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Radio and Resistance during World War II

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ABSTRACT

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

Can counter-propaganda by a foreign democratic country help to overthrow an authoritarian military regime? And if so, what are the mechanisms through which this happens? We analyze these questions in the context of the Nazi-fascist occupation of Italy during WWII. We study the effect of BBC radio counter-propaganda (*Radio Londra*) on the intensity of internal resistance to the Nazi-fascist regime. Using variation in monthly sunspots activities affecting 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 prove that BBC radio played an important role in coordinating resistance activities, but had no lasting role in motivating the population against the fascist regime.

JEL Classification:	D74, L82, N44
Keywords:	media, BBC, counter-propaganda, insurgency, violence, WWII, sunspots

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1 Introduction

This paper studies the effect of the media in the context of a civil war. A primary concern in these violent circumstances is to mobilize and coordinate insurgency and opposition to the occupying forces (or to prevent this from happening). The media can play a critical role in providing information, conveying propaganda or spreading emotions, and coordinating protests or violent opposition.

We study these issues in the context of the Nazi-fascist occupation of Italy between 1943 and 1945 and of the associated civil war between fascist and partisan forces that claimed about 75,000 Italian casualties. Partisan resistance played an important role in the Italian liberation and was violently opposed by the Nazi-fascist forces. We study the effects of BBC counter-propaganda (*Radio Londra*) on the intensity of the resistance movement against the Nazi occupation and fascist regime. The BBC was heavily engaged in encouraging opposition to the German occupation throughout Europe. Its strategy was to target individuals and organizations that were already inclined towards an active resistance to the German occupation, beside providing information and counter-propaganda for the masses. Specifically, the BBC provided accurate and reliable information on the military campaigns and the resistance activities. It also diffused counter-propaganda messages against the fascist regime. Finally, it conveyed encrypted messages to the partisan brigades, to direct and coordinate their military activities.

We propose a novel identification strategy that exploits exogenous time and geographic variation in the BBC signal strength across Italian municipalities, induced by sunspot activities. Unlike other local radios, BBC radio broadcasted from the UK and relied on the ionospheric propagation of high-frequency waves (short-waves and medium-waves). Time variation in signal strength within municipalities is induced exclusively by seasonal changes in daylight time, and by monthly variation in sunspot activities. Different geographic areas in Italy were differently affected, depending on the location of BBC transmitters, which did

not change throughout this period. Using the *Voice of America Coverage Analysis Program* (VOACAP), we could simulate the strength of BBC signal across Italian municipalities in each month. We then study the effects of these predicted monthly changes in BBC signal strength on indicators of insurgency against Nazi-fascist occupation within Italian municipalities. As a proxy for the intensity of resistance activities against the foreign occupation, we use Nazi-fascist episodes of violence in response to partisan or civilian resistance.

Our main result is that BBC signal strength is positively associated with Nazi-fascist violence. A 10% increase in signal strength (corresponding to almost one standard deviation) increases the number of episodes of Nazi-fascist violence by more than 2.5 times, relative to the monthly average. This is a large effect, which is possibly explained by the role of the BBC messages. As we discuss in Section 2, the Italian program of the BBC provided counter-propaganda targeted to the overall Italian population, but it also conveyed information and encrypted messages to resistance fighters. For instance, *Radio Londra* was used by the Allies to deliver encrypted messages with precise instructions on the timing and locations of air-drops, bombings by the allied air forces, or movements of the Nazi-fascist and allied troops on the ground. A change in the quality of BBC signal could determine whether or not partisan brigades would receive such key information, and therefore be able to undertake their resistance activities.

Some additional evidence further reinforces the interpretation that BBC broadcasting on the intensity of partisan activities mainly operates through improved coordination. First, the effect on Nazi-fascist violence is contemporaneous to the change in signal strength, and does not depend on the quality of past transmissions. The lack of a long lasting effect suggests that the main mechanism occurs through the coordination of allied and resistance activities, rather than through propaganda or persuasion. This interpretation is confirmed by the finding that there is no robust effect of changes in the transmission of the competing fascist radio EIAR or of the Allied Forces radio (broadcasting from liberated cities in the south of Italy), which were both mainly aimed at propaganda instead. Moreover, we find that the effect of the

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BBC is higher in the presence of bombings by the Allied Forces, which is further evidence of complementarities between the BBC counter-propaganda and the Allied Forces' military effort. Finally, we could not find any correlation between the cumulative BBC signal strength between 1943 and 1945 and the outcomes of the first post-war elections held in 1946. Although the identification strategy here is less compelling, this too is evidence against a motivation or propaganda channel. Putting together all these pieces of evidence, we infer that BBC radio 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.

A rapidly growing literature studies the role of the media in the context of political protests. For example, 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. Enikolopov *et al.* (2016) show that social media diffusion increased protest participation in Russia, predominantly through improved coordination. Compared to these papers, we focus on military insurgencies in times of war rather than on protest participation. This allows us to measure the impact of media in a context where several human lives are at stake.[1]

Several other papers have studied the role of the radio in diffusing political propaganda. Yanagizawa-Drott (2014) shows that broadcasting of a popular radio station had a large effect on violence against minorities in the Rwandan genocide, the main mechanism at work being persuasion and imitation by neighboring villages. 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 treasons (e.g., work slowdown) and that the exposure to BBC counter-propaganda tends to amplify such effects. DellaVigna *et al.* (2014) find sizable effects of exposure to Serbian public radio

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[1] Kern 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.

on Croatian nationalism. Interestingly, in in our framework radio exposure does not seem to operate through propaganda, although BBC transmissions were also aimed at motivating the civilian population against the regime. One possible explanation is that the emergence of formally organized brigades catalyzed most of the opposition to the Nazi-fascist regime, and these brigades largely benefited from tactical information on the allied military activities, rather than from pure counter-propaganda.

Finally, our paper is also related to the literature on foreign intervention in weakly institutionalized environments. For example, Dell and Querubin (2016) 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. Our results show that the BBC role in providing critical information to insurgents successfully increased the intensity of resistance against the Nazi-fascist regime.

The rest of the paper is organized as follows. Section 2 provides some historical background. Section 3 describes the data. Section 4 explains our empirical strategy. The main empirical results are illustrated in Section 5, while Section 6 discusses the mechanisms and the interpretation. Section 7 concludes. Appendix A provides technical details on the BBC radio signal. Appendix B presents illustrative examples of BBC messages. Appendix C contains additional tables which are also discussed in the main text.

2 Background

2.1 The Italian Civil War and the Resistance

The allied troops landed and liberated Sicily in July 1943. They advanced quickly in the South of Italy that was liberated by the end of September 1943. The allied troops were then halted by the Germans between Naples and Rome (along the so called *Gustav line*) until the

Spring of 1944. From there, the battlefront moved quickly to another German line of the defense, the *Gothic line*, that cut Italy from East to West between Florence and Bologna. The battles around the Gothic line took place between the Summer of 1944 and April 1945. The Germans surrendered the control of Italy 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, and they were opposed by an active resistance movement (the *Resistenza*, literally the Resistance). This partisan insurgency was largely a bottom-up phenomenon that grew spontaneously from a few thousands of 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 Program* of the BBC

The Italian Service of the BBC (also called the *Italian Program*) 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: in May 1940 the Italian Program was already one hour and thirty minutes long, and in August 1943 it reached four hours and fifteen minutes of daily broadcasting.[2]

The *Italian Program* was providing counter-propaganda messages against the fascist regime along with information on the war events both within and outside Italy, as well as encoded

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[2] The program always started with four morse codes identifying the "V" letter according to the Churchill's V-for-Victory campaign.

messages for the resistance. These "special messages" aimed at delivering logistic and military information to resistance fighters (upcoming military operations, shipments of supplies, weapons, movements of troops, etc., see Section 2.3).

While it is clearly difficult to have a precise estimate of the number of people listening (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 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 respondents listened to the BBC on average 18 times a month; 47% considered "Radio Palermo" (i.e., the allies radio broadcasting from the former EIAR facilities in the city of Palermo) as the most credible radio station; 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 the EIAR or German radios, 66% did so to listen to music and only 7% for 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 by the BBC which was the result of the British editorial principle of separation between facts and opinion and, most importantly, of a specific strategic choice of British Counter-Propaganda.[3]

The number of radio subscribers (which was relatively low compared with other western European countries at that 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-

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[3] "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).

made receivers. This created what was called "mass clandestine listenership" (Papa, 1978; Piccialuti-Caprioli, 1979).

An indirect measure of the success of BBC counter-propaganda is given by the effort of the fascist regime to contrast it. The regime introduced laws aiming at discouraging BBC listenership. The penalty for listening to the BBC in 1941 was two months in jail and one thousand liras of pecuniary fine, plus the confiscation of the radio. A report issued by the *"Guardia nazionale repubblicana"* - a military police corps 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 transmitters 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 counter-propaganda is represented by the many attempts of the fascist regime to sabotage BBC broadcasting through jamming devices.[4]

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 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

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

the SOE (Special Operations Executive).[5] 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 years of the Italian civil war, the BBC not only sent encrypted information to the partisans concerning air-drops of weapons and supplies or the setting-up of improvised airfields, but also gave precise information on Nazi-fascist targets to sabotage, and forewarning to the areas that were going to be interested by incoming allied attacks.[6]

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 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

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[5] The Allies also assisted the resistance movement by means of the Special Operations Executive (SOE), a secret organization. In particular, sometimes airdrops were organized with the help of SOE radio operators on the ground, in connection with partisan groups. These radio operators were themselves parachuted along with small radio 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). Note that SOE communications had different points of transmission and reception than the BBC signal. Moreover, the frequency of transmission and the power of these "parasets" was quite different from that of the BBC antenna transmitters located in the UK (Pidgeon, 2003). Nevertheless, using the same software that we use for the BBC radio (VOACAP), we could simulate the within municipality variation in the signal strength of SOE radios, which turns out to be negatively correlated with the BBC signal. Our main results are robust to controlling for the signal strength of SOE radios transmitting from Italian municipalities to the Allied headquarters (these estimates available upon request).

[6] *"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). See Appendix B.2 for more details on these messages. It is also important to remark that, as shown by Piffer (2010), the Allies did not discriminate among partisan groups with different political ideologies. Accordingly, they did not target their supplies to specific partisan groups.

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 it 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 liberated the cities where the EIAR radio stations were located, the former EIAR transmitters became a tool to broadcast counter-propaganda from within Italy. For example on August 6th, 1943, soon after the Allies landed and liberated Sicily, "Radio Palermo" started broadcasting four hours per day, and in September the hours of daily broadcasts increased to nine (Isola, 1996). The same happened with "Radio Bari" and "Radio Napoli", that started broadcasting soon after the September 1943 Armistice, and "Radio Roma" broadcasting after the liberation of Rome. The most famous program broadcasted by these radios was "Italia Combatte" which was mostly delivering news on the partisan resistance movement (Monteleone, 1995).

Since all these radios were under the control of Allied Forces, in what follows we will refer to them simply as "Allied Forces Radio".

3 Data

3.1 Radio Exposure

Our analysis focuses on one radio broadcasting from abroad (BBC) and two competing radio broadcasting from within Italy (EIAR and the Allied Forces Radio). Broadcasting from these two sets of radios relied on different technologies. Specifically, broadcasting from within Italy exploited the ground-waves generated from medium-wave and long-wave transmitters. The propagation of this type of signal essentially follows the line-of-sight and, holding constant the frequency and power of the transmission, it is affected by the distance from the transmitters and by the orographic characteristics of the terrain (see Figure 1). The BBC was, instead, broadcasting from the UK to Italy (and, more generally, to all continental Europe) using the sky-waves ionospheric propagation generated by medium-wave and short-wave transmitters (see Figure 2). Accordingly, we use two different sets of information and different radio signal prediction software, one to calculate the strength of the EIAR and Allied Forces Radio signals, the other one for the BBC signal.

3.1.1 Radio Signal Prediction: EIAR and Allied Forces Radio

We calculate the radio signal strength of the EIAR radio in each Italian municipalities using information on transmitter location, frequency, and power from all the months from 1925 up to 1945. We gathered this information from the historical archives of the *Radio Corriere*.[7] This was the weekly radio digest providing information on the broadcasting programs and, most importantly, the location, frequency and power of the Italian radio stations. We also cross-checked this information with that in Papa (1978); Monteleone (1995) and Isola (1996). Exploiting this data, we calculated the predicted radio signal strength for all Italian municipalities in each year using the Irregular Terrain Model (Hufford, 2002), which combines the information on the radio transmitters with the orographic characteristics of the terrain.

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[7] www.radiocorriere.teche.rai.it/.

This methodology was also used by 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). As in the previous papers, the unit of measure for signal strength is the decibels above the power required for top quality signal reception for TV. Similarly, for the Allied Forces Radio we exploit the information on EIAR transmitters along with the 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 bombings of the Allies themselves during the war.

3.1.2 Radio Signal Prediction: BBC

As concerns the BBC, since it broadcasted from long-distance by exploiting the ionospheric propagation of high-frequency (HF) short-waves and medium-waves, we cannot rely on the Irregular Terrain Model as in the existing literature that exploits variations in radio/TV signal strength (and as we do for the EIAR/Allied Forces Radio). Therefore, to calculate the BBC signal strength in each Italian municipality, we exploit the *Voice of America Coverage Analysis Program* (VOACAP). This program is considered as the most reliable software for point-to-point prediction of HF radio signal strength (see Appendix A for technical details on VOACAP). Similarly to the *Irregular Terrain Model* (ITM) it exploits, among the other inputs, information on transmitter location, frequency, and power. The program provides a prediction of radio signal strength in terms of Signal-to-Noise Ratio (SNR) for each BBC transmitter-frequency-power combination, in each Italian municipality in each month, and in each half-an-hour range.

As concerns the medium wave transmitters, we gathered data from the "Directory of Long and Medium Wave Usage in the United Kingdom, 1922-2007" by Martin Watkins. We also cross-checked this information with the one contained in the "Broadcasting Yearbook" (1939-1948) and Pawley (1972). The latter two sources were 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 greater details in Appendix A, we focus on medium-wave transmissions since multiple short-wave frequencies were used within a day, and we cannot thus recover a precise estimate of the short-wave signal strength in a municipality in a given month.

Differently from the ground-wave propagation of national radios, the HF transmission through the ionosphere is not influenced by the orographic characteristics of the terrain. Instead, it is affected by the sunspots (i.e., solar activities), i.e., a crucial input of the VOACAP software is given by the number of sunspots in the period under investigation. We extrapolated data on the number of monthly sunspots from historical archives of solar weather from the *National Oceanic and Atmosphere Administration* (NOAA). A variation in the level of sunspots affects the ionosphere and, in turn, it affects how a radio signal propagates. Hence, holding constant the frequency, power and location of a radio transmitter (e.g., a BBC radio transmitter), a variation in the level of sunspots affects differently different receiving locations (e.g., Italian municipalities), and differently so for each given frequency-power combination of the transmitter. The HF transmission is also affected by the daylight time, as hours of darkness are typically conducive of a better ionospheric propagation. Accordingly, VOACAP takes into account that different months (e.g., summer/winter months) are characterized by different daylight times. Figure 3 shows that the average BBC signal follows a seasonal pattern, with stronger signal during months characterized by fewer hours of daylight.

Overall, once taking into account seasonal effects and geographical patterns, the residual variation in BBC signal is the one induced by variations in sunspot activities that affect the propagation of the signal. Figures 4 and 5 provide an example of how the average (medium-wave) signal strength of the BBC varies within municipalities, between a month characterized by high sunspots activity (April 1945) and one characterized by a low sunspots activity (April 1944).[8]

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[8] Similarly to us, Garcia-Arenas (2016) also exploits the variation in ionospheric HF radio propagation.

One final caveat has to be considered. We could not recover the threshold in the Signal-to-Noise Ratio above which the BBC signal was "good enough" to allow reception. At that time, in fact, radio signal was analogic, i.e., the quality of the signal was continuous, ranging from extremely noisy to extremely clear. Although in principle we could rely on thresholds considered as good proxies for reliable signal reception in HF radio transmission today, the lower quality of radio receivers at that time (working against good signal reception), along with the lower noise in the surrounding environment (working in favour of good signal reception), do not allow us to do so.

3.2   Victims of Nazi-Fascist Violence

Ideally, we would like to measure the activity of partisan brigades in each month-municipality observation. Since no such measure is available, we rely on an indirect measure of the intensity of insurgency against the Nazi-fascists, namely the number of episodes of violence perpetrated by the Nazi-fascists against civilians or partisans in a given municipality in each month, in retaliation for partisan insurgency (an episode is classified as violent if there was at least one Italian victim). The data come from the *Atlas of Nazi-fascist Massacres*, which provides a comprehensive census of all Nazi-fascist episodes of violence that took place during the Italian civil war (July 1943 - May 1945), together with the motivation or type of violence. The Atlas identifies more than 5,500 episodes of Nazi-fascist violence for a total of 23,000 victims, and provides information on their date and location.[9] In addition, the Atlas classifies victims

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However, differently from us, he exploits ionospheric data to predict 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) and takes this as a proxy of the quality of radio reception. Aside from the location of the transmitters, our approach also exploits the information on the transmitters power and frequency, which are key inputs for predicting the actual quality of radio signal at the point of reception. Importantly, by using the VOACAP software we are able to pinpoint a prediction on the strength of BBC signal in each municipality-month for each combination of sunspots, transmitter frequency, transmitter power, and transmitter location.

[9] The Atlas is the result of a joint research project (2009-2016) of Italian and German historians sponsored by the Italian and the German governments. Information on the episodes of Nazi-fascist violence is available at http://www.straginazifasciste.it/.

in civilians or partisans, and distinguishes between victims of Nazi-fascist violence related to partisan or civil resistance (e.g., retaliations, raids, etc.) and those less connected to the resistance activity (e.g., victims of racial or gender motivated violence).

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 with the areas of activity of partisan groups. Information from these maps was then elaborated by Fontana *et al.* (2017). Unfortunately, however, here we only know the area of operation but not the period in which the brigades were active, nor how intensive was their activity.

3.3   Sample

As we discussed in Section 2, the allied troops liberated Southern Italy by the end of September 1943 and the Germans surrendered Italy 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 was rather sporadic south of the Gustav line. This results in the exclusion of the 30% of municipalities in Campania, 85% in Apulia, and of all municipalities in Basilicata, Calabria, Sicily and Sardinia. We also exclude all the municipalities in Valle d'Aosta, for which there are no victims' data. We are thus left with 6,473 municipalities out of the initial 8,011.[10]

As Figure 6 shows, the episodes of Nazi-fascist violence were mainly concentrated in the proximity of the front line. As the allied troops advanced from south to north, the intensity of the conflict between partisans and Nazi-fascists increased. 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 when they were no longer under Nazi-

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[10] Since a few municipalities appeared or disappeared in the decades after the WWII, we use municipal administrative entities as of 1995, for which we managed to collect a homogeneous set of pre-war and post-war available characteristics.

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fascist occupation and, thus, not exposed to Nazi-fascist violence. Second, we would include municipalities still under occupation but far from the front line and, thus, not so heavily involved in the Italian civil war (e.g., northern municipalities were exposed to little Nazi-fascist violence in the early periods of the occupation). Finally, we only have information on the exact date of liberation from the Nazi-fascist occupation of the provincial capital.[11] This explains why, as the top panel of Figure 7 documents, we still observe a significant number of episodes of Nazi-fascist violence taking place one month after the imputed liberation of a municipality. All these considerations led us to restrict the sampling period from ten months before to the first month after the liberation of the province capital (for a total of a 12-months window).

As the top panel in Figure 7 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 documents that, by doing so, we are also able to run our estimates on a rather balanced panel of municipalities observed over a period of similar length around their liberation date.

Table 1 reports the summary statistics for the sample. As our sample includes only municipalities above the Gustav line, 79.5% of our observations are located in the North of Italy and 15.6% in the Center. The average number of episodes with victims is 0.06, distributed quite evenly between those with civilian and partisan victims.

4   Empirical Strategy

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

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[11] For several hundreds of municipalities near 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.

the following linear model:

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

Here, y_{it} is the number of episodes observed in a municipality i in a month t of Nazi-fascist violence classified as episodes related to partisan or civilian resistance (retaliations, raids, punitive expeditions, search, territorial control and desertification).[12] Since episodes of Nazi-fascist violence occurring at the beginning of a month are very 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) over the current and previous month, i.e., t and $t-1$.[13] X_{it} is a vector of time-varying municipal level covariates, which includes: a dummy for whether a municipality was within 15 kilometers from S.S. or H. Goering Nazi troops (or both);[14] the number of bombing attacks carried out by the Allied Forces;[15] the average monthly rainfalls (in millimiters);[16] and the municipality's (absolute) distance in months to/from the liberation date of its provincial capital (see the discussion in Section 3.3). In addition, the model includes municipality fixed effects (ρ_i), and month-year fixed effects (δ_t). Standard errors are clustered at the province level.

As discussed in Section 3.1, in order to identify the causal effect of the strength of the

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[12] We could have use 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.

[13] All of our results are robust to considering the BBC signal strength in month t only. These estimates available upon request.

[14] 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.

[15] These data come from Davis (2010), who provides detailed information on the date and location of bombing attacks and on the nature of the targets involved (e.g., roads, railroads, military houses, troops etc.).

[16] Source: *Tyndall Centre for Climate Change Research* (version CRU TS 1.2)

BBC signal on Nazi-fascist violence it is crucial 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 at the same time have orographic characteristics that could affect the intensity of the insurgents' activity.[17] At the same time, the quality of the BBC signal varied across months because of the impact of the different average daylight on the ionospheric propagation (see Figure 3), and could have simultaneously an impact on the insurgents' activity (e.g., one could expect a lower intensity of insurgency in the 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 only due to the monthly random sunspot activity, which in turn impacts on the quality of the radio reception in each municipality through its effect on the ionospheric propagation of the signal (*Conditional Independence Assumption*).[18]

Before moving to the results, it is important to discuss the identification of other competing radios on the ground. In Section 6, in fact, we also account for the broadcasting by radios other than the BBC by including in equation (1) variables that measure the signal's quality of the Fascist radio EIAR and of the Allied Forces 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. In the period from October 1943 to May 1945, this variation was caused by: *i*) the destruction of EIAR transmitters by the allied bombing; *ii*) the installation of new transmitters or *iii*) the change of the transmitters' radio frequency operated by the Fascists or Allied Forces. Moreover, transmitters switched from broadcasting Fascist propaganda to anti-Fascist counter-propaganda when a municipality hosting a transmitter was freed from the Nazi-fascists. To account for the po-

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[17] According 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.

[18] Another potential concern is that the information conveyed by the BBC could easily spread to neighboring municipalities. If this was true, some municipalities with a relatively worse BBC signal could still have received the information, in which case our estimate would probably be a lower bound of the true one.

tential endogeneity of the transmitters' location, we follow Olken (2009) and Durante *et al.* (2015) and compute 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). After controlling 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.

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 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 victim, while in column (2) and (3) we consider the number of episodes where victims are civilians and partisans, respectively.

The estimated coefficient reported in column (1) is positive and statistically significant. Since the variable that measures the BBC's signal strength is taken in logs, the estimated coefficient of 0.994 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 165%, relative to its average.[19]

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[19] As shown in Table C.1 in Appendix C, the effect of the strength of the BBC signal on Nazi-fascist violence turns out to be positive only after we control in column (3) for both municipality and month-year fixed effects. However, the estimate of the coefficient of interest is negative in column (2) when we do not include fixed effects by month-year. This is because omitting to control for seasonal variations causes a significant downward bias in the estimated effect of the BBC signal. As Figure 3 documents, the quality of the BBC signal improves in the winter because of the lower average daylight, while at the same time adverse weather conditions make insurgency actions less likely to happen. If we also omit controlling for municipality fixed effects, as we do in column (1), the estimates coefficient of interest becomes slightly more negative. This can be explained by considering that 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 in the Center and, only later on during the war, in the Center-North of the country. Also, the most northern areas of Italy, such as the

Estimated coefficients are positive and statistically significant at the 5% level in the last two columns of Table 2, where we separate episodes with civilian or 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 223% of its average) in column (2) where we consider episodes with civilian victims, compared to column (3) where we consider partisan victims (113%). This difference can be explained by the fact that partisans were able to adopt guerrilla-like strategies (i.e., attack and then hide), so that the Nazi-fascists typically retaliated against the unarmed civilian population (Battistelli and Crociani, 2015).

The large effect of an improvement in the quality of the BBC signal 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 encrypted messages to Resistance fighters (see Appendix B.2 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 would determine whether or not partisans were able get these supplies, and hence to conduct acts of insurgency. 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.

5.2   Robustness

In this section we report estimates from a variety of exercises meant to assess the robustness of our baseline empirical exercise. For the sake of exposition, from now on we only focus on

Alps, almost never experienced large scale partisan action (see Figure 6). Finally, it is worth mentioning that adding, as we do in column (4), the full set of our control variables reduces by almost 50% our coefficient of interest, although it still remains positive and statistically significant as it is in column (3).

the number of episodes of Nazi-fascist violence against both civilians and partisans.[20] These estimates are presented in Table 3.

Estimates in column (1) are obtained by keeping in our sample all municipalities above the Gustav line for all available months, removing the 12-months window sampling around the time of liberation. We, therefore, include also municipality-month pairs that were far from the front line and, thus, characterized by a lower incidence of the military operations. The estimated effect of the BBC signal strength is still positive and statistically significant, albeit, as expected, smaller in magnitude than that reported in column (1) of Table 2. A 10% increase in the signal strength is now associated to an increase in the number of episodes of violence of about 70% relative to its average of 0.029.

In column (2), as proposed by Conley (1999), we allow for spatial error correlation among municipalities that fall within 100 kilometers of each other (as opposed to using province administrative boundaries). The estimated coefficient of interest remains statistically significant at the 1% level.[21] As column (3) documents, our estimates are also robust to experimenting with a different time specification, like replacing month-year fixed effects with calendar month fixed effects and a quadratic time trend. In column (4) we allow for a more generous specification of the time to/from liberation by including fixed effects by month rather than the distance in months. In this case the coefficient is similar in magnitude to that of column (1) of Table 2, and statistically significant at the 5% level.

Finally, in column (5) we analyze whether using the number of victims of the Nazi-fascist violence, instead of the number of episodes, would deliver a different result. The estimated effect of the broadcasting by the BBC remains positive and statistically significant, and it is quite sizable: a 10% increase in the BBC's signal strength leads to an increase in the number of victims of about 204% relative to its average of 0.261.

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[20] Almost all of the following results hold true when we separate victims by civilian and partisan. These estimates available upon request.

[21] Very similar figures could be obtained by considering a radius of 200, 300 and 400 kilometers.

5.3 Validation

In Table 4 we provide additional evidence to corroborate the interpretation that BBC broadcasting fostered resistance against the Nazi-fascists.

In the spirit of a placebo test, we start by testing for the presence of anticipation effects in the BBC broadcasting. Up to a certain degree of serial correlation in the BBC signal over time (see Figure 3), one should expect no effect on current episodes of Nazi-fascist violence of the BBC signal at time *t+1*, as this could not possibly convey any useful information for the resistance activity at time *t*. Estimates reported in column (1) reassure about the interpretation of our findings. The estimated coefficient of the BBC signal at time *t+1* is, indeed, positive but not statistically significant.

Another hypothesis is that, if the BBC had an effect on the intensity of the resistance movement by coordinating the insurgents' action, we should expect its impact to be stronger in municipalities with active partisan brigades. We explore this prediction in column (2) of Table 4. Here, we interact the quality of the BBC signal with a dummy variable from Fontana *et al.* (2017) that takes value of one if a partisan brigade was ever 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, indeed, larger in places where partisans were known to be more active.

We then provide additional evidence on the possible relevance of the BBC service for the resistance groups and their fight against the Nazi-fascists. In specific, we focus on a narrower time interval around the date of liberation of the capital of a municipality's province, i.e., on a period where the intensity of confrontation between Nazi-fascist troops and partisan brigades is expected to increase. To this purpose, in column (3) we restrict our analysis to a 6-months window around the liberation of a municipality's provincial capital (from four months before to one after). As expected, the magnitude of the estimated coefficient of interest is positive and significantly larger than the one in Table 2.

To further prove the validity of out interpretation, we should find no evidence of a signif-

icant effect of the strength of the BBC signal and forms violence perpetrated by the Nazi-fascists for reasons not immediately related to the activity of the resistance groups (such as racial and gender motivated violence). Accordingly, in column (4) we report estimates when the dependent variable is constructed by using episodes of racial and gender motivated violence only. The estimated coefficient is positive but not statistically different from zero. This is consistent with our hypothesis, that BBC broadcasting led to a higher number of episodes of Nazi-fascist violence via an increase in intensity of resistance activities, rather than through an increase in the overall level of Nazi-fascist violence.[22]

Finally, we test for the presence of non-linearities in the effect of the BBC signal strength on the number of episodes of Nazi-fascist violence. Although we do not know the threshold in the Signal-to-Noise Ratio above which the BBC signal was "good enough" to allow reception (see the discussion in Section 3.1.2), we may still infer it in an indirect way by looking at non-linear effects. To this purpose, in the specification reported in column (6) we include two dummy variables that take value one if the average BBC monthly signal in a given municipality is, respectively, below the 25th percentile or above the 75th percentile of the BBC signal over the entire sample. The coefficient of the first dummy is not statistically significant, while that of the second one is positive and statistically significant. This evidence suggests that BBC broadcasting was especially effective when the signal quality was sufficiently "good".

6 Mechanism

In this section we investigate the possible mechanisms behind the estimated effect in Table 2. First, we look at how the BBC transmissions compared to other radios that were also broadcasting over Italian municipalities at the same time. Second, we investigate whether previous exposure to BBC had an impact on Nazi-fascist violence. Third, we look at how the

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[22] We need, though, to take the result in column (4) with a word of caution, since the absence of any effect may also reflect the lower incidence of episodes of racial and gender motivated violence relative to those we consider in Table 1.

BBC signal interacts with the allied military activities, that we proxy with the number of allied bombings. Finally, we investigate whether exposure to BBC broadcasting is correlated with political behavior in the immediate post-war elections.

6.1 Competing Radios

A natural question concerns the role that other radios - possibly competing with the BBC - played in these war years. As Section 2 illustrates, in this period there were at least two main radios - besides the BBC - actively involved in the "war of the waves". They were the official radio of the fascist regime (EIAR) and the radio of the Allied Forces.[23]

Columns (1) and (2) of Table 5 report the coefficient estimates of the BBC signal strength and, respectively, of the quality of the EIAR and of the Allied Forces Radio signal. As explained in Section 4, to deal with the potential endogeneity of the transmitters' location, we follow Olken (2009) and Durante *et al.* (2015) and include in these specifications also the theoretical radio signal intensity in the absence of any geo-morphological obstacles. Estimates of the coefficient of the quality of reception of the BBC signal are 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, possibly because broadcasts of the fascist radio EIAR provided some motivation to act against resistance groups.

Overall, the evidence we provide in this section suggests that in the years of the Italian civil war the BBC radio service played a more relevant role than the fascist or Allied Forces radio, although we must admit that the lower monthly variation in the signal of these last two radio signals could limit the power of this exercise.

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[23] In 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 was never to support resistance activities on the ground.

6.2 Past Exposure

As discussed in Section 2, historians traditionally identify two roles for the BBC counter-propaganda during the WWII years (Briggs, 1970). First, the BBC might have enhanced coordination among insurgents by providing them with operational orders or news on the time of arrival of the Allied Forces. If this is the 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 may 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 broadcasting by the BBC also had a *motivation* effect, we should observe a significant lagged effect of the quality of the BBC signal on the dependent variable.

We investigate this issue in the specification reported in columns (3) and (4) of Table 5, where we add to 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 transmissions. Interestingly, 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 in the previous months are not statistically different from zero.[24]

6.3 Interaction with the Allied Bombings

A last point that we examine is whether there was any interplay between the BBC radio service and the allied bombing over Italy on the occurrence of Nazi-fascist violence. The allied bombing of Italy started 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

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[24] Similar results could be obtained by looking at the average BBC signal in the previous six months. The same evidence of a contemporaneous rather than a long lasting effect is also confirmed by the absence of any significant effect of BBC exposure on post-war electoral outcomes (see Section 6.4).

military targets (Davis 2010).

Our empirical strategy in this case needs to take into consideration that the timing and location of bombing strikes could have been influenced itself by the on-going military activities on the ground. However, since we only exploit within-municipality variation in the BBC signal, and as long as it was not possible even to the Allied Forces to predict the quality of the BBC signal in certain municipality and month, we believe that reverse causation should be less of a concern here, at least in the case of bombings over pre-existing infrastructures (e.g., production facilities, railroads, highways, etc.).[25] The identifying assumption in this case is that the timing and number of the bombings over a certain municipality were orthogonal to the timing of partisan activities on the ground, once we condition for the quality of the BBC signal. While this seems a reasonable assumption in the case of unmovable targets (armaments' production facilities had to be destroyed no matter what), the same is not true for movable targets (e.g., marshaling yards, military bases, etc.), as the same changing location of these targets could be affected by partisan attacks and, as a consequence, by the violence by the Nazi-fascists.

Following the above discussion, we construct two separate dummy variables. The first one takes value of one when the number of allied bombing attacks in a month on pre-existing infrastructures is above the 75th percentile of all the observations with at least one bombing, and zero otherwise, while the second one does the same but using movable targets. We then add these two dummy variables to equation (1), including their interaction with BBC radio signal, which is our main parameter of interest. Since bombing might be especially sensitive to weather conditions that could alter visibility, we also add two additional variables for the monthly average cloud intensity and temperature at the municipal level.[26]

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[25] Appendix A provides a detailed discussion on the (non) predictability of the BBC radio signal at that time.

[26] To the extent that strikes were facilitated by good weather conditions, we also tried instrumenting bombings with the cloud cover in a municipality-month, but the instrument turned out to be extremely weak.

Estimates in column (5) show that neither of the two dummy variables for bombing has an impact on the occurrence of Nazi-fascist violence. The estimated coefficient of the bombing of infrastructures is negative, while that of the bombing of other military targets is positive. However, they are both statistically not different from zero. Also, estimates of the interaction of bombing with the measure of strength of the BBC signal are both not statistically significant. All in all, we could not find any evidence of a relevant interplay between the BBC and the allied military effort.

However, it could still be that the interplay between the BBC and the Allies' military effort is only relevant when the latter reaches considerable intensity. If so, by focusing on a narrower time window around the liberation of a municipality we aim at assessing whether the interaction between BBC and Allied military effort becomes more significant when the conclusion of the Nazi-fascist occupation of a municipality is more imminent. To this purpose, in column (6) we restrict the sample to a 6-months window around the liberation of the provincial capital (from four months before to the first after), as we also do in column (3) of Table 4. In this case, the negative coefficient of the bombing of infrastructures becomes larger in absolute value and statistically significant at the 10% level. One possible explanation is that a more intense allied military effort makes the Nazi-fascists less likely to engage in violence against insurgents as they need to divert their military resources to face attacks by the Allies. More importantly, the estimate of the interaction between the BBC signal and bombing of infrastructures turns positive and statistically significant. We interpret this result as evidence that an improvement in the reception of the BBC signal helped partisans to coordinate their activity with that of the Allies, especially in proximity of the liberation of a municipality. Finally, estimates in column (6) also document that neither the dummy variable for the bombing of movable military targets nor its interaction with the quality of the BBC signal are statistically different from zero.

6.4   Post-war electoral outcomes

As a last check that the main mechanism operates through coordination of insurgent activities, rather than motivation, we consider the effect of BBC Radio on post-war electoral outcomes. If indeed BBC Radio affected insurgency through its propaganda and motivation, then arguably it could also have influenced political behavior in the immediate post-war elections, possibly in favor of the moderate Christian Democratic Party. In Tables C.2-C.4 (in Appendix C) we thus report 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, and the extreme right (the Monarchic and the Fascist party) in three elections: to the Constitutional Assembly in 1946, and to the newly constituted Parliament in 1948 and 1953. The right hand side variable of interest in this case is the number of months (between October 1943 and May 1945) in which the BBC signal in a municipality was above the sample median.

Of course, in this exercise we could only estimate a correlation but not a causal effect, because this is a cross-sectional regression with several possible omitted variables. To reduce the concern, we control for province fixed effects, plus several features of the municipality: besides geography (altitude, surface, latitude and longitude) and demographics (resident population, the share of women and the share of illiterates in the 1951 Census) we also control for the vote shares of different parties in the last three free elections before the war (1919, 1921 and 1924), the total number of months in which the municipality was under Nazi-fascist occupation, the total number of months in which SS and H. Goering troops were present in the municipality, and the total number of bombing attacks by the Allies over the municipality. The estimated coefficient of the cumulative BBC signal has the expected sign (positive on the Christian Democrat vote share, negative on the vote share of the extreme left), but it is almost never statistically significant. This too is evidence that BBC propaganda did not seem to have a lasting motivating effect.

7   Concluding Remarks

This paper provides evidence on the role that broadcasts by a foreign mass media during a civil war play in coordinating the activity of insurgent groups engaged in a military opposition to an oppressive non-democratic regime. We document that in the last years of World War II, improvements in the quality of reception of the BBC radio, 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.

We also show that BBC radio 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 diffusing political propaganda (Yanagizawa-Drott, 2014; Adena *et al.*, 2015; DellaVigna *et al.*, 2014; Garcia-Arenas, 2016). One possible explanation is that, in our framework, 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 in hiding and with few directions from their national leaders. In these circumstances, organizational and coordination challenges are of paramount importance, and external directions and assistance through the radio or other media can significantly increase the effectiveness of resistance activities. This could have happened through the provision of information about military targets, or about the movement of enemy troops, or simply by letting the insurgents know that they are not alone and that their acts of insurgency are deemed of strategic importance by other military forces.

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 BBC radio were right on target, and that the military and strategic goals of the resistance movement were met.

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Tables and Figures

Figure 1: Theoretical Radio Coverage (ground-wave)
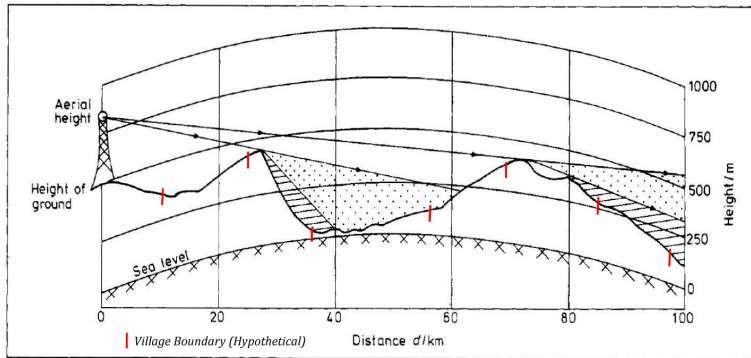
Notes. The figure illustrates the ground propagation of signal broadcasting. Dotted space marks low signal strength, and striped space marks even lower signal strength. The red bars mark hypothetical village boundaries (source: Yanagizawa-Drott 2014).

Figure 2: Theoretical Radio Coverage (sky-wave)
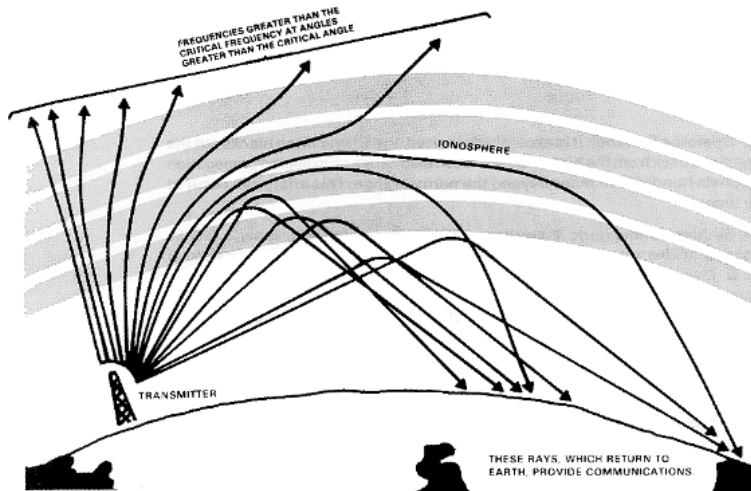
Notes. The figure illustrates the ionospheric propagation of high-frequency signal broadcasting.

Figure 3: BBC Medium Wave Signal
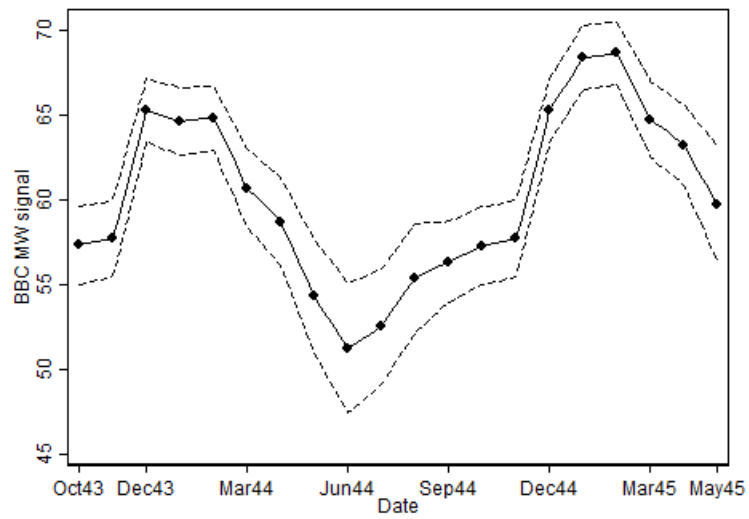
Notes. The figure illustrates the variation in the BBC average medium-wave signal (SNR) over the period of interest (October 1943 - May 1945). Dash lines indicate 1/2 standard deviation.

Figure 4: Sunspots and Within-municipality Variation in BBC Signal
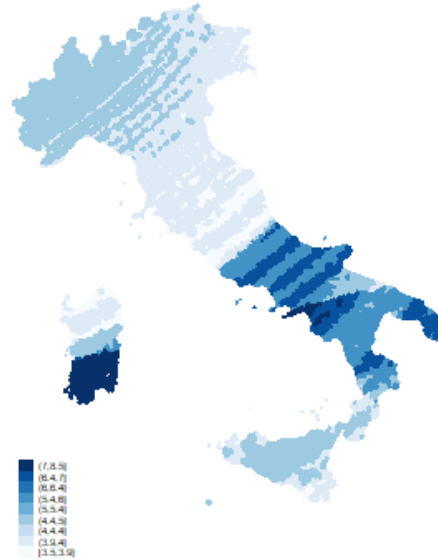
Notes. The figure illustrates the variation in the BBC average medium-wave signal (SNR) at the municipal level between April 1945 (a month with a high level of sunspots) and April 1944 (a month with a low level of sunspots) throughout Italy.

Figure 5: Sunspots and Within-municipality Variation in BBC Signal (Tuscany)
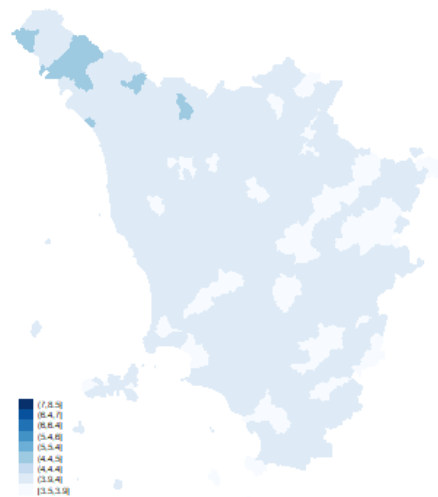
Notes. The figure illustrates the variation in the BBC average medium-wave signal (SNR) at the municipal level between April 1945 (a month with a high level of sunspots) and April 1944 (a month with a low level of sunspots) in the region of Tuscany.

Figure 6: Geographical Distribution of Episodes of Nazi-fascist Violence over Time
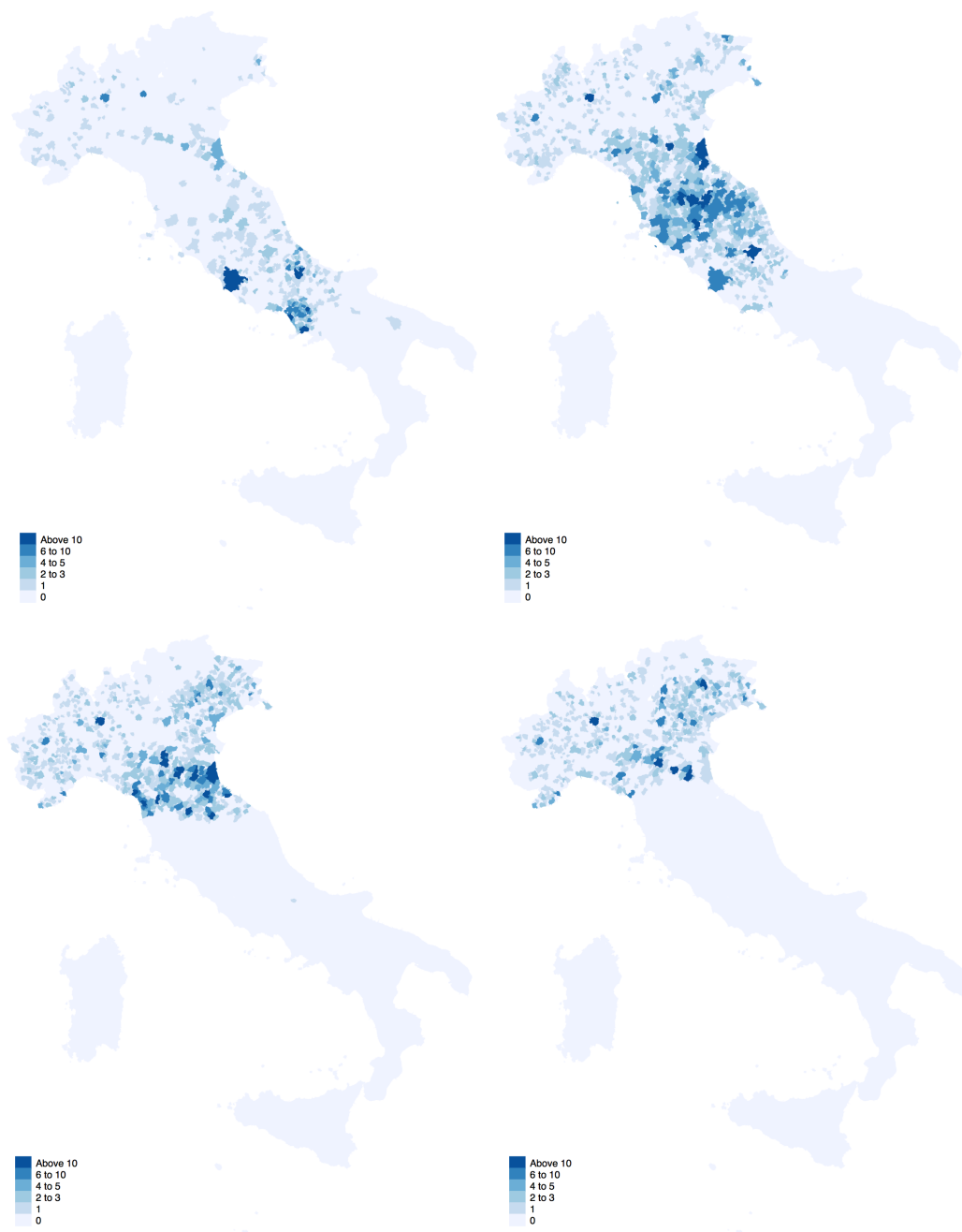
Notes. The figure illustrates the geographical distribution of episodes of Nazi-fascist violence throughout Italy in the periods October 1943 - February 1944 (top-left), March 1944 - July 1944 (top-right), August 1944 - December 1944 (bottom-left), and January 1945 - May 1945 (bottom-right).

Figure 7: Episodes of Nazi-fascist Violence and Observations by Months to/from Liberation
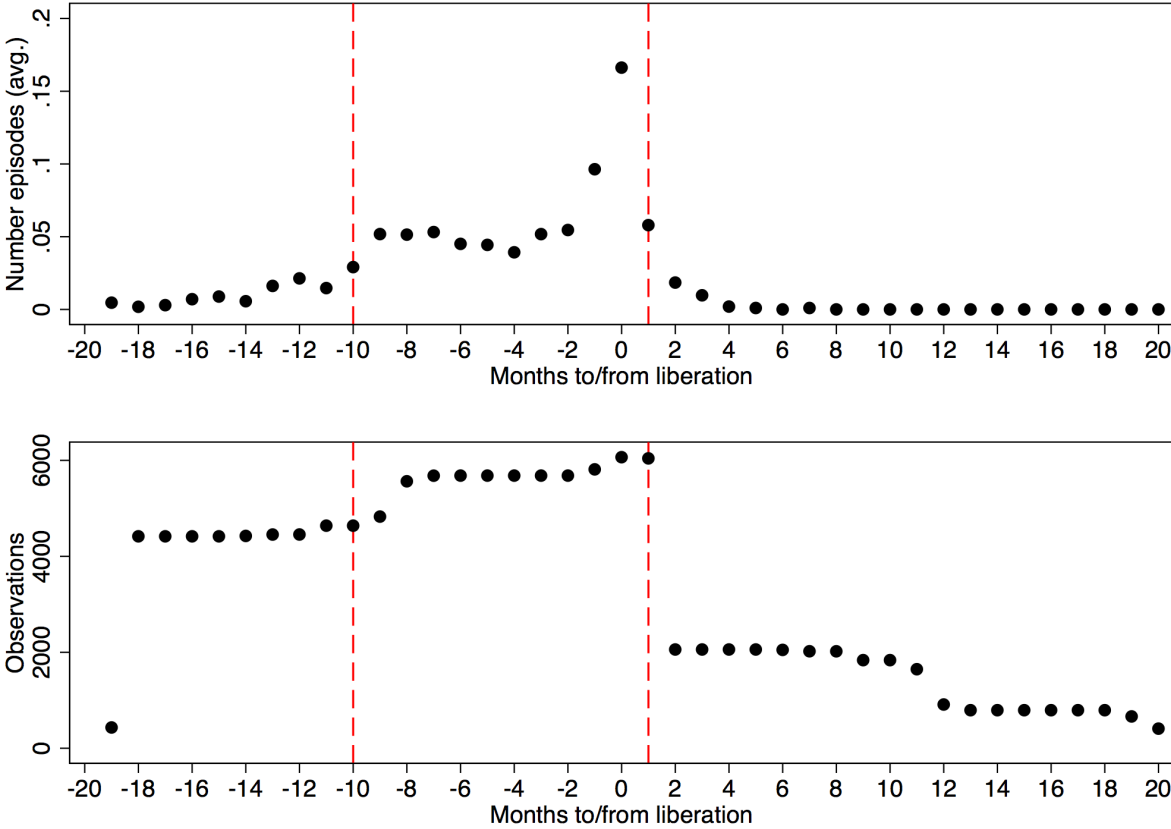
Notes. The figure illustrates the distribution of the average number of episodes of Nazi-fascist violence (top) and the overall number of municipality-months observations (bottom) with respect to the liberation of the provincial capital. Dotted lines delimit the baseline sample used in the analysis.

Table 1: Descriptive Statistics

	Mean	S.d.	Min	Median	Max
North	0.795	0.403	0	1	1
Center	0.156	0.363	0	0	1
South	0.048	0.214	0	0	1
Episodes with victims	0.060	0.372	0	0	17
Episodes with civilian victims	0.031	0.270	0	0	17
Episodes with partisan victims	0.027	0.207	0	0	11
N. months to/from liberation (abs.)	4.490	3.168	0	4	10
Presence of SS and H. Goering troops	0.006	0.079	0	0	1
N. bombings	0.445	12.170	0	0	2156
N. bombings (inf.)	0.124	3.929	0	0	349
Rain precipitations	72.209	64.166	0	55.600	382.500
BBC in the month	61.179	6.320	42	60.750	73
N. municipality-months			66,622		
N. municipalities			6,065		

Notes. *BBC in the month (log)* is the average BBC medium-wave signal (SNR) between t and $t-1$. *Nazi-fascist occupation* is a dummy variable taking value one if the provincial capital is under Nazi-fascist occupation. *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. *N. months to/from liberation (abs.)* is the absolute value of the distance to the liberation of the provincial capital (in months). *N. bombings* is the number of bombing attacks by the Allies. *N. bombings (inf.)* is the number of bombing attacks by the Allies targeted to infrastructures or production facilities. *Rain precipitations* is the monthly average of rainfalls in millimeters.

Table 2: BBC and Nazi-Fascist Violence

	(1) Any	(2) Civilian	(3) Partisan
BBC in the month (log)	0.994***	0.701**	0.301**
	(0.327)	(0.266)	(0.115)
Municipality FE	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Average outcome	0.0604	0.0313	0.0266
N. municipality-months	66,622	66,622	66,622

Notes. The dependent variable is the number of episodes of Nazi-fascist violence. *BBC in the month (log)* is the log of the average BBC medium-wave signal (SNR) between t and $t-1$. *Controls* include a dummy for the presence of SS and H. Goering troops, the number of bombing attacks by the Allies, rain precipitations, and the absolute value of the distance to the liberation of the provincial capital (in months). 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) All months	(2) Conley s.e	(3) Quadratic trend	(4) Distance to/from liberation FE	(5) Number of victims
BBC in the month (log)	0.212***	0.994***	1.146***	0.961**	5.604**
	(0.059)	(0.292)	(0.294)	(0.390)	(2.633)
Municipality FE	Yes	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	No	Yes	Yes
Month FE	No	No	Yes	No	No
Controls	Yes	Yes	Yes	Yes	Yes
Average outcome	0.0287	0.0287	0.0604	0.0604	0.261
N. municipality-months	168,297	67,030	66,622	66,622	66,622

Notes. In columns (1) to (4) the dependent variable is the number of episodes of Nazi-fascist violence, while in column (5) it is the number of victims. *BBC in the month (log)* is the log of the average BBC signal (SNR) between t and $t-1$. *Distance to liberation* measured in months. *Controls* include a dummy for the presence of SS and H. Goering troops, the number of bombing attacks by the Allies, and rain precipitations. In columns (1) to (3) and (5) the controls also include the absolute value of the distance to the liberation of the provincial capital (in months). In column (3) we replace month-year fixed effects with calendar month fixed effects and a quadratic month-year trend. In column (4) we include distance to/from the liberation of the provincial capital fixed effects. Standard errors robust to clustering at province level, except in column (2) where we allow for spatial correlation among municipalities that fall within 100 kilometers of each other. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table 4: BBC and Nazi-Fascist Violence - Validation

	(1) Placebo	(2) Presence of partisan brigades	(3) Close to liberation	(4) Episodes unrelated to resistance	(5) Non-linear BBC signal
BBC in the month (log)	0.683**	0.968***	2.650***	0.030	
	(0.369)	(0.317)	(0.992)	(0.018)	
BBC in the month +1 (log)	0.435				
	(0.483)				
BBC X Partisan brigades		0.141**			
		(0.061)			
BBC in the month $< 25^{th}$					0.014
					(0.013)
BBC in the month $> 75^{th}$					0.039***
					(0.014)
Municipality FE	Yes	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Average outcome	0.0639	0.0604	0.0735	0.0007	0.0604
N. municipality-months	62,206	66,622	34,552	66,622	66,622

Notes. The dependent variable is the number of episodes of Nazi-fascist violence. *BBC in the month (log)* is the log of the average BBC medium-wave signal (SNR) between t and $t-1$. *Controls* include a dummy for the presence of SS and H. Goering troops, the number of bombing attacks by the Allies, rain precipitations, and the absolute value of the distance to the liberation of the provincial capital (in months). *Partisan brigades* is a dummy for whether a partisan brigade was ever active in the municipality. *BBC in the month $< 25^{th}$* and *BBC in the month $> 75^{th}$* are dummies for whether the BBC medium-wave signal is below (above) the 25th (75th) percentile of the sample, respectively. In column (3) the sample includes municipality-months around six months from the date of liberation of the provincial capital (from four months before to one month after) only. In column (4) the dependent variable includes episodes of nazi-fascist violence unrelated to partisan or civilian resistance (gender or racial violence) only. 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) BBC vs. EIAR	(2) BBC vs. Allies radio	(3) Lagged effects (2 months)	(4) Lagged effects (4 months)	(5) Interaction with bombings	(6) Interaction with bombings (close-window)
BBC in the month (log)	0.974***	0.854**	1.039***	0.923***	1.065***	2.631***
	(0.332)	(0.344)	(0.331)	(0.315)	(0.337)	(0.960)
EIAR in the month (log)	0.054*					
	(0.031)					
Allies radio in the month (log)		0.117				
		(0.074)				
Avg. BBC previous 2 months (log)			-0.216			
			(0.343)			
Avg. BBC previous 4 months (log)				-0.477		
				(0.380)		
N. bombings (inf.) $> 75^{th}$ pct.					-5.661	-12.230*
					(3.988)	(7.067)
BBC X N. bombings (inf.) $> 75^{th}$ pct.					1.387	2.939*
					(0.985)	(1.710)
N. bombings (other) $> 75^{th}$ pct.					1.538	6.584
					(5.721)	(8.524)
BBC X N. bombings (other) $> 75^{th}$ pct.					-0.311	-1.456
					(1.399)	(2.059)
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Average outcome	0.0639	0.0604	0.0604	0.0604	0.0604	0.0735
N. municipality-months	62,206	66,622	66,622	66,622	66,622	34,552

Notes. The dependent variable is the number of episodes of Nazi-fascist violence. *BBC in the month (log)* is the log of the average BBC medium-wave signal (SNR) between t and $t-1$. *EIAR in the year* and *Allies radio in the year* is the effective signal intensity in the year of EIAR and Allied Forces Radio, respectively. *Controls* include a dummy for the presence of SS and H. Goering troops, the number of bombing attacks by the Allies (except in columns (5) and (6)), rain precipitations, and the absolute value of the distance to the liberation of the provincial capital (in months). 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. In columns (5) and (6) we also control for average cloud intensity and temperature in the month. In column (6) the sample includes municipality-months around six months from the date of liberation of the provincial capital (from four months before to one month after) only. *Bombing infrastructures* $> 75^{th}$ *pct.* and *Bombing other* $> 75^{th}$ *pct.* are dummies for whether the number of allied bombing attacks in a municipality-month aimed at infrastructures or other targets, respectively, is above the 75th percentile of the month-year observations with at least one bombing. Standard errors robust to clustering at province level. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

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Appendix A   Sky-wave Signal Prediction

A.1   VOACAP and RadioPropagAnDA

VOACAP is an acronym for *Voice of America Coverage Analysis Program*. It is a modeling software used to predict the level of coverage of a high-frequency radio, in which the electromagnetic waves propagate according to a sky-wave propagation mechanism. In this way it is possible to evaluate the path-loss (propagation loss) point-to-point, and consequently the level of service that a given transmitter (short or medium wave) is able to offer. The main inputs, necessary for the correct execution of a simulation VOACAP, are given by: a) the configuration (frequency, power) and location (latitude and longitude) of the transmitter antennas, and the location (latitude and longitude) of the receiver (e.g., each Italian municipality); b) the level of solar activity (i.e., number of sunspots); c) the time and date (i.e., VOACAP automatically computes the sunrise and sunset time at the transmitter and receiver location in each given month). VOACAP is written in Fortran and appears to be the natural evolution of IONCAP (*Ionospheric Communications Analysis Prediction*) which inherits the entire theoretical basis.[27]

This software was originally designed for *Voice of America* (the official broadcasting service of the Federal Government of the United States, supervised by the Broadcasting Board of Governors), and today is considered "the most professional HF system performance prediction tool available on the market" (www.voacap.com).[28] In order to be able to have an automated procedure to obtain the required output data, we had two engineers developing a custom software interface (*Radio Propagation And Data Aggregation - RadioPropagAnDA*) to complete this task. The program provides a prediction of radio signal strength in terms of Signal-to-Noise Ratio (SNR) for each BBC transmitter-frequency-power combination, in each Italian municipality in each month and in each half-an-hour range. We then average out the

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[27] www.voacap.com/documents/familychart.pdf.

[28] See also www.met.nps.edu/~psguest/EMEO_online/module3.

data at the municipal-month level.

A.2 BBC Medium-wave and Short-wave Transmissions

The BBC was broadcasting toward continental Europe using both medium-wave and short-wave frequencies. As discussed in the paper, our analysis exploits variation in the BBC medium-wave signal strength only. There are two main reasons why we decided to focus on medium waves. First, while the set of medium-wave frequencies allocated to overseas broadcasting was constant through the relevant period, short-wave broadcasting operated over a large set of frequencies which were changed quite often to try to obtain the most effective broadcasting (the so-called "maximum usable frequency"). In particular the prediction of the maximum usable frequency "for a particular service, area, time of the day, time of the year and sunspot number is part science, part experience, and part guesswork" (Cant 2006, p. 2). Hence, it is not possible to obtain a reliable estimate of the quality of BBC short-wave signal reception in Italian municipalities in a given month-year. Most importantly, the BBC had no technical instrument to obtain reliable predictions on how a given change in (medium-wave or short-wave) transmission frequency might have impacted the quality of its signal in a specific location.[29] That is, they could not decide to specifically target a specific area in a given month-year by choosing a specific frequency, so excluding the BBC short-wave signal from the analysis simply introduces a classical measurement error.

At the same time, another reason for focusing on medium-wave signal reception instead of short-wave comes from the characteristics of Italian radio receivers in the war years. In fact, 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).

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[29] The first computer prediction software for high-frequency propagation was released in 1966 (http://www.voacap.com/documents/familychart.pdf).

Appendix B   Examples of BBC Messages

B.1   Tactical Information (Not Encrypted)

From the archives of *Radio Londra* (Piccialuti-Caprioli, 1976):

- 15 June 1944: BBC message communicating the presence of a new German defensive line between Livorno and Rimini.

- 15 August 1944: General Alexander Message encouraging partisans to be organized in committees, request for information on data on territories liberated by the partisans.

- 4 Semptember 1944: Breach in the Gothic line around the Adriatic sea.

- 3 October 1944: During winter, partisans need to restrict their operation area.

Two days before the general strike of March 1944, the BBC broadcasted the information on the date of the strike (Piccialuti-Caprioli 1976, p. ciii).

B.2   The "Special Messages" (Encrypted)

The "special messages" of the BBC were used to convey to partisan brigades specific information on oncoming military operations, air drops of weapons, supplies, operating agents, etc. (Piccialuti-Caprioli 1976, p. cii).

B.2.1   Air Drops

Several historical sources and documents report that, during the Italian civil war, the BBC was the one responsible for delivering encrypted messages announcing an upcoming airdrop aimed at a given partisan group (Piccialuti-Caprioli 1976; Stafford 2011; Tudor 2011). An example of this is "*Margherita is blonde/The cherries are mature*". The first part was referring to the preparation of an air drop, the second was indicating that within three days the drop would

take place. BBC officers recall that sometimes the date of a given operation was signaled by simply suspending the message itself (Piccialuti-Caprioli 1976, p. 10).

The following transcript is extracted from a partisan "booklet instruction book" providing specific instruction on how to interpret the BBC messages announcing an air drop:

- "Once our military commands would signal the fields suitable for the airdrops, the Allied Command, once the conditions would be favorable, will execute the air drop announcing it throughout *Radio Londra* with the following procedure. Special message n. 502 for the bee: 1st. The sky is cloudy; 2nd. The rain drops. Where the number indicated the field, the conventional name (the bee) the department to whom the drop is targeted; the message n.1 (negative) signals the interested field and that the air drop will take place soon. The message n.2 (positive) indicated that the air drop will take place during the very same evening or in the following one, keeping in mind that the first message may also been used to signal that the air drop will soon take place with no following instruction. As a particular case, sometimes after the conventional name (the bee) a number could be inserted (1, 2, 3 usually no more) that indicated that along with the material, 1, 2 or 3 people (technicians, operating officers, others) will be dropped." (Istruzioni del Comitato Militare Alta Italia ai comitati militari Alta Italia sui criteri tecnici per la scelta dei campi di Lancio, Allegato III "Norme sui lanci di rifornimento", reported in *Istituto per la storia della Resistenza di Padova, cartella X, doc. 1*, cited in Piccialuti-Caprioli (1976, 103).

B.2.2   Tactical Information

The BBC provided crucial strategic information to the partisans during the liberation of Bologna in April 1945. The BBC sent them the following special message: "*There will be racing at the Hippodrome tomorrow.*" Thanks to this information, on April $19^{t}h$ partisans rose-up. They captured or killed 1,300 Germans and preserved with their action the working

of important city utilities such as water, electricity, and gas. By April $21^{s}t$ the allied troops reached the city of Bologna (Tompkins, 1998).

Appendix C Additional Tables

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

	(1)	(2) Add municipality FE	(3) Add month-year FE	(4) Add controls
BBC in the month (log)	-0.371***	-0.236***	1.412***	0.994***
	(0.083)	(0.063)	(0.398)	(0.327)
Municipality FE	No	Yes	Yes	Yes
Month-Year FE	No	No	Yes	Yes
Controls	No	No	No	Yes
Average outcome	0.0630	0.0604	0.0604	0.0604
N. municipality-months	67,030	66,622	66,622	66,622

Notes. The dependent variable is the number of episodes of nazi-fascist violence. *BBC in the month (log)* is the log of the average BBC medium-wave signal (SNR) between t and $t-1$. *Controls* include a dummy for the presence of SS and H. Goering troops, the number of bombing attacks by the Allies over the municipality, rain precipitations, and the absolute value of the distance to the liberation of the provincial capital (in months). Standard errors robust to clustering at province level. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table C.2: BBC and Post-war Electoral Outcomes - 1946 Elections

	(1) Extreme left	(2) Christian democrats	(3) Extreme right
BBC above median	-0.003	0.003	0.001
	(0.006)	(0.005)	(0.001)
Province FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Average outcome	0.394	0.417	0.0142
N. municipalities	5,588	5,588	5,588

Notes. *Extreme-left* is the total vote share of communist, socialist and other extreme left parties. *Extreme-right* is the total vote share of the monarchic party. *BBC above median* is the number of months (between October 1943 and May 1945) in which the BBC medium-wave signal in the municipality was above the median (calculated over all municipalities above the Gustav line). *Controls* include the altitude, the surface, and the latitude and longitude of the municipality. They also include the resident population, the share of women and the share of illiterates in the 1951 Census, and the vote shares of different parties in the last three free elections before the war (1919, 1921 and 1924). Finally, they also include the total number of months in which the municipality was under nazi-fascist occupation and in which SS and H. Goering troops were present in the municipality, and the total number of bombing attacks by the Allies over the municipality. Standard errors robust to clustering at province level. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table C.3: BBC and Post-war Electoral Outcomes - 1948 Elections

	(1) Extreme left	(2) Christian democrats	(3) Extreme right
BBC above median	-0.007	0.007*	0.001
	(0.005)	(0.004)	(0.001)
Province FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Average outcome	0.357	0.542	0.0299
N. municipalities	6,058	6,058	6,058

Notes. *Extreme-left* is the total vote share of communist, socialist and other extreme left parties. *Extreme-right* is the total vote share of the monarchic party and of the fascist party. *BBC above median* is the number of months (between October 1943 and May 1945) in which the BBC medium-wave signal in the municipality was above the median (calculated over all municipalities above the Gustav line). *Controls* include the altitude, the surface, and the latitude and longitude of the municipality. They also include the resident population, the share of women and the share of illiterates in the 1951 Census, and the vote shares of different parties in the last three free elections before the war (1919, 1921 and 1924). Finally, they also include the total number of months in which the municipality was under nazi-fascist occupation and in which SS and H. Goering troops were present in the municipality, and the total number of bombing attacks by the Allies over the municipality. Standard errors robust to clustering at province level. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.

Table C.4: BBC and Post-war Electoral Outcomes - 1953 Elections

	(1) Extreme left	(2) Christian democrats	(3) Extreme right
BBC above median	-0.007*	0.001	0.002
	(0.004)	(0.004)	(0.003)
Province FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Avgerage outcome	0.226	0.478	0.0917
N. municipalities	6,415	6,415	6,415

Notes. *Extreme-left* is the total vote share of communist, socialist and other extreme left parties. *Extreme-right* is the total vote share of the monarchic party and of the fascist party. *BBC above median* is the number of months (between October 1943 and May 1945) in which the BBC medium-wave signal in the municipality was above the median (calculated over all municipalities above the Gustav line). *Controls* include the altitude, the surface, and the latitude and longitude of the municipality. They also include the resident population, the share of women and the share of illiterates in the 1951 Census, and the vote shares of different parties in the last three free elections before the war (1919, 1921 and 1924). Finally, they also include the total number of months in which the municipality was under nazi-fascist occupation and in which SS and H. Goering troops were present in the municipality, and the total number of bombing attacks by the Allies over the municipality. Standard errors robust to clustering at province level. ***, **, *: denote significant at 1, 5 and 10 percent level, respectively.