controlling for the signal strength of SOE radios (these estimates reported in column (1) of Table A.2).

⁹“*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 under-cover allied corps in Italy (Bussoni 2017, p. 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.

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.”

2.4 EIAR 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 broadcasted by the EIAR. In 1931, 22% of EIAR radio programs had a clear propaganda content. This percentage increased to 33% 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 eighteen rates ([Cannistraro 1975](#), p. 243).

2.5 Radio Counter-Propaganda within Italy

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 there located and used them to broadcast counter-propaganda from within Italy. For example on August 6th, 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 broadcasted 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”.

3 Data

3.1 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 section, we use two different sets of information and softwares for the prediction of the radio signal: one to calculate the strength of the EIAR and Allied Forces Radio signals, another one for the BBC signal.

3.1.1 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 *Radio Corriere*.¹⁰ This was the weekly radio digest providing information on the broadcasting programs and, most importantly, on the location, frequency and power of the Italian radio stations. We cross-checked this information with that in [Papa \(1978\)](#); [Monteleone \(1995\)](#) and [Isola \(1996\)](#). Similarly, for the Allied Forces Radio we exploit data on EIAR transmitters along with information 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

¹⁰www.radiocorriere.teche.rai.it/.

for all Italian municipalities in each year using the Irregular Terrain Model (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) and Adena *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 strengths 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 geo-morphological 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 Section 4).

3.1.2 Radio Signal Prediction: BBC

The BBC broadcast from the UK toward Italy using medium-waves and short-waves 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 Martin Watkins. We also cross-checked it with the “Broadcasting Yearbook” (1939-1948) and Pawley (1972). The latter two sources were also used to collect information on short-wave transmitters as well as the information contained in the “Stevenson’s Radio Bulletin” (1935-1948). Nevertheless, as we explain in great detail in the on-line technical appendix, our analysis focuses on medium-wave transmissions for two main reasons. The first one concerns the characteristics of Italian radio handsets in the WWII period. In particular, only “luxury” handsets were able to receive short-wave broadcasting. The most popular receivers, such as “Radio Balilla,” were able to receive only medium-wave signals (RAI, 2017). Hence, it is reasonable to assume that only a negligible share of the Italian population and partisans were able to receive BBC short-wave radio broadcasting. In addition, on any given day multiple short-wave frequencies were used.

Hence, it is not possible to obtain a reliable estimate of the quality of BBC short-wave signal reception across Italian municipalities in a given month-year.¹¹

The medium (and short) wave broadcasting by the BBC allowed to reach very distant locations by exploiting the so-called “sky-wave” or ionospheric radio propagation, which is illustrated in Figure 1. Therefore, we cannot rely on the Irregular Terrain Model, as in the existing literature and as we do for the EIAR and “AF Radio”, given that it exploits variations in radio/TV signal strength due to physical distance and topography between the transmitting and receiving locations. To calculate the BBC signal strength in each Italian municipality, we make use of the “Voice of America Coverage Analysis Program” (VoACAP). While in the on-line technical appendix we describe in details the “sky-wave” propagation, VoACAP and the technical aspects of predicting the BBC radio signal, in the remaining part of this section we provide some basic information.

Similarly to the Irregular Terrain Model (ITM), VoACAP exploits information on transmitter locations, frequency, and power. To predict the radio signal, the VoACAP program also uses data on the latitude and longitude of the receiving 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. Variations in solar activity affect the ionosphere and, consequently, the propagation of the radio signal. Hence, holding the frequency, power and location of the radio transmitters constant (e.g., the BBC’s ones), a variation in the number of sunspots affects the different receiving locations (e.g., Italian municipalities) in different ways. This holds for every frequency-power combination of the transmitter.¹²

¹¹As we explain in details in the on-line technical appendix, the BBC had no technical instruments to obtain reliable predictions on how a given change in short-wave (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 short-wave 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 Second World War.

¹²Similarly, [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

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. 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-hertz. Specifically, it provides a predicted SNR for each BBC transmitter-frequency-power combination in each Italian municipality and month at every half-an-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 9.30pm to 11.30pm. Analogously to what done with the EIAR and the Allied Forces radio stations, our measure of the BBC signal strength for each municipality-month is the maximum of the signal strength across all BBC transmitters.

A crucial point of our empirical strategy is that the only source of time variation in predicted BBC signal strength (besides seasonality) is the monthly variation in sunspots. All other determinants of predicted signal strength (i.e., medium-waves transmitter locations, frequency and power) were constant during our sample period. Figure 2 plots the variation over time of the monthly mean total sunspots and of the average residual of the predicted BBC medium wave signal after taking into account month-year and municipality fixed effects.¹³ Overall, Figure 2 shows that the residual variation of the predicted BBC medium wave signal after controlling for seasonal effects (i.e., month of the year fixed effects) and receiver location (i.e., municipality fixed effects) is driven by variations in monthly sunspots. In particular, on average, the quality BBC medium wave signal is higher during periods of low solar activity.

It is also worth pointing out that the monthly variation in sunspots creates a variation in the BBC signal which is heterogeneous across municipalities. Indeed, the quality of the BBC signal at the receiver location (i.e., in a given municipality) depends on a complex interaction among sunspots, transmitter and receiver locations, and other inputs used by VoACAP (e.g., transmitters' frequency and power). Figure 3 illustrates the within-municipality variation in the quality of BBC medium wave signal between March 1943 and March 1944 (left panel) and

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.

¹³The monthly mean total sunspot number is obtained by taking the arithmetic mean of the daily total sunspot number over all days of each calendar month.

between March 1944 and March 1945 (right panel).

Summing up, after taking into account seasonal effects and geographical patterns, the residual variation in the BBC signal is only induced by variations in the number of sunspots, which, in turn, affect the propagation of the signal across different municipalities (see also the on-line appendix).

Note that we are not able to recover the threshold in the Signal-to-Noise Ratio 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 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 signal-to-noise ratio above 48), who was one of the main developers of VoACAP.

3.2 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*, which 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 1945.¹⁴ Overall, the *Atlas* identifies more than 5,500 episodes of Nazi-

¹⁴The *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/>.

fascist violence for a total of 23,000 victims and specify 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 to identify 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.¹⁵ 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 on-line appendix describes some examples of episodes of Nazi violence in retaliation for partisan activities, included in our data set.

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 et al. \(2000\)](#), 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. \(2017\)](#).

3.3 Sample

As discussed in Section 2, 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.¹⁶ This amounts to excluding 77% of municipalities in Campania and all municipalities in Apulia, Basilicata, Calabria, Sicily and Sardinia. We also exclude all municipalities in the region of Valle

¹⁵We 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 \(2015, p. 148\)](#) “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).

¹⁶Given the fuzziness of the Gustav line (e.g., it moved from September to December) and to capture portions of a municipality above it, we also include municipality whose centroid lies within 50 kilometers south of the Gustav line. Results are robust to choosing different cut-offs.

d'Aosta, for which no data on victims are recorded. We are thus left with 5,873 municipalities out of the initial 8,011.¹⁷

Figure 4 shows that the Nazi-fascist violence episodes were mainly concentrated in the proximity of the front-line. As the allied troops advanced northwards, the 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 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 front-line, 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.¹⁸ 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

¹⁷Since 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 pre-war and post-war available characteristics.

¹⁸For 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.

panel of municipalities observed over a period of similar length around their liberation date. In the appendix we provide a robustness check, where we control for the (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% of our observations are located in the North of Italy and 15.7% 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.¹⁹ 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 3.1), it is important to stress that in all three cases a higher value corresponds to a better signal reception.

4 Empirical Strategy

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

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

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 3.2).²⁰ 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 log of the average medium-wave BBC signal (Signal-to-Noise Ratio) taken over the current and previous month, i.e., t and $t-1$.²¹ X_{it} is

¹⁹Notice that the 64% of municipalities in our sample never experience any episode of nazi-fascist violence

²⁰We could have used the actual number of victims instead of the number of episodes, but the latter outcome is more likely to suffer from measurement error. In Section 5.2 we experiment with this alternative dependent variable.

²¹Our results are robust to considering the BBC signal strength in month t only. Results are available upon request to the authors.

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.²² In addition, the model includes municipality fixed effects (ρ_i), and month-year fixed effects (δ_t).²³ Standard errors are clustered at the province level.

As discussed in Section 3.1.2, to identify the causal effect of the strength of the BBC signal on Nazi-fascist violence, it is necessary to control for municipality and month-year 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.²⁴ At the same time, the quality of the BBC signal varied across months of the year because of the impact on the ionospheric propagation of different average daylight (see Figure T11 in the on-line appendix), which could have an impact also on the insurgents' activity (e.g., one could expect a lower intensity of insurgency in winter). Our claim is that, after controlling for municipality and month-year fixed effects, the residual within-municipality variation in the BBC signal over time is due only to the monthly random sunspot activity, which in turn affects the quality of the radio reception in each municipality through its effect on the ionospheric propagation of the

²²Source: *Tyndall Center for Climate Change Research* (version CRU TS 1.2).

²³Table A.2 in the Appendix presents 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 3.3), which also captures any eventual backlash of Nazi-fascist troops in the immediacy of liberation; *iii*) a dummy for the presence of any S.S. 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 élites 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.

²⁴According to Gentile (2015, p. 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.

signal (as suggested by Figure 2).²⁵

Note that, as in the previous literature that exploits variation in radio or TV signal, 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). This is not a threat to our identification strategy, however, because our variable of interest, BBC_{it} , is the predicted signal strength, not the actual reception. As explained in Section 3.1.2, the variation in BBC_{it} is exclusively due to variation in the number of sunspots (which is common to all municipalities) and to seasonal patterns in daylight time affecting the ionosphere. To the best of our knowledge, there is no conclusive evidence on the effects of solar weather on terrestrial weather (Lindsay, 2013; Thompson, 2013). Nevertheless, as said, we always control for monthly rainfalls, cloud coverage and temperatures.

Before moving to the results, it is important to discuss the identification of the effect of other competing radio stations. In Section 6 we account for the broadcasting by radios other than the BBC by including in equation (1) variables that measure the signal quality of the Fascist radio EIAR and of the “AF Radio”. 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 municipality hosting a transmitter was freed from the Nazi-fascists, transmitters switched from broadcasting Fascist propaganda to anti-Fascist counter-propaganda. As explained in Section 3.1, 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 geo-morphological 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.

²⁵Another potential concern is that the information conveyed by the BBC could easily spread towards 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.

5 Results

5.1 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 estimated 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 column (2) and (3) we consider the number of episodes where victims are civilians or partisans, respectively.

The estimated coefficient reported in column (1) is positive and statistically significant. Since the variable that measures the BBC signal strength is taken in log, the estimated coefficient of 1.527 implies that a 10% increase in the signal strength is associated with an increase in the number of episodes with any type of victims of about 286%, relative to its average.²⁶

Estimated coefficients are positive and statistically significant in the remaining two columns of Table 2, where we separate episodes with civilian and partisan victims when constructing our dependent variable. Expressed as a percentage of the average outcome of interest, the effect of a 10% increase in the quality of the signal strength is considerably larger (almost 430% of its average) in column (2) where we consider episodes with civilian victims, compared to column (3) where we consider partisan victims (170%). This difference can be explained by taking into account that partisans adopted guerrilla-like strategies (i.e., attack and hide). This implies that Nazi-fascist army units typically retaliated against unarmed civilian populations (Battistelli and Crociani, 2015).²⁷

²⁶As shown in 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 month-year and municipality fixed effects. However, the estimate of the coefficient of interest is negative in column (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 U.K.) while much of the action by the partisans occurs near the battle front. That is, 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), the full set of our control variables does not have a significant impact on our coefficient of interest.

²⁷See also the on-line appendix for an illustrative description of retaliations undertaken by the Nazi-fascists.

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 2, the Italian program of the BBC provided counter-propaganda targeted to the overall Italian population. At the same time, the BBC delivered information and coded messages to Resistance fighters (see the on-line 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, we analyze in Figure 7 how episodes of Nazi-fascist violence change with respect to leads and lags of the BBC signal. We can, therefore, test for the potential presence of pre-trends in episodes of Nazi-fascist violence and study the impact over time of variations in the quality of the BBC signal on our dependent variable. In the spirit of a placebo test, up to a certain degree of serial correlation in the BBC signal over time (see Figure T11 in the on-line technical appendix), 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 . The estimates reported in graph are reassuring on the interpretation of our findings. Variations in the quality of BBC signal at time t do not have any significant impact on past episodes of Nazi-fascist violence up to time $t - 1$.²⁸ Moreover, a variation in the quality of BBC signal at time t has a positive and significant impact on episodes of Nazi-fascists violence at time t and $t + 1$, while it does not have much of an impact in later periods. 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 can be due to a crowding out effect of past episodes of Nazi-fascist violence on future ones because of the likely constraints and limitations that the insurgents' ca-

²⁸The positive correlation at time $t - 1$ can be explained by a certain degree of serial correlation in the quality of the BBC signal, especially in the presence of episodes taking place at the end of month $t - 1$.

capacity of action faced. Section 6.2 provides a detailed discussion of the effect of past exposure to BBC on our outcome variable. Most importantly, Figure 7 documents the absence of pre-trends 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.

5.2 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.²⁹ Estimates are reported in Table 3.

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. The estimated coefficient of interest remains statistically significant at the 1% level.³⁰

In column (2) 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 positive and statistically significant at the 1% level.

To strengthen the causal interpretation of our findings, in column (3) we 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 statistically significant at the 1% level. Column (4) shows that our results are robust to using a Poisson model.

Finally, in column (5) we check whether using the number of victims rather than the number of episodes of Nazi-fascist violence leads to different results. The estimated effect of broadcasting by the BBC remains positive and statistically significant and is quite sizable: a 10% increase in

²⁹Almost all the following results hold when we distinguish between civilian and partisan victims in constructing our dependent variable. These estimates are available upon request.

³⁰We obtain very similar estimates by considering a radius of 200, 300 and 400 kilometers. We also clustered standard errors at the regional level. Results were substantially similar. (see column (2) in Table A.2).

the BBC signal strength leads to an increase in the number of victims of about 430% relative to its average.³¹

5.3 Validation

In Table 4 we provide additional evidence to corroborate the interpretation that BBC broadcasts fostered insurgency against the Nazi-fascists. If the BBC had any effect on the intensity of the resistance movement by coordinating the insurgents' actions, we should expect its impact to be stronger in municipalities with active partisan brigades. We empirically test this prediction in column (1) of Table 4, by interacting the quality of the BBC signal with a dummy variable from Fontana *et al.* (2017), which takes 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 where partisan groups were active.

If the interpretation of the results so far discussed is valid, we should 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. The estimated effect of the explanatory variable of main interest on retaliations committed by Nazi-fascists is positive and statistically significant, while it is not statistically different from zero when we use episodes of violence unrelated to the resistance as dependent variable. 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 intensity of resistance activities rather than to a spike in the overall level of Nazi-fascist violence.

As an additional 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 signal-to-noise ratio of 48. Column (4) shows

³¹Results are qualitatively similar when we use a dummy for the occurrence of any episode of Nazi-fascist violence as dependent variable (see column (4) in Table A.2).

that our results hold 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.³²

6 Mechanism

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

6.1 Time to Liberation

As explained in Section 3.3, our main analysis focuses on a 12-month window around the liberation of the municipality’s provincial capital. Column (1) of Table 5 tests whether the impact of the BBC was higher in a narrower time interval around the liberation, i.e. when the intensity of confrontation between Nazi-fascist troops and partisan brigades is expected to be higher. To this end, we interact the BBC signal with a dummy that takes value of one for municipalities that are in a 6-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.³³

³²To further document that the variability identified in our data is capturing meaningful variations in the BBC signal quality, we investigate the presence of non-linearities 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 signal-to-noise ratio between 38 and 55). These results are available upon request to the authors.

³³See also column (5) in Table A.2, where we include in our sample also 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.

6.2 Past Exposure

As discussed in Section 2, historians traditionally identify two main roles that the BBC broadcasting played during WWII (Briggs, 1970). First, the BBC enhanced coordination among insurgents by providing them with operational orders or news on the approach of the Allied Forces. In this case, coordination should be empirically detected mainly through a contemporaneous (i.e., in a given time t) effect of the BBC signal strength on the number of episodes of Nazi-fascist violence. Second, the BBC might have 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. If the BBC also had a motivation effect, 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 the 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. 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.³⁴ 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.

6.3 Spatial Interactions

As we explained before, in a typical month the BBC broadcasts included propaganda messages, war accounts, and tactical information sent to partisan troops on the ground. Clearly, we are not able to directly test which of these broadcasts is driving the estimated effects. However, we could learn something on this issue by looking at whether there is any evidence of spatial correlation in insurgent activities depending on the quality of the BBC signal across neighboring

³⁴Similar results could be obtained by looking at the average BBC signal in the previous six months (these estimates available upon request).

municipalities (i.e., municipalities sharing a border with a given municipality i).³⁵

Estimates in column (4) of Table 5 point out that an increase in the average quality of the BBC signal in neighboring municipalities has a large positive impact on the number of episodes of Nazi-fascist violence. There are two plausible and not-mutually exclusive interpretation of this finding. 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 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 estimated coefficient of the interaction term between the strength of the average signal in neighboring municipalities and in a given municipality i is negative. In other words, the quality of the BBC signal in municipality i is less important when also other surrounding municipalities 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.

6.4 Competing Radios

What role did other competing radios play in these war years? As explained in Section 2, besides the BBC there were at least 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”).³⁶

³⁵This is of course not an easy task in our context, as the quality of the signal is very much correlated across space (see Figure 3), which will eventually work against finding any meaningful result. We also explored an alternative definition of neighboring municipalities by focusing on all municipalities belonging to the same province. Results are substantially similar and available upon request.

³⁶In those years, another important radio broadcasting in Italy on both medium and short-waves 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

Columns (1) and (2) of Table 6 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 4, 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 geo-morphological obstacles is also included in these specifications. The estimated coefficient of the BBC signal strength is positive and statistically significant in both columns. More importantly, the coefficients of the EIAR and of the Allied Forces Radio signal are both positive but only the first one is marginally significant. Broadcasts by the fascist radio EIAR could have provided motivation to act against resistance groups or, vice-versa, may have had a back-firing effect and pushed people to rebel against the Nazi-fascist regime (see [Adena *et al.* \(2015\)](#)).

This evidence suggests that the BBC played a more relevant role than the fascist or Allied Forces radios. 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.

6.5 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 towards 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.³⁷ We measure the intensity of bombings over a municipality by the

was never to support resistance activities on the ground.

³⁷Specifically, 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 placements;

number of days in a month in which a municipality was under allied bombing attack (with both German and non-German targets).³⁸

Our empirical strategy 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 pre-existing infrastructures.³⁹ The identifying assumption is that the timing and 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 - 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 6 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. 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

weapon launching sites; tactical targets; supply dumps; tracks and marshaling yards; moving trains; highways and vehicles; transportation facilities (page 10, [Bianchi and Giorelli \(2018\)](#)).

³⁸In 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.

³⁹The on-line appendix provides a detailed discussion on the (non) predictability of the BBC radio signal at that time.

significant in both column (3) and (4). More importantly, 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.

6.6 Post-war 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 post-war 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 post-war elections.⁴⁰ In Tables 7-9 we report estimates from cross-sectional regressions where the dependent variables are the vote shares obtained by the extreme left (Communist, Socialist and other extreme left parties), the Christian Democrats, the Monarchic party and the extreme right (the neo-fascist party) in the elections held in 1946 for the Constitutional Assembly and in 1948 and 1953 for the newly constituted Parliament. The explanatory variable of main interest is the log of the average BBC signal strength between October 1943 and May 1945. We also include in our econometric specifications the average signal strength (in log) of the EIAR and “AF radio” stations. Their estimated coefficients are reported in Tables 7-9 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

⁴⁰Fontana *et al.* (2017) study how post-war 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 towards the Communists (that were more active in the Resistance movement), and away from the Christian Democrats.

we also report estimates from a specification where we include a set of control variables related to the Italian civil war. By doing so, we account for the possibility that insurgent activities rather than the BBC propaganda had any effect on post-war electoral outcomes. Specifically, this set of variables includes the total number of episodes of Nazi-fascist violence in a given municipality; the total number of months in which a municipality was under Nazi-fascist occupation; the total number of months of presence of SS and H. Goering troops in a given municipality; the total number of days with bombing attacks by the Allies on German and non-German targets, at the municipality level; the number of partisan brigades operating in a given municipality.

Interestingly, 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 post-war free elections.

7 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 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 counter-propaganda. 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 under cover 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 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.

References

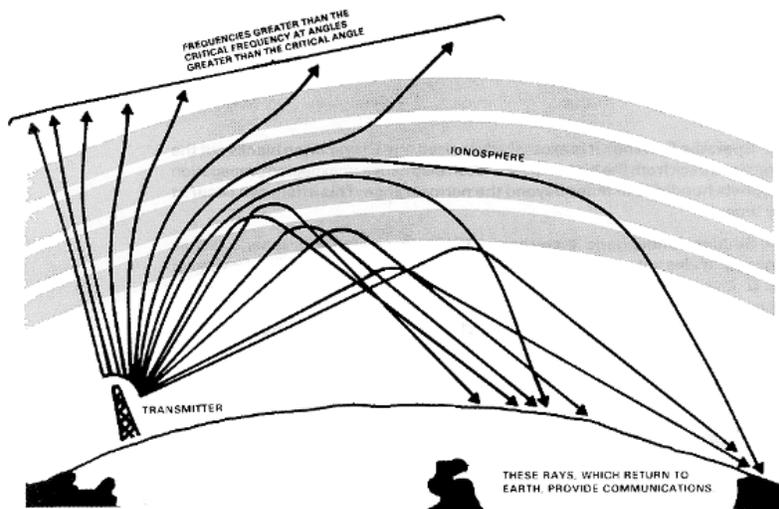
- ACEMOGLU, D., HASSAN, T. A. and TAHOUN, A. (2018). The Power of the Street: Evidence from Egypt's Arab Spring. *Review of Financial Studies*, **31** (1), 1–42.
- ADENA, M., ENIKOLOPOV, R., PETROVA, M., SANTAROSA, V. and ZHURAVSKAYA, E. (2015). Radio and the Rise of the Nazis in Prewar Germany. *The Quarterly Journal of Economics*, **130** (4), 1885–1939.
- , —, — and VOTH, H.-J. (2017). Bombs, Broadcasts, and Betrayal at the Home Front: Determinants of Treason in Germany during World War II. *Slides*.
- BALDISSARA, L. *et al.* (2000). *Atlante Storico della Resistenza italiana*. Mondadori.
- BATTISTELLI, P. P. and CROCIANI, P. (2015). *World War II Partisan Warfare in Italy*. Osprey Publishing.
- BBC (1944). *BBC Handbook*. British Broadcasting Corporation.
- (1945). *BBC Handbook*. British Broadcasting Corporation.
- (2007). BBC World Service. http://www.bbc.co.uk/worldservice/history/story/2007/02/070122_html_40s.shtml/, [Online; accessed 01-July-2018].
- BIANCHI, N. and GIORCELLI, M. (2018). Reconstruction Aid, Public Infrastructure, and Economic Growth. *Working Paper*.
- BRIGGS, A. (1970). *The War of Words: The History of Broadcasting in the United Kingdom, Vol. III*. Oxford University Press.
- BURSZTYN, L. and CANTONI, D. (2016). A Tear in the Iron Curtain: The Impact of Western Television on Consumption Behavior. *The Review of Economics and Statistics*, **98** (1), 25–41.
- BUSSONI, M. (2017). *Radio Londra: Voci dalla Libertà*. Archivio Storia.
- CANNISTRARO, P. V. (1975). *La Fabbrica del Consenso: Fascismo e Mass Media*, vol. 74. Laterza.
- CONLEY, T. G. (1999). GMM Estimation with Cross-Sectional Dependence. *Journal of Econometrics*, **92** (1), 1–45.
- DAVISON, W. P. (1963). Political Communication as an Instrument of Foreign Policy. *Public Opinion Quarterly*, **27** (1), 28–36.
- DELL, M. and QUERUBIN, P. (2018). Nation Building Through Foreign Intervention: Evidence from Discontinuities in Military Strategies. *Quarterly Journal of Economics*, **133** (2), 701–764.

- DELLAVIGNA, S., ENIKOLOPOV, R., MIRONOVA, V., PETROVA, M. and ZHURAVSKAYA, E. (2014). Cross-border Media and Nationalism: Evidence from Serbian Radio in Croatia. *American Economic Journals: Applied Economics*, **6** (3), 103–132.
- DURANTE, R., PINOTTI, P. and TESEI, A. (2015). *The Political Legacy of Entertainment TV*. CEPR Discussion Paper 10738.
- ENIKOLOPOV, R., MAKARIN, A. and PETROVA, M. (2016). *Social Media and Protest Participation: Evidence from Russia*. CEPR Discussion Paper 11254.
- , PETROVA, M. and ZHURAVSKAYA, E. (2011). Media and Political Persuasion: Evidence from Russia. *The American Economic Review*, **101** (7), 3253–3285.
- FONTANA, N., NANNICINI, T. and TABELLINI, G. (2017). *Historical Roots of Political Extremism: The Effects of Nazi Occupation of Italy*. IZA Discussion Paper 10551.
- GARCIA-ARENAS, J. (2016). *The Impact of Free Media on Regime Change: Evidence from Russia*. Working paper.
- GENTILE, C. (2015). *I Crimini di Guerra Tedeschi in Italia*. Giulio Einaudi Editore.
- HOLT, R. T. and VAN DE VELDE, R. W. (1960). *Strategic Psychological Operations and American Foreign Policy*. University of Chicago Press.
- HUFFORD, G. A. (2002). The ITS Irregular Terrain model, version 1.2. 2 the algorithm. *Institute for Telecommunication Sciences, National Telecommunications and Information Administration, US Department of Commerce*. <http://flattop.its.bldrdoc.gov/itm.html>.
- ISOLA, G. (1996). Il Microfono Conteso. La Guerra delle Onde nella Lotta di Liberazione Nazionale (1943-1945). *Mélanges de l'Ecole française de Rome. Italie et Méditerranée*, **108** (1), 83–124.
- KERN, H. L. and HAINMUELLER, J. (2009). Opium for the Masses: How Foreign Media Can Stabilize Authoritarian Regimes. *Political Analysis*, **17** (4), 377–399.
- LANE, G. (1997). Required Signal-to-Interference Ratios for Shortwave Broadcasting. *Radio Science*, **32** (5), 2091–2098.
- LINDSAY, R. (2013). Under A Variable Sun. *Earth Observatory - NASA*. <https://earthobservatory.nasa.gov/Features/VariableSun/printall.php>, [Online; accessed 01-July-2018].
- LT COL ROBERTSON, J., BURR, R. and BARTH, B. (2013). USAF THOR Database. www.afri.au.af.mil/thor, [Online; accessed 01-July-2018].
- MANACORDA, M. and TESEI, A. (2016). *Liberation Technology: Mobile Phones and Political Mobilization in Africa*. CEPR Discussion Paper 11278.

- MONTELEONE, F. (1980). *Storia della RAI dagli Alleati alla DC, 1944-1954*, vol. 114. Laterza.
- (1995). *Storia della Radio e della Televisione in Italia: Un Secolo di Suoni e di Immagini*. Marsilio.
- OLKEN, B. A. (2009). Do Television and Radio Destroy Social Capital? Evidence from Indonesian Villages. *American Economic Journal: Applied Economics*, **1** (4), 1–33.
- PAPA, A. (1978). *Storia Politica delle Radio in Italia: Dalla Guerra d’Etiopia al Crollo del Fascismo, 1935-1943*. Guida editore.
- PAWLEY, E. L. E. (1972). *BBC Engineering, 1922-1972*. British Broadcasting Corporation.
- PICCIALUTI-CAPRIOLI, M. (1976). *Radio Londra 1940-1945: Inventario delle Trasmissioni per l’Italia*. Ministero per i beni culturali ed ambientali.
- (1979). *Radio Londra, 1939-1945*, vol. 108. Laterza.
- PIDGEON, G. (2003). *The Secret Wireless War: The Story of MI6 Communications 1939–1945*. Universal Publishing Solutions Online Ltd, ISBN.
- PIFFER, T. (2010). *Gli Alleati e la Resistenza Italiana*. Il Mulino.
- QIN, B., STRÖMBERG, D. and WU, Y. (2017). Why Does China Allow Freer Social Media? Protests versus Surveillance and Propaganda. *Journal of Economic Perspectives*, **31** (1), 117–40.
- RAI (2017). Storia della Radio. <http://www.storiadellaradio.rai.it/dl/portali/site/articolo/ContentItem-0753dc40-9abf-4be6-95da-6f4dc74a471b.html>, [Online; accessed 01-July-2018].
- SHAPIRO, J. N. and WEIDMANN, N. B. (2015). Is the Phone Mightier Than the Sword? Cell-phones and Insurgent Violence in Iraq. *International Organization*, **69** (2), 247–274.
- SINAGRA, F. (1970). *La Crittografia nel Movimento di Liberazione Italiano*.
- SPRIANO, P. (1975). *Storia del Partito Comunista Italiano: La Resistenza. Togliatti e il Partito Nuovo*, vol. 5. Einaudi.
- STAFFORD, D. (2011). *Mission Accomplished: SOE and Italy 1943-1945*. Random House.
- THOMPSON, R. (2013). Solar Activity and Weather - Is there a Connection? *Australian Government - Bureau of Metereology*. <http://www.sws.bom.gov.au/Educational/1/3/13>, [Online; accessed 01-July-2018].
- YANAGIZAWA-DROTT, D. (2014). Propaganda and Conflict: Evidence from the Rwandan Genocide. *Quarterly Journal of Economics*, **129** (4), 1947–1994.

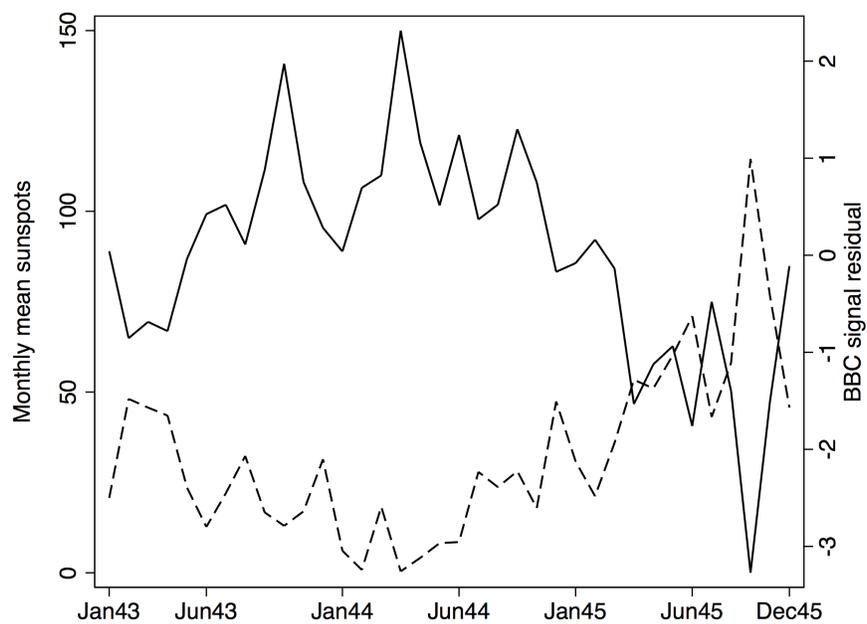
Tables and Figures

Figure 1: Sky-wave Ionospheric Propagation



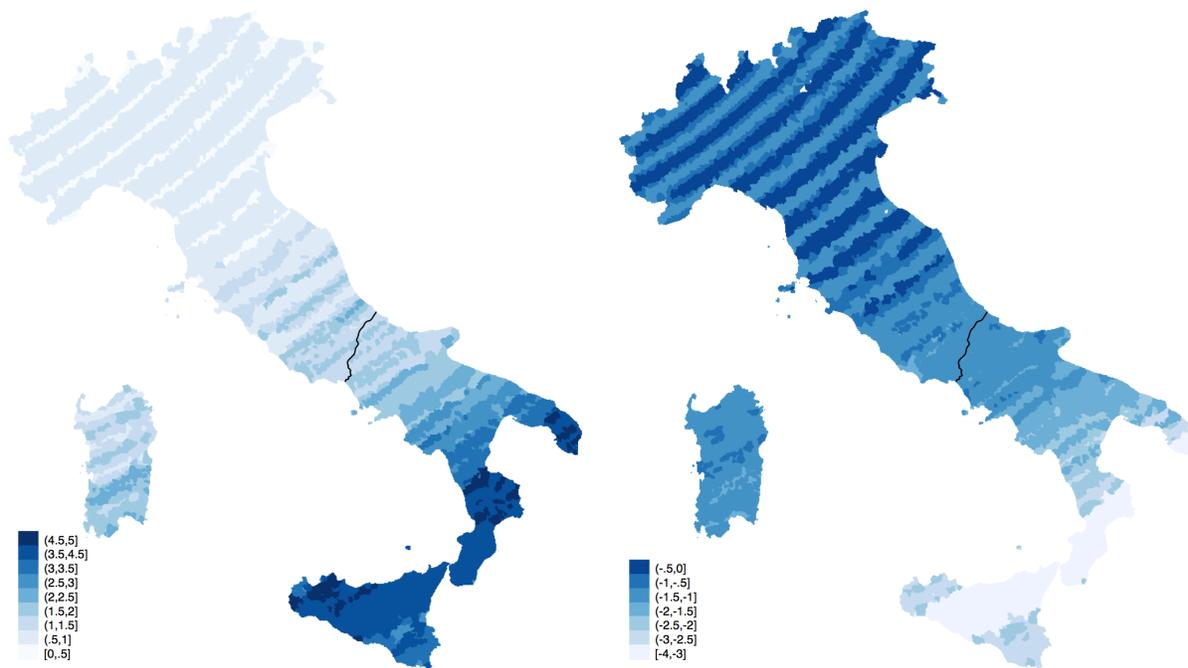
Notes. The figure illustrates the sky-wave ionospheric propagation of radio signal broadcasting.

Figure 2: BBC Signal Residual and Sunspots Over Time



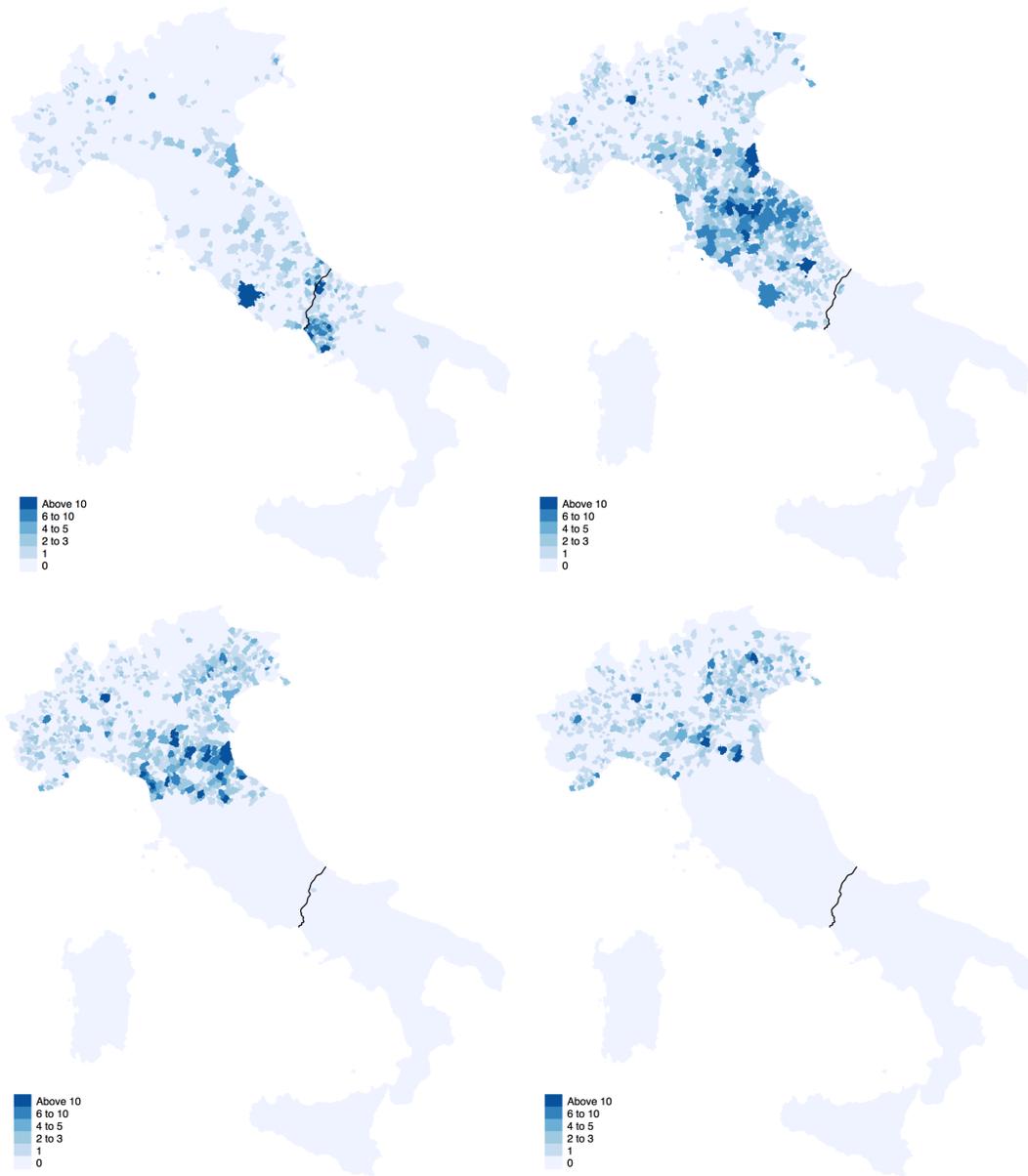
Notes. The figure illustrates the variation over time in the number of monthly mean sunspots (dashed line) and in the average residual of the predicted BBC signal once taking into account month-year and municipality fixed effects (solid line). The number of monthly mean sunspots is obtained by taking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

Figure 3: Within-Municipality Variation in BBC Signal



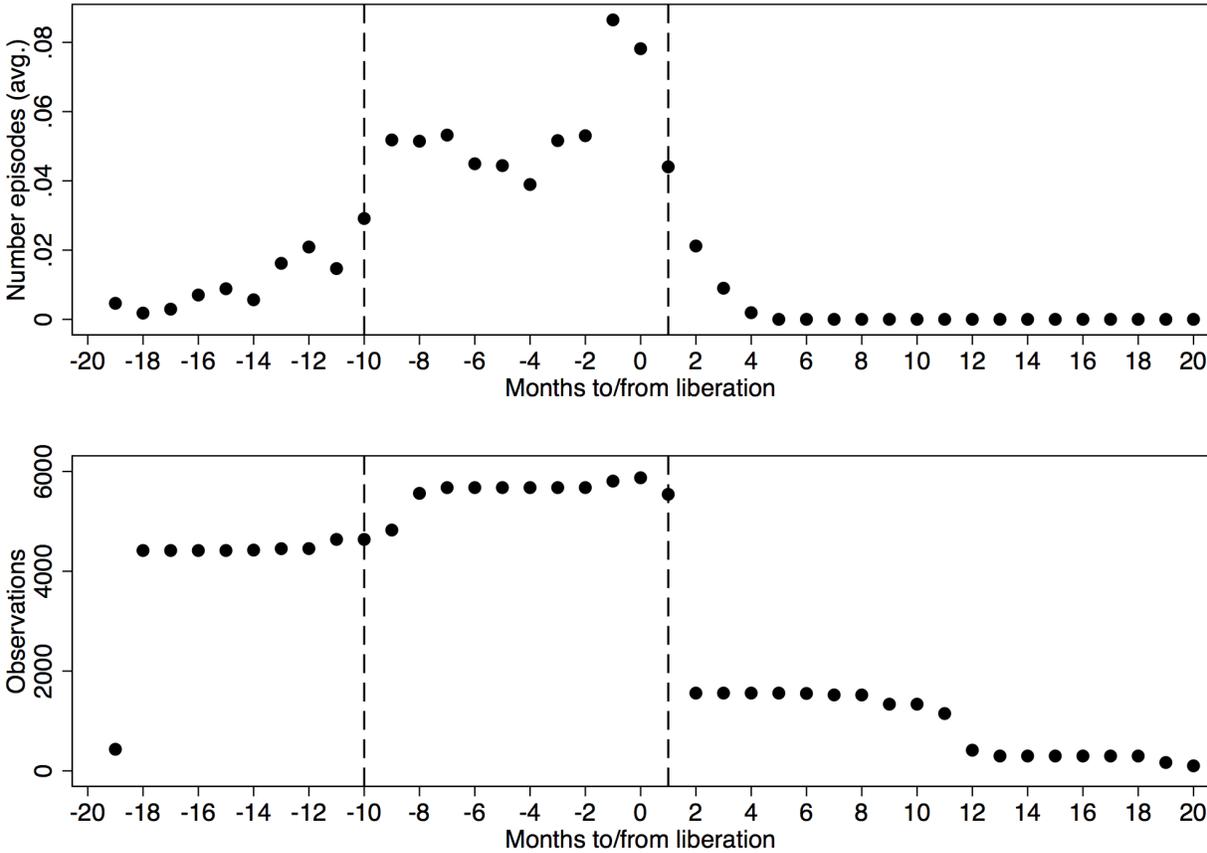
Notes. The figure illustrates the within-municipality variation in the BBC signal throughout Italy between March 1943 and March 1944 (left panel) and between March 1944 and March 1945 (right panel). The black line represents the “Gustav line”.

Figure 4: Geographical Distribution of Episodes of Nazi-fascist Violence Over Time



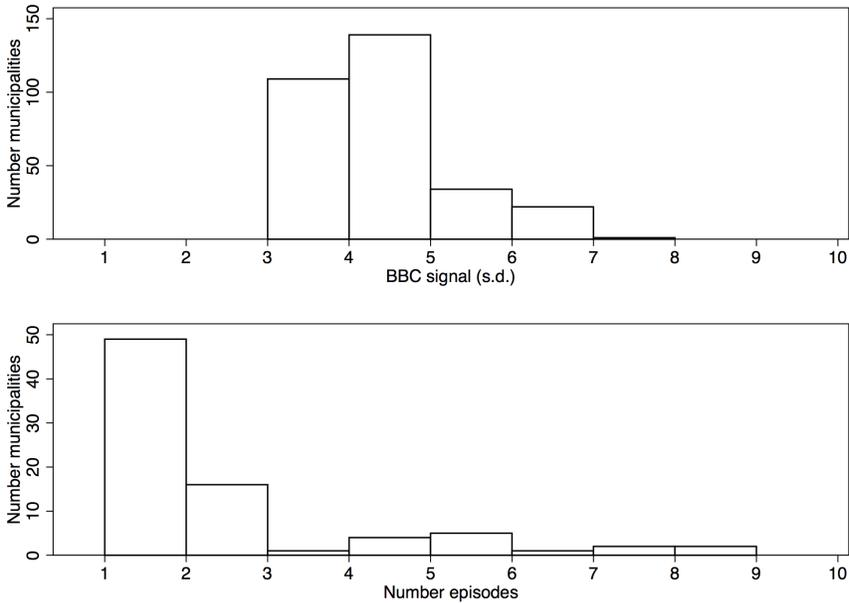
Notes. The figure illustrates the geographical distribution of episodes of Nazi-fascist violence, related to partisan or civilian resistance, throughout Italy in the periods October 1943 - February 1944 (top-left), March 1944 - July 1944 (top-right), August 1944 - December 1944 (bottom-left), and January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

Figure 5: Episodes of Nazi-fascist Violence and Observations by Months to/from Liberation



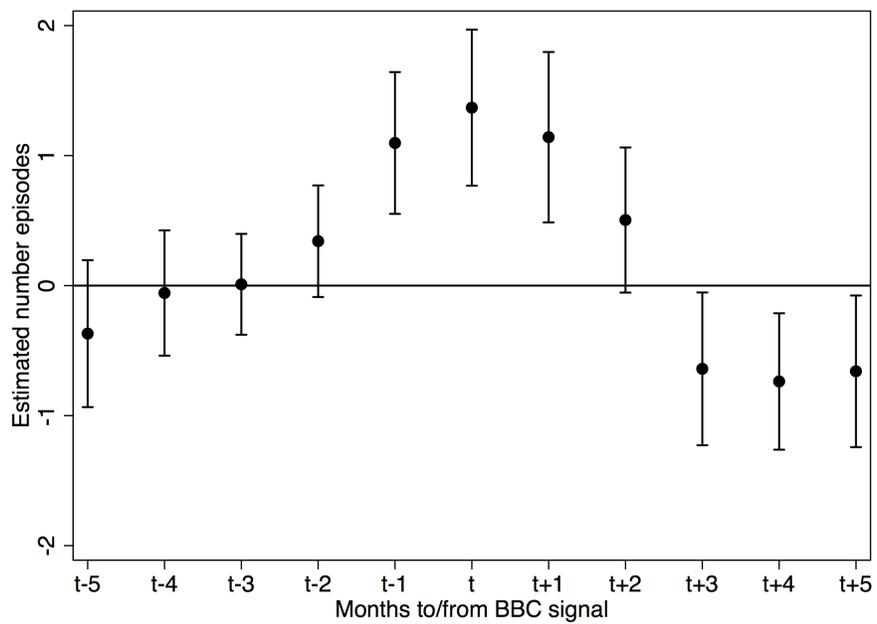
Notes. The figure illustrates the distribution of the average number of monthly episodes of Nazi-fascist violence related to partisan or civilian resistance (top) and the overall number of municipality-month observations (bottom) with respect to the liberation of the provincial capital. Dotted lines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

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).

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. 95 percent confidence intervals reported.

Table 1: Descriptive Statistics

	Mean	S.d.	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
N. 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
N. municipality-months			66,197		
N. 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. *N. 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.

Table 2: BBC and Nazi-Fascist Violence

	(1)	(2)	(3)
	Any	Civilian	Partisan
BBC (log)	1.527*** (0.360)	1.094*** (0.292)	0.439*** (0.123)
Municipality FE	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Avg. outcome	0.0507	0.0241	0.0244
N. 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 (log)* is the log of 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. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table 3: BBC and Nazi-Fascist Violence - Robustness

	(1) Conley s.e	(2) Add municipalities below Gustav	(3) Add provincial trends	(4) Poisson	(5) Number of victims
BBC (log)	1.527*** (0.373)	1.515*** (0.359)	1.226*** (0.319)		10.131*** (3.450)
BBC				0.308*** (0.055)	
Municipality FE	Yes	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes	Yes	Yes
Province trend	No	No	Yes	No	No
Controls	Yes	Yes	Yes	Yes	Yes
Avg. outcome	0.0507	0.0506	0.0507	0.877	0.224
N. municipality-months	66,197	66,569	66,197	16,927	66,197

Notes. In columns (1) to (4) the dependent variable is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance, while in column (5) it is the number of victims. *BBC (log)* is the log of the average BBC signal (SNR) between month t and month $t - 1$. *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. In column (2) we also include municipalities below the Gustav line. In column (3) we include province-specific (linear) time trends. In column (4) we estimate a Poisson model. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table 4: BBC and Nazi-Fascist Violence - Validation

	(1) Interaction brigades	(2) Only retaliations	(3) Unrelated to resistance	(4) Good reception
BBC (log)	1.492*** (0.352)	0.299*** (0.101)	0.239 (0.153)	
BBC (log) X Partisan brigades	0.137* (0.075)			
Good BBC reception				0.241*** (0.058)
Municipality FE	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Average outcome	0.0507	0.0117	0.0104	0.0507
N. 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 (log)* is the log of 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. *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 (signal-to-noise ratio above 48) according to Lane (1997). Standard errors robust to clustering at province level. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table 5: BBC and Nazi-Fascist Violence - Mechanism

	(1)	(2)	(3)	(4)
	Close window	Lag effects (2 months)	Lag effects (4 months)	Neighbor municipalities
BBC (log)	0.962*** (0.280)	1.555*** (0.362)	1.453*** (0.350)	1.093 (0.905)
BBC (log) X Close window	0.813*** (0.238)			
Avg. BBC previous 2 months (log)		-0.257 (0.374)		
Avg. BBC previous 4 months (log)			-0.277 (0.376)	
Avg. BBC neighbor (log)				17.805*** (5.461)
BBC (log) X Avg. BBC neighbor (log)				-4.787*** (1.449)
Municipality FE	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Average outcome	0.0507	0.0507	0.0507	0.0507
N. 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. *BBC (log)* is the log of 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. *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). *Avg. BBC neighbor (log)* is the log of the average BBC signal (SNR) in all the municipalities sharing a border with a given municipality i (between month t and month $t - 1$). Standard errors robust to clustering at province level. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table 6: BBC and Nazi-Fascist Violence - Mechanism (cont'd)

	(1) EIAR	(2) AF Radio	(3) Bombings	(4) Bombings (infr. vs. non-infr.)
BBC (log)	1.529*** (0.367)	1.492*** (0.372)	1.534*** (0.358)	1.532*** (0.358)
EIAR (log)	0.079* (0.041)			
AF radio (log)		0.027 (0.066)		
Days bombings (German)			1.578* (0.793)	
Days bombings (non-German)			0.178 (0.595)	0.257 (0.584)
Days bombings (German - infr.)				3.934** (1.539)
Days bombings (German - non infr.)				0.280 (0.876)
BBC (log) X Days bombings (German)			-0.386** (0.193)	
BBC (log) X Days bombings (non-German)			-0.043 (0.146)	-0.062 (0.143)
BBC (log) X Days bombings (German - infr.)				-0.969** (0.376)
BBC (log) X Days bombings (German - non infr.)				-0.065 (0.214)
Municipality FE	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Average outcome	0.0542	0.0507	0.0507	0.0507
N. 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 (log)* is the log of the average BBC signal (SNR) between month t and month $t - 1$. *EIAR (log)* and *AF Radio (log)* is the log of 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., non-movable) 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. Standard errors robust to clustering at province level. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table 7: BBC and Post-war Electoral Outcomes - 1946 Elections

	(1) Extreme left	(2) Extreme left	(3) Christian Democrats	(4) Christian Democrats	(5) Monarchists	(6) Monarchists
BBC (log)	1.855 (2.030)	1.981 (2.061)	-0.289 (1.164)	-0.182 (1.207)	-0.284 (0.221)	-0.308 (0.230)
EIAR (log)	0.045* (0.027)	0.044 (0.027)	-0.044 (0.027)	-0.045 (0.027)	-0.004 (0.007)	-0.003 (0.007)
AF radio	0.009 (0.061)	0.007 (0.061)	0.067 (0.048)	0.066 (0.047)	0.006 (0.017)	0.007 (0.017)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Civil War controls	No	Yes	No	Yes	No	Yes
Average outcome	0.416	0.416	0.417	0.417	0.0112	0.0112
N. municipalities	5,011	5,011	5,011	5,011	5,011	5,011

Notes. *BBC*, *EIAR* and *AF Radio* represent the log of the average signal (over the period October 1943 and May 1945) of BBC, EIAR and Allied Forces Radio (respectively) in the municipality. *Extreme-left* is the total vote share of communist, socialist and other extreme left parties in the 1946 constitutional assembly elections. *Christian Democrats* is the total vote share of the Christian-Democratic (DC) party in the 1946 constitutional assembly elections. *Monarchists* is the total vote share of 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 number of months (between October 1943 and May 1945) in which the theoretical radio signal intensity in the absence of orographic obstacles of EIAR and Allied Forces Radio (respectively) in the municipality was above the median (calculated over all municipalities above the Gustav line). 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; *v*) partisan brigades operating in the municipality. Standard errors robust to clustering at province level. ***, **, *, denote significant at 1, 5 and 10 percent level, respectively.

Table 8: BBC and Post-war Electoral Outcomes - 1948 Elections

	(1) Extreme left	(2) Extreme left	(3) Christian Democrats	(4) Christian Democrats	(5) Monarchists	(6) Monarchists	(7) Extreme Right	(8) Extreme Right
BBC (log)	0.620 (2.877)	0.632 (2.898)	-0.753 (2.035)	-0.730 (2.042)	0.088 (0.201)	0.143 (0.178)	0.111 (0.123)	0.135 (0.130)
EIAR (log)	0.036 (0.025)	0.037 (0.026)	-0.045* (0.025)	-0.044* (0.026)	0.004 (0.005)	0.004 (0.005)	0.004 (0.005)	0.004 (0.005)
AF radio (log)	0.026 (0.059)	0.025 (0.059)	0.049 (0.047)	0.049 (0.046)	-0.032* (0.017)	-0.032* (0.017)	-0.016 (0.010)	-0.017 (0.010)
Province FE	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	0.374	0.374	0.542	0.542	0.0101	0.0101	0.0113	0.0113
N. 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 log of the average signal (over the period October 1943 and May 1945) of BBC, EIAR and Allied Forces Radio (respectively) in the municipality. *Extreme left* is the total vote share of communist, socialist and other extreme left parties in the 1948 parliamentary elections. *Christian Democrats* is the total vote share of the Christian-Democratic (DC) party in the 1948 parliamentary elections. *Monarchists* is the total vote share of the monarchic party in the 1948 parliamentary elections. *Extreme right* is the total vote share of 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, the vote shares of different parties in the last three free elections before the war (1919, 1921 and 1924). The controls also include the number of months (between October 1943 and May 1945) in which the theoretical radio signal intensity in the absence of orographic obstacles of EIAR and Allied Forces Radio (respectively) in the municipality was above the median (calculated over all municipalities above the Gustav line). 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; *v*) partisan brigades operating in the municipality. Standard errors robust to clustering at province level. ***, **, *, . denote significant at 1, 5 and 10 percent level, respectively.

Table 9: BBC and Post-war Electoral Outcomes - 1953 Elections

	(1) Extreme left	(2) Extreme left	(3) Christian Democrats	(4) Christian Democrats	(5) Monarchists	(6) Monarchists	(7) Extreme Right	(8) Extreme Right
BBC (log)	-1.604 (1.666)	-1.478 (1.708)	0.035 (0.775)	0.097 (0.774)	0.912 (0.985)	0.828 (0.947)	0.447 (0.502)	0.463 (0.513)
EIAR (log)	-0.012 (0.020)	-0.012 (0.020)	-0.039 (0.031)	-0.039 (0.031)	0.008 (0.012)	0.008 (0.012)	-0.005 (0.007)	-0.005 (0.007)
AF radio (log)	0.046 (0.038)	0.044 (0.037)	0.084 (0.054)	0.085 (0.053)	-0.070** (0.030)	-0.069** (0.030)	-0.016 (0.015)	-0.016 (0.016)
Province FE	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	0.239	0.239	0.476	0.476	0.0454	0.0454	0.0363	0.0363
N. 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 log of the average signal (over the period October 1943 and May 1945) of BBC, EIAR and Allied Forces Radio (respectively) in the municipality. *Extreme left* is the total vote share of communist, socialist and other extreme left parties in the 1953 parliamentary elections. *Christian Democrats* is the total vote share of the Christian-Democratic (DC) party in the 1953 parliamentary elections. *Monarchists* is the total vote share of the monarchic party in the 1953 parliamentary elections. *Extreme right* is the total vote share of 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, the vote shares of different parties in the last three free elections before the war (1919, 1921 and 1924). The controls also include the number of months (between October 1943 and May 1945) in which the theoretical radio signal intensity in the absence of orographic obstacles of EIAR and Allied Forces Radio (respectively) in the municipality was above the median (calculated over all municipalities above the Gustav line). 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; *v*) partisan brigades operating in the municipality. Standard errors robust to clustering at province level. ***, **, *, denote significant at 1, 5 and 10 percent level, respectively.

Appendix

Table A.1: BBC and Nazi-Fascist Violence - Incremental Controls

	(1) No controls	(2) Add month-year FE	(3) Add municipality FE	(4) Add controls
BBC (log)	-0.376*** (0.089)	-0.724*** (0.170)	1.495*** (0.361)	1.527*** (0.360)
Municipality FE	No	No	Yes	Yes
Month-Year FE	No	Yes	Yes	Yes
Controls	No	No	No	Yes
Average outcome	0.0528	0.0528	0.0507	0.0507
N. municipality-months	66,297	66,297	66,197	66,197

Notes. The dependent variable is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance. *BBC (log)* is the log of 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. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table A.2: BBC and Nazi-Fascist Violence - Additional Robustness

	(1) SOE Radio	(2) Regional s.e.	(3) Add end. controls	(4) Any episode	(5) All months	(6) Linear- linear
BBC (log)	1.478*** (0.350)	1.527** (0.536)	1.196*** (0.299)	0.819*** (0.195)	0.176 (0.138)	
SOE (log)	-0.002 (0.004)					
BBC						0.029*** (0.008)
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Endogenous controls	No	No	Yes	No	No	No
Avg. outcome	0.0507	0.0507	0.0507	0.0367	0.0327	0.0507
N. municipality-months	66,126	66,197	66,197	66,197	119,459	66,197

Notes. The dependent variable is the number of episodes of Nazi-fascist violence related to partisan or civilian resistance except in column (4) where it is a dummy for the occurrence of any episode of Nazi-fascist violence (related to partisan or civilian resistance). *BBC (log)* is the log of the average BBC signal (SNR) between month t and month $t - 1$. *SOE (log)* is the log of the average Special Operations Executive (SOE) 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. In column (3) we also include endogenous controls: a dummy for the presence of SS and H. Goering troops, the number of days in the month with bombing attacks by the Allies with German and non-German targets, and the absolute value of the distance (in months) to the liberation of the provincial capital. In column (5) we include all available months for each municipality, i.e., not restricting to the 12-month window sampling around the time of liberation. Standard errors robust to clustering at province level, except in column (2) where we allow for clustering at region level. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.