# Bombs, Broadcasts and Resistance: Allied Intervention and Domestic Opposition to the Nazi Regime during World War II

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**Abstract.** Can bombs and broadcasts instigate resistance against a foreign regime? We examine the canonical case of bombing designed to undermine enemy morale—the Allied bomber offensive against Germany during WWII. Our evidence shows that both air power and the airwaves undermined regime support. Using plausibly exogenous variation in weather, we show that places that suffered more bombardment saw noticeably more opposition. Bombing also reduced the combat motivation of soldiers: fighter pilots from bombed-out cities performed markedly less well after raids. We also provide evidence that exposure to BBC radio, especially together with bombing, increased the number of resistance cases.

Keywords: Media, BBC, bombing, resistance, WWII

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## 1. Introduction

Is the word mightier than the sword? In most conflicts, adversaries aim for victory by both direct force and indirectly, by undermining the enemy's will to resist. Rapid, easy victories often rely as much on military might as on destroying the enemy's morale (Hastings 2011; Horne 2012). Two tools are often used in a bid to weaken the enemy's determination: "shock and awe"—impressive shows of strength—and propaganda. Air power advocates have long argued that bombing can weaken support for a regime, undermining the enemy's morale while boosting internal dissent (Douhet 1921). Some argue that the atomic bombing of Japan hastened the end of the war (Hastings 2011).[1] Similarly, propaganda is often used by foreign powers during wartime to undermine morale and promote resistance (Somerville 2012).

There is widespread skepticism about the efficacy of both aerial attack and foreign propaganda: US bombing in Vietnam boosted Communist insurgents' popularity (Dell and Querubin 2018); the "Blitz"— Germany's bombing of London in 1940 — may have increased support for the UK government (Hastings 2013, 458). Because German armament production and civilian morale did not collapse, the Allied bomber offensive during World War II against Germany is widely considered a failure (Overy 2013; Pape 1996).[2] Similarly, Pütter (1997) suggests that allied radio programs did little to win German hearts and minds. Generally, there is substantial skepticism about the effectiveness of foreign media campaigns because people will not trust "the enemy" (Martinez-Bravo 2019; Manheim 1986; Pieslak 2009). However, recent policy work has emphasized potential synergies between propaganda and the use of military force (Hosmer 1996).

In this paper, we examine the effects of bombing and radio propaganda on domestic opposition and morale during World War II. We do so for the Allied air offensive against Germany in World War II—the second-largest bombing campaign in history.[3] Between 1939 and 1945, British and American bombers dropped more than two million tons of TNT[4] in

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[1] The claim is disputed by some other scholars (Wilson 2007).

[2] John K. Galbraith called it "... the greatest miscalculation of the war." Galbraith acted as one of the civilian directors of the US Strategic Bombing Survey, tasked with evaluating the effects of the air war. One leading historian, Richard Overy (2013) went as far as to argue that, "the effect of bombing was not, as the Allies hoped, to drive a wedge between people and regime, but the opposite…"

[3] The bombing of Vietnam involved higher tonnages dropped, but fewer aircrafts.

[4] The explosive power of different explosives is, by convention, measured in tons of TNT (specifically, 2,4,6-trinitrotoluene)—a unit of energy that equals 4.184 gigajoules.

Europe alone, the equivalent of more than 100 times the destructive force of the Hiroshima and Nagasaki bombs. The air war was costly for all combatants: The UK devoted one third of wartime production to strategic bombing.[5] Allied air attacks killed 360,000 Germans alone. Casualties among Allied aircrews outnumbered the number of service men killed in ground combat on the Western front: of the Royal Air Force (RAF) bomber crews 56,000 men died; the United States Army Air Force (USAAF) lost 20,000 men (Hastings 2013). At the same time, all belligerents used radio propaganda for the first time on a significant scale, spreading falsehoods and half-truths well as disseminating actual information (Briggs 1995).

We examine the impact of bombing and radio propaganda on two groups of Germans: those potentially critical of the regime, and those potentially favoring the regime, i.e. highly motivated military personnel. First, we show that bombing increased the frequency of active resistance substantially—even against an overwhelmingly powerful, efficiently run, and deeply entrenched government (Evans 2008). Second, we demonstrate that bombing of the *Reich* had a pronounced, negative impact on the morale of German fighter pilots—a key group of highly skilled military personnel whose motivation was crucial for success (Ager et al. 2017). Third, we provide evidence that exposure to BBC radio, especially when combined with aerial bombardment, increased the number of resistance cases.

We begin by compiling new data on resistance against the Nazi regime in Germany during World War II. Information from treason trials provides details on the scale and seriousness of resistance activity.[6] We focus on the years 1943–44—the period when the overwhelming share of bombing occurred, but before Germany's final defeat was certain. This is also the period when the People's Court, a high-level court staffed by determined Nazi judges, had exclusive jurisdiction over treason trials. Treasonable activity ranged from defeatist comments, distributing leaflets, and encouraging sabotage by foreign slave workers to the attempted assassination of Hitler and the overthrow of his government, including the famous von Stauffenberg plot of military officers in the summer of 1944.

For most of the war, Allied bombers flew from UK bases. German cities beyond the operational range of these planes were bombed much less—and, as we show, they also saw fewer acts of resistance. Bombers' limited operational range created discontinuity in bombing and resistance. Using a regression discontinuity approach, we first show that the drop in

[5] O'Brien (2015) shows that half of German armament and munitions output was devoted to aircraft and anti-aircraft guns.
[6] These data were first exploited in a quantitative fashion by Geerling, Magee, and Brooks (2013).

bombing beyond the range of the main bomber used by the Allies neatly coincides with a decline in resistance activity. Next, we analyze changes in the frequency of bombing and resistance activity over time, exploiting the panel nature of our data. Volatile weather conditions serve as an exogenous source of variation. We predict daily bombing from daily data on winds speeds over German cities during World War II. A doubling of bomb volume increased the number of resistance cases in our data by 4.8%, and the probability of resistance grew by 3.8%. Importantly, our results are not driven by a rise in policing after bombing raids.

Allied bombing not only targeted civilians; it also aimed to undermine the German armed forces' will to resist. To study this channel, we analyze the performance of German fighter pilots during World War II. In aerial combat, individual motivation is key—asymmetric information abounds, and there is no effective control by superiors during an air battle (Ager et al. 2017). For 352 German pilots who scored more than 5 victories ("aces" who are in the top 7% of pilots), we collect data on their city of origin.[7] Combining this information with the time of bombing and data on the number of aerial victories, we test whether aerial attack on pilots' hometowns undermined their combat effectiveness. We find sharp reductions in the frequency of monthly aerial victories: while pilots downed on average 1.9 Allied aircrafts per month, this rate declined by 10–30% after home-town bombings.

Importantly, the flames of resistance activity were fanned more effectively where Germans could listen to the BBC. For identification, we exploit quasi-exogenous variation in signal strength of the BBC (similar to the approach in Olken 2009; Yanagizawa-Drott 2014; Adena et al. 2015). In the resistance data, we find that where news from London arrived together with Allied bombers, German resistance became markedly more likely. In terms of the magnitudes, with a one standard deviation increase in BBC availability, the Allies could have achieved the same effect on domestic opposition while reducing bombing by 25.3%.

The synergy between bombing and media exposure suggests that undermining the belief in victory can be a key factor in creating domestic opposition. the United States Strategic Bombing Survey (USSBS) show that German citizens thought the war lost earlier where bombing was heaviest. The combination of—honest—BBC reporting of the war's direction and the direct evidence confirming the overwhelming military might of the Allies is likely to

[7] By using the term "aces"—shorthand for high-performing pilots—we do by no means wish to glorify their deeds, which served to keep a genocidal regime in power.

have contributed to a decline in civilian morale, potentially leading to resistance. Our main contribution is to document and quantify the impact of bombing and foreign radio on domestic opposition and morale during the deadliest military conflict in history. Our paper is related to Dell and Querubin (2018). They show that US bombing in Vietnam reduced support for the Southern Vietnamese government, while increasing popular backing for the Vietcong. The Vietnamese case is unusual—villages were bombed by their *own* government's main ally. Our paper examines air attack in a more common setting: an enemy power aims to undermine citizens' backing for their own government. In both cases, the regime's failure to protect its citizenry resulted in less popular support. Our study sheds light on effective strategies against dictatorial governments, and it underlines the role of radio propaganda as a potential complement to bombing.

We further contribute to three distinct literatures—the effects of media on political attitudes, the determinants of regime support, and the history of the air war during World War II. There is a growing consensus that media exposure can change political attitudes and voting behavior. Numerous examples when media exposure influenced voting behavior include Fox News in the United States (DellaVigna and Kaplan 2007), NTV in Russia (Enikolopov, Petrova, and Zhuravskaya 2011), Berlusconi channels in Italy (Durante, Pinotti, and Tesei 2017). In addition, an emerging literature looks at the effect of radio on more extreme forms of behavior. Yanagizawa-Drott (2014) demonstrates that radio propaganda was an important driver of violence against the Tutsi minority in Rwanda. Relatedly, Gagliarducci et al. (2020) argue that the BBC helped to coordinate partisan activity in German-occupied Italy during WWII, leading to more reprisals. However, they find no effects on the motivation of Italians to oppose the fascist regime.[8] At the same time, Armand et al. (2020) document that radio can help to mitigate civil conflict in Uganda. Our paper contributes to this literature by showing that propaganda can be effective—even in the extreme case of encouraging resistance against one's own government during a war with a foreign power.

We also contribute to the literature on autocracies and their public support. Classic treatments like Arendt (1973) as well as Acemoglu and Robinson (2000) emphasize potential conflict between a small elite and the populace at large. Recent research has increasingly emphasized that dictatorships endure by co-opting one part of the population while repressing another (Gandhi and Przeworski 2006; 2007; Wintrobe 1998). Guriev and Treisman (2019) argue that

[8] One potential explanation is that Italy had relatively few listeners—there were less than 1 million of radio sets in 1938 (Briggs 1995) and 1.02 million in 1944 (Laden 2018).

propaganda and misinformation are common tools for dictators to ensure public support. Adena et al. (2015) show that German radio promoted electoral support of the Nazis and encouraged violence against Jews in late 30s.[9] Also, people who have experienced state repression seem to reduce their support of authoritarian governments (Iwanowsky and Madestam 2019, Bautista et al. 2020). While some historians have emphasized the Nazi regime's popularity as a result of plunder and exploitation after 1939, others underline the importance of totalitarian surveillance and repression, ranging from local party representatives to the secret police (Gestapo) and concentration camps (Evans 2008; Aly 2005). Our paper furthers this literature by examining the role of military destruction and foreign propaganda on the support for an autocracy at war.

By examining the efficacy of bombing, we also relate to the economic history of war. Many historians have questioned the effects of bombing. Allied victory in World War II is mainly attributed to the Western powers' economic superiority and the Red Army's sacrifices on the battlefield (Harrison 1998; Beevor 2012; Hastings 2011). Following skepticism by the one of the chief authors of the Strategic Bombing Survey's, the economist John K. Galbraith, several historians have emphasized that German industrial production continued to surge under the hail of bombs unleashed by Western Allies—and that the population did not turn against the Nazi government. Both Hastings (2013) and Overy (2014) argue that the effects on morale were disappointing from the perspective of the US and UK air forces, and that armament production was not affected significantly. In contrast, O'Brien (2015) argues that the logistical demands of both sea and air battle undermined Germany's war effort. Along similar lines, some scholars see an important role of the bomber offensive in undermining the *Luftwaffe*'s fighting strength (Keeney 1988). There is no agreement about the effect of air power on the morale of the German armed forces. The *Wehrmacht* fought hard until the very end of the war, despite heavy bombardment at home and on the front (Kershaw 2016). Therefore, it appears that devastation at the home front failed to undermine the troops' fighting spirit (Hastings 1981).

To sum up, we make the following contributions to the existing literature: we show that bombing had important effects, generating domestic opposition while depressing servicemen's morale. This is in line with the main aim of aerial bombardment in World War

[9] We cannot survey the vast literature on the rise of the Nazi party here. Among recent contributions, Spenkuch and Tillmann (2018) argue that religion played an important role in ensuring Nazi party support. Satyanath et al. (2017) argue that social capital facilitated transmission of Nazi beliefs before 1933.

II, which was to increase opposition against the Nazi regime (Overy 2014). Second, we find a synergistic effect with radio propaganda. This is important because there is, until now, no empirical study on the topic.[10] Both the BBC and the UK government believed in the effectiveness of its German service; media historians have doubted its effect (Pütter 1986, 26). Our findings show that bombing and broadcasts in combination were particularly effective in creating opposition, while the effect of radio alone was rather limited.

The rest of the paper is organized as follows. Section 2 provides historical background. Section 3 describes the data. Section 4 summarizes the results for bombing. Section 5 provides further evidence on the impact of radio propaganda and its interaction with bombing. Section 6 concludes.

## 2. Context

In this section, we discuss the context of our study—the theory of aerial warfare, and the history of WW II, especially as it relates to civilian morale, BBC radio propaganda, and combat motivation in the German armed forces.

***Theory***

After World War I, many strategists believed that future conflicts could be won by air power alone. Long-range ("strategic") bombing could be carried out with two objectives in mind—to undermine enemy morale, or to destroy military capabilities, mainly by reducing armament production.

The dominant view among military thinkers emphasized the first mechanism. Italian general Douhet, an early pioneer of air power theory, argued that *populations* would rise up and overthrow their rulers if bombed heavily (Douhet 1921). By the 1930s, his views had gained wide currency. British Prime Minister Stanley Baldwin, predicted that future wars would inevitably involve the massive use of aerial bombardment against civilian populations: "the man in the street [should] realize that there is no power on earth that can protect him from being bombed… *the bomber will always get through*. The only defense is in offence, which means [to] kill more women and children more quickly than the enemy…" (emphasis added, Hastings 2013). Since World War II, the psychological dimension of air power has become an

[10] The related paper by Gagliarducci et al. (2020) examines radio as a means to coordinate partisan activity, not a tool to instigate opposition.

increasingly important aspect of US Air Force doctrine. A RAND[11] review of the PSYOPS (psychological warfare) dimension of bombing during the Vietnam, Korea, and the First Gulf War argues that demoralization not just of the enemy's civilian population, but of his *armed forces* can be an important outcome of bombing (Hosmer 1996).[12] The review emphasizes the potential synergies with other PSYOPS tools such as media usage and propaganda themes. Among the main psychological mechanisms at work in undermining combat motivation, it emphasizes the importance of demonstrating the inevitability of defeat—the "shock and awe" dimension, as well as less enforcement of discipline in bombed enemy formations. Hosmer's (1996) discussion considers Germany during World War II an outlier, and cites a number of idiosyncratic reasons like indoctrination and primary group attachment why general lessons did not apply.

Bombing can theoretically demoralize enemy morale directly, through threats to life and property; it can also undermine the credibility of the enemy's government. Most governments provide information to their populations, often with a slant, in a bid to boost domestic morale. Bombing, in such a setting, could work like a "state-verification" technology—the truth of statements by one's own government or lack thereof can be independently, and immediately, confirmed. In other words, when forming a view of whether the war is gained or lost, direct experience of massive enemy air superiority may be important—as it was in the observations made about the course of the war during secret Gestapo reports from World War. Winston Churchill, at the height of the "Blitz," pointed to bombing as a good indicator of who was to be believed:

> If, after all these boastings and blood-curdling threats and lurid accounts trumpeted around the world of the damage he [Hitler] has inflicted..., after tales of the panic-stricken British crouched in their holes cursing the plutocratic parliament which has led them to such a plight, his whole air onslaught were forced tamely to peter out, the Führer's reputation for veracity of statement might be seriously impugned. (Churchill, 21.8.1940)

The second approach aims to destroy the industries that produce the tools needed to win in total wars. Armament production absorbed 40% or more of the major belligerents' productive capacity during World War II (Hastings 2013). USAAF doctrine during WW II aimed to destroy it. Putting its trust in a new, secret bomb aiming device, the Norton bomb sight, the USAAF expected that precision attacks could knock out critical parts of the enemy's

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[11] The Research and Development Corporation (RAND) is a nonprofit thinktank created in 1948 by the Douglas Aircraft Corporation (https://www.rand.org/).
[12] The RAND study also concludes that Germany during World War II appears not to fit this pattern.

production system—having carefully identified the most vulnerable parts by use of input-output-table analysis.

***Strategic bombing during World War II***

By the autumn of 1940, after failing to win air superiority, the German air force began to bomb London, Coventry, and other British large cities. The Royal Air Force in turn attacked Berlin and other German cities. The RAF's Bomber Command received a high share of available resources, reaching a maximum of almost 2,000 operational planes by the end of the war. Bomber Command flew more than 300,000 sorties against Germany resulting in a loss of around 8,000 aircraft and 55,000 air crew killed (Davis 2006). Under the leadership of its commander-in-chief Arthur C. Harris, Bomber Command emphasized area attacks—an attempt to demoralize, maim, and de-house the population of German cities.[13]

Once the US joined the Allied war effort, the strategic bombing of German industry and cities intensified.[14] By the end of the war, the 8th and 15th US Air Forces in Europe each employed more than 150,000 men and could field up to 1,000 bombers plus 800 escort fighters. USAAF lost 20,000 men over Europe, flying 410,000 missions. In combination, the US and UK air forces dropped more than 2 million tons of bombs during the period 1942 to May 1945,[15] losing some 14,000 aircraft in the process (Davis 2006).

The US strategy of precision bombing fared poorly under European conditions. Poor visibility[16] and fierce German defense[17] led the USAAF to switch to area attacks. Ultimately, it devoted twice as many bombs to attacking city areas as to "precision bombing" (Ross 2003). As the German air force declined in strength, Allied bombing accelerated—more than three quarters of all tonnage was dropped in the last 12 months of the war (Overy 2014).

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[13] UK strategy was the "destruction of housing and public amenities ... [to] undermine both the ability and the willingness of the industrial workers to maintain their posts at the factories." (Este 1991).

[14] The US was unique in having a four-engined bomber in production when World War II began, the B-17 "Flying Fortress." In the UK, such aircraft were still on the drawing board; in Germany, they would mostly remain there for the rest of the conflict.

[15] Of these, 1.2 million tons were dropped on Germany.

[16] For example, on Sept. 6, 1943, the 8th US Air Force sent a force of 338 bombers to attack Stuttgart. Only 262 planes made it to Germany; out of these, only 46 attacked Stuttgart because of dense cloud over the city. The other planes diverted to alternative targets including Karlsruhe and Offenburg, about 100 km away.

[17] In the famous raids on the Schweinfurt ball bearing factories in October 1943, the USAAF used 376 B-17s. Of these, 147 were shot down. In a second raid, 60 USAAF aircrafts were destroyed and 142 were damaged, out of 291 employed.

***Bombing's military and industrial consequences***

Attacks on the oil industry and on rail transport after the summer of 1944 made troop movement increasingly difficult, and hampered training (Overy 2014).[18] The effect of bombing on armament production is harder to assess. Immediately after the end of the war, the United States conducted a detailed survey, the United States Strategic Bombing Survey (USSBS). It employed over 1,100 officers and civilian experts, including John Kenneth Galbraith. The study found that German armament production numbers had surged during the war. German output of aircraft, tanks, and guns only peaked in the second half of 1944, when the intensity of bombing reached its highest level.

The USSBS conducted numerous detailed, plant-level analyses. There were several cases of significant reductions of actual production, but these were typically short-lived. Clearly, area bombardment was ineffective in reducing production. The fire-bombing attack on Hamburg in July 1943 destroyed over 300,000 dwellings and killed 40,000—and yet, only the equivalent of 1.8 months of industrial production were lost as a result. Albert Speer, the German Minister of Armaments and War Production, predicted at first that production would collapse if the Hamburg attack was repeated six more times—but was astonished to see how quickly output recovered (Hastings 2013). The British bombing survey estimated that area attacks never reduced German production by more than 7%, and that its effect was possibly as low as 1% as late as 1944 (Overy 2014).

***Bombing and civilian morale***

Pre-war strategists had envisaged air power as a war-winning weapon because of its expected effect on morale. Next to the goal of reducing military production, both the German bombing of Britain, and the Allied bomber offensive against Germany, were designed to destroy the population's will to resist. This is especially true of the RAF's strategy of nighttime attacks on German population centers.

Regular, massive bombing raids on Berlin during the RAF's "Battle of Berlin" (1943–44) seemingly undermined the regime's prestige. At the start of the war, Hermann Göring, the head of the German air force, had boasted that if a single bomb were to fall on Berlin, people could start calling him Meier. Throughout the later years of the war, Berliners commonly

[18] Many of the planes, tanks, and artillery pieces produced during Speer's "armament miracle" in 1943 and 1944 never reached the front line because of the rail network's collapse. Once these weapons were in the *Wehrmacht's* hands, many had to be abandoned for lack of fuel, also made a priority target in 1944 (Beevor 2016).

referred to air raid sirens as "Meier's trumpets" (Hastings 2013). Massive raids undermined beliefs in final victory. Hermann Göring himself, while witnessing B-17s over Berlin in early 1944, told a confidante that Germany had had lost the war (Overy 2014).

Numerous Germans resisted the Nazi regime, but—apart from the military plotters on July 20th, 1944—never got close to actually seizing power. There was no mass uprising and no collapse at the front during the Second World War, as there had been in 1918. This failure to destroy the Germans' will to resist is often seen as proof that Allied strategic bombing was fundamentally flawed.[19] At the same time, anecdotal evidence shows that support for the regime was heavily dented by the devastation of German cities. After the fire bombing of Hamburg in July 1943, the German security services reported that across the Reich, all "feeling of security" had collapsed (Stargardt 2015). Indeed, for several months after the Hamburg raid, Gestapo reports point to a generalized belief that the war was lost, and that the Nazi leadership had to go—as happened to Mussolini in Italy at the same time. While the acute crisis in 1943 passed, aerial attacks dented the belief in victory: Open criticism of the war and the regime became common-place, Nazi party members were set upon in the streets, and open contempt for the air force leadership became common (Evans 2008). While the regime stressed defiance in the face of mass destruction, secret surveys by the Gestapo of public sentiment paint a very different picture (Boberach 1984). One representative report from October 1943—at a time when bombing was light compared to later attacks—describes the effect of American daytime attacks on the population was described as "depressing"; people increasingly felt that the Allies dominated German air space. The report quotes citizens as saying "They [the enemy] can do what they whatever they want," and "They are going to finish us" (Boberach 1984). The fact that bombing did not lead to open mass revolt opposition against the regime may therefore tell us more about the repressive powers of the government than the failure of strategic bombing to undermine morale.

***BBC German services and radio technology***

Germany was a country of radio listeners—there were 9 million registered receivers by 1938, growing to over 16 million in 1943 (see figure F.1 in Appendix F). Some estimates indicate that by January 1938, half of all households possessed a *Volksempfänger* (people's

[19] Major Alexander Seversky, of the USAAF, concluded in 1942 that "it had been generally assumed that aerial bombardment would quite quickly shatter popular morale … it now seems clear that despite large casualties and impressive physical destruction, civilians can 'take it.' On the whole, indeed, armed forces have been more quickly demoralised by air power than unarmed city dwellers." (Hastings 2015, p. 458).

receiver).[20] This also meant that Germans could and did listen in large numbers to foreign radio, the BBC in particular, despite the fact that this activity was strictly prohibited by the government. According to Briggs (1995, p.11) the BBC "did more than any comparable agency both to pull together different elements of resistance in each separate European country—by giving news... by providing ideas and inspiration and at certain stages by passing on operational orders—and to spread relevant information between countries."

In contrast to German and Soviet propaganda, the BBC maintained a high standard of journalistic probity. Its broadcasts included timely and accurate information about the course of the war. This included open admissions of defeats and failures, such as the fall of Dunkirk, which enhanced the BBC credibility with German listeners (Somerville 2012). BBC programming also aimed to uncover German propaganda lies in a bid to undermine support for the Hitler government, and included popular items such as messages from German prisoners of war. Programming focused on exposing Nazi lies and propaganda.

The BBC recruited prominent speakers such as the writer and Nobel laureate Thomas Mann. Mann addressed the bombing in his radio broadcasts:

> Hitler is boasting that his Reich is ready for ten, even twenty years of war. I assume that you Germans have your own ideas about that—for example, that after a fraction of this time no stone will stand on top of another in Germany. (Mann 1943) [21]

Overall, during the war, the BBC (1944) felt that "Germans listen to London and take seriously what they hear." Over time, more and more Germans turned to it as a reliable source of information (Evans 2008, p. 576). There was an important synergy between radio propaganda and the air war. In the words of the Morale Division's report in the USSBS, "Black [illegal] radio listening and disbelief in official propaganda increased steadily during the last 2 years of the war… Bombing had much to do with the final discrediting of propaganda and of the Nazis because it brought home to millions the tangible proof of almost unopposed Allied air power, indisputable proof completely at variance with familiar Nazi propaganda…"

In Germany, listening to "Radio London" (and many other foreign broadcasts) was strictly prohibited. Every radio receiver came with official stickers warning listeners of severe penalties for anyone tuning in to foreign stations. Violating the ban on listening to enemy

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[20] Plock (2020)
[21] April 1942, special broadcast.

stations was punishable by imprisonment or, in case of additional spreading of foreign propaganda, by death. To block the BBC reception, a number of jamming transmitters were installed, but they were apparently largely ineffective (Klingler 1983, p. 56). Despite prohibitions and penalties, anecdotal evidence suggests that many Germans tuned in secretly to the BBC. While accurate estimates are impossible to obtain, the Gestapo estimated the number of listeners to the London Christmas program in 1941 at around 1 million (Klingler 1983). By 1944, the BBC guessed that 10–15 million Germans were listening (Kaufmann 2013).

From its start in 1938, the BBC German Service broadcast on medium wave frequencies, using transmitters in south-east England. Short wave technology was well-developed by the 1930s, but the number of compatible German receivers was kept low on purpose; owners were placed under observation. Those who purchased parts to build powerful receivers were routinely reported to the Gestapo (Weidenhaupt 2001, p. 56). The people's receiver, the most popular radio set in wartime Germany, did not offer short-wave reception. Both the main German radio program as well as the BBC German Services were transmitted on medium wave.

Therefore, we confine our attention to medium wave transmissions. As one media historian argued:

> The German broadcast of the BBC was the first and for a long time the only program for the Reich which could be transmitted via medium-wave and which was strong enough to reach the famous "man in the street" in the first place. (Pütter 1978, p.127)

To identify the effect of the BBC we rely on the exogeneity of radio reception. The quality of the BBC signal was largely determined by distances to transmitters and topography. The impact of geography on radio reception allows us to exploit variation over relatively small geographical areas.

***Resistance***

Resistance against the regime took a variety of forms. Even trivial offences such as jokes about the party and leadership were officially considered treasonous. More serious were comments about the course of the war and the possibility that Germany might lose, or anti-regime graffiti and the circulation of flyers—a crime against the people's will to resist, in Nazi parlance, a crime punishable by death. Even more important were attempts to sabotage the war effort, aiding the escape of prisoners of war, and the like. The most serious form of resistance included attempts to violently overthrow the government. Our data covers the

entire range of opposition activities, and includes the conspirators of the July 1944 who plotted to kill Hitler and overthrow the regime.

Soon after the Nazis came to power, they put in place powerful secret police, the Gestapo, to stamp out subversive activities. Under the overall control of Heinrich Himmler and the SS, the internal security apparatus quickly won the war on crime and reduced all organized opposition networks to impotence (Evans 2005). By the late 1930s, there was almost no scope for internal resistance. Only after the start of World War II did some measure of resistance activity reemerge, often centered on working class neighborhoods where the Communists had polled strongly before 1933.

Widespread skepticism about the effectiveness of air power and propaganda can be rationalized by the fact there was no mass uprising against Nazi rule, and that no attempt to overturn the regime was successful. At the same time, Hitler was the subject of no fewer than 42 documented assassination attempts—possibly a world record (Berthold 1997).

***Morale in the German military***

The fighting spirit of Germany's armies was relatively high during much of the war (Van Creveld 2007). Nonetheless, bombing of the home front seemingly undermined military morale. Soldiers on home leave witnessed the destruction of their hometowns and experienced air raids. Others received news from their families:

> With the increasing bombing attacks on German towns, and the heavy civilian losses, the morale of troops is badly affected. Every day, soldiers receive news of the destruction of their homes, the tragic death of wives and children. They return from leave depressed. (Hastings 1981)

By 1944, Berliners joked that volunteers for the Eastern front were the real cowards, because life was less dangerous there than at home. For airmen in particular, the destruction of German cities was a severe blow to their status: every bomb that landed on German soil demonstrated the *Luftwaffe's* weakness (Evans 2008).

## 3. Data

In this section, we briefly describe our data sources and discuss basic patterns. Note that summary statistics for key variables used in the analysis are shown in Table A.1 in the Appendix A. More details on data sources can be found in Appendix G.

**Resistance.** To measure resistance, we digitize high treason court cases held during the years 1943 and 1944. This yields data on almost 2,000 accused individuals who stood trial before

the People's Court. This court was established in 1934 outside the normal legal structure, after the German Supreme Court had offended the Hitler government by acquitting all but one of the defendants in the famous Reichstag fire case. Charged with prosecuting political crimes and staffed by hand-picked Nazi judges, it handed down a large number of death sentences during the war (Geerling, Magee, and Brooks 2013; Geerling et al. 2018).

All cases in our dataset concern political opposition. Defendants include members of the "White Rose" resistance movement—the group of Munich students around Hans and Sophie Scholl—as well as some of the conspirators of the July 20, 1944 plot. In the sample there are at least 53 individuals accused of planning, assisting, or executing 5 distinct plots to assassinate Hitler. Overwhelmingly, however, the accused are ordinary citizens whose trials (and frequently, death) left little trace in the public consciousness. Charges include undermining Germany war-making powers (*Wehrkraftzersetzung*), work slowdowns, defeatism, and treason.

For each of our court cases we collect information from the trial documents about the start of resistance, the time of arrest, place and type of resistance, and if there was any mentioning of radio listening. We find evidence of resistance in 532 distinct locations in 1943 and 192 in 1944. Because of the lag between the start of resistance activity and arrest (and further delays until the case was brought to trial) there are effectively no cases that began in 1945. We exclude the ones we find in the records.[22] Our main variable—new resistance—is measured monthly at the city level.[23] We show the location of the resistance cases on the map in Figure 1. Resistance took place all over the Germany.[24] The timing of the resistance and the distribution of time between the beginning of resistance and the date of arrest are summarized in Figure 2.

Figure 3 illustrates the timing of resistance activity for one case—Berndhard Klamroth, one of the conspirators of July 20, 1944. A former lieutenant-colonel in the German army, he first started to participate in the planning of the Hitler assassination in January 1944, when bombing of Berlin—where he was serving—reached a peak. He then transported the explosives to kill Hitler to Berlin and was arrested by the Gestapo the day after the failed

[22] Indeed, there is only one such case in 1945: resistance in Stettin. The court itself was hit hard by the bombing of Berlin in March 1945, when its head judge, Roland Freisler, was killed in a USAAF raid.
[23] We aggregate resistance cases at the monthly level since in many instances the exact date of the start of resistance is somewhat vague.
[24] Some observations from other countries are deliberately not included in our main sample. Note that in our main regressions, we use the log transformation (+1) of resistance variables to avoid losing zeros.

Stauffenberg plot. He was sentenced by the People's Court on 15 August 1944 and executed the same day.

**Bombing.** We use detailed information on the tonnage of bombs dropped on all German locations, based on (Davis 2006). In our regression discontinuity design analysis, we use both the intensive and extensive margin of bombing. In panel analysis, we exclude places with no bombing in either 1943 or 1944, to avoid making an inference based on locations that were never bombed and base our identification only on the timing of bombing. We depict the location and intensity of bombing on the map in Figure 4. Note that we only include locations inside Germany in its pre-1938 borders in our main data sample. The circle shows the maximum range for bombers flying from East Anglia.[25] The histogram in Figure A.2 also shows that although Allied bombing began in 1941, it intensified in 1943–1945.

**Sample.** We perform analyses at two different levels. Our main results are based on the sample of German cities, and some of our results are based on the sample of districts (*Kreise*). The city sample consists of 936 places. It includes all cities over 20,000 inhabitants plus other places being bombed plus places of resistance (place of living). For small places next to each other (or next to a larger city), a rule of thumb of 5 km (straight line) is used to merge them together (or to a larger city). Places outside of the pre-1938 Reich boundaries[26] are dropped. Also places that are further than 120 km from the nearest weather station are dropped to ensure the reliability of weather data.

**German Pilots.** The data on fighter pilots come from the claim registry of the Oberkommando der *Luftwaffe* (Air Force High Command—OKL). The OKL fighter claims list was extracted by Jim Perry and Tony Wood from microfilms of the handwritten records of the *Luftwaffe* Personalamt stored at the German Federal Archives (*Bundesarchiv*) in Freiburg. This data is supplemented by information from the Kracker Archive. Because some OKL fighter claims records did not survive the war, Tony Wood augmented the list with claims from other published sources—such as Donald Caldwell's (1996) JG26 war diary—to obtain a comprehensive list of German fighter claims for the years 1939–1945.[27]

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[25] For simplicity, we use distances from Chelmsford, in East Anglia. The vast majority of allied bomber airfields were located in East Anglia (cf. Appendix A Figure A.1).

[26] See https://web.archive.org/web/20170709100924/http://censusmosaic.org/data/historical-gis-files for exact historical German boundaries.

[27] For more information about Tony Wood's combat claims list and the Kracker Luftwaffe Archive, see https://web.archive.org/web/20130928070316/http://lesbutler.co.uk/claims/tonywood.htm and http://www.aircrewremembered.com/KrackerDatabase/.

From these records, we take information for 352 high-scoring pilots whose place of birth is known.[28] While we do not know whether pilots' families still lived there, this is the only information on pilots' home towns. Also, by focusing on high-performing pilots, we are measuring the impact amongst soldiers responsible for the vast majority of aerial "victories"—the top 5% of pilots accounted for one third of Allied aircraft shot down.

**Other Socio-Economic Controls.** We also use other district level socio-economic information from the 1925 and 1933 censuses, including shares of Jews and Catholics, blue- and white-collar workers, WWI participation, property tax, welfare recipients; political preferences in terms of voting in 1933; city status of the district; access to other sources of information: German radio signal strength, newspapers in the 1930s, and the number of cinemas.

**USSBS Moral Division Survey.** In addition, we assemble data from the post-war survey conducted by the United States Strategic Bombing Survey, Morale Division. Over 3,700 individuals were surveyed between March–July 1945 in 34 cities all over Germany, including seven never bombed cities, and excluding the Soviet zone of occupation. While earlier studies have only used the aggregated responses from the USSBS, we located all individual returns and digitized them. Amongst other items, the survey asked when and whether the person had started listening to Allied radio—around 50% of respondents reported that they started listening at some point before or during the war. The survey also questioned people about when they thought the war was lost, and their views of the Nazi leadership, the reasons for losing the war, and people's assessment of the post-war situation.

**BBC Reception.** In order to measure BBC reception in Germany, we collect information on BBC transmitters used to broadcast German services: their location (mainly in South-East England) and their power.[29] We predict BBC radio availability—the strength of radio signal, for 1943–1945 for every German locality, using information on the location and power of transmitters derived from the irregular terrain model (Hufford 2002; Olken 2009).

As is standard in the literature on radio's effects, we exploit information on actual listening as a function of reception quality. This yields an S-curve, with listenership declining rapidly

[28] There is no simple cut-off of overall victory claims for inclusion in the list. Pilots are "famous" and have biographical entries in various lists of fighter pilots (cf. Ager et al. 2017 for details). Their overall victory score puts them in the top 10% of German WWII pilots.
[29] There were no significant changes in the power over time in the period under study.

below a threshold value of acceptable reception quality.[30] We unfortunately do not have systematic data on listenership to the BBC to estimate radio listening directly. Instead, we use self-reported listenership to the BBC from the USSBS to examine diffusion patterns. As Figure 5 suggests, people were able to listen to BBC with signal strength far below the conventional threshold, and we do not observe a flat tail on the left-hand side of the distribution (probably because people were willing to tolerate a noisy signal to obtain information). At the right-hand side, the curve flattens out around 0.[31] In what follows, we use the estimated relationship, as presented in Figure 5, to create a non-parametric function of signal strength to predict BBC listening.[32]

**Weather data.** Weather data is available for 146 weather stations all over Germany at daily, 6-hourly, or hourly frequency for pre-war and war years.[33] We use data on wind speed for 1943–45. We interpolate this data for the sample of 936 towns and cities using a standard interpolation procedure (Pebesma 2004; Pebesma and Wesseling 1998; Acemoglu, De Feo, and De Luca 2020) and exclude cities further than 120km from the closest weather stations. Due to data availability, the interpolations for 1943 are based on 6-hourly weather reports, while for 1944, we use hourly reports; in both cases we first run the interpolations and then take an average for each day.[34]

## 4. Results: Bombing

In our main analysis, we exploit variation in bombing intensity over time and space to explain resistance against the regime. Figure 6 gives a first impression: resistance in the most heavily bombed towns and cities was markedly higher than resistance in unbombed or little-bombed cities.

However, this correlational evidence should not be interpreted as causal: even though Allied bombing was highly inaccurate, it was not random. Omitted variables like military value, population density and pre-existing skepticism vis-a-vis the Nazi regime could potentially

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[30] More precisely, we use the predicted signal strength and combine it with the information on actual listenership to infer acceptable levels of reception quality at the time under study. Other papers use similar functional forms (Olken 2009; Yanagizawa-Drott 2014; Adena et al. 2015).

[31] Note that signal strength on our scale is mostly negative. It means that the quality of reception was not as good as modern-day standards imply. At the same time, Figure 4 suggests that listeners were willing to accept this lower quality for listening to foreign radio during the war.

[32] Figure A.3 also reports the geographic distribution of our measure of BBC availability.

[33] The source of data is www.kachelmannwetter.com.

[34] Note that our panel regressions always include time fixed effects to deal with the concern of potentially different data quality over time.

explain this strong association. In order to eliminate those confounding factors, we use complementary sources of variation to deal with potential unobserved heterogeneity. We first report cross-sectional results from a spatial discontinuity-based exercise. Next, we exploit weather-induced variation in panel data. Finally, we analyze data from the victory records of German fighter pilots, analyzing how bombardment of their hometowns affected performance.

***Basic Patterns: Bombers' Combat Range and the Geography of Resistance***

We first exploit technical limitations of WWII aircraft for identification. Allied aircraft could not reach all German targets with equal ease. Aachen, on the Dutch border, is a mere 250 miles (405 km) from East Anglia, where most Allied bombers were stationed during 1939–1945. In contrast, Königsberg is 850 miles (1,368 km) away. The RAF's Lancaster bombers had a long range and could reach most German cities. In contrast, the USAAF used the B-17,for strategic bombing missions, which had a more limited combat range. The official history of the US Army Air Force in World War II states:

> A typical mission by B-17s in the European theatre in 1944–45 would take them to Berlin, Munich, or Leipzig. From their airfields in East Anglia, the bombers would have a practical radius of 600 or 700 miles with a bomb load of 4,000 or 5,000 pounds… Longer missions were occasionally flown… with reduced bomb loads… (Craven and Cate 1948)[35]

The value stated by the USAAF—600 miles, or 521 nautical miles—is close to the actual maximum monthly range of attacks (with a full bomb load) flown by the US 8th Air Force (985 km, or 532 nautical miles). In Appendix H, we summarize how technical characteristics of B-17s, together with operational conditions, created this threshold. In our analysis, we consider all cities at a distance of less than 985 km to East Anglia to be within range of the 8th USAAF.

Figure 4 above shows a map of Europe with the maximum combat radius of B-17 bombers. As the map suggests, most of the bombing indeed occurred within B-17 range, with some occasional attacks outside the 985 km radius. Table 1 summarizes the extensive margin of bombing: Of the 149 cities in our sample outside the normal range of B-17s, only 14 were bombed at all—a rate of less than 10%. In contrast, out of the 875 cities in the sample within

[35] The first operational model, the B-17B, had an effective combat range of 600 miles (Craven and Cate 1948). While later models had larger fuel tanks and better engines, the weight of armor and defensive armament also increased. Operating conditions in general made distances flown shorter than expected: "Prewar statistics on range of aircraft were generally found to be exaggerated when actual wartime experience brought home to the AAF the great host of factors affecting combat radius of action." (Craven and Cate 1948).

range, 53% were bombed—an increase in relative risk by a factor of more than 5. The frequency of resistance per million inhabitants also jumped sharply in cities that were ever bombed: from a frequency of 0.08 in towns without bombing and outside the range of B-17s to 1.08 in those bombed and in range.[36]

Figure 7 shows a heatmap of bombing and resistance within and outside of the B-17's range. Panel A demonstrates that most bombing occurred within 532 nautical miles (985 km) circle around the East Anglia airfields; it declines discontinuously when the maximum combat radius was reached. Similarly, panel B indicates that resistance was more likely to occur in places within the combat range of B-17 bombers, compared with places just outside the circle.[37]

This raw comparison ignores potential differences between industrial cities in West versus East Germany. Because cities were deliberately targeted and not bombed at random, we next perform an RDD analysis. We denote resistance as $R_i$, distance to B-17 maximum range as $D_i$, and maximum bombing range as $\overline{d}$. We estimate

$$E[R_i(1) - R_i(0)|D_i = 0, \phi_m] = \lim_{d\downarrow 0} E[R_i|D_i = 0, \phi_m] - \lim_{d\uparrow 0} E[R_i|D_i = 0, \phi_m] \quad (1)$$

where $\phi_m$ are month fixed effects, capturing time-varying characteristics. The optimally chosen bandwidth (Calonico et al. 2014) is 167.65 km. Table 2 reports the results of this regression discontinuity analysis, with and without controls for longitude and latitude included (following Dell and Querubin 2018). Figure 8 shows the results graphically, zooming in for an even smaller bandwidth.

The numerical analysis implies that with a simple RDD and a cut-off of 985 km, we observe a 0.15 log points higher bombing within the B-17 range (columns 1 and 4, significant at 5% level) and 1.9% higher number of monthly new cases of resistance in range of B-17 bombers (columns 2 and 5, significant at 10% and 5% levels, respectively), which is equivalent to 28% of a standard deviation. Results from implementing a fuzzy RDD design, using bombing as the running variable, imply that the elasticity of new resistance cases with respect to bombing

[36] The rate of resistance is even a little higher in towns bombed but outside the range of B-17—but these were very rare. This suggests that bombing carried out by the RAF had similar effects to USAAF bombing.

[37] Two-dimensional versions of these graphs are also summarized in Figure A.4 in Appendix A. We also report the results of a McCrary test (McCrary 2008) in Figure A.5 in Appendix A. Even though the density of the population in general declines as the distance to East Anglia increases, there is no discontinuous jump in density at the threshold. Also, we should note that, as shown in the heatmap in Figure A.6, average city size does not seem to decline with distance, with perhaps exception of Berlin.

is 0.122–0.124 (columns 3 and 6, significant at 5% level). In other words, a doubling of bombing tonnage led to a 12.4% higher frequency of resistance, on average.

Some additional checks demonstrate the validity of our approach. For example, we report the robustness to the method of choosing the optimal bandwidth in Table A.2 in the Appendix A. Table A.3 presents balance (placebo) results to show that there is no jump in the coefficient of interest for a number of alternative place characteristics like Nazi party vote share in 1933 and some measures for income and population. We also show the results for alternative cut-offs of up to ±30 km in Table A.4; the coefficient of interest for fuzzy RDD is broadly stable across specifications. Table A.5 reports that the results are robust to excluding particular locations close to the maximum range, like Berlin or Munich. To dispel any concerns over spatial correlation and our standard errors, Figure A.8 shows the distribution of simulated coefficients from randomization inference for RDD estimates (Cattaneo, Frandsen and Titiunik, 2015).

***Panel Results***

The RDD estimates based on the B-17's combat radius suggest that bombing increased resistance. At the same time, unobserved characteristics of cities (like military importance) could be correlated with both a population's willingness to oppose the regime in power and geographical distance that are not fully taken into account in the RDD analysis. To deal with this possibility, we introduce a complementary identification strategy, which exploits the panel structure of the data and allows us to control for time invariant characteristics of cities. Note that even with fixed effects of cities taken into account, OLS estimates are still likely to be biased, since strategically important cities were likely to be bombed earlier. At the same time, these cities might also be more likely foci for resistance. We therefore pursue an instrumental variable strategy that exploits quasi-exogenous variation in the timing of bombing of different cities.

We use the weather as a plausibly exogenous source of variation in bombing intensity. Specifically, we interact average daily wind across Germany with each city's distance to East Anglia. Wind has an effect on the speed and ultimately, on the range that aircraft could fly with a full load. The 8th USAAF (1945) summary of tactical conditions states (p. 90) that "...a

strong wind at this altitude ... further reduced the effective radius of operations."[38] Therefore, on days with strong wind, planes were more likely to bomb targets closer to their bases.[39]

The first stage results, reported in Table 3, confirm our logic: there is a negative relationship between wind and bombing for locations relatively far from East Anglia, while the relationship turns positive for closer targets.[40] We also find that it is wind conditions on the day of the bombing and the day before—but neither earlier nor later—that predict tonnage dropped on a target.[41] The effect of weather on bombing the day after can be explained by (i) a direct effect on the bombing after midnight for planes that took off before and (ii) an indirect effect since the targeting was often decided the day before, and the decision-making was influenced by weather conditions during that day—there is a positive correlation over time and the weather forecast was not very reliable. Overall, the results in Table 3 demonstrate that bombing was influenced by day-to-day variation in wind speeds.

To exploit variation over time in the intensity of bombing and the frequency of resistance, we estimate the following equation:

$$R_{im} = \beta_0 + \beta_1 Bombing_{im} + \phi_m + \mu_i + \epsilon_{im} \qquad (2)$$

where $R_{im}$ is a measure of new acts of resistance in city *i* in month *m*, *Bombing* is measured in tons of bombs dropped, and we include month and city fixed effects. We take natural logs of bombing tonnage and resistance variables (plus one in both cases). Because $Bombing_{im}$ is a potentially endogenous variable, we instead report the results from the two-step procedure with bombing predicted from variation in the daily wind strength, as summarized in Table 3.

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[38] Note that the radius of operations is reduced regardless of the direction of the wind. A tailwind increases outbound speed. On the return journey, the aircraft then faces a headwind. However, the effect is not symmetric. For example, a tailwind equal to planes' cruising speed would cut their time to target in half, but they would never return. Therefore, the stronger the wind is, the larger is the reduction in effective range.

[39] While clouds could be considered an alternative source of exogenous variation, they have opposing effects on bombing. On the one hand, they make it harder to find targets. On the other hand, they protect the bombers from being observed directly by anti-aircraft gun crew. There is no obvious relation to the flying range. The same holds for rain. Both perform poorly as an instrument in daily data. Therefore, we confine our attention to the interaction between wind and distance as an instrument.

[40] The opposite is true for locations that are closer to England. Specifically, we estimate the following non-linear equation $bombing_{it} = \alpha_0 + \alpha_1 wind_t distL_i + \alpha_2 wind_t distL_i^2 + \epsilon_{it}$ our daily data, which allows the effect of the wind to have a different sign depending on whether a target was relatively close or far from London. We find that for small distances, the effect of the wind on bombing was positive, while for large distances this effect turns negative (see the effects of wind for various percentiles of *distL*, computed in the last rows of Table 3).

[41] The coefficient on wind conditions when considering bombing on the same or next day are significant at the 1% level (column 4 of Table 3). In contrast, the coefficients are one third in size and far from significant for bombing 1/2/3 days before or 2/3 days after.

Then, to be able to estimate equation (2) at the monthly level, we aggregate daily bombing, as predicted from the daily weather following specification in column 4 in Table 3, to the city-month level.[42] We cluster standard errors by city and month.[43]

Table 4 presents the results of this estimation. Bombing led to a higher number of new resistance cases (column 1 of Table 4): a doubling of bombing tonnage predicts a 4.8% increase in the number of new resistance cases. Similarly, we find that bombing increased the probability of having at least one resistance case (column 3 of Table 4) by 3.8% following a doubling of bombing tonnage induced by weather variation, with coefficients being significant at 5% level in all the columns of this table.[44]

Could the effect of bombing on resistance be explained by more Gestapo activity after a raid? We focus on new resistance cases (and not ongoing ones), mitigating this concern.[45] Nevertheless, to rule out this possibility, we collected data on the number of arrests in each month and place, and control for the number of arrests in columns 2 and 4 of Table 4. The coefficients for arrests are numerically small and far from statistically significance. Furthermore, although arrests are included in the specification, they hardly change the coefficient for bombing (e.g. 0.48 without this control in column 1, 0.49 with a control for arrests in column 2). Thus, we conclude that contemporaneous Gestapo activity is unlikely to explain the estimated effect of bombing on resistance.[46]

We also investigate pre- and post- trends in resistance in Table 5. Future bombing does not affect contemporaneous resistance activity, and, moreover, the effect seems to be concentrated precisely during the month of bombing, not later. The main takeaway message from this table is that there are no significant pre-trends in resistance before bombing actually

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[42] Numerically, we compute mean values of predicted bombing for each city and month, taking city and month fixed effects into account. We then take a natural log of this measure, to avoid uneven impact of outliers.
[43] We also report the results of estimation with Conley standard errors (Table A.6 in the Appendix A).
[44] In Table A.7 in Appendix A we also report results from OLS regressions that are likely biased as explained above. The OLS coefficients are negative but not significant. This is consistent with the premise that more military important cities, which also tend to have higher growth in resistance, got bombed first (when total bombing volume was lower), thus masking the relationship between bombing and resistance.
[45] Only in 12.5% of resistance cases in our sample did the arrest occur in the same month as the start of resistance.
[46] We also analyze the geography of bombing and resistance within Berlin. We estimate the effect of bombing on resistance using grid cell month variation, controlling for grid cell and time fixed effects. The assumption is that the Gestapo was equally active in all parts of Berlin, sidestepping the issue of the timing of persecution. This data and corresponding results are discussed in the Appendix B.

took place.[47] Also, there is no significant heterogeneity in the effect of bombing with respect to pre-existing political preferences or racism (Table A.8).

We also analyze the geography of bombing and resistance within Berlin. Even within the German capital, bomb damage varied by neighborhood—and where more bombs fell, more people resisted. Because we estimate based on variation at the neighborhood level, concerns about city-level unobservables interacting with aggregate shocks are reduced. We estimate the effect of bombing on resistance using grid cell month variation, controlling for grid cell and time fixed effects, and find a large effect. Also, because Gestapo activity varied less within one city than across all of Germany, this also reduces the risk of variation in persecution driving our results. The data and corresponding results are discussed in the Appendix B.

Overall, the results in Tables 3–5 and in Appendix B suggest that bombing created more resistance—in line with our findings from bombing range-based discontinuities (subsection 4.1). Note, however, that the panel IV identification strategy only allows us to estimate LATE, i.e. the effect of bombing driven by weather conditions on a given day. The true effect of bombing probably lies between 4.8% (panel IV estimates) and 12.2% (RDD estimate) for a 100% increase in bombing tonnage.

***Bombing and fighter pilots' performance***

So far, we have examined the impact of bombing on domestic opposition; bombing arguably encouraged Germans already opposed to the regime to take action. In this section, we study the impact of bombing on the performance of leading German fighter pilots—i.e. in a population with, on average, positive attitudes towards the regime. Figure 8 shows that pilots hailed from all over Germany, while the airfields from which they flew covered all of occupied Europe and the European part of Soviet Union.

As the war wore on, an increasing number of fighter pilots' hometowns were hit by Allied bombing. We examine the performance of each fighter pilot as a function of his individual ability (a personal fixed effect $C_i$), experience (in months), front (East or West), as well as squadron ($S_{it}$), aircraft ($A_{it}$), and time fixed effects ($K_t$):

$$V_{it} = \alpha Bombing_{it} + \beta Experience_{it} + \gamma Front_{it} + C_i + \delta_{Kt} + \rho S_{it} + \theta A_{it} + \epsilon_{it} \qquad (3)$$

[47] We also investigated pre-trends for arrests in Appendix C, Table C.1.

where $V$ is the number of "victories" by pilot $i$ in month $t$, *Front* is a dummy that takes the value of unity if the pilot was posted to a squadron on the Eastern front, *Experience* is measured in months since entry into our database, and *Bombing* is a dummy that takes the value of unity after a pilot's home town has been bombed for the first time.[48] Standard errors are clustered by pilot.[49] Analogously, we estimate equation (3) with the standard Cox model for exits (death, missing, prisoner of war, or wounded and not returning to combat).

Table 6, Panel A, shows the results. Pilots performed less well after their hometown was bombed for the first time. On average, the pilots in our data shot down 1.94 enemy planes per month. After the bombing of their hometown, their monthly tally declined by 0.42–0.57 aircraft when we account for pilot fixed effects. Even when controlling for pilot, time, and squadron fixed effects, we still find a decline in monthly victory rates of 0.42, or almost a quarter of the average success rate per month. In terms of the magnitudes, hometown bombing in 1942–1944 accounted for 1006 less enemy airplanes shot, or 22.5% decline (based on column 4, Table 6A specification).[50]

Note that the distribution of standard errors for our explanatory variable "home town bombed" may be non-standard, since it reflects an absorbing state. To deal with this issue, we employ randomization inference: we create randomly-assigned bombings of home towns, generate placebo treatments, and run this against actual monthly victory rates of pilots 1,000 times. The results are displayed in Figure 10. Our OLS coefficient lies at the extreme lower end of the distribution of simulated coefficients. This underlines the statistical significance of our results.

In our difference-in-difference estimation, all untreated pilots effectively act as the comparison group for the "treated" pilot whose hometown was bombed. In a setting with substantial heterogeneity in performance across pilots (and over time), this is not ideal. To demonstrate the robustness and size of the treatment effect, we also use synthetic control group analysis. Here, for each treated pilot $i$, we form a comparison group of pilots that (with appropriate weights) performed similarly to $i$ in the period leading up to the treatment

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[48] Note that the time distribution of first bombing of pilots' hometowns was largely uniform over the period of our study (Figure A.7 in Appendix A).

[49] We also report the results of estimation with double clustering by pilot and month in Table A.9 in the Appendix A.

[50] The counterfactual applies to the 352 aces in our data. If the effect applied similarly to all German fighter pilots, the overall decline would be even larger (German pilots with at least one victory claim shot down 54,829 Allied aircraft. A 25% reduction for 22.5% of the sample of pilot-months would translate into the 2,775 planes "saved."

(Abadie, Diamond, and Hainmueller 2010). In our particular case, with different treatments at different points in time, we use the modified synthetic control approach of Xu (2017), based on interacted fixed effect models.[51]

Figure 11 reports the result of this estimation. In panel A, we plot the month-by-month deviation in victory rates between pilots whose home town is bombed at t=0, and those pilots whose pre-bombing performance is similar. Panel B displays the cumulative effect. The effect of bombing is immediately visible at t=0, and then grows in magnitude. The maximum deviation is almost 2 aircraft per month, suggesting a 100% decline of performance at its lowest point. The change remains significant even 30 months after a pilot's first home-town bombing. At a horizon of 20 months, the total cumulative effect amounts to 20 fewer enemy aircraft shot down (Figure A.9). Overall, both the evidence from standard diff-in-diff analysis and synthetic control methods suggests a major reduction in the motivation of high-flying German soldiers in response to (home town) bombing.

After a pilot's hometown was bombed, pilots' exit rates also declined (Table 6, panel B). The vast majority of exits in our data are caused by death—but the variable can also reflect pilots being shot down and taken as a prisoner of war, wounded and not returning to combat, or missing in action. We find a marked reduction in the risk of exit, by between a quarter and over 40%.[52] The combination of lower "victory" rates and fewer exits implies that bombing reduced motivation and effort, reflected in less risk-taking and "success."

One obvious concern is that pilots may have been stationed near their hometowns, and that their own operations were accordingly interrupted by bombing raids. Figure 8 shows the location of Luftwaffe airfields used by pilots in our data as well as their hometowns. The vast majority of pilots operated from airfields far away. Also, the analysis in Table 6 uses a simple indicator of bombing in a pilot's hometown, coding the month of the *first* attack and all subsequent months as unity. Could the effect instead be cumulative, rising in magnitude; or conversely, were there diminishing returns from ever more attacks? Figure A.11 plots the coefficient on home town bombing when we split the order of attacks into $1^{st}$–$5^{th}$, $6^{th}$–$15^{th}$, and $>15^{th}$, controlling for pilot and time fixed effects.[53] We also augment our estimation from Table 6, restricting the sample to pilots whose current airfield (at the time of the bombing

[51] Note that our data is heavily imbalanced because of pilot entry and deaths (cf. Figure A.9).
[52] Since death is an absorbing state, we cannot account for pilot fixed effects; Cox regressions with time fixed effects do not converge.
[53] The results of this analysis are also summarized in Table A.10 in the Appendix A.

attack) was at least 250, 500, or 750 km away from their home town. The coefficient rises in size with distance, suggesting that operational disruptions after bombing raids are not responsible for declining performance. Coefficients are significant at the 90% level throughout. If anything, the magnitude of the effect increases as ever more attacks hit a pilot's hometown.

According to narrative reports, when air attack destroyed the hometowns of servicemen, their morale often suffered (Hastings 1981). The quantitative evidence on German fighter pilots demonstrates the size of this effect—the more the cities of the *Reich* turned into heaps of rubble, the fewer victories even *Luftwaffe* aces scored, and the smaller the risks they took.

## 5. Radio and Resistance

So far, we have analyzed the impact of bombing on resistance as well as the motivation of German soldiers. This section studies the effect of the BBC German service on opinions using the USSBS survey. We also test whether radio availability led to more resistance and examine the interaction of propaganda and bombing. First, we investigate how radio reception was related to self-reported BBC listening as stated in the USSBS survey.

***Listenership to BBC and Perceived Bias of German propaganda***

In this section, we analyze the impact of BBC signal strength on both self-reported listenership to foreign radio and Germans' perception of bias in information provided by the German government, as derived from the USSBS.[54] We estimate the following equation:

$$y_{ic} = \alpha_0 + \alpha_1 BBC_c + \alpha_2 X_{ic} + \epsilon_{ic} \qquad (4)$$

where $y_{ic}$ is a self-reported opinions of respondent *i* in city *c*, $BBC_c$ is a measure of BBC availability, as described above, and $X_{ic}$ is a vector of individual level controls. The identifying assumption is that BBC availability only affects individual's opinion through listening to BBC.[55] Standard errors are clustered at city level.

Table 7 summarizes these results. Odd columns report the results without additional controls, while even columns also add individual controls. Higher BBC availability based on signal strength translated into higher listenership of Radio London (columns 1–2) as well as of any

[54] The USSBS survey may suffer from social desirability bias. At the same time, we do not expect this bias to vary systematically for cities in our analysis.

[55] In Table A.11 in the Appendix A, we report how survey demographics were related to BBC availability. Consistent with our identifying assumption, we did do find a significant relationship.

Allied radio station (columns 3–4).[56] A one standard deviation increase in BBC availability led to 10.1% increase in the probability of (reported) listening to Radio London, and a 7.9% increase for any Allied radio station.

Furthermore, BBC listening decreased people's confidence in German government propaganda. Columns 5–6 report this relationship either without or with demographic controls. Column 6 suggests that a one standard deviation increase in BBC predicted availability predicts a 21.8% increase in people reporting self-perceived bias in German information. This result is consistent with radio changing people's evaluation of information from various sources.[57]

***Radio Reception and Resistance***

Did better radio reception of Radio London lead to more resistance? We first examine the effect of signal strength, and then analyze interaction effects with Allied bombing.

We start by looking at the direct effect of predicted BBC radio availability on resistance. The results indicate that it had a positive effect on resistance, significant at 10% level (Table 8, columns 1–3) once pre-existing political preferences are controlled for. The effect is relatively small, with a one standard deviation increase in BBC signal availability leading to a 0.32% increase in resistance.[58]

Next, we study complementarities between BBC availability and bombing intensity. Column 4 of Table 8 summarizes the results of the corresponding panel estimates. We use a 2SLS specification, predicting bombing volume from wind speed, as discussed earlier. This suggests a positive interaction between bombing and BBC radio reception: radio and bombing reinforced each other. The magnitude implies that for the highest level of BBC availability, a doubling of bombing led to an 8.3% increase in resistance. For the lowest value of BBC availability, the effect of bombing is close to zero; it is not significant at conventional levels.

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[56] Respondents sometimes could confuse foreign radio stations. We therefore show the results for listening to Radio London and to any Allied radio station separately.

[57] We present further results based on USSBS data in Appendix D. In particular, we find that the earlier people self-report starting to listen to the BBC, the earlier they held the belief that the war was lost or wished to end the war, in a panel framework controlling for individual fixed effects (Table D.1). We also find that both exposure to BBC and its interaction with bombing were associated with markedly different opinions about the war, the Nazis, and occupation (Table D.2).

[58] Given that we can only estimate functional form of S-curve using USSBS survey, and jamming being used to depress the quality of the signal, this measure is likely to be noisy, thus our coefficient here is likely to be underestimated.

Put differently, a one standard deviation increase in BBC availability across Germany would have generated the same level of domestic opposition, even if bombing had declined by 25%.

## 6. Discussion

Can air power and propaganda contribute to victory? Or are drone strikes on suspected terrorist camps, for example, counterproductive, resulting in the recruitment of yet more terrorists (Shah 2018; Kattelman 2020; Piazza and Choi 2018)? We examine the effect of Allied bombing and propaganda on domestic resistance against the Nazi regime in WWII Germany. Despite the Gestapo's effectiveness and the Nazi regime's propaganda prowess (Evans 2008), we find that a combination of Allied radio propaganda and military force fanned the flames of resistance in Germany's ruined cities; it also sapped morale at the front. The more German cities burned and turned into rubble, and the more Germans could listen to the BBC, the clearer it became that the war was lost—and the more likely active acts of domestic resistance became (USSBS 1945).

We exploit spatial variation in bombing and radio coverage to support this argument. In addition, we use variation in the intensity of bombing over time. Exogenous variation in bombing driven by weather conditions demonstrates that the effect is arguably causal. In addition to instigating resistance against the Nazi regime, bombing decreased the combat motivation of German fighter pilots, undermining the performance of Germany's military machine. Effects were large: The magnitudes imply that a 100% increase bombing led to 12.2% higher resistance in the RDD specification, and to 4.8% higher resistance in the panel specification. When a pilot's hometown was bombed, his monthly rate of destroying Allied aircraft fell by 20–30%.

Bombing became more effective when combined with BBC propaganda. Using terrain characteristics to identify exogenous variation in radio listenership, we demonstrate that German government strictures against listening to foreign stations were issued with good reason: foreign radio created more resistance, especially in those towns and cities where bombing was heavy. The message that Germany was losing the war became more convincing under a hail of bombs (Brader, Valentino, and Suhay 2008). As the USSBS data suggests, the more strongly a city was bombed, and the better Allied radio reception was, the earlier Germans thought the war was lost. Our results imply that a one standard deviation increase in BBC listening had the same effect on domestic resistance as a 25% increase in bombing tonnage. Since the bombing of Germany claimed the lives of an estimated 360,000 civilians in

Germany and of 76,000 Allied airmen, this implies a potential "saving" of 112,000 lives. We cannot determine with certainty why the combination of bombing and radio propaganda fanned the flames of resistance particularly strongly. We surmise that undermining the belief in victory was crucial—the key channel also emphasized in recent policy work on the psychological effect of air operations (Hosmer 1996).

While no large-scale uprising took place in Germany, the morale effects on the German population were severe, as secret Gestapo reports also made clear.[59] In consequence, the Nazi regime, laboring under the perceived threat of a repeat of 1918, when domestic revolt had knocked Germany out of the war, did its utmost to protect the Reich. It diverted artillery and German fighter aircraft to the "home front" (Hastings 2013); by 1944, 12,000 heavy guns and more than 400,000 men and women were employed in flak units all over Germany (Hastings 2013). Most German army units received little air cover from 1943 onwards; at the same time, more than half of Germany's front-line fighters were sent to defend the Reich against air attack. Battling the RAF and USAAF in the skies over Germany devastated the Luftwaffe, leading to an accelerating decline of air support (Keeney 1988). In addition, our findings suggest that the combat effectiveness of the Luftwaffe further declined because of the negative morale effect of bombing.

The effectiveness of history's second-greatest bombing campaign, and of allied radio propaganda, has largely been dismissed in the historical literature: no mass uprising took place in Germany during World War II, and no attempt to overthrow the regime was successful. Nonetheless, we argue that city attacks largely worked as intended, crushing the morale of the German people. While the overall course of the war was not altered by domestic German opposition, we can gain insight into the general effects of bombing from the German experience. The ultimate failure of air attack to instigate major unrest largely reflects the Nazi government's capacity to suppress opposition. In other words, the Gestapo's ruthlessness and efficiency ensured that bombing and propaganda did not map into an effective domestic resistance movement. Bombing also had important military knock-on effects—it undermined the fighting spirit of the German army, as evidenced by the declining motivation of fighter pilots; and it caused the Nazi regime to divert artillery and fighter aircraft to protect the Reich on a major scale. As in the case of Vietnam (Dell and Querubin 2018), the government's

[59] For example, on 11.10.1943, the Gestapo (Boberach 1984) reported that in the bombed districts of Munich, women were openly saying "Jetzt sollen sie endlich einmal mit dem Krieg Schluß machen!" ("they should finally put an end to the war").

failure to protect its citizens from bombing undermined its legitimacy. Foreign air attack, especially when combined with the effective use of mass media, can bring people to resist their own government—even against heavy odds, and at the potential price of their lives.

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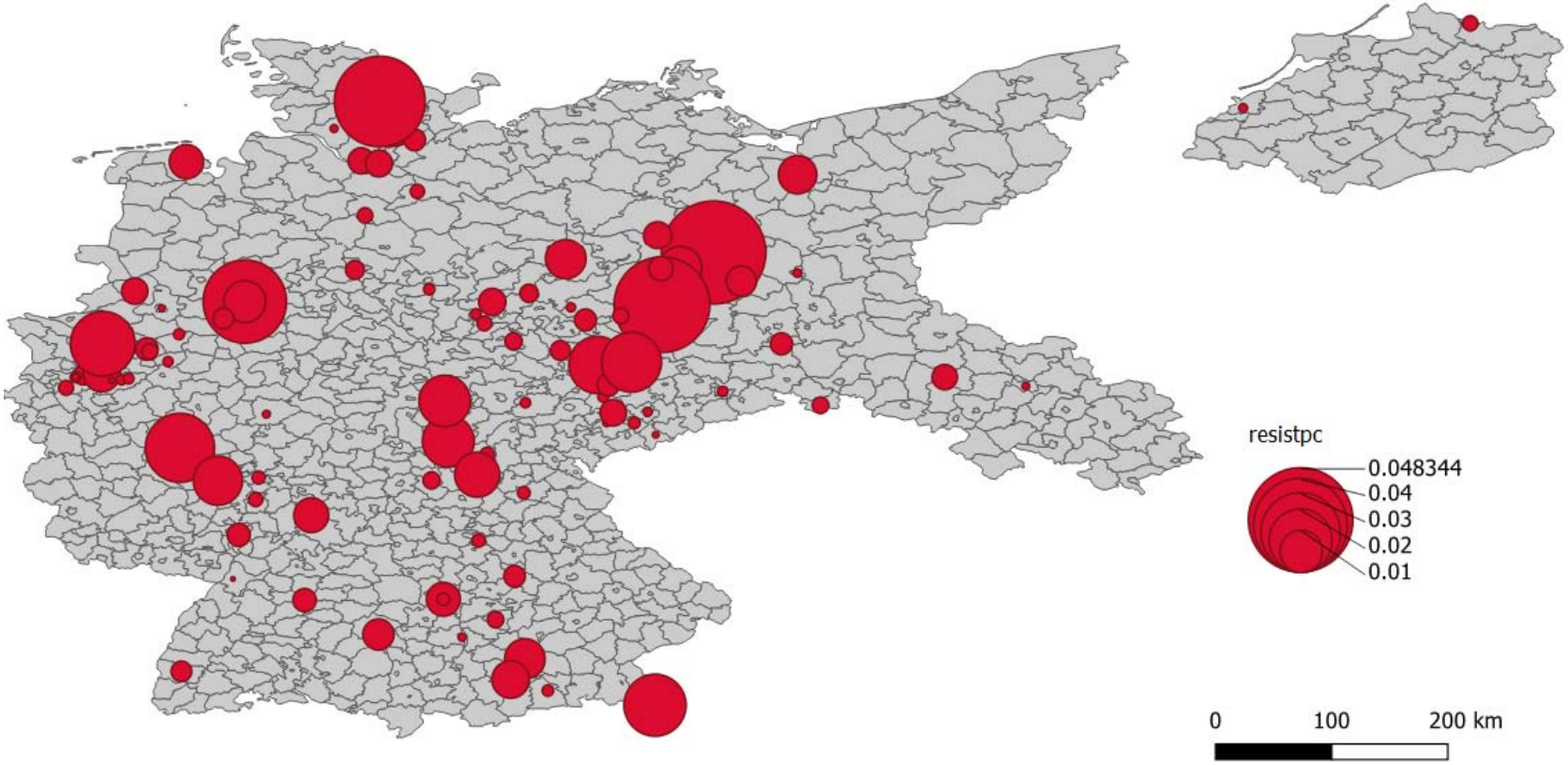
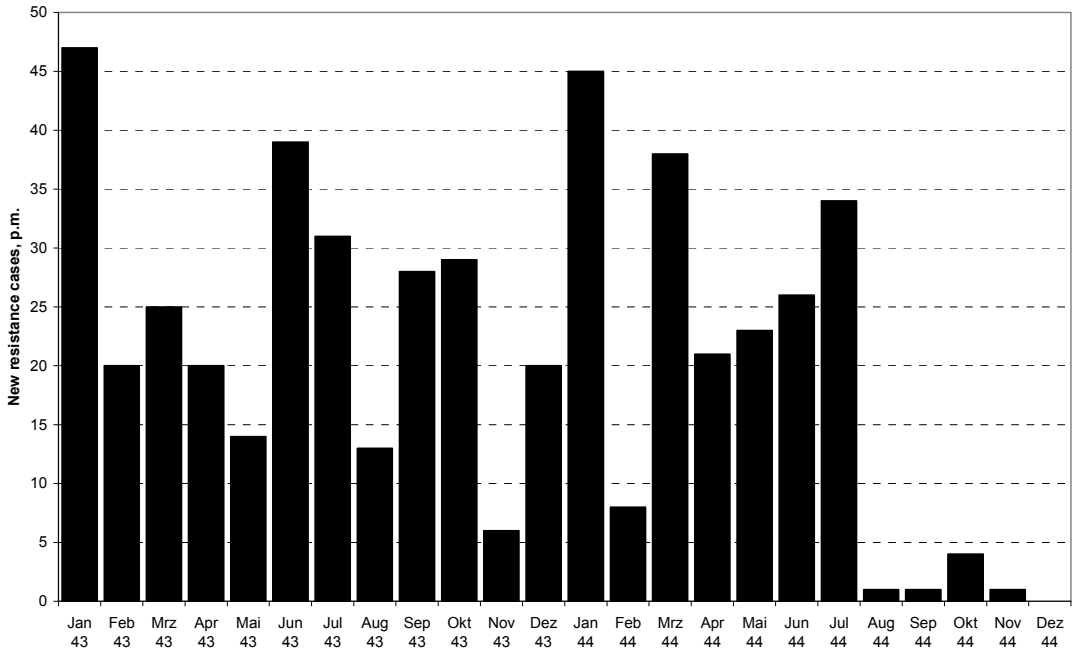
# TABLES AND FIGURES

**Figure 1: Geography of Resistance, 1943–1944.**

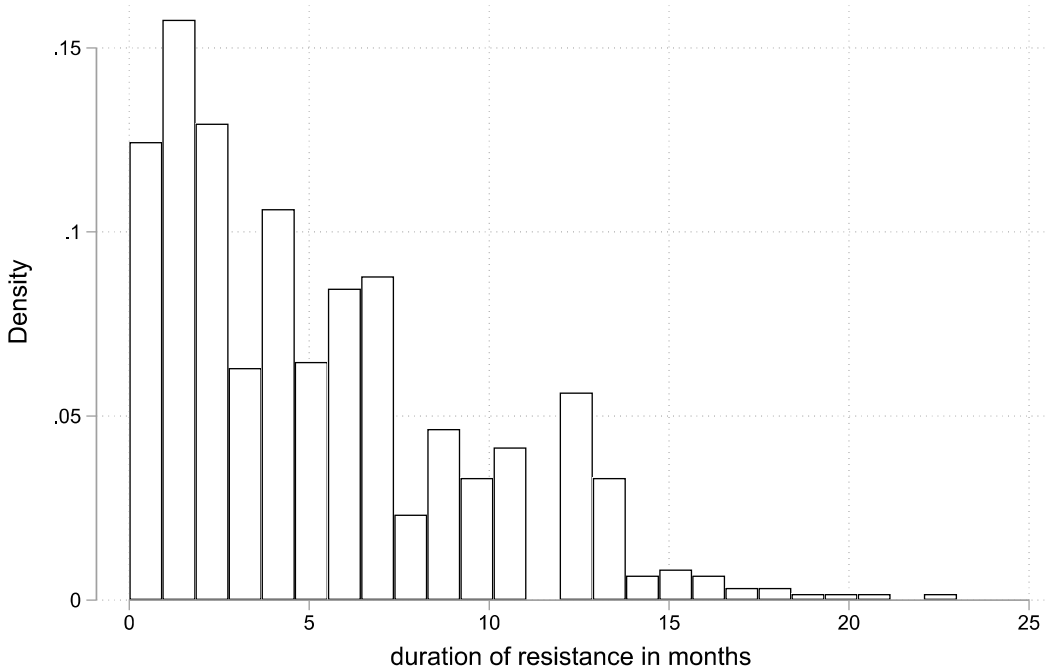



**Note**: The map shows the place of residence, for subjects charged with high treason, before the People's Court (Volksgerichtshof).

**Figure 2. Start of new resistance by month and duration of resistance activity, in months.**

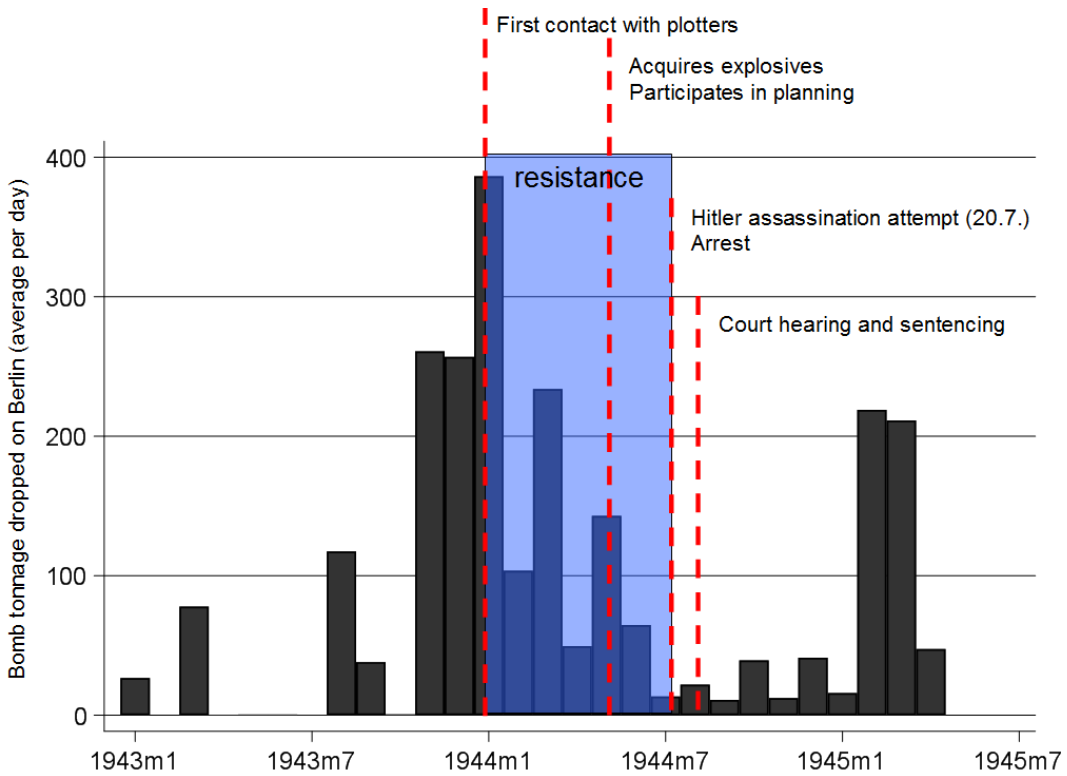



Panel A. Timing of New Resistance Cases (People involved, per month)



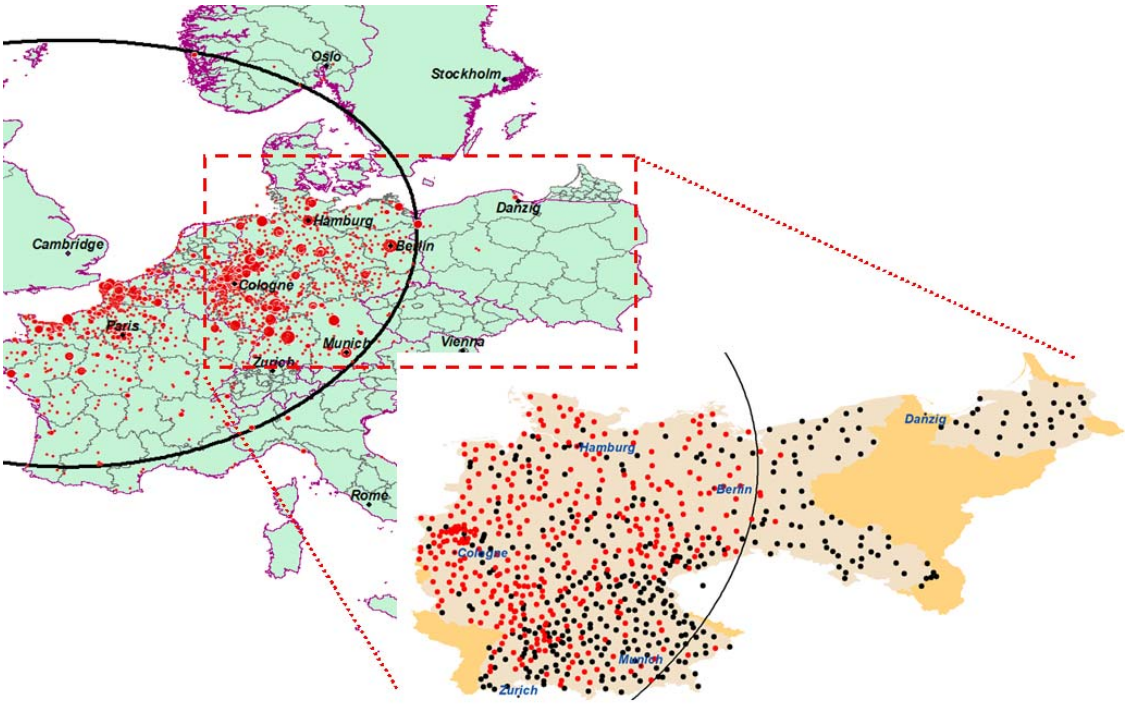

Panel B. Time between Initiation of Resistance Activity and Arrest (in months)

**Figure 3. Bombing and Resistance – Case Study**




**Note:** Bombing of Berlin, per month, in average tons per day, 1943-1945, and resistance involvement of Bernhard Klamroth.

**Figure 4. Map of Allied Total Bombing across Germany and Maximum Bombing Range.**




**Note:** In the upper map, the size of dots corresponds to the overall volume of bombs (tonnage dropped). In the lower map, black dots indicate unbombed towns and cities (by 12/1944). The black line indicates the effective combat range of B-17 bombers by 1943 (985 km).

**Figure 5. BBC Signal Strength and (USSBS Self-Reported) Listenership to BBC.**

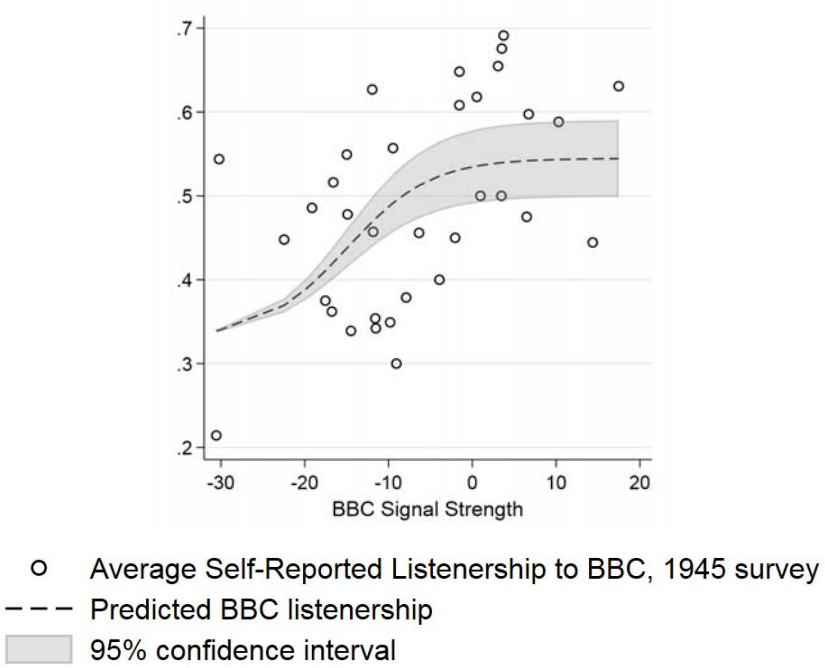



**Figure 6. Binscatter plot for bombing and resistance.**

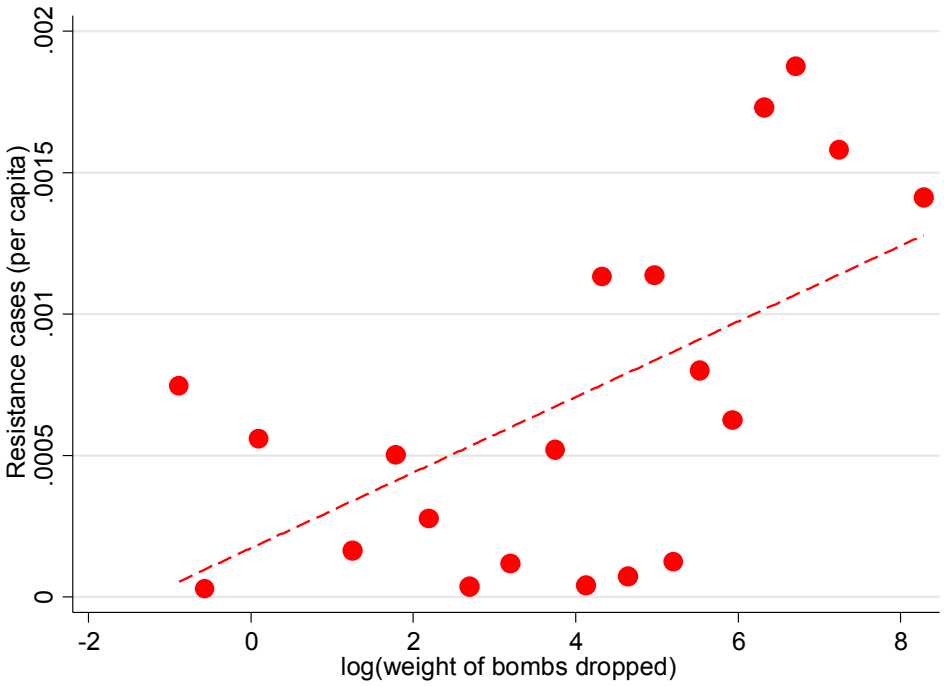
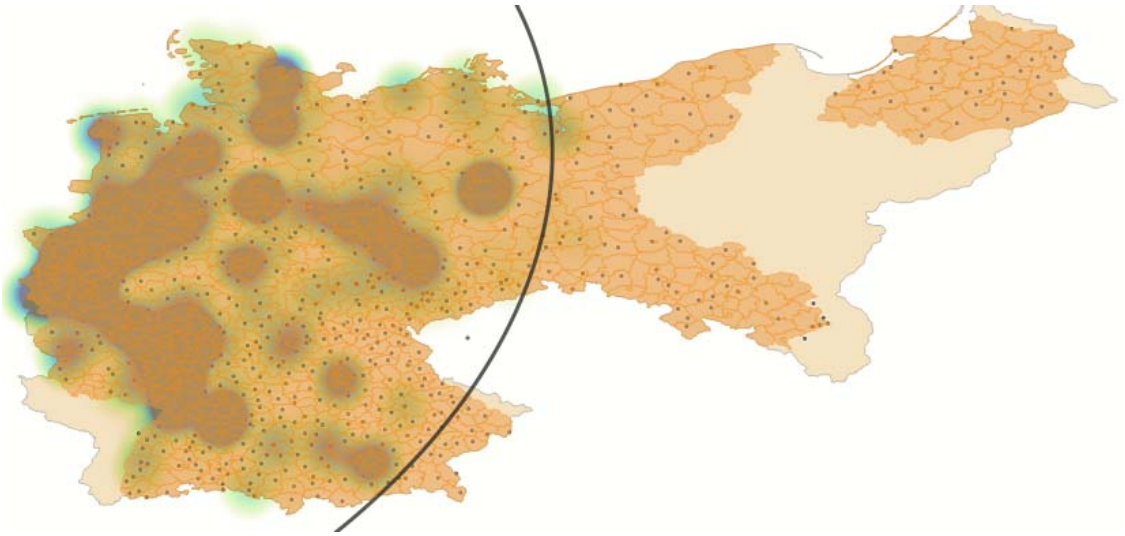
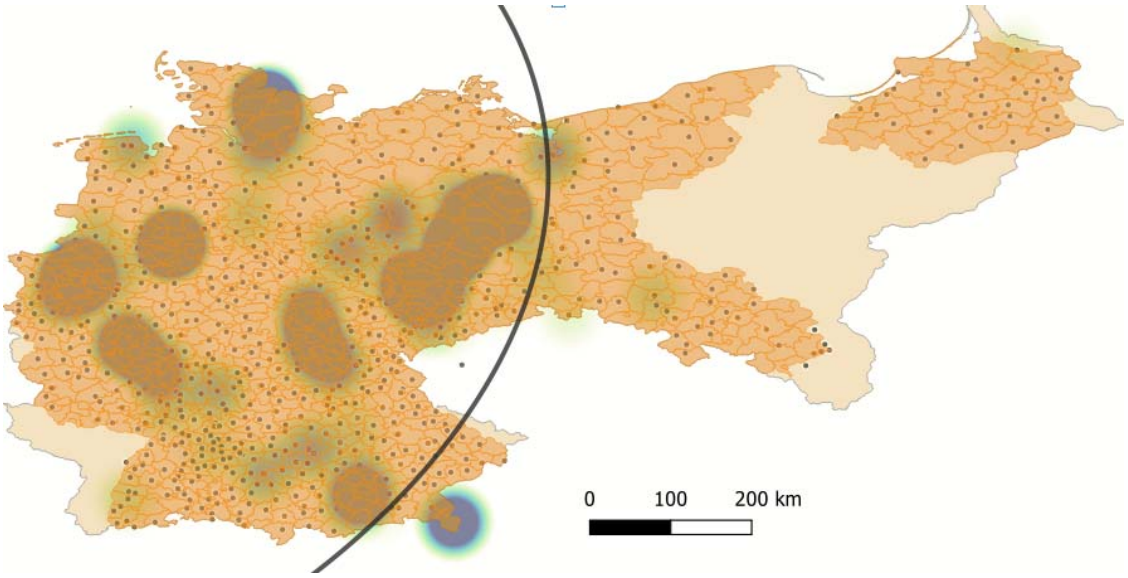


**Figure 7: Bombing, Resistance, and Distance to Chelmsford, East Anglia.**



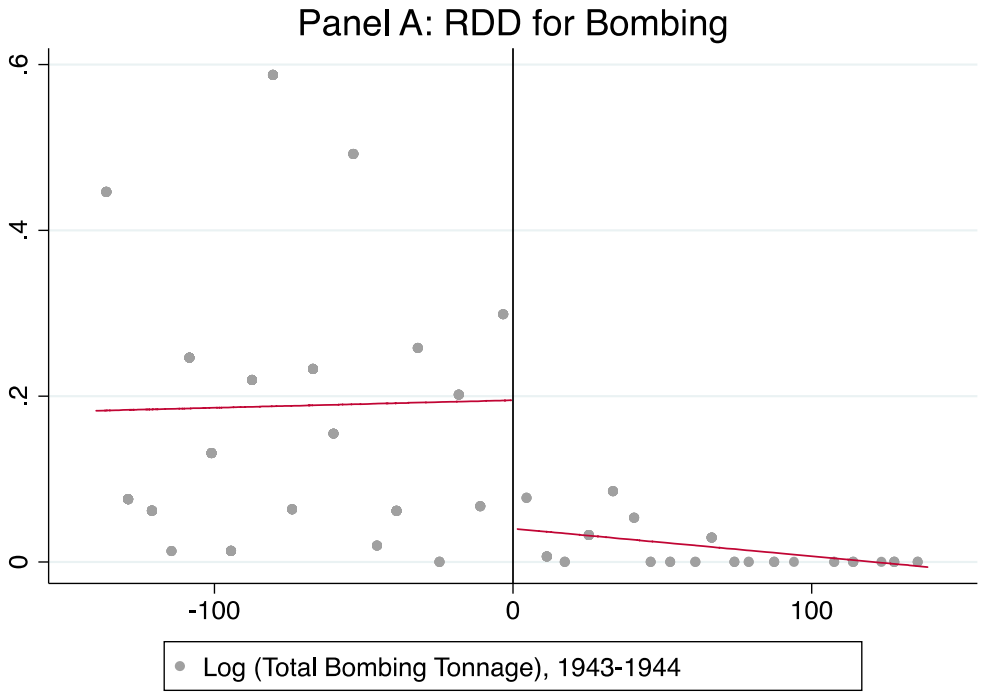
Panel A: Heatmap of (log) Bombing in Germany

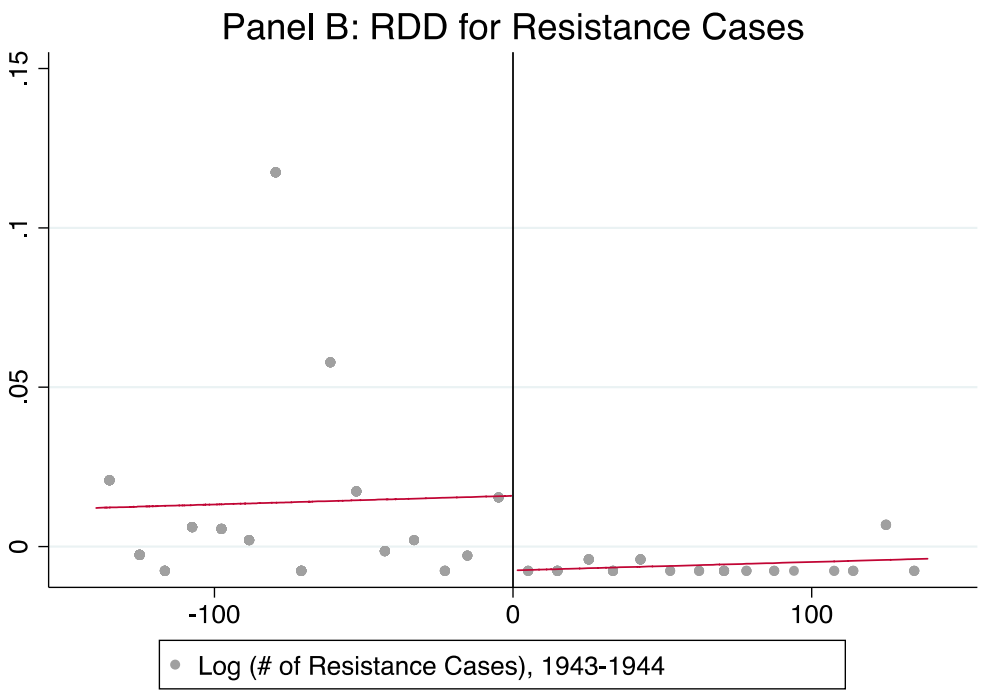



Panel B: Heatmap of Resistance p.c. in Germany

**Note**: The two maps show bombing volume (in logs) for 1943–44 (Panel A) and the incidence of resistance (p.c.) using 1938 population as a scaling variable. Darker areas were bombed more heavily and showed more resistance. Areas of Germany in 1938 in darker color. Dots indicate towns and cities in our dataset. We exclude annexed Austria as we do not include it in our study.

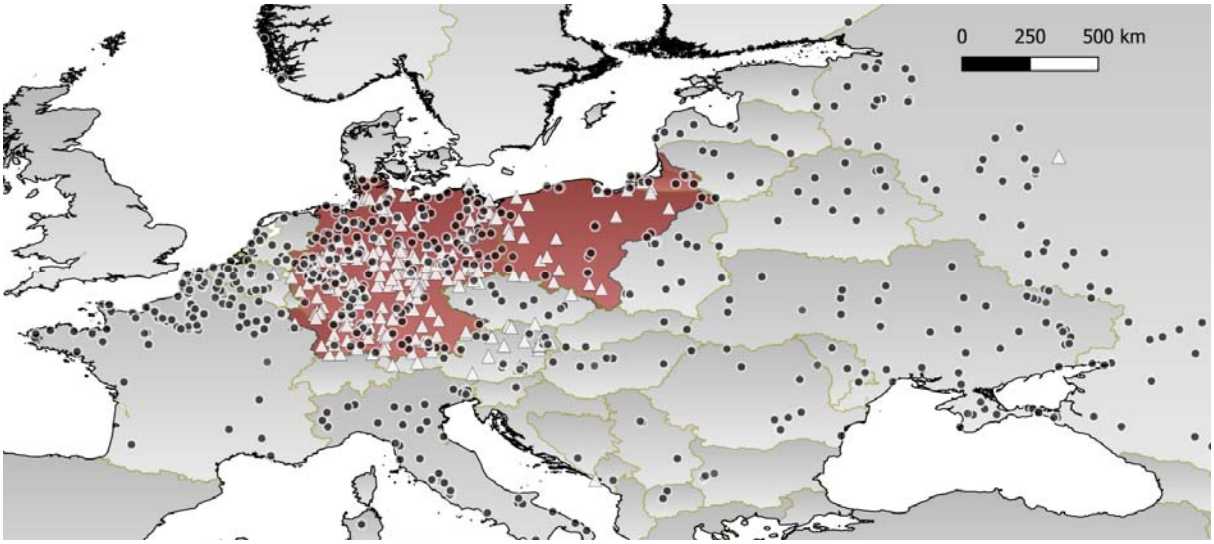
**Figure 8. Regression Discontinuity Graphs.**



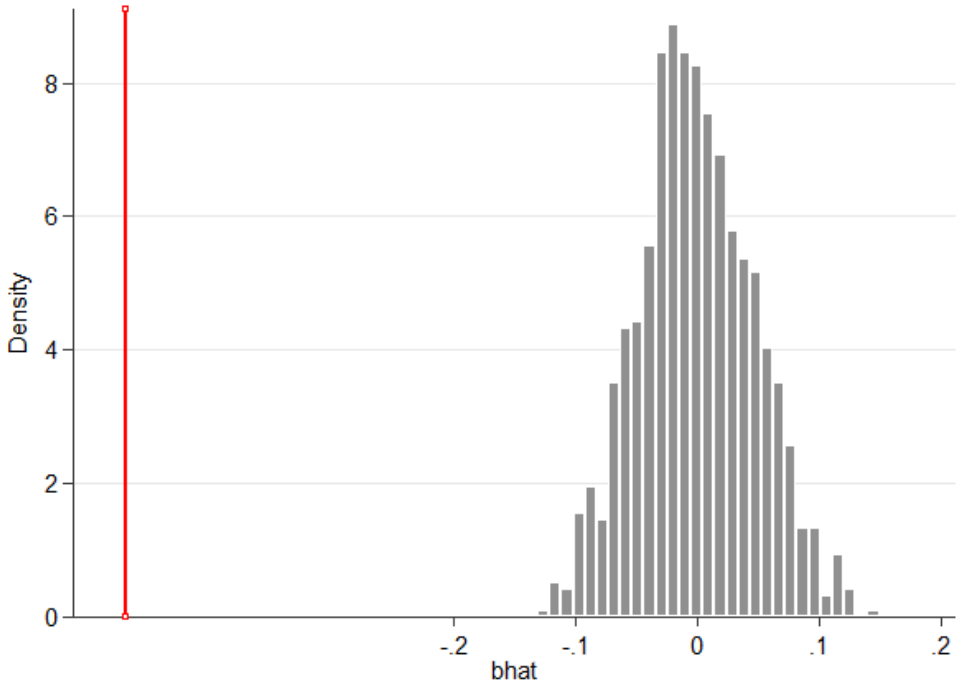

Note: Regression discontinuity plots are constructed following Calonico et al. (2014a, 2014b) robust RDD procedures. Figure A.7 in the Appendix reports similar results for bombing and resistance per capita.

**Figure 9: Location of Fighter Pilot Home Towns and Airfields**



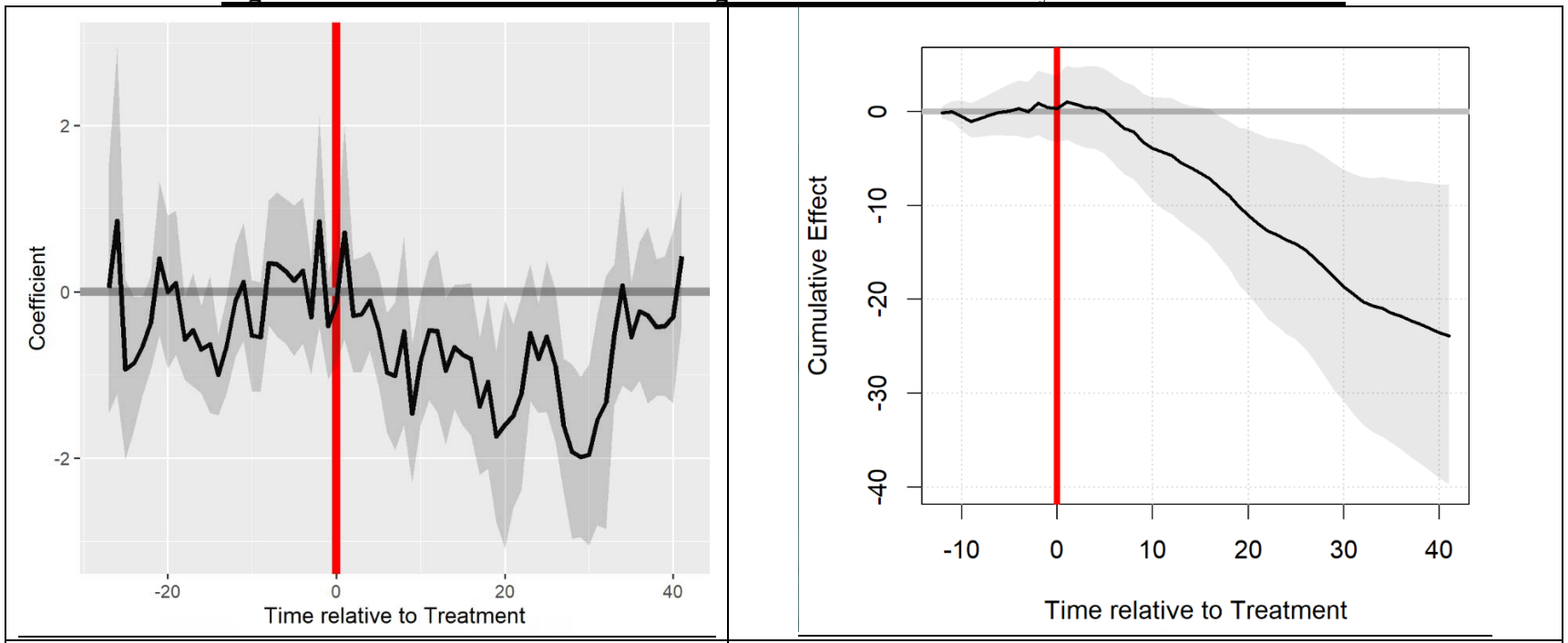

**Note**: The map shows the location of airfields used by pilots in our dataset (black dots) and their birthplaces (white triangles).

**Figure 10: Distribution of randomly generated "bombing at home" coefficients vs estimated coefficient for fighter pilots' performance.**




**Note**: The histogram reports regression coefficients from a randomization exercise. We randomly assign home bombing to pilots' hometowns 1,000 times, and run this variable against actual victories. Coefficients reported are from the specification with pilot fixed effects, squadron fixed effects, and time fixed effects (column 4 of Table 6A).

**Figure 11. Effect of Home Town Bombing on Pilot Performance—Synthetic Control Method.**




| Panel A: ATT by month | Panel B: Cumulative treatment effect |
|---|---|

**Note**: The figure shows the effect of bombing a pilot's home town on monthly victories. The left panel (A) shows the effect month-by-month; the right (B) shows the cumulative impact. Time of home-town bombing is normalized to zero and indicated by a red line. The coefficient is derived from 1,000 bootstrap iterations of the synthetic control procedure described in Xu (2017). The coefficient is equivalent to the change in the number/cumulative number of Allied aircraft shot down per month.

**Table 1: Bombing, B-17 Maximum Range, and Resistance.**

| | | No | Yes | sum/average |
|---|---|---|---|---|
| | | | **Any bombing** | |
| | | | Count | |
| In B-17 range | No | 135 | 14 | 149 |
| | Yes | 412 | 463 | 875 |
| | | | **Any resistance** | |
| | | | Count | |
| In B-17 range | No | 142 | 7 | 149 |
| | Yes | 761 | 114 | 875 |
| | | | per million inhabitants | |
| In B-17 range | No | 0,08 | 1.4 | 0.2 |
| | Yes | 0.28 | 1.08 | 0.7 |

**Note**: N=1,024 towns and cities. In the main sample, due to the need to use controls, sample size is somewhat reduced.

**Table 2: RDD results – Resistance and Bombing.**

| | Log (Total Bomb Tonnage) | Log (New Resistance Cases) | Log (New Resistance Cases) | Log (Total Bomb Tonnage) | Log (New Resistance Cases) | Log (New Resistance Cases) |
|---|---|---|---|---|---|---|
| | **First Stage** | | **Fuzzy RDD** | **First Stage** | | **Fuzzy RDD** |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| In range | 0.152** | 0.019* | | 0.159** | 0.019** | |
| | [0.074] | [0.010] | | [0.071] | [0.010] | |
| Log (Bombing), average | | | 0.124** | | | 0.122** |
| | | | [0.050] | | | [0.048] |
| Latitude + Longitude | No | No | No | Yes | Yes | Yes |
| Observations | 357 | 357 | 357 | 357 | 357 | 357 |

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Fuzzy RDD is estimated as an IV with distance to the max operational range (985 km) as the running variable. Optimal bandwidth (167.65 km) is chosen following Calonico, Cattaneo, and Titunik (2014a). The results for alternative bandwidths are reported in Table A2. We follow Calonico, Cattaneo, and Titunik (2014a, 2014b) robust RDD procedures. Resistance is the average residual of the log of monthly beginning resistance activity (+1) on month dummies. The results look very similar in the panel version of this estimation.

**Table 3: Predicting daily bombing from wind and distance to London**

| | Bombing, 3 days before (1) | Bombing, 2 days before (2) | Bombing, 1 day before (3) | Bombing, same day (4) | Bombing, 1 day later (5) | Bombing, 2 days later (6) | Bombing, 3 days later (7) |
|---|---|---|---|---|---|---|---|
| Average wind x Distance to London | 0.227 | 0.181 | 0.081 | 0.583*** | 0.598*** | 0.279 | -0.069 |
| | [0.194] | [0.194] | [0.193] | [0.193] | [0.194] | [0.194] | [0.194] |
| Average wind x (Distance to London)^2 | -0.275 | -0.267 | -0.226 | -0.718*** | -0.642*** | -0.266 | 0.066 |
| | [0.236] | [0.236] | [0.235] | [0.235] | [0.235] | [0.236] | [0.236] |
| City Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Full effect of wind at minimum of distance | 0.047 | 0.028 | -0.008 | 0.118 | 0.138 | 0.071 | -0.017 |
| p-value of full effect of wind at minimum | 0.265 | 0.498 | 0.855 | 0.005 | 0.001 | 0.091 | 0.680 |
| Full effect of wind at 25th percentile of distance | 0.038 | 0.014 | -0.031 | 0.095 | 0.129 | 0.072 | -0.018 |
| p-value of full effect of wind at 25th percentile | 0.318 | 0.711 | 0.425 | 0.014 | 0.001 | 0.063 | 0.652 |
| Full effect of wind at 50th percentile of distance | 0.021 | -0.008 | -0.059 | 0.048 | 0.098 | 0.064 | -0.015 |
| p-value of full effect of wind at 50th percentile | 0.521 | 0.813 | 0.074 | 0.144 | 0.003 | 0.057 | 0.648 |
| Full effect of wind at 75th percentile of distance | -0.005 | -0.039 | -0.094 | -0.022 | 0.045 | 0.046 | -0.011 |
| p-value of full effect of wind at 75th percentile | 0.880 | 0.283 | 0.009 | 0.541 | 0.218 | 0.211 | 0.770 |
| Full effect of wind at maximum of distance | -0.109 | -0.152 | -0.213 | -0.297 | -0.177 | -0.036 | 0.010 |
| p-value of full effect of wind at maximum | 0.325 | 0.169 | 0.053 | 0.007 | 0.110 | 0.747 | 0.928 |
| Observations | 684,216 | 684,216 | 684,216 | 684,216 | 683,280 | 682,344 | 681,408 |
| R-squared | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 |

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Distance to London is measured in 1000s of kilometers.

## Table 4: Bombing (Predicted by Weather) and Resistance

| | Log(New Resistance Cases) | | At least 1 new resistance case (dummy) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Predicted Bombing | 0.048** | 0.049** | 0.038** | 0.038** |
| | [0.021] | [0.022] | [0.017] | [0.017] |
| Log (Arrests) | | -0.032 | | -0.000 |
| | | [0.033] | | [0.025] |
| City Fixed Effects | Yes | Yes | Yes | Yes |
| Month Fixed Effects | Yes | Yes | Yes | Yes |
| Observations | 22,464 | 22,464 | 22,464 | 22,464 |
| R-squared | 0.393 | 0.394 | 0.186 | 0.186 |

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1. Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

## Table 5: Bombing (Predicted from Weather), and Resistance—Post- and Pre-Trends

| | Log(New Resistance Cases) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Log (Bombing), 2 months later | 0.020 | | | | |
| | [0.022] | | | | |
| Log (Bombing), 1 month later | | 0.035 | | | |
| | | [0.023] | | | |
| Log (Bombing), same month | | | 0.048** | | |
| | | | [0.021] | | |
| Log (Bombing), 1 month earlier | | | | 0.016 | |
| | | | | [0.035] | |
| Log (Bombing), 2 months earlier | | | | | -0.021 |
| | | | | | [0.044] |
| City Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Month Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 22,464 | 22,464 | 22,464 | 21,528 | 19,656 |

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1. Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

## Table 6: Fighter Pilot Motivation and Bombing of Home Towns

| Panel A: | Number of enemy planes shot down | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Hometown Bombed | -0.175* | -0.572*** | -0.472** | -0.437* | -0.422* |
| | [0.094] | [0.212] | [0.204] | [0.25] | [0.251] |
| Experience | -0.009*** | 0.0117*** | | | |
| | [0.002] | [0.0040] | | | |
| Eastern Front dummy | 1.690*** | 1.841*** | 1.425*** | 1.250*** | 1.258*** |
| | [0.070] | [0.137] | [0.162] | [0.175] | [0.178] |
| Pilot Fixed Effects | | Yes | Yes | Yes | Yes |
| Time Fixed Effects | | | Yes | Yes | Yes |
| Squadron Fixed Effects | | | | Yes | Yes |
| Aircraft Fixed Effects | | | | | Yes |
| Mean of Dependent Variable | 1.94 | 1.94 | 1.94 | 1.94 | 1.94 |
| Observations | 13983 | 13983 | 13983 | 13957 | 13957 |
| R-squared | 0.041 | 0.137 | 0.205 | 0.233 | 0.235 |

| Panel B: | Exit | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| homebombed_ever | 0.753* | 0.775 | 0.763* | 0.569*** |
| | -0.117 | -0.121 | -0.119 | -0.115 |
| exp | | 0.977*** | 0.976*** | 0.984* |
| | | -0.00443 | -0.00453 | -0.00801 |
| front | | | 0.797 | 0.931 |
| | | | -0.115 | -0.272 |
| Mean of Dependent Variable | 0.0154 | 0.0154 | 0.0154 | 0.0154 |
| Observations | 13983 | 13983 | 13983 | 13983 |

Robust standard errors, clustered by pilot id, in brackets. *** p<0.01, ** p<0.05, * p<0.1. Unit of observation is pilot-month. Exponentiated coefficients from Cox regressions in Panel B. Exit is defined as KIA or severely wounded.

## Table 7: Radio Availability, Self-reported Listening, and Perception of Bias in German Sources

| | Listened to Radio London | | Listened to Allied Radio Broadcasts | | Perceived bias in German sources of information | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| BBC Radio Availability | 0.650* | 0.500* | 0.631* | 0.533* | 0.451*** | 0.462*** |
| | [0.350] | [0.275] | [0.321] | [0.290] | [0.135] | [0.128] |
| Demographic controls | | Yes | | Yes | | Yes |
| Observations | 2,282 | 2,272 | 2,282 | 2,272 | 1291 | 1277 |
| Number of Cities | 34 | 34 | 34 | 34 | 34 | 34 |
| R-squared | 0.008 | 0.066 | 0.009 | 0.058 | 0.007 | 0.021 |

Robust standard errors in brackets, clustered by city. *** p<0.01, ** p<0.05, * p<0.1. Demographic controls include gender, age, age squared, high school education dummy, and being married. Radio availability is predicted from the signal strength in each city.

## Table 8: Resistance, BBC Radio, and Bombing 1943–44

| | Log (# of Resistance Cases), 1943-1944 | | | Log(New Resistance Cases) |
|---|---|---|---|---|
| | OLS | OLS | OLS | 2SLS |
| | (1) | (2) | (3) | (4) |
| BBC Radio Availability | 0.019 | 0.028* | 0.031* | |
| | [0.012] | [0.017] | [0.017] | |
| BBC Radio Availability * Predicted Bombing | | | | 0.144* |
| | | | | [0.087] |
| Predicted Bombing | | | | 0.094** |
| | | | | [0.041] |
| Socioeconomic + geographic controls | Yes | Yes | Yes | |
| Elections controls | | Yes | Yes | |
| German radio availability | | | Yes | |
| City Fixed Effects | | | | Yes |
| Month Fixed Effects | | | | Yes |
| Observations | 865 | 865 | 865 | 22,296 |
| R-squared | 0.137 | 0.141 | 0.146 | 0.394 |

Robust standard errors in brackets, clustered by district. *** p<0.01, ** p<0.05, * p<0.1. The unit of observation is a city (columns 1-3) and city-month (columns 4-5). Geographic controls include distance to London and altitude. Socioeconomic controls include district population in 1938, share of welfare recepients in 1932, share of social renters in 1932, property tax in 1930. Election controls are from 1933 and include votes shares of NSDAP, KPD, SPD, and turnout. German radio availability is computed for 1940.

# APPENDICES

## APPENDIX A: ADDITIONAL TABLES AND FIGURES

**Figure A.1: Map of USAAF 8th AF airfields.**

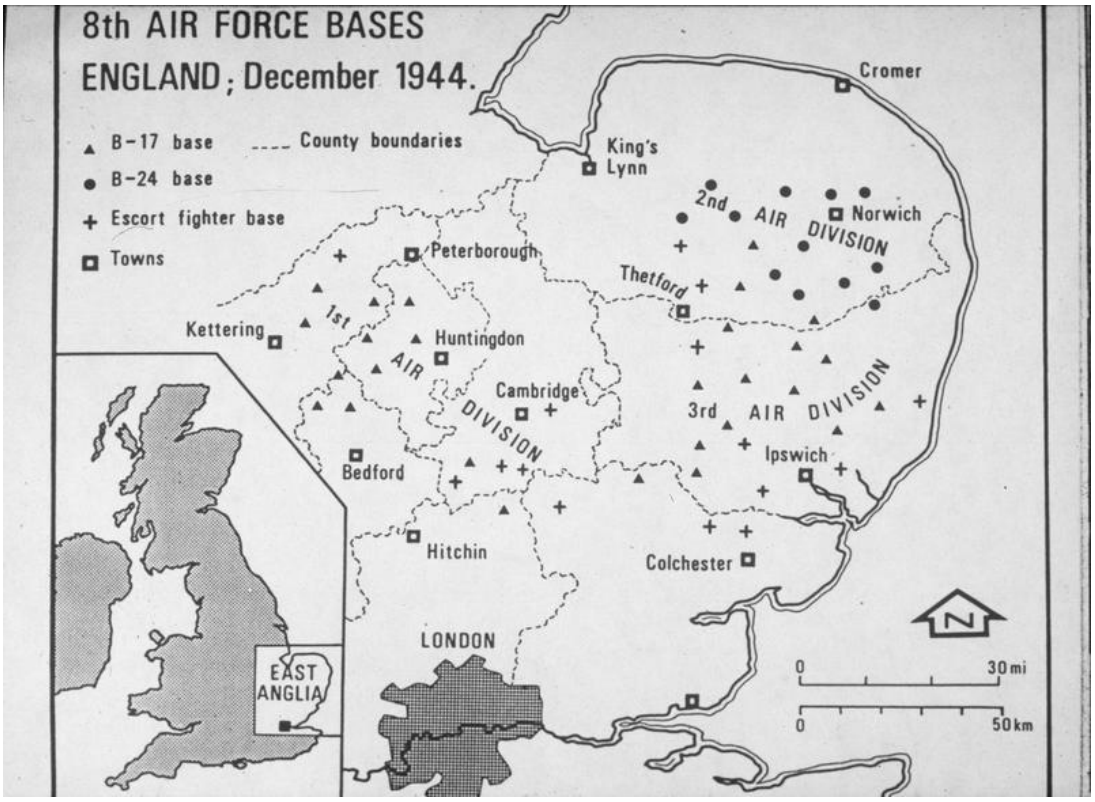



**Figure A.2: Allied Bombing by Month.**

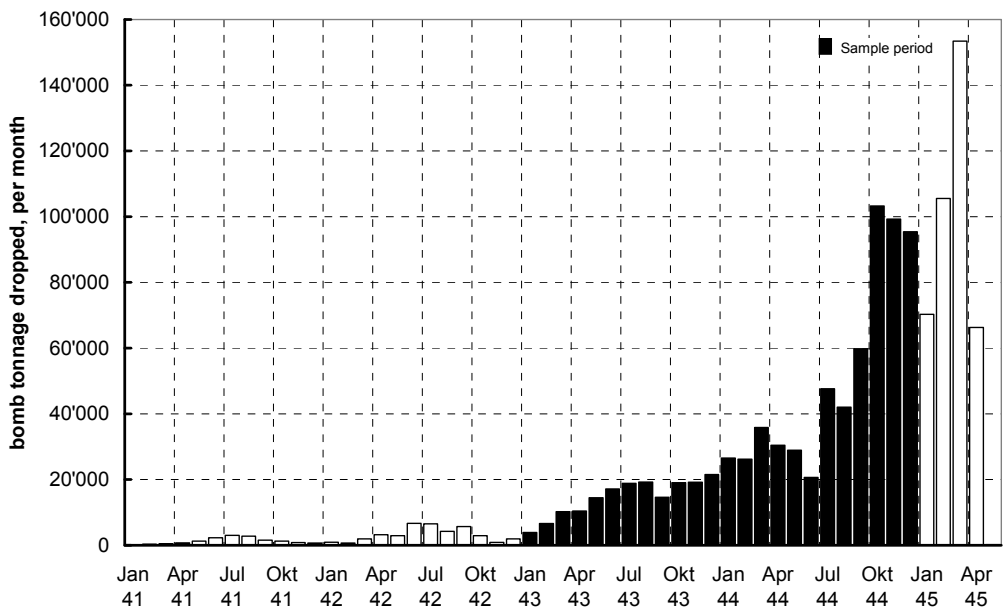


**Figure A.3: BBC Radio Predicted Availability over German territory.**

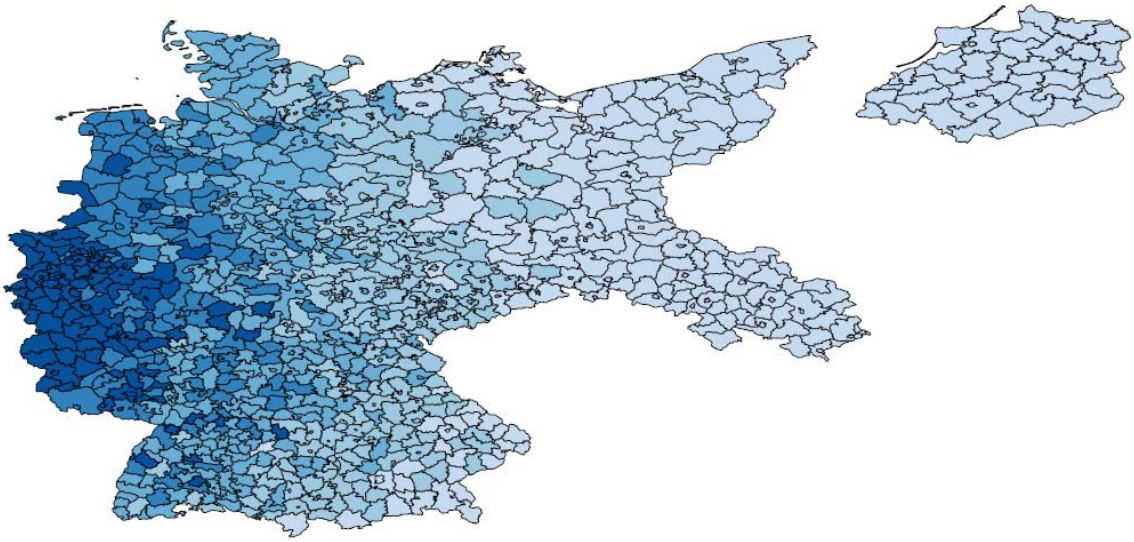
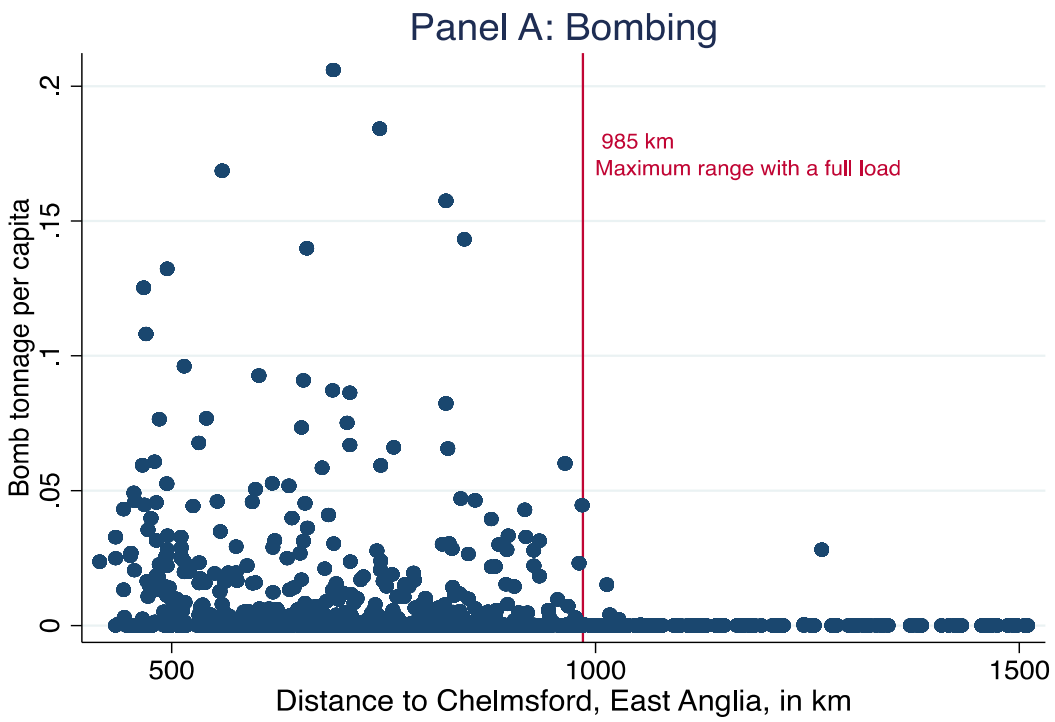


**Figure A.4: Bombing, Resistance, and Distance to Chelmsford, East Anglia.**



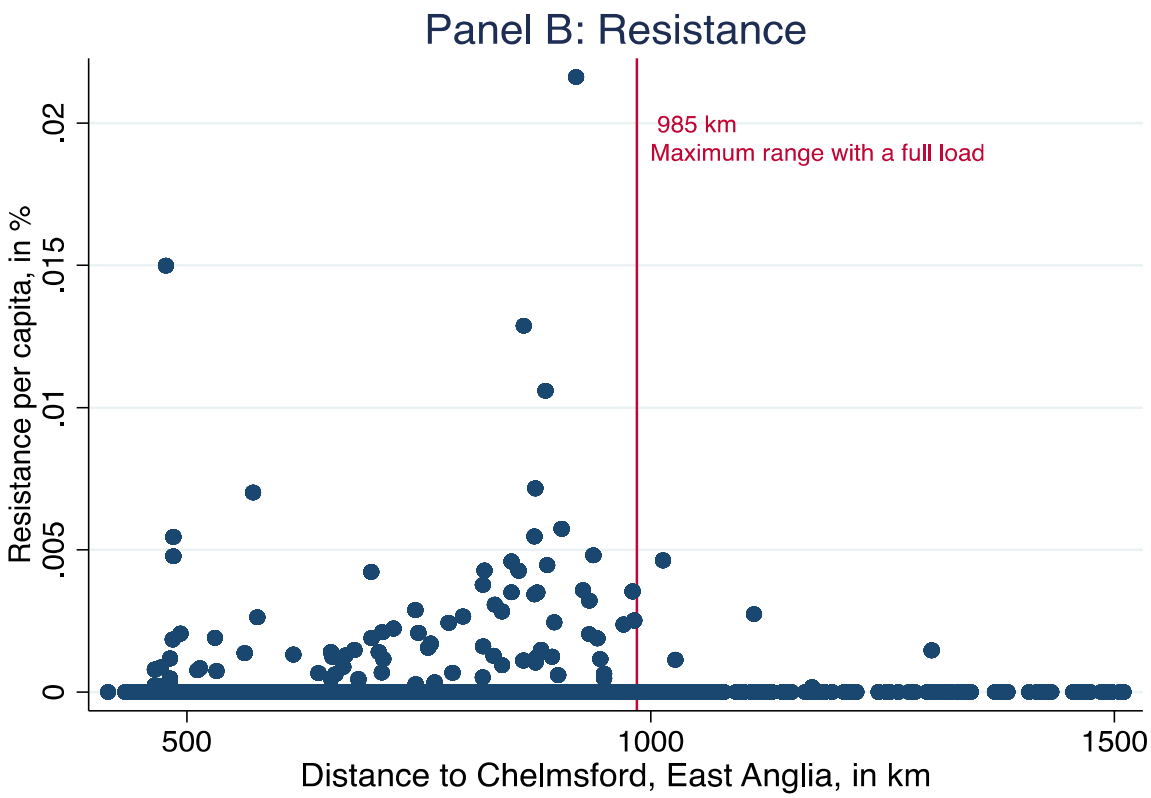



**Figure A.5: McCrary Density Plot.**

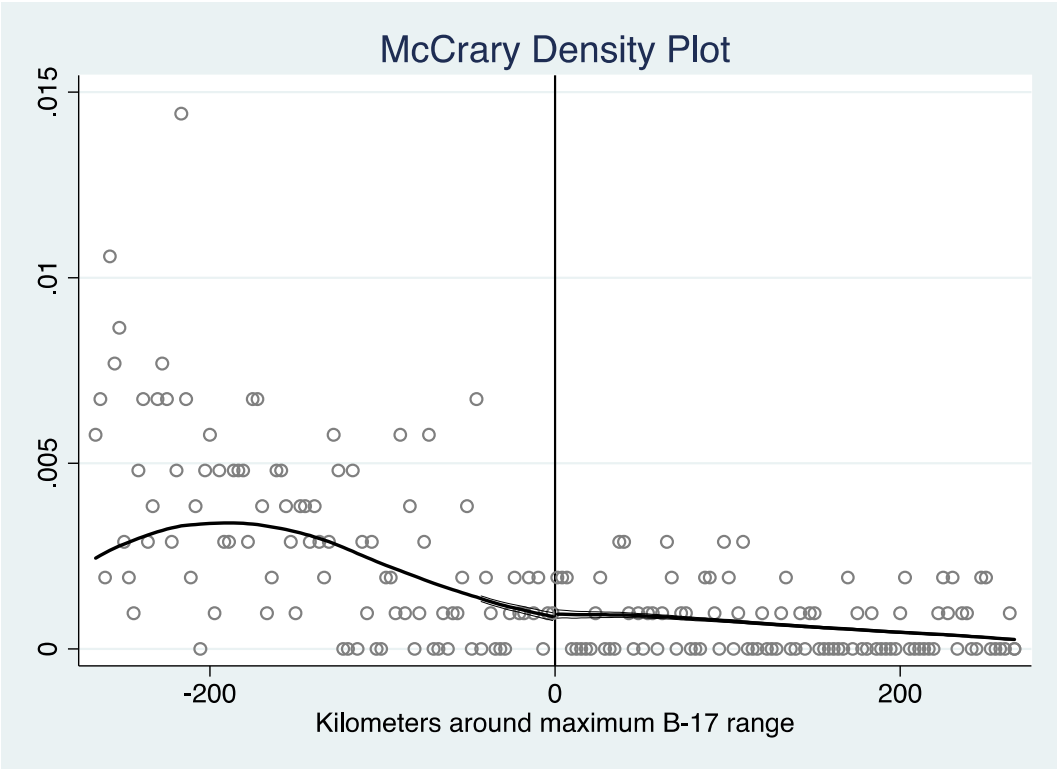
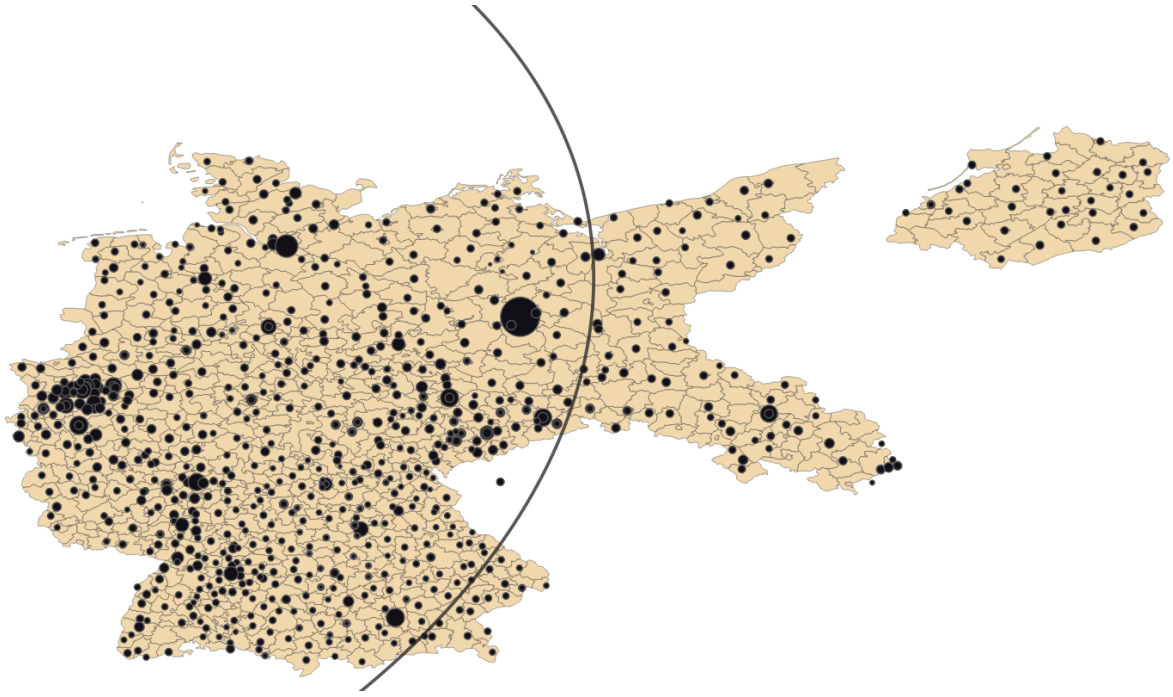
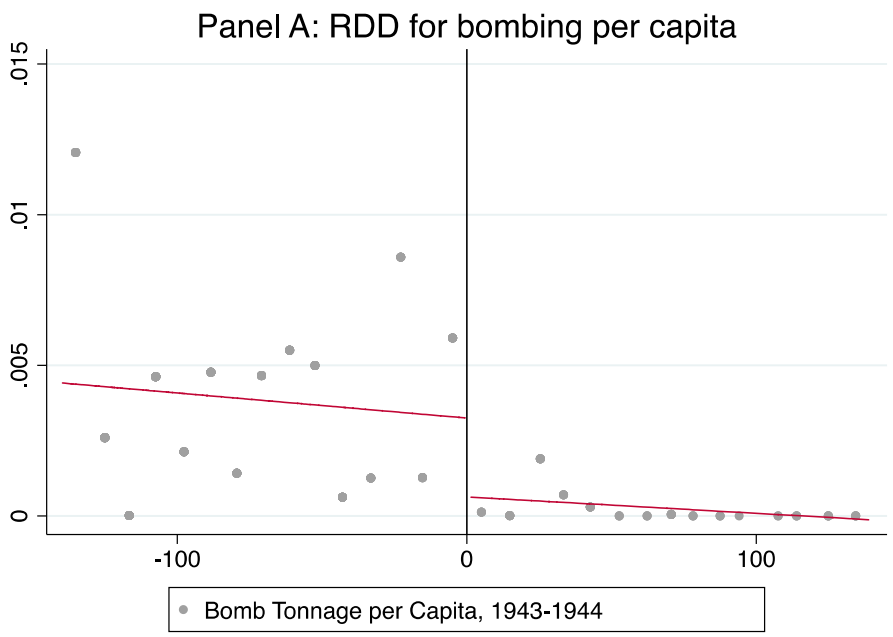


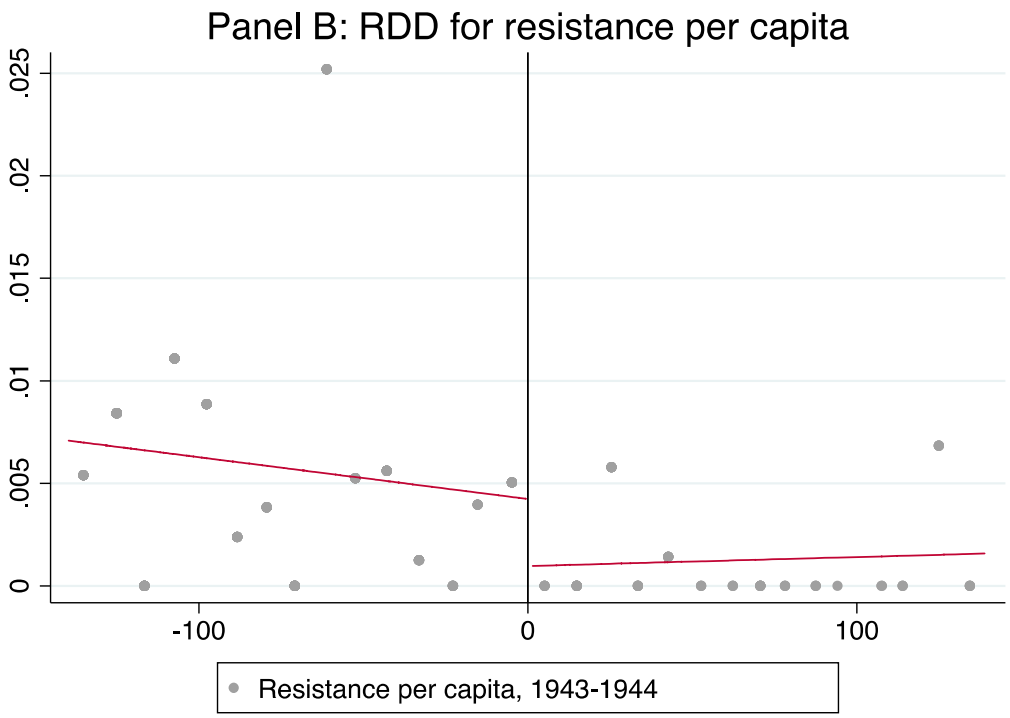

**Figure A.6: Population distribution in Germany.**



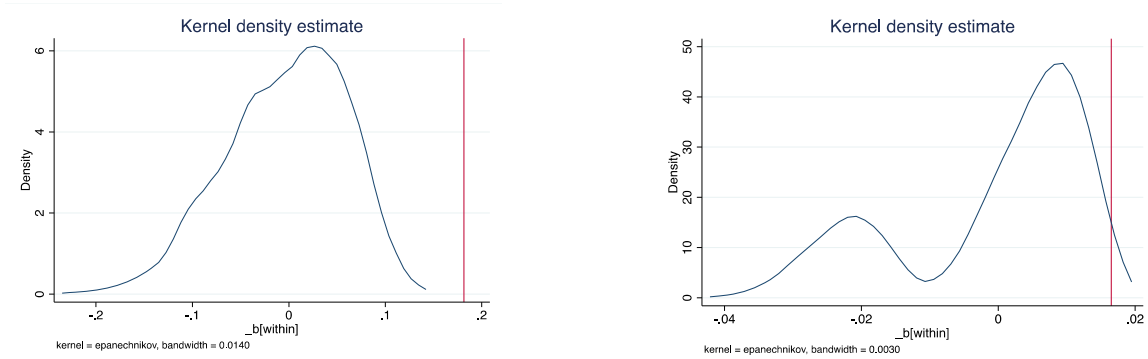
**Note**: The area of each dot is proportional to the size of a city. The black line indicates the maximum operational range of B-17 bombers operating from East Anglia, as described in the text.

**Figure A.7: RDD around threshold for per capita bombing and resistance.**



## Figure A.8: Randomization Inference—RDD Coefficients.




Share of coefficients larger than estimated: 0%
**Panel A:** Simulated coefficients vs estimated for the effect on bombing (specification 1, Table 2)

Share of coefficients larger than estimated: 0.3%
**Panel B:** Simulated coefficients vs estimated for the effect on resistance (specification 2, Table 2)

**Note**: The dashed red line indicates the estimation result from Table 2; the distribution shows the coefficients estimates via randomization inference with 1,000 iterations.

## Figure A.9: Timing of First Bombing—Home Town of Pilots

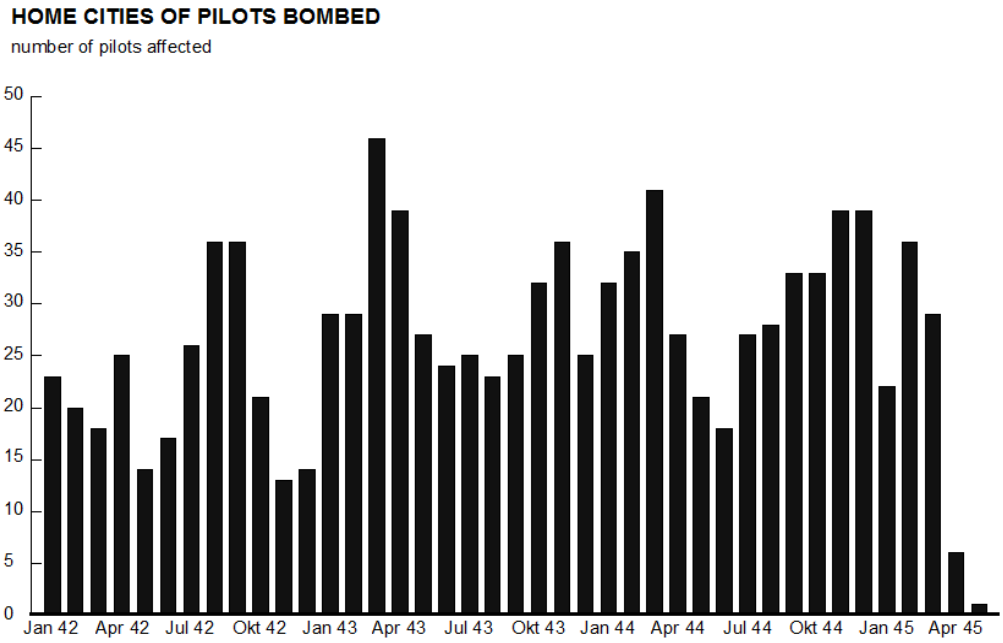
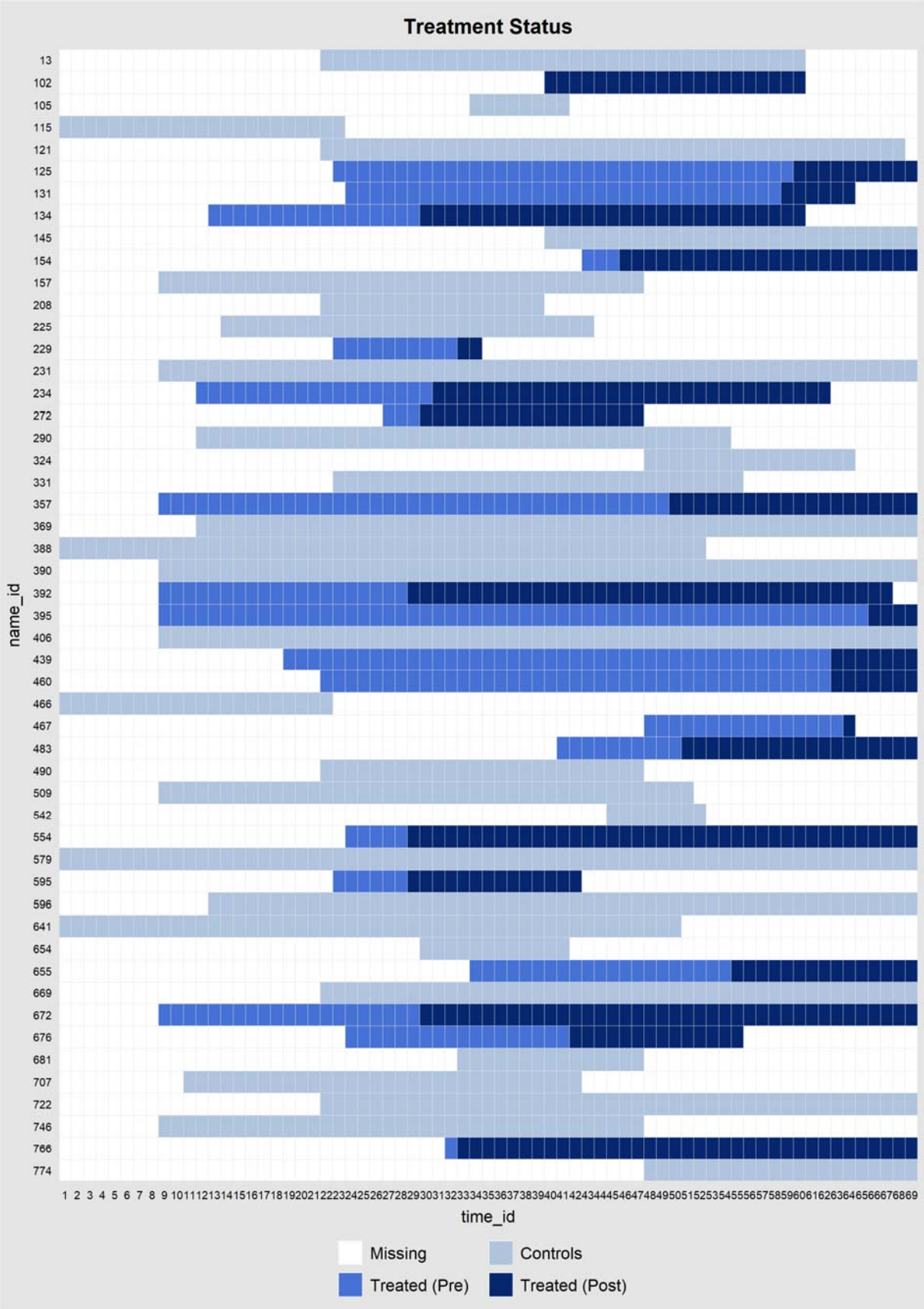
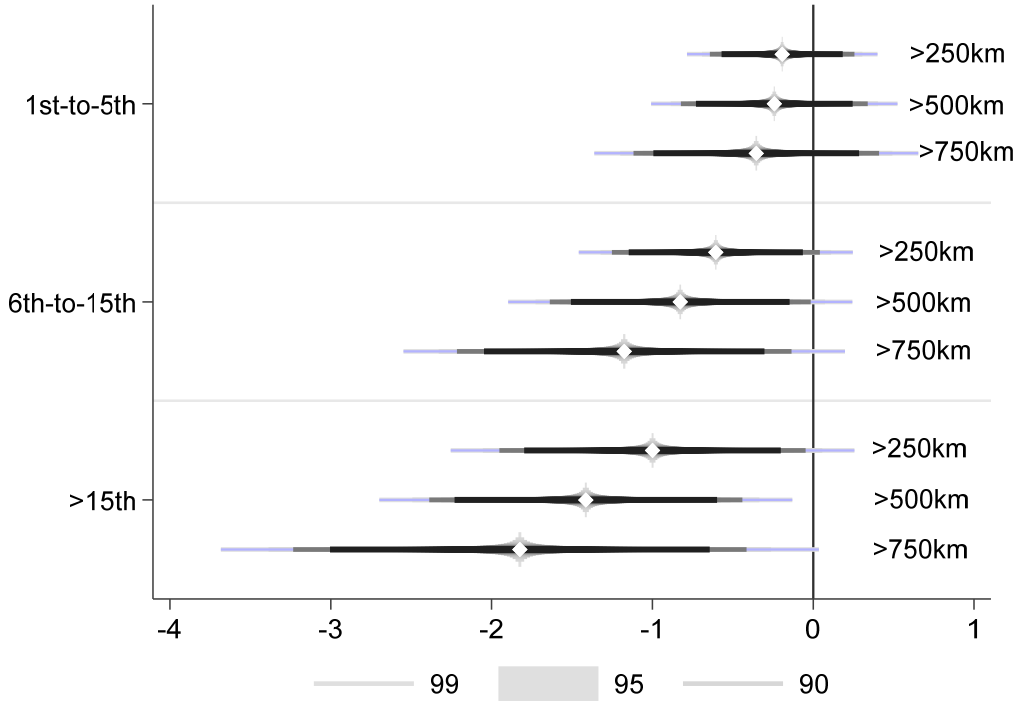


**Figure A.10: Unbalanced sample—fighter pilots.**



**Note**: The figure shows, for a subset of the pilots in our dataset, the evolution of treatment status—pre-periods for treated(blue), treated period (black), potential control units (gray) that are not treated, and missing data (white).

**Figure A.11: Effect of Bombing on Fighter Pilot Performance, by Distance to Home Town**




**Note**: The figure plots the coefficients from three separate regressions, with a pilot's monthly victory rate on the left-hand side. The bars show coefficient for three "home town attacked" dummies, coded separately to distinguish the 1st-5th attack from that of the 6th-15th and the 16th and further attacks. The excluded category is no-attack. We include individual pilot fixed effects and cluster at the pilot-month level. We restrict the sample to a) pilots flying from airfield more than 250 km from their home town, b) more than 500 km, and c) more than 750 km. The blue bar shows the error band for 99% significance; the thinnest black bar, for 95%; and the thick black one, for 90% significance. The regression equivalent is reported in Table A.8.

## Table A.1: Summary Statistics.

**Panel A. Daily Analysis Variables.**

| | N | min | Mean | Median | max | St.Dev |
|---|---|---|---|---|---|---|
| Daily Bombing Tonnage | 684216 | 0 | 1.14 | 0 | 10449.04 | 41.836 |
| Distance from London | 684216 | 434.074 | 725.256 | 718.107 | 1166.435 | 161.159 |
| Average Wind | 684216 | 1.039 | 3.714 | 3.295 | 14.033 | 1.835 |

**Panel B. Monthly Panel Variables.**

| | N | min | Mean | Median | max | St.Dev |
|---|---|---|---|---|---|---|
| Log (1+ # of arrests) | 22464 | 0 | .011 | 0 | 4.543 | .128 |
| Log (1+ # of new resistance cases) | 22464 | 0 | .008 | 0 | 3.526 | .107 |
| Monthly bombing, predicted from weather | 22464 | 0 | 1.018 | 1.05 | 1.211 | .12 |
| At least one new resistance case | 22464 | 0 | .008 | 0 | 1 | .09 |
| Log(mean monthly bombing) | 22464 | 0 | .109 | 0 | 6.48 | .56 |

**Panel C. Fighter Pilots**

| | N | min | Mean | Median | max | St.Dev |
|---|---|---|---|---|---|---|
| Eastern Front | 13983 | 0 | .516 | 1 | 1 | .5 |
| Experience | 13983 | 1 | 23.515 | 21 | 69 | 15.843 |
| Victory | 13983 | 0 | 1.94 | 0 | 68 | 4.3 |
| Hometown Bombed | 13983 | 0 | .165 | 0 | 1 | .372 |

**Panel D. RDD**

| | N | min | Mean | Median | max | St.Dev |
|---|---|---|---|---|---|---|
| Distance from East Anglia | 1024 | 414.998 | 792.534 | 772.449 | 1509.832 | 214.452 |
| Within range | 1024 | 0 | .854 | 1 | 1 | .353 |
| Log (New Resistance Cases), avg | 1024 | -.008 | 0 | -.008 | 1.869 | .066 |
| Log (monthly bombing), avg | 1024 | 0 | .278 | 0 | 6.225 | .631 |

**Panel E. Cross Sectional variables.**

| | N | min | Mean | Median | max | St.Dev |
|---|---|---|---|---|---|---|
| Log (Population), 1938 | 920 | 8.236 | 10.945 | 10.901 | 15.208 | .724 |
| Nazi vote share, 1933 | 876 | 13.293 | 44.859 | 44.454 | 83.006 | 12.465 |
| SPD vote share, 1933 | 876 | .011 | .162 | .157 | .464 | .091 |
| KPD vote share, 1933 | 876 | .002 | .09 | .076 | .36 | .062 |
| Turnout, 1933 | 876 | 72.064 | 88.888 | 89.389 | 96.039 | 3.241 |
| Welfare recipients, 1932 | 907 | 3.5 | 25.754 | 23.4 | 93.9 | 14.491 |
| Social Renters per capita, 1932 | 907 | 1.043 | 8.83 | 7.932 | 33 | 5.035 |
| Log (Property Tax), 1930 | 894 | 2.805 | 6.311 | 6.45 | 8.446 | .761 |
| Log (New Resistance Casess) | 936 | 0 | .007 | 0 | 1.558 | .056 |
| BBC Signal Availability | 936 | -1.341 | -.165 | -.116 | -.08 | .115 |
| German Radio Availability | 936 | .052 | .27 | .26 | .75 | .104 |

**Panel F. USSBS Variables**

| | N | min | Mean | Median | max | St.Dev |
|---|---|---|---|---|---|---|
| Gender | 3579 | 0 | .611 | 1 | 1 | .488 |
| Age | 3579 | 1 | 6.845 | 7 | 101 | 8.123 |
| Married | 3578 | 0 | .711 | 1 | 1 | .453 |
| HighSchool | 3561 | 0 | .226 | 0 | 1 | .418 |
| Listened to Radio London | 2282 | 0 | .393 | 0 | 1 | .488 |
| Listened to Allies | 2282 | 0 | .501 | 1 | 1 | .5 |
| Perceived Bias in German Sources | 1291 | 0 | .125 | 0 | 1 | .331 |

## Table A.2: Alternative Optimal Bandwidths for RDD.

| | Log (New Resistance Cases) | | |
|---|---|---|---|
| Bandwidth selection method | Calonico et al. 2014a | Imbens and Kalyanamaran 2012 | Ludwig and Miller 2007 |
| | (1) | (2) | (3) |
| Log (Bombing), average | 0.124** | 0.205*** | 0.231** |
| | [0.050] | [0.076] | [0.091] |
| Optimal Bandwidth | 167.6 | 406.8 | 523.4 |
| Observations | 357 | 840 | 1,005 |

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Fuzzy RDD is estimated as an IV with distance to the max operational range (985 km) as the running variable. Resistance is the average residual of the log of monthly beginning resistance activity (+1) on month dummies.

## Table A.3: RDD and Other Variables. Balance (Placebo) Estimates.

| | Coefficients for fuzzy RDD estimates | Standard errors for fuzzy RDD estimates |
|---|---|---|
| Log (Population) | 2.044 | [1.247] |
| Nazi (NSDAP) Vote Share, 1933 | -17.814 | [20.983] |
| Communists (KPD) Vote Share, 1933 | 24.114 | [29.540] |
| SPD Vote Share, 1933 | 0.080 | [0.171] |
| Turnout, 1933 | 0.009 | [0.088] |
| Welfare Recipients, 1933 | 24.114 | [29.540] |
| Social renters, 1933 | 9.486 | [9.384] |
| Property Tax, 1930 | 0.689 | [1.325] |
| Observations | 357 | |

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Each cell represents the result of a separate regression with a variable from the left used as a dependent variable. Fuzzy RDD is estimated as an IV with distance to the max operational range (985 km) as the running variable (the precise specification follows column 3 of Table 2.

## Table A.4: RDD and Different Thresholds.

| | Log (New Resistance Cases) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Fuzzy RDD** | | | | | | |
| Threshold: | 138 km | 148 km | 158 km | 168 km | 178 km | 188 km | 198 km |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Log (Bombing), average | 0.084* | 0.098** | 0.110** | 0.124** | 0.136** | 0.143** | 0.149*** |
| | [0.044] | [0.043] | [0.045] | [0.050] | [0.054] | [0.057] | [0.058] |
| Latitude and Longitude | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 277 | 304 | 323 | 357 | 373 | 403 | 423 |

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Fuzzy RDD is estimated as an IV with distance to the max operational range (985 km) as the running variable. Following Calonico, Cattaneo, and Titunik (2014a), optimal bandwidtch is 167.65; the table shows that the results are robust to changes in the bandwidth. We follow Calonico, Cattaneo, and Titunik (2014a, 2014b) robust RDD procedures. Resistance is the average residual of the log of monthly beginning resistance activity (+1) on month dummies.

## Table A.5: RDD and exclusion of some locations.

| | Excluding nearby large cities | | |
|---|---|---|---|
| Bandwidth: | Excluding Munich | Excluding Berlin | Excluding Berlin+Munich |
| | (1) | (2) | (3) |
| Log (Bombing), average | 0.141** | 0.105** | 0.121** |
| | [0.061] | [0.047] | [0.061] |
| Latitude and Longitude | Yes | Yes | Yes |
| Observations | 356 | 356 | 355 |

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Fuzzy RDD is estimated as an IV with distance to the max operational range (985 km) as the running variable. Following Calonico, Cattaneo, and Titunik (2014a), optimal bandwidtch is 167.65. We follow Calonico, Cattaneo, and Titunik (2014a, 2014b) robust RDD procedures. Resistance is the average residual of the log of monthly beginning resistance activity (+1) on month dummies.

**Table A.6: Bombing (Predicted by Weather) and Resistance. Conley standard errors.**

| | Log(New Resistance Cases) | | At least 1 new resistance case (dummy) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Predicted Bombing | 0.048** | 0.049** | 0.038* | 0.038* |
| | [0.022] | [0.021] | [0.022] | [0.022] |
| Log (Arrests) | | -0.032 | | -0.000 |
| | | [0.034] | | [0.021] |
| City Fixed Effects | Yes | Yes | Yes | Yes |
| Month Fixed Effects | Yes | Yes | Yes | Yes |
| Observations | 22,464 | 22,464 | 22,464 | 22,464 |
| R-squared | 0.393 | 0.394 | 0.186 | 0.186 |

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1. Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

**Table A.7: Bombing and New Resistance Cases. OLS Estimates.**

| | Log(New Resistance Cases) | | At least 1 new resistance case (dummy) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Predicted Bombing | -0.001 | -0.002 | -0.004 | -0.004 |
| | [0.004] | [0.004] | [0.003] | [0.003] |
| Log (Arrests) | | -0.032 | | -0.001 |
| | | [0.032] | | [0.025] |
| City Fixed Effects | Yes | Yes | Yes | Yes |
| Month Fixed Effects | Yes | Yes | Yes | Yes |
| Observations | 22,464 | 22,464 | 22,464 | 22,464 |
| R-squared | 0.393 | 0.394 | 0.187 | 0.187 |

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1. Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

## Table A.8: Bombing, Predicted from Weather, Resistance, and Predispositions.

| | Log(New Resistance Cases) | | At least 1 new resistance case (dummy) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Predicted Bombing | 0.060** | 0.050** | 0.047** | 0.053** |
| | [0.022] | [0.018] | [0.019] | [0.024] |
| Predicted Bombing x NSDAP Vote share in 1928 | -0.005 | | -0.004 | |
| | [0.003] | | [0.003] | |
| Predicted Bombing x Pogroms in 1349 | | 0.009 | | 0.001 |
| | | [0.032] | | [0.047] |
| City Fixed Effects | Yes | Yes | Yes | Yes |
| Month Fixed Effects | Yes | Yes | Yes | Yes |
| Observations | 22,032 | 8,928 | 22,032 | 8,928 |
| R-squared | 0.403 | 0.131 | 0.187 | 0.135 |

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1. Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944. Columns 2 and 4 only include places that existed in 1349.

## Table A.9: Bombing at Home and Pilot Motivation. Double Clustering.

| | Number of enemy planes shot down | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Hometown Bombed | -0.175* | -0.572*** | -0.472** | -0.437* | -0.422* |
| | [0.094] | [0.212] | [0.204] | [0.25] | [0.251] |
| Experience | -0.009*** | 0.0117*** | | | |
| | [0.002] | [0.0040] | | | |
| Eastern Front dummy | 1.690*** | 1.841*** | 1.425*** | 1.250*** | 1.258*** |
| | [0.070] | [0.137] | [0.162] | [0.175] | [0.178] |
| Pilot Fixed Effects | | Yes | Yes | Yes | Yes |
| Time Fixed Effects | | | Yes | Yes | Yes |
| Squadron Fixed Effects | | | | Yes | Yes |
| Aircraft Fixed Effects | | | | | Yes |
| Mean of Dependent Variable | 1.94 | 1.94 | 1.94 | 1.94 | 1.94 |
| Observations | 13983 | 13983 | 13983 | 13957 | 13957 |
| R-squared | 0.041 | 0.137 | 0.205 | 0.233 | 0.235 |

Robust standard errors, clustered by pilot and month, in brackets. *** p<0.01, ** p<0.05, * p<0.1. Unit of observation is pilot-month. Exponentiated coefficients from Cox regressions in Panel B. Exit is defined as KIA or severely wounded.

## Table A.10: Bombing at Home and Pilot Motivation.

| | (1) all | (2) >250km | (3) >500km | (4) >750km |
|---|---|---|---|---|
| 1st-to-5th | -0.372* | -0.193 | -0.242 | -0.354 |
| | (0.193) | (0.228) | (0.295) | (0.387) |
| 6th-to-15th | -0.591** | -0.606* | -0.827** | -1.175** |
| | (0.300) | (0.328) | (0.412) | (0.527) |
| 16th + | -0.911** | -0.999** | -1.414*** | -1.824** |
| | (0.391) | (0.483) | (0.494) | (0.714) |
| front | 1.418*** | 1.516*** | 1.859*** | 2.165*** |
| | (0.166) | (0.185) | (0.209) | (0.243) |
| *N* | 13815 | 11459 | 9232 | 7084 |
| $R^2$ | 0.205 | 0.214 | 0.223 | 0.239 |

**Note**: The regression reports coefficients for the change in monthly victory rates of pilots, by order of attack on their home towns and distance from home town to pilot's airfield. Standard errors in parentheses.
* p < .1, ** p < .05, *** p < .01

**Table A.11: BBC Availability vs Survey Demographics.**

| | Gender | Age | High School education | Protestant |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| BBC Radio Availability | -0.068 | 2.091 | -0.276 | -0.462 |
| | [0.196] | [1.818] | [0.287] | [1.138] |
| Observations | 3,579 | 3,579 | 3,561 | 3,573 |
| R-squared | 0.000 | 0.000 | 0.001 | 0.003 |

Robust standard errors in brackets, clustered by city. *** p<0.01, ** p<0.05, * p<0.1.

## APPENDIX B: BOMBING AND THE GEOGRAPHY OF RESISTANCE IN BERLIN

As the capital of Germany, Berlin was a prime target for allied bombers throughout the war. Bomber Command's commander-in-chief, Arthur Harries, sought to destroy the city during the so-called "Battle of Berlin" (Nov 1943 to Mar 1944), ordering 16 massive raids. Bomber Command dispatched reconnaissance planes after every major raid, taking detailed aerial photographs. These were then used to compile destruction maps of major German cities. Cartographers hand-colored every destroyed building in blue in large transparent overlays of enlarged city maps. The collected damage assessments were collected in the so-called "Blue Books".[1] Contemporary newspaper articles show the head of Bomber Command, Arthur Harris, examining the damage maps under the headline "The Brain Behind the Death of Berlin Look at His Work from Afar" (Figure B.1).

Some of the maps contained in the Blue Books have survived the war. We digitize the one for Berlin, compiled in March 1945 (Figure B.2), and combine it with precise geo-referenced information on the location of resistance activity. Did areas that suffered from more aerial bombardment within Berlin witness more resistance against the regime?[2] Data from March 1945 is useful for our purposes since the massive destruction during the capture of Berlin by Soviet troops in April 1945 had not yet occurred—effectively all documented damage is the result of aerial bombardment.

We use a finely-grained grid of 1,479 cells, corresponding to about 0.5km$^2$ each. We can assign 130 resistance cases to the part of the Berlin map covered by the Blue Book. A first impression of the nature of the data can be gleaned from Figure B.3, which shows a bin-scatter of the number of resistance cases against the (log) of bomb damage in a grid-cell: more resistance occurred where the bomb damage was the heaviest in Berlin. Nonetheless, it may well have been the case that district characteristics interacted with bombing volume (i.e. there might have been more bombing in workers' districts where more industrial plants were located, and where sympathy for the Nazis was lower to start with).

[1] Analysts examined hundred of photographs taken after each air raids. They evaluated details like the shadow of a house to determine whether the roof had burned down.
[2] Unfortunately, there are no earlier damage maps that would allow us to assess changes over time.

To deal with this issue, we exploit variation over time in bombing and resistance. Since we do not have panel data on the destruction of different neighborhoods of Berlin, we construct a time-varying measure of destruction of different neighborhoods by interacting the level of destruction of a particular grid cell in March 1945 with the monthly bombing volume for the whole Berlin.[3]

Table B.1 reports the results. New resistance was more likely to occur in the months following intense bombing, with the difference between most heavily bombed grid cell and least heavily bombed grid cell leading to 1.8% more resistance cases at the mean value of bombing and 2.5% higher probability of having at least one resistance case at the grid cell-month level.[4] Overall, these results confirm our previous findings that bombing furthered resistance activity.

**Table B.1: Damage from Bombing and Resistance in Berlin.**

| | Log (1+Resistance Cases) | | At Least One New Resistance | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Log (Bombing of Berlin)*Final Damage to Grid Cell | 0.0002** | 0.0002** | 0.0003* | 0.0003* |
| | [0.0001] | [0.0001] | [0.0001] | [0.0001] |
| Log (Bombing of Berlin) | 0.0007 | -0.0002 | 0.0008 | -0.0003 |
| | [0.0004] | [0.0006] | [0.0005] | [0.0005] |
| Grid Cell Fixed Effects | Yes | Yes | Yes | Yes |
| Quarter Fixed Effects | | Yes | | Yes |
| Observations | 10,353 | 10,353 | 10,353 | 10,353 |
| Number of grid cells | 1,479 | 1,479 | 1,479 | 1,479 |

Note: Robust standard errors, cllustered by gridcell and quarter, in brackets. *** p<0.01, ** p<0.05, * p<0.1.

[3] This approach is similar to the sift-share instrument used in the study labor demand shocks (Bartick 1991), import penetration (Autor, Dorn, and Hanson (2013), or immigration (Dustman, Schönberg, and Stuhler 2017).
[4] To get these numbers, we multiply the coefficient of interest for the interaction term by the difference in log total damage between most bombed and least bombed district and by the number of quarters since the beginning of 1943 till the end of the war.

**Figure B.1: Sir Arthur C. Harris and the Destruction of Berlin**

Battle of Berlin (continued)

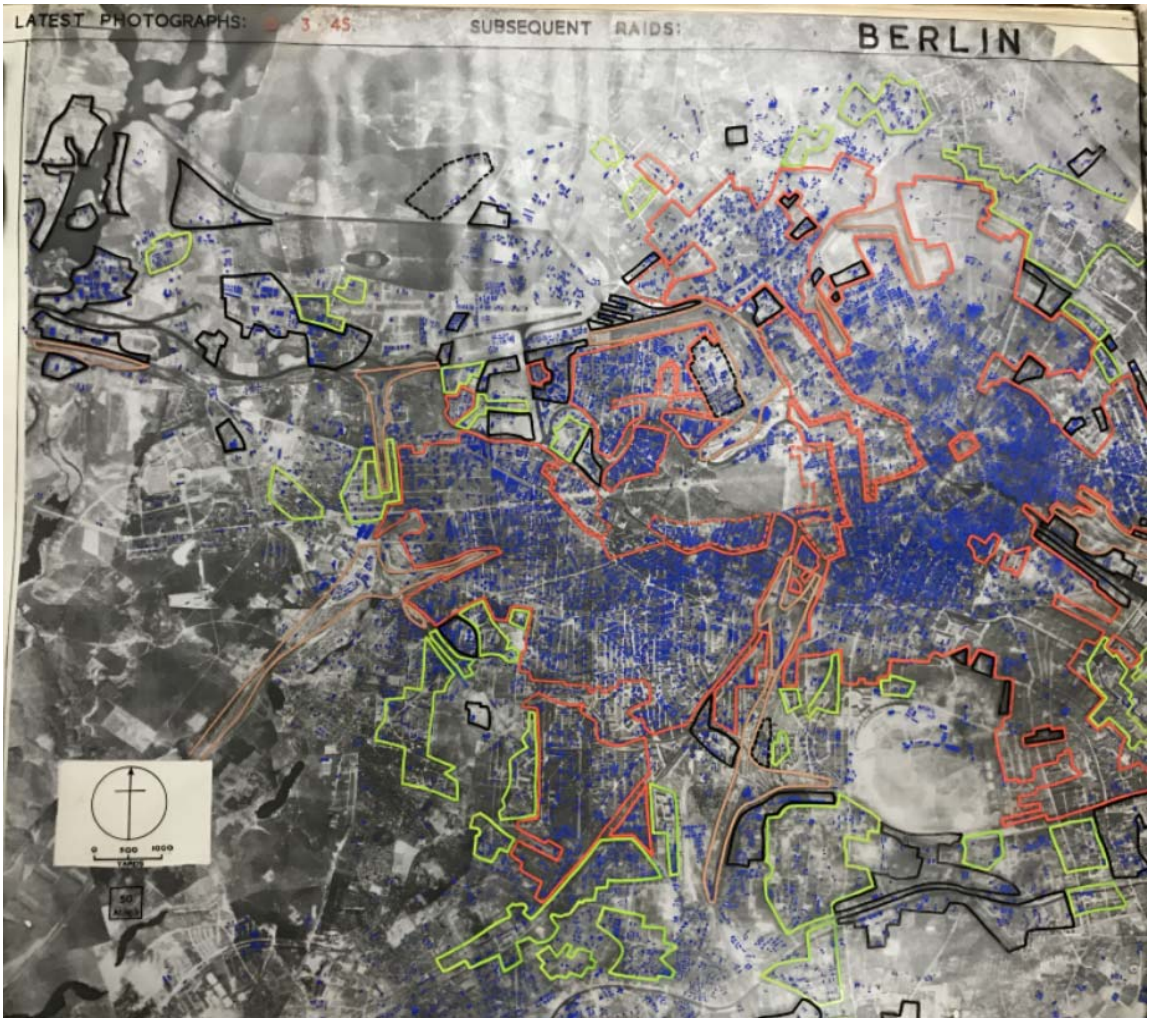
**The Blue Book,** in which are bound mosaic air views of all European cities damaged by bombing, is here inspected by Chief Marshal Sir Arthur Harris (*leaning over*) in his supersecret headquarters of the Bomber Command. His immediate subordinates are, (*from left*), Morris, Saundby and Inness. This is the first time this room has been photographed.

## THE BRAIN BEHIND THE DEATH OF BERLIN LOOKS AT HIS WORK FROM AFAR

The bombing of Berlin is primarily a trucking and dumping job, but the trucking is violently opposed by the enemy and the dumping has to be in the right place. The man in charge of all this is tough, soft-spoken Air Chief Marshal Sir Arthur T. Harris. He developed the "saturation raid," the massive blasting of a whole area. In this he uses incendiaries, remembering the nights of the London blitz when a thousand fires raged, including as many as nine huge conflagrations out of control. He knows that a good fire can knock a factory out for longer than even a direct hit with a blast-bomb, and that fire spreads on its own. He knows, too, the price of bombing Germany: a total of 3,366 Allied bombers lost over north Europe in 1943.

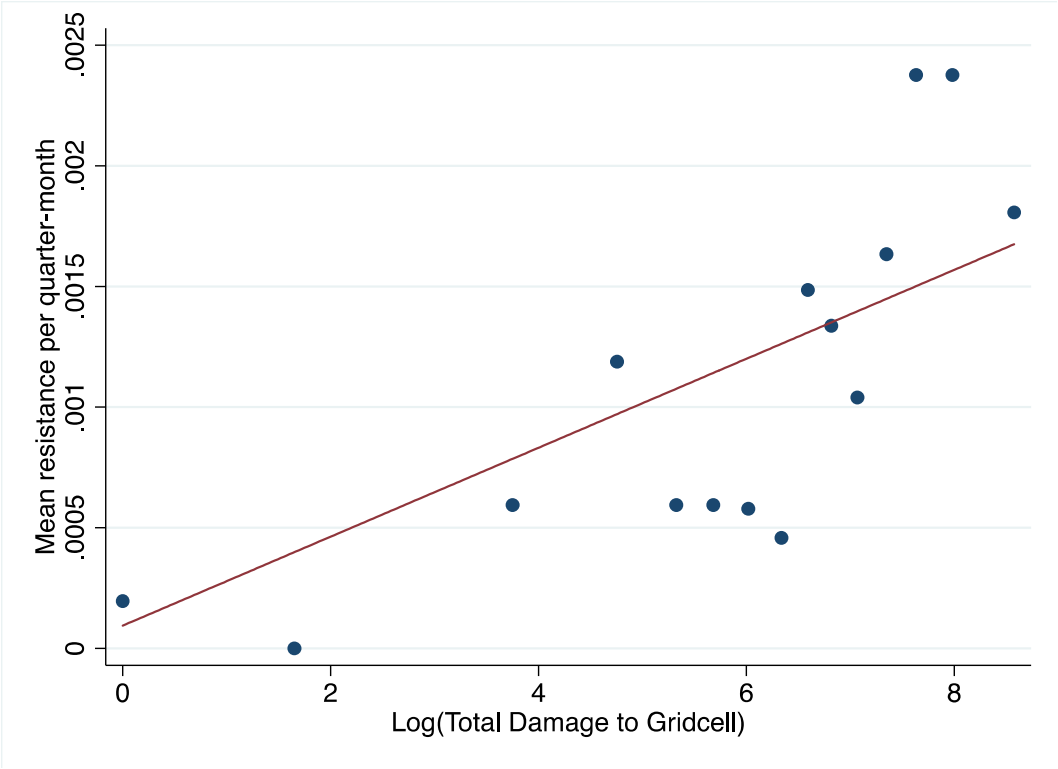
The pictures here of the Photographic Reconnaissance Section of Bomber Headquarters and the famous Blue Book are the first ever permitted.

**Figure B.2: Berlin Damage Map from the "Blue Book" (March 1945).**




Notes: Blue areas: destroyed or badly damaged; red contours: fully built-up residential areas; black contours: industrial areas; green: 40–70% residential. Source: Imperial War Museum.

**Figure B.2:. Bombing of grid cells and average resistance in Berlin sample.**

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## APPENDIX C: RESISTANCE, ARRESTS AND THE TIMING OF GESTAPO ACTIVITY

In Table C.1 below, as recommended by Angrist and Pischke (2008), we examine lags and leads to see whether there is any evidence of pre-trends in terms of arrests. To this end, this table reports coefficients for bombing either 1 or 2 months before/after an actual attack. We do not observe a significant impact of bombing on contemporary arrests or for arrests 1 or 2 months earlier. There is, however, some evidence that Gestapo arrests followed bombing attacks with a lag of one month (column 4), suggesting that 100% increase in bombing led to a 7.9% increase in arrests one month later. The rapid uptick in arrests implies that only a short time often passed between the beginning of resistance and arrest, in line with historical accounts underlining the ruthless efficiency of the Gestapo.[5]

**Table C.1. Bombing, predicted from Weather, and Arrests. Pre- and post- trends.**

| | Log(New Arrests) | | | | |
|---|---|---|---|---|---|
| Log (Bombing), 2 months later | 0.029 | | | | |
| | [0.046] | | | | |
| Log (Bombing), 1 month later | | 0.019 | | | |
| | | [0.054] | | | |
| Log (Bombing), same month | | | 0.043 | | |
| | | | [0.056] | | |
| Log (Bombing), 1 month earlier | | | | 0.079* | |
| | | | | [0.042] | |
| Log (Bombing), 2 months earlier | | | | | 0.054 |
| | | | | | [0.036] |
| City Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Month Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 22,464 | 22,464 | 22,464 | 21,528 | 19,656 |

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1. Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

**References:**

Angrist, J.D. and Pischke, J.S., 2008. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton UP.

[5] The distribution of time to arrest is shown in Figure 2 of the main text.

# APPENDIX D: BBC, BOMBING, AND PUBLIC OPINION – EVIDENCE FROM THE USBSS

**The USBSS**

We first use newly digitized data from the survey responses of 4,309 Germans interviewed by Allied investigators immediately after the end of World War II. Members of the staff of the USSBS carried out detailed interviews of the civilian population in bombed cities. This offers an opportunity to study public opinion about the war right after its end. Among other questions, USSBS survey asked the respondents when they started to listen to BBC (see Figure D.1 for the distribution of these answers). This allows us to relate some opinion questions to the timing of starting to listen to the BBC in a panel framework, controlling for individual fixed effects. Table D.1 reports these results. Panel A shows that the earlier people started listening to the BBC, the earlier they held the (self-reported) belief that the war was lost. There are no associated pre-trends. Similarly, Panel B shows a positive correlation between wanting the war to end and beginning to listen to BBC. While these results are based on self-reported responses on timing, and need be interpreted with caution, they suggest that listening to the BBC German service was associated with greater pessimism about the war among the German populace.

However, we do not have a good source of exogenous variation to study the causal impact of bombing using this data: our survey cities (shown on the map in Figure D.2) were not sufficiently close to maximum B-17 bombing range to use the bombing range discontinuity, and the weather instrument is not informative in the cross section. Nonetheless, we can analyze basic patterns in the data, as presented in Figure D.3.

In cities that were bombed more by the Allies, respondents report a higher frequency of air raids—providing some external validation for our bombing measure (Panels A and B of Figure D.3). Moreover, there is some suggestive evidence that respondents who experienced more bombing reported low overall levels of morale and were more likely to report passive attitudes towards Nazis (Panels C and D of Figure D.3).[6] These results are broadly consistent with the results for bombing as reported in section 4 of the main text.

[6] The morale index was constructed from 12 different subcomponents by USSBS survey personnel; it was intended to measure the level of ordinary people's morale at the end of the war.

**Radio's Effect**

Did wartime exposure to the BBC affect people's opinions more generally? In Panel A of Table D.2, we instrument self-reported BBC listening with our city level measure of BBC signal availability. Essentially, the results from Table 7 (column 4) constitute the first stage of this estimation. These results are computed with the help of weak instrument robust confidence sets (Andrews 2017, Sun 2018), which are reported in the separate row under their coefficients. We find that, on average, people listened to Allied radio were more likely to think that the war was lost because of shortages or superior Allied air power (+29% and +31% in probability of agreeing). They also assessed the occupation experience more favorably (+94%). In Panel B of Table D.2, we report the results for bombing and BBC together, using OLS estimation.[7] Consistent with our panel data results, listening in places where Allied radio reception was good and where the Allied bombed, respondents were more likely to state that the war was lost because of shortages or superior Allied air power, that the war was lost from the beginning, and they had passive attitudes towards Nazis.

While self-reported attitudes after the end of World War II are not necessarily compelling evidence in favor of the effects of broadcasts and air power, we note that around 40% of respondents self-identified as Nazi supporters; this suggests that social desirability bias did not entirely distort survey responses.

[7] Unfortunately, we cannot estimate this specification using IV, for two reasons. First, our weather instrument only works for short term fluctuations in bombing rather than for aggregate volumes. Second, in the specification with interactions, signal strength becomes a very weak predictor of self-reported exposure to BBC, with weak instrument robust confidence sets covering entire grid.

**Figure D.1: Listening habits to Allied broadcasts, reported by USSBS respondents.**

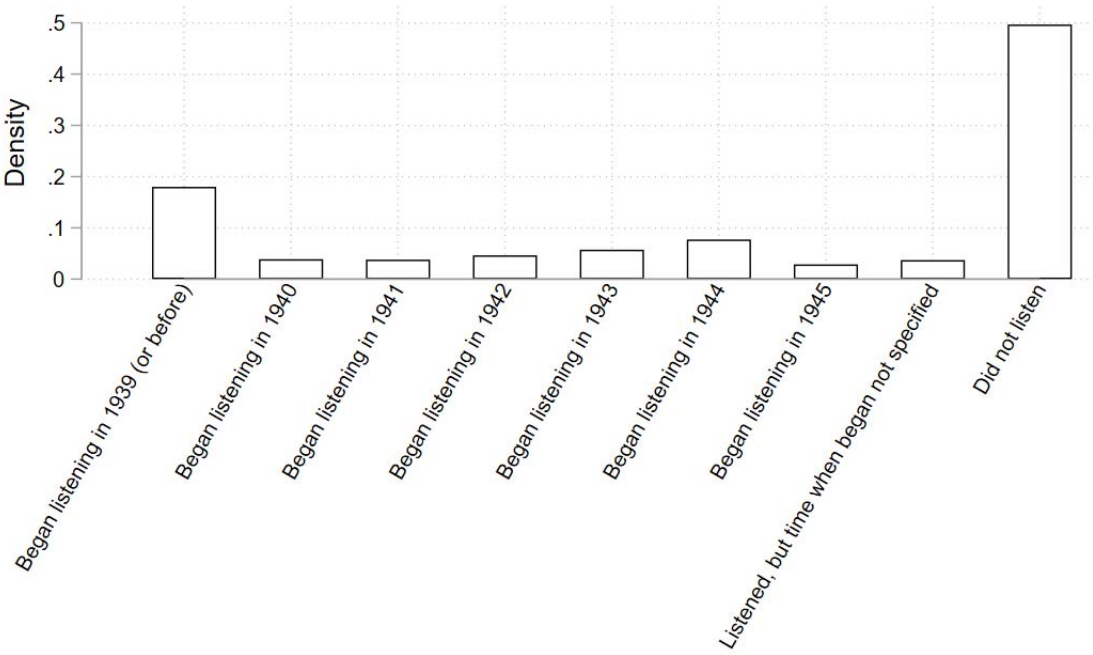
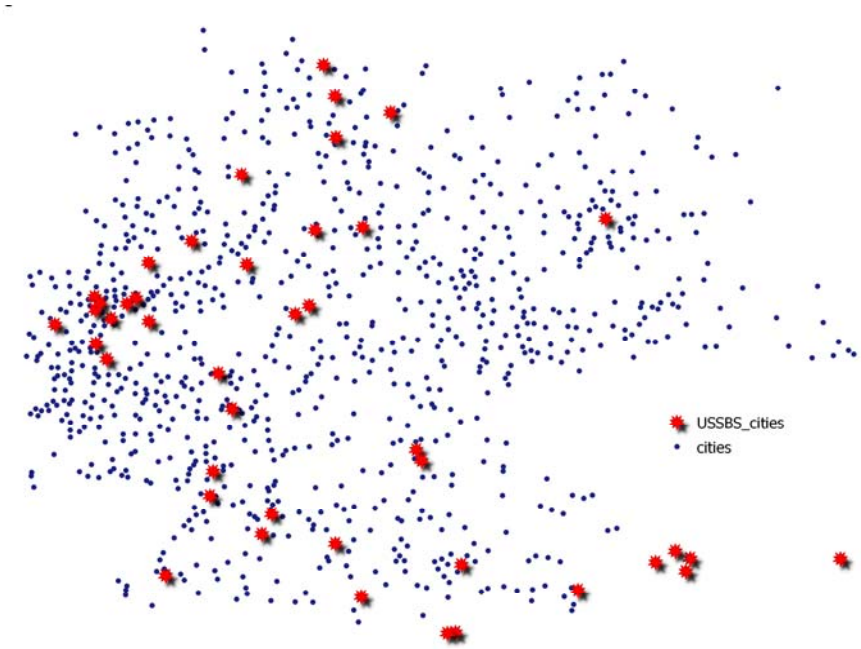
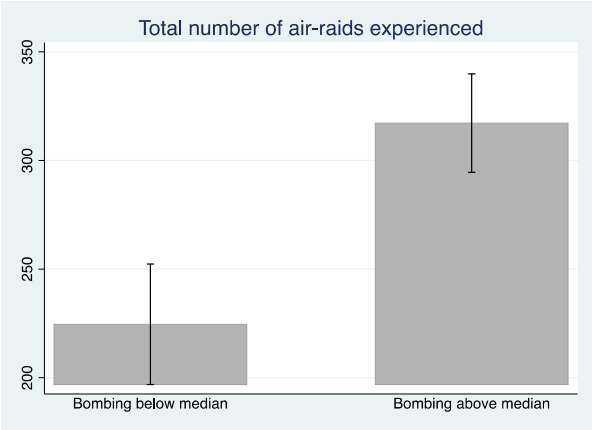


**Figure D.2: Cities surveyed by the USSBS.**

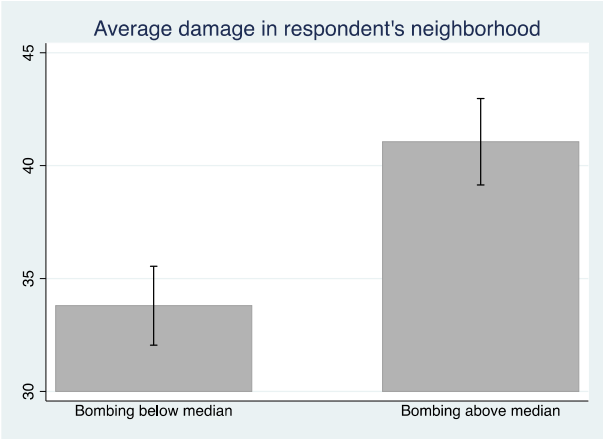


## Figure D.3: Bombing and USSBS survey data.

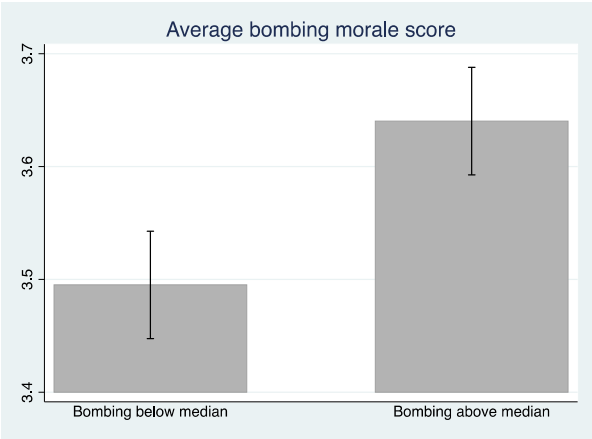
A. Bombing and (self-reported) air raids.



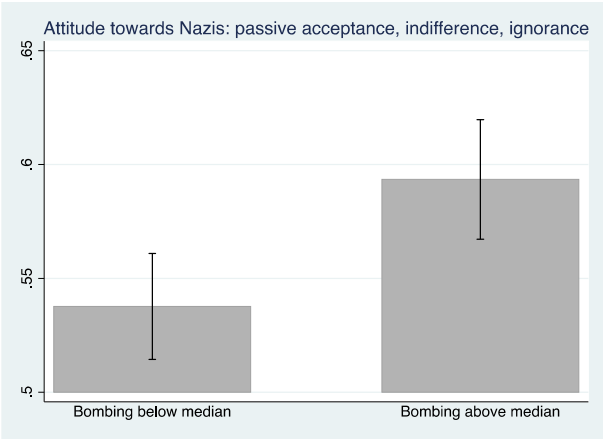

B. Bombing and (self-reported) neighborhood destruction




C. Bombing and Bombing Morale Score (higher value indicates lower morale)




D. Bombing and attitudes to Nazis (passive acceptance, indifference, ignorance)



## Table D.1: Public Opinion in 1945 and Exposure to BBC. Panel Results.

| Panel A. Thought war was lost | When did you first think that the war was lost? | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Started to Listen to BBC, 2 periods before | -0.002 | | | | |
| | [0.022] | | | | |
| Started to Listen to BBC, 1 period before | | 0.010 | | | |
| | | [0.017] | | | |
| Started to Listen to BBC | | | 0.095*** | | |
| | | | [0.015] | | |
| Started to Listen to BBC, 1 period after | | | | 0.058*** | |
| | | | | [0.016] | |
| Started to Listen to BBC, 2 periods after | | | | | 0.037*** |
| | | | | | [0.012] |
| Respondent Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,795 | 9,060 | 11,325 | 9,060 | 6,795 |
| Number of repondents | 2,265 | 2,265 | 2,265 | 2,265 | 2,265 |

| Panel B. Wanted the war over | When did you first want the war to be over? | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Started to Listen to BBC, 2 periods before | -0.014 | | | | |
| | [0.016] | | | | |
| Started to Listen to BBC, 1 period before | | -0.019 | | | |
| | | [0.016] | | | |
| Started to Listen to BBC | | | 0.093*** | | |
| | | | [0.014] | | |
| Started to Listen to BBC, 1 period after | | | | 0.005 | |
| | | | | [0.011] | |
| Started to Listen to BBC, 2 periods after | | | | | 0.021 |
| | | | | | [0.014] |
| Respondent Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,501 | 8,668 | 10,835 | 8,668 | 6,501 |
| Number of repondents | 2,167 | 2,167 | 2,167 | 2,167 | 2,167 |

Robust standard errors, clustered by city, in brackets. Period: one (1939, 1944, 1945) or two years (1940-41, 1942-43) due to the formulation of the question in the USBSS survey. *** p<0.01, ** p<0.05, * p<0.1.

## Table D.2: Public Opinion in 1945, Exposure to BBC, and Bombing.

| Panel A. BBC and Opinions.2SLS. | Reason lost war: Shortages | Reason lost war: Allies Air Power | Reason lost war: Bad Leadership by Nazis | Thought War is Lost from the Beginning | Attitude to Nazis: Passive | Satisfaction with occupation: favorable | Satisfaction with occupation: unfavorable |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Listened to Allied radio | 0.290*** | 0.313*** | -0.245 | 0.203 | -0.012 | 0.942*** | -0.259* |
| | [0.182] | [0.180] | [0.320] | [0.229] | [0.281] | [0.327] | [0.134] |
| Weak Instrument Robust 95% Confidence Sets | [ .055; .958] | [ .046; .901] | [-1.164; .294] | [ -.272; .724] | [-.819; .461] | [ .327; 1.815] | [-.564; .046] |
| Olea-Montiel and Pflueger Effective F-statistics | 13.853 | 13.853 | 13.853 | 13.967 | 13.682 | 13.809 | 13.809 |
| Observations | 2,253 | 2,253 | 2,253 | 2,255 | 2,255 | 2,256 | 2,256 |
| Number of cities | 34 | 34 | 34 | 34 | 34 | 34 | 34 |

| Panel B. BBC, Bombing, and Opinions. OLS | Reason lost war: Shortages | Reason lost war: Allies Air Power | Reason lost war: Bad Leadership by Nazis | Thought War is Lost from the Beginning | Attitude to Nazis: Passive | Satisfaction with occupation: favorable | Satisfaction with occupation: unfavorable |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Listened to Allied radio x Bombing Tonnage | 0.002** | 0.002** | -0.002 | 0.003*** | 0.003* | 0.000 | -0.000 |
| | [0.001] | [0.001] | [0.002] | [0.001] | [0.002] | [0.001] | [0.000] |
| Listened to Allied radio | -0.049*** | -0.038** | 0.092*** | 0.039* | 0.121*** | 0.039 | -0.038*** |
| | [0.016] | [0.018] | [0.016] | [0.022] | [0.034] | [0.024] | [0.011] |
| Bombing Tonnage | -0.001* | -0.001** | 0.001 | -0.002** | 0.000 | 0.003*** | -0.001 |
| | [0.001] | [0.001] | [0.001] | [0.001] | [0.002] | [0.001] | [0.001] |
| Observations | 2,253 | 2,253 | 2,253 | 2,255 | 2,255 | 2,256 | 2,256 |
| Number of cities | 34 | 34 | 34 | 34 | 34 | 34 | 34 |

Robust standard errors, clustered by city, in brackets. *** p<0.01, ** p<0.05, * p<0.1. In Panel A, levels of significance are reported based on weak instrument robust confidence sets. In Panel B, weak instrument robust confidence sets do not consist of a single limited interval, thus we are only able to compute OLS esimtates.

**Table D.3: Demographics in USSBS cities and BBC Radio Availability. Placebo test.**

| | Gender | Age | High School education | Protestant |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| BBC Radio Availability | -0.068 | 2.091 | -0.276 | -0.462 |
| | [0.196] | [1.818] | [0.287] | [1.138] |
| Observations | 3,579 | 3,579 | 3,561 | 3,573 |
| R-squared | 0.000 | 0.000 | 0.001 | 0.003 |

Robust standard errors in brackets, clustered by city. *** p<0.01, ** p<0.05, * p<0.1.

## APPENDIX E: RESISTANCE SAMPLE

The full sample consits of 1,944 individuals, 15,5% of them female. Of those, whose trial was completed before the end of WWII (1607 individuals) 44,2% received death penalty (but only 26% of females), 39% received a penalty of 6,3 year on average of work camp (plus were dishonored for usually the same duration), 8,5% were sentenced to, on average, 2.2 years in prison, and 8,2% were found not guilty. 24.8% had some previous criminal records. The graph below shows the correclations between having a criminal record, the type of accusation, and the sentence. The duration of resistance is on average, 15 months. The time lag between the end of resistance and accusation is, on average 295 days, but it is skewed. Only 25% were accused within of 103 days, 50% within of 222, and 75% within of 390 days. The average time lag between the accusation and sentence was 72 days.

**Table A. 2:** Summary statistics for the resistance sample

| | count | mean | sd | min | max |
|---|---|---|---|---|---|
| female | 1944 | 0.155 | 0.362 | 0 | 1 |
| criminal record | 1944 | 0.248 | 0.432 | 0 | 1 |
| acc. of high treason | 1944 | 0.931 | 0.254 | 0 | 1 |
| acc. of undermining defensive capability | 1944 | 0.167 | 0.373 | 0 | 1 |
| acc. of aiding the enemy | 1944 | 0.509 | 0.500 | 0 | 1 |
| acc. of failure to disclose | 1944 | 0.103 | 0.304 | 0 | 1 |
| sentenced | 1607 | 1.000 | 0.000 | 1 | 1 |
| death penalty | 1944 | 0.366 | 0.482 | 0 | 1 |
| work camp dummy | 1607 | 0.390 | 0.488 | 0 | 1 |
| duration work camp | 627 | 6.308 | 3.068 | 1 | 15 |
| prison dummy | 1607 | 0.085 | 0.278 | 0 | 1 |
| duration prison | 136 | 2.224 | 1.539 | 0.33 | 10 |
| dishonor dummy | 1607 | 0.381 | 0.486 | 0 | 1 |
| acquitted of a charge | 1944 | 0.068 | 0.252 | 0 | 1 |
| difference between resistance and accusation in days | 1515 | 295.034 | 307.524 | 6 | 3750 |
| difference between accusation and conviction in days | 1324 | 71.850 | 50.901 | 0 | 455 |
| duration of resistance in months | 1533 | 15.116 | 18.573 | 0 | 134 |
| Observations | 1944 | | | | |

**Figure A. 3 Correlations in the resistance sample**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| criminal record | | | | | | | | | |
| 0.045 | high treason | | | | | | | | |
| 0.090 | 0.101 | subversion of the war effort | | | | | | | |
| 0.069 | 0.181 | 0.203 | acc. of aiding the enemy | | | | | | |
| -0.058 | -0.534 | -0.124 | -0.203 | acc. of failure to disclose | | | | | |
| 0.110 | 0.182 | 0.158 | 0.267 | -0.229 | death penalty | | | | |
| -0.073 | 0.033 | -0.150 | -0.199 | 0.009 | -0.524 | work camp | | | |
| -0.055 | -0.179 | -0.080 | -0.102 | 0.325 | -0.208 | -0.189 | prison | | |
| -0.072 | 0.028 | -0.146 | -0.194 | 0.007 | -0.515 | 0.980 | -0.186 | dishonor | |
| -0.042 | -0.103 | -0.077 | -0.128 | 0.124 | -0.205 | -0.186 | -0.074 | -0.183 | acquitted of a charge |

Example cases (short summary) as provided by the accusation and sentence documents:

**Berndhard K**., a former lieutenant-colonel. Since the turn of the year 1943/44, he received hints about a planned assassination by his superior Stieff. In May 1944, he brought explosives for the planned Hitler assassination to Berlin and continued to participate in preparations for the assassination attempt. He was kept up to date by Stauffenberg. Place of living: Zossen; Place of crime: Berlin; Resistance start: May 1944; Resistance end: July 1944; Date of accusation: August 1944; Date of court decision August 1944; He received death penalty

**Otto W.** was a councilor at the police headquarters in Berlin before being drafted into the military. In March 1943 he allegedly wrote (but never sent) a letter addressed directly to the Fuhrer in which he asked for the Fuhrer's resignation so to stop the ongoing war. He wrote another note titled "Mission to Save Germany" addressed to known military men as well as important public figures. There, he called for peace negotiations with the Allies (Great Britain and USA) in order to overthrow the German government in a joint effort. He also tried to convince several high-ranking military officials to stage a coup against the Hitler regime. W.

was arrested at the Swiss border in September 1943, when he attempted to flee. He was sentenced to death by the military court on 14 February 1944.

**Adam von T.** was a co-conspirator of the Stauffenberg-assassination plot of 20 July 1944. Beginning in 1940 von T. used his position at the Federal Foreign Office in Berlin to get access to insider information and in order to participate in official business trips to foreign countries. Over time he established an extensive network of regime opposing military personnel and private citizens inside and outside of Germany. Closer to the planned assassination he attempted to make contact with the Allies so as to gain their support for the coming coup. von T. was also a member of the Kreisau Circle. The main objective of this group was to plan the restructuring of the government after the fall of the fascist regime. One of his last acts was to visit the exiled socialist Willy B. in Stockholm whom he approached concerning a government position in a post-Hitler era. After the failed coup the people's court sentenced him to death on 15 August 1944.

The siblings **Hans and Sophia S.** were part of the student resistance group White Rose which originated at the University of Munich. After returning from the Eastern Front in the summer of 1942 Hans S. composed several leaflets in which he criticized the fascist ideology and reported on atrocities committed by the German regime, e.g. the mass murder of Jews. While Hans returned to the front, Sophia learned of her brother’s involvement in the activities of the White Rose and following Hans return in January 1943 she helped to produce and distribute 6000 to 9000 copies of the leaflet "Appeal to All Germans". Most of the leaflets were mailed to University employees and students. Additionally, Hans put anti-fascist slogans ("Down with Hitler") and crossed-out Swastikas on walls of prominent Munich buildings like the University, National Theater, Ministry of Commerce and the Festival Theater. Hans and Sophie S. as well as other members of the White Rose were arrested on 18 February 1943 and sentenced to the death by the people's court on 22 February 1943. Place of living: Munich; Place of crime: Munich, Augsburg, Salzburg, Wien, Stuttgart; Start of resistance: Juni 1942, End of resistnace: February 1943.

**Robert H., Georg G., Herbert R. and Paul R.** met regularly in Berlin to discuss the political situation and recent military developments. At a meeting in July 1943 the group of academics (chemist, doctor, architect and dentist) agreed that they needed to take measures as Germany was about to lose the war. Hence, they founded a resistance organization "European Union". The organization's manifest—"Answer to all Fascists"—embraced communist and democratic ideology while at the same time condemning the Fuhrer and his fascist regime. The four members became increasingly involved in supporting Jews living illegally in Germany by

providing housing, paying for living expenses and obtaining forged documents. Moreover, they tried to get in touch with Russian spies through foreign workers they recruited beforehand. Their activities were discovered in September and they were sentenced to death by the people's court on 16 December 1943. Resistance begin: July1943; Resistance end: September 1943.

**Richard L.**, a commercial clerk participated in the illegal activities of the communist organization "National Committee for a Free Germany (NKFD)". He distributed pamphlets for the NKFD in and around Leipzig. From 1943 to 1944 he held political discussions with fellow communists based on the information he acquired through foreign sources (radio stations, other pamphlets). In May 1944 he hid Friedrich K., a communist sympathizer and SPD operative who was on the wanted list, for two weeks in his apartment. L. was found guilty by the people's court and sentenced to death on 24 November 1944.

**Heinrich N.**, a former KPD member engaged with Soviet prisoners preparing a riot at the prison camp near Rodisfort. His occupation as a farmer and forestry worker allowed N. repeated contacts with Soviet soldiers who were forced to work in the fields. From 1942 to 1943 he spread news about the war at the Eastern Front among the prisoners which he gathered by listening to foreign Wstations. He was aware that the prisoners waited for the right opportunity to riot and promised them help. In November 1943 he was discovered storing guns, ammunition and maps. N. was sentenced to death by the people's court on 19 September 1944. Resistance begin: May 1943; Resistance end: November 1943.

**Hans L.**, a secondary school teacher in Hamburg criticized the biased reporting of the German media in front of his students. The father of one of his students (a lieutenant in the German air force) reported him to the authorities for making defeatist statements between August and December 1943. The following statements were reported: "It's all nonsense what is reported in the news. I don't believe any of it." "Back when the Brits retreated it was a sign of defeat on their part. Now that Germany did it, it is called a victory." and "One thing is clear: Someone will win this war. The question is, who." Moreover, L. tried to persuade his students to quit the Hitler Youth. On 26 July 1944 the people's court sentenced him to four years in prison, where he died of poor health in February 1945.

The vicar **Walter H.** ran a circle dedicated to religious education in Hamburg which Carl G. (mechanic), Ludwig S.-G. (chapelmeister), Richard H. (clerk), Dietrich H. (teacher and corporal) and Werner W. (carpenter) were members of. H. was already known to the police: He received a warning in 1942 for sending religious pamphlets to soldiers at the Front. The focus of the meetings was religious and political matters, especially the amorality of the Hitler

regime. At one such meeting in June 1944 S.-G. disclosed his disgust at the random attacks on London citizens which in his opinion were the work of the Anti-Christ and a sign that the Last Judgment has come. In the wake of the Stauffenberg-assassination attempt H. commented on the failure as follows: "Who knows what plans God made for Hitler. Maybe, He doesn't want his death to be that pleasant.", while mimicking a dreadful pain. H. further explained that under the given circumstances an attack on the Fuhrer was justifiable before God. The circle members got arrested in October 1944.

**Karl Z.** (locksmith and caretaker) and **Emma H.** (accountant) were members in the communist group "Anti-Nazi German Popular Front (ADV)"[8]. Alongside other members, they produced a total of twelve leaflets and two editions of the newspaper "The Alarm Clock." Foremost, they advocated for an end to the war and the fascist regime. In summer of 1943 the ADV started cooperating with the "Brotherly Union of Prisoners of War (BSW)."[9] The ADV provided members of the BSW with accommodations, food supplies, fake documents and weapons. The BSW consisted of escaped Soviet prisoners and former Red Armey soldiers. Their prerogative was to destabilize Germany from the inside and to be ready to take up arms in case of riots or the approach of the Soviet Army. Shortly after the BSW was discovered by the Gestapo in late 1943, the majority of ADV members were arrested as well. Z. was the only detained member to survive the war due to pleading insanity. The rest of the ADV was sentenced to death by the people's court in winter of 1944.

**Rudolf W.** (driver) sheltered Erich V. in October 1944, knowing that the latter was a sought member of a communist organization that planned the violent overthrow of the fascist government. V. put W. in touch with other communist in Stettin and managed to recruit him for the cause. Since then W. took part in meetings where the attendees listened to foreign radio stations, talked about politics, discussed means to secure weapons and made fail-safe plans in case they were found out. In November W. fled his home after V. alerted him of the Gestapo's investigation into one of their acquaintances. Later, he was arrested by the police. He was sentenced to death by the people's court on 9 February 1945.

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[8] Antinazistische Deutsche Volksfront (ADV).
[9] Bratskoje Sotrudnitschetswo Wojennoplennych, BSW.

## APPENDIX F: RADIO LISTENERS IN GERMANY

**Figure F.4: Numbers of radio subscriptions in Germany (approximate number of radio receivers) and the introduction of people's receiver.**

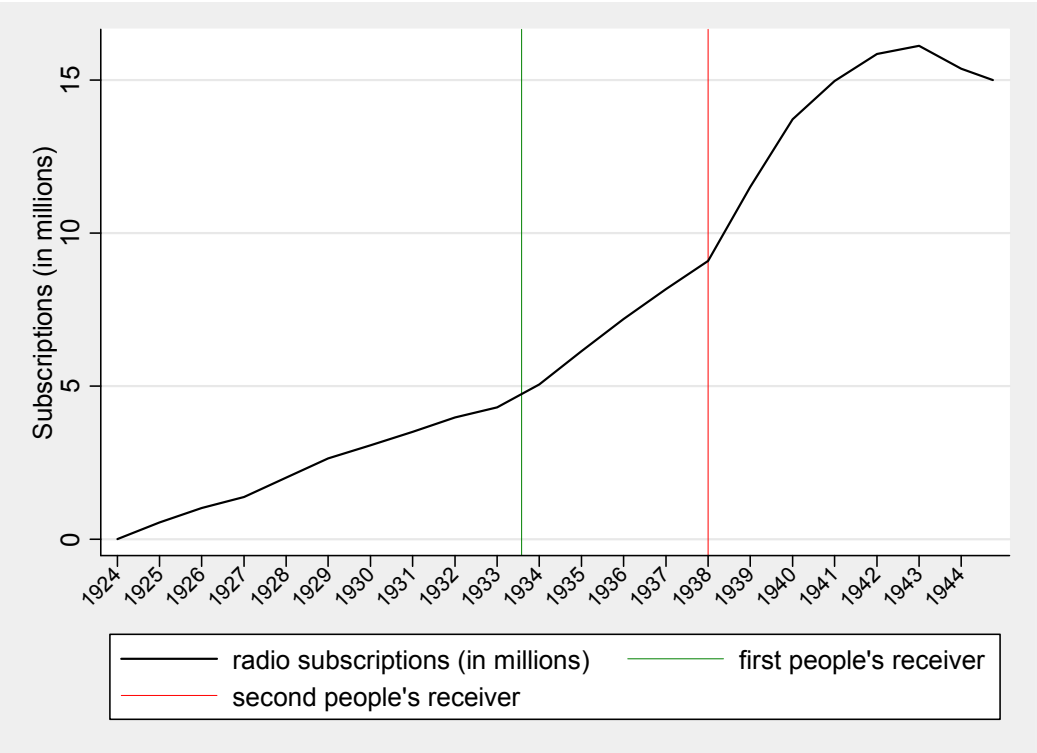


**Table F.1. BBC German Service Broadcast Example Programme**

| GMT | |
|---|---|
| 0400-0500 | Workers' Programme |
| 0900-0915 | News |
| 1200-1230 | Miscellaneous |
| 1300-1315 | Miscellaneous |
| 1400-1415 | Aus der Freien Welt |
| 1600-1615 | Forces' Programme |
| 1745-1800 | Seamen's Programme |
| 1800-1830 | News and Commentary |
| 2000-2020 | News and Talks |
| 2100-2115 | Austrian Programme |
| 0000-0015 | News |

Notes: Example: The Daily Schedule of the German Broadcasts in 1942; source: Briggs 1970, p. 430

**Radio Listening – Anecdotal Evidence**

*(wherever the German text precedes,*
*author's translation follows)*

To strengthen his broadcasting monopoly, Joseph Goebbels authorized the production of an inexpensive radio set, the "Volksempfänger" ("People's Set"), which could tune in to regional stations via medium wave, and the national station, Deutschlandsender (Radio Germany), via long wave but which prevented listeners from receiving the short-wave transmissions issued by foreign broadcasters.

Vike Martina Plock (2020)

Mann also reminded Sherwood that she was "too familiar with the situation in Germany and German-occupied countries, as not to realize the futility of the short-wave enterprise" for which she had been commissioned to write. There "exist only five groups of people who possess short wave receivers" in Germany, she stated, a fact she had "repeatedly pointed out" (Mann to Sherwood, 1). These are "Nazi officials, big industrialists, air-men, navy-men, and radio-professionals," and for that reason it seems "a hopeless enterprise" "to write short-wave-propaganda for the German middle classes" or "talk . . . to Germany's women via short-wave" as these listeners owned the specially designed "Volksempfänger" ("People's Set"), which could not receive programs on short-wave frequencies (1–2). To "devote one's time and strength to the making of 'propaganda' which cannot be heard," Mann concluded, "is sadder than to write poetry exclusively for one's own drawers" (2).

Vike Martina Plock (2020)

Only the longer short-wave bands could be used effectively for transmission over relatively short distances and only a minority of listeners in Europe had short-wave receivers.

Pawley (1972) p.253

The NSDAP rulers' fear of the subversive effect of enemy propaganda and their low confidence in their self-assertion can be seen from their commitment to interfere foreign broadcasting with technical measures. All radios were sold without receiver for short waves, which disabled to receive 95% of all foreign radio. For the People's receiver VE301 and of the German small

receiver these technical constraints were already considered in their development and production from 1933 to 1935. These cheap devices were produced without a short wave receiver. The others who were under suspicion of a shortwave receiver were monitored (Putter, 1978, p.127). Thereby radio dealers should report people to the Gestapo, who buy such parts.

Wittek (1962) p.39

BBC foreign services in German was broadcasted using short, middle and long waves. However, Volksempfänger and Kleinempfänger (the later version of the popular radio) owned by the most of the population was technically not able to receive short wave broadcasting. The few individuals owning older and more expensive receivers allowing reception of short waves were under observation and those who purchased replacement parts to build such powerful receiver were to be reported to Gestapo.

Weidenhaupt (2001) p.56

The first black stations had been ostensibly run by secret resistance groups inside the countries at which they were directed. Anyone with an apparatus to locate the source of radio signals could quickly unmask the pretence but few of the intended audience were so equipped - even supposing that they had the short-wave sets needed to receive the programmes at all.

Balfour (1979) p.97

So great has become the influence of the BBC that the Germans gave orders that all sets in

the large towns of the ' Protectorate' of Bohemia and Moravia must be brought in so that they might be made incapable of receiving short waves.

BBC (1944) p.77

BBC was the first broadcasting service and remained the only one for a long time, sending on medium wave and receivable anywhere in Germany.

Dussel (1999) p. 107

Wie groß bei den nationalsozialistischen Machthabern die Furcht vor der zersetzenden Wirkung ausländischer Rundfunkpropaganda war und wie wenig sie auf die Durchsetzungs- und Überzeugungskraft ihrer eigenen Gesetze vertrauten, zeigt die Tatsache, daß sie den Empfang ausländischer Sendungen auch technisch zu verhindern suchten. Schon die Entwicklung und die Produktion des Volksempfängers VE 301 186 und des Deutschen Kleinempfängers in den Jahren 1933 bzw. 1935 standen unter dieser Maßgabe. Bei diesen beiden Billiggeräten fehlte ein Empfangsteil für Kurzwellen, auf denen rund 95 Prozent der ausländischen Sendungen ausgestrahlt wurden.

Weidenhaupt (2001) p.56

How much the national socialist authorities feared the subvertive power of foreign broadcasting propaganda and how little trust they had in their own laws can be seen by their attempts to physically prevent the radio reception of foreign programs. Even the development and production of the Volksempfänger VE 301 186 and the Kleinempfänger in the years 1933 and 1935 was structured accordingly. Both low-priced devices were lacking a receiver capable to receive short-waves on which around 95 percent of the foreign programs were transmitted.

Weidenhaupt (2001) p.56

Großbritannien reagierte auf die deutschen Abschottungsbemühungen mit verschiedenen Gegenmaßnahmen. Hatte man bei Ausbruch des Krieges den Kurzwellenbereich wegen seiner hohen Reichweite und seines geringeren atmosphärischen Schwundes favorisiert und dem Europa-Dienst der BBC lediglich einen einzigen Mittelwellensender zugestanden, so installierte man im Verlauf des Krieges angesichts der fehlenden Kurzwellenteile in einem Großteil der deutschen Radios vermehrt, Mittel- und Langwellensendeanlagen.

Weidenhaupt (2001) p.56

Great Britain reacted to the German isolation attempts with various countermeasures. At the beginning of the war short-waves were favored because of the high range and low atmospheric losses and the BBC was equipped with only one medium wave transmitter. But because most German radios were lacking short-wave receivers it was decided to install additional medium-wave and long-wave transmitters during the ongoing war.

Weidenhaupt (2001) p.56

lm Jahr 1943 verfügte der Europa-Dienst bereits neben 24 Kurzwellensendern über drei Mittelwellen- und einen Langwellensender. Die über Mittelwellen ausgestrahlten deutschsprachigen Sendungen der BBC waren lange Zeit die einzigen Sendungen, die von den leistungsschwachen Geräten in den deutschen Haushalten überhaupt empfangen werden konnten.

Weidenhaupt (2001) p.56-57

In 1943 the Europa-Dienst already had three medium-wave and one long-wave transmitters besides its 24 short-wave transmitters. The medium-wave transmitted German broadcasts of the BBC were for a long time the only programs that could be received by German households at all.

Weidenhaupt (2001) p.56-57

Den Höhepunkt bildete das Jahr 1943 mit wöchentlich mehr als 34 Stunden, die vor allem über Kurzwelle, abends und nachts aber auch mit Hilfe starker Mittel- und Langwellensender nach Deutschland gesendet wurden. Die Verwendung von größeren Wellenlängen sollte auch den vielen Deutschen, die über kein zum Kurzwellenempfang geeignetes Radiogerät verfügten, das Hören des Deutschen Dienstes ermöglichen.

Kaufmann (2013) p.42

The high point was reached in 1943 when over 34 hours of weekly broadcast was transmitted to Germany mainly via short-wave and at night via strong medium-wave and long-wave transmitters. Longer wavelengths were intended to facilitate listening to the German Service by the many Germans who didn't possess a radio that was capable to receive short-waves.

Kaufmann (2013) p.42

Die individuelle Einstellmöglichkeit der Rundfunkempfänger sollte dem Zwangsempfang weichen. […] Zusätzlich wurde die Möglichkeit erörtert, neue Geräte grundsätzlich ohne Kurzwellenteil zu produzieren und in bereits vorhandenen die Kurzwellenteile stillzulegen oder auszubauen.

Klinger (1983) p.227

The individual setting possibility had to move for compulsory reception. Furthermore it was discussed to always produce the new devices without a short-wave receiver and to shut down or remove the short-wave receivers of the already existing radios.

Klinger (1983) p.227

Rund 95 Prozent dieser Programme und Sender wurden über Kurzwelle ausgestrahlt. Nun verfügte aber der "Deutsche Volksempfänger" vom Typ VE 301 GW, das in Deutschland am weitesten verbreitete Empfangsgerat, nur über einen Mittel- und Langwellenteil.

Pütter (1978) p.127

About 95 percent of the programs and channels were transmitted via short-waves. But the "Deutsche Volksempfänger" VE 301 GW which was the most widespread receiver in Germany did only have a medium-wave and long-wave device.

Pütter (1978) p.127

Da die Mehrzahl der Auslandssender ihre Programme über Kurzwellenfrequenzen ausstrahlte, für die das am meisten verbreitete Rundfunkgerät, der Volksempfänger, gar keinen Empfangsteil besaß, war der potentielle Hörerkreis von vornherein eingeschränkt.

Pütter (1986) p.11

Because most of the foreign channels transmitted their programs via short-waves for which the most widespread radios didn't have a suitable receiving device the potential audience was limited from the start.

Pütter (1986) p.11

Die deutschsprachigen Sendungen der BBC waren die ersten und lange Zeit über auch die einzigen Sendungen für das Reich, die über Mittelwelle ausgestrahlt wurden und leistungsstark genug waren, um den berühmten "Mann auf der Straße" überhaupt zu erreichen.

Pütter (1978) p.127

The German broadcast of the BBC was the first and for a long time the only program for the Reich which could be transmitted via medium-wave and which was strong enough to reach the famous "man in the street" in the first place.

Pütter (1978) p.127

Short-wave receivers were not very popular already before the Nazis came to power:

Die Fabrikation von Kurzwellengeräten, die z. B. in den Vereinigten Staaten von Amerika für den Inlandsmarkt und den Export (namentlich nach tropischen Gebieten) eine größere Rolle spielt, scheint in Deutschland nicht rentabel zu sein; denn <u>ausgesprochene Kurzwellenempfänger wurden in der vergangenen Saison, von wenigen Ausnahmen abgesehen, nicht hergestellt.</u>

Institut für Konjunkturforschung (1933) p.17-18

The production of short-wave devices which for example was very important for the United States of America in respect to its domestic market and export (namely to tropical regions) seems to be uneconomical in Germany; that is because real short-wave receivers were—apart from a few exceptions—not produced in the last season.

Institut für Konjunkturforschung (1933) p.17-18

Ohne Zusatzgeräte konnten mit dem Volksempfänger nur nahe gelegene deutsche Sender empfangen werden, das Hören ausländischer Rundfunkprogramme, die über Kurzwelle gesendet wurden, war nicht möglich.

Benz (2008) p.50-51

Without additional devices the Volksempfänger was only able to receive nearby German channels, the listening to foreign radio channels which were transmitted via short-waves was not possible.

Benz (2008) p.50-51

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## APPENDIX G: DETAILED DATA SOURCES

*High treason court cases:*

1943-1945: Widerstand als "Hochverrat" 1933 - 1945 / hrsg. vom Institut für Zeitgeschichte, München

*Data on BBC transmitters:*

Martin Watkins' AMFREQS Spreadsheet: http://www.mds975.co.uk/Content/AMFREQS.zip (retrieved on 7. Nov 2016)

*Data on listeners in Germany:*

1 April 1940: Schaefer, Horst, Rundfunk Archiv. Rundfunk und Fernsehen in Wissenschaft und Praxis, Jan. 1941, vol 1, R. v. Decker's Verlag, p.71-77. („Die Verbreitung des Rundfunks im Deutschen Reich in den kleineren Verwaltungsbezirken am 1. April 1940")

1 April 1939: Schaefer, Horst, Rundfunk Archiv. Rundfunk und Fernsehen in Wissenschaft und Praxis, Jan. 1940, vol. 13, R. v. Decker's Verlag, p.71-77. („Die Verbreitung des Rundfunks im Deutschen Reich in den kleineren Verwaltungsbezirken am 1. April 1939")

*Data on bombing:*

Davis¸ Richard G., Bombing the European Axis Powers: A Historical Digest Of The Combined Bomber Offensive, 1939-1945 Maxwell Air Force Base, Ala: Air University Press. 2006 (with CD-ROM)

*Other district level data:*

Data compiled by Adena et al. (2015), see data description in the original article.

*Data on transmitters in Germany including jamming transmitters:*

1944: Möller, Bernd-Andreas (2009) Handbuch der Funksende- und empfangsstellen der Deutschen Reichspost. Funk-Verlag Hein.

*Data on weather:*

We received weather station data on daily cloud density, rain and wind strength in 1943-1945 from Kachelmann GmbH, kachelmannwetter.com. There were 146 weather stations but not all are active thorough the complete period under study. We use a spherical variogram for the interpolation (for implementation see: https://cran.r-project.org/web/packages/gstat/) and a grid with 50.000 cells. Cloud density, rain and wind strength are interpolated for a set of places that consists of all cities over 20,000 plus other places being bombed plus places of resistance (place of living or resistance act). For small places localized next to each other (or next to a larger city), a rule of thumb of 5 km (straight line) is used to merge them together (or to a larger city). For example Rheinhausen, Rheinhausen/Krupps, Duisburg/Rheinhausen,

Friemersheim, Ruhrort, Meiderich are all merged with Duisburg. Places outside of German empire boundaries (https://web.archive.org/web/20170709100924/http://censusmosaic.org/data/historical-gis-files based on: MPIDR [Max Planck Institute for Demographic Research] and CGG [Chair for Geodesy and Geoinformatics, University of Rostock] 2011: MPIDR Population History GIS Collection (partly based on Hubatsch and Klein 1975 ff.)—Rostock; Hubatsch, W. and T. Klein (eds.) 1975 ff.: Grundriß der deutschen Verwaltungsgeschichte—Marburg.) are dropped (especially relevant for the resistance sample). Also places outside of 120 km around the weather stations are dropped for reasons of reliability of the interpolation.

*Berlin damage maps:*

"Blue Book" (March 1945) from Imperial War Museum. Note that the data is pre-Red Army invasion and destruction thus reflects bombing damage. This is in contrast with the map from the Agency for Cartography of Berlin in 1945 ("Gebäudeschäden im Gebiet der Stadt Berlin, Stand 1945, Topographische Karte 1:25000," Herausgeber: Hauptamt für Vermessung der Stadt Berlin).

*Moral Division Survey:*

Data is from the USSBS. The individual returns were located in the National Archives in Washington and digitized.

## APPENDIX H: EFFECTIVE COMBAT RANGE

Actual combat conditions in WW II differed significantly from those for which the B-17 had been designed, the USAAF had expected, and manufacturers had incorporated in their design. We use the declassified design specification of the B-17, which gives the plane's range and combat radius as a function of bomb load, height flown, and speed (Boeing 1949). Because of the strength of German fighter attacks and flack, the entire journey from crossing the Dutch coast to the German target would normally be flown at altitude, while the manufacturer had only expected a climb 30 minutes prior to the bomb run. Also, combat flying was markedly faster than expected. Operational data from the USAAF shows that B-17s flew both high and fast. They also required significant time to form up: bomber formations were often so large that the first planes had reached their targets inside in Germany when the last planes were just crossing the Dutch coast. Accounting for the effect of these factors on combat radius is not an exact science.

We use the manufacturer's model calculations for combat radius with the following assumptions: Boeing's model gives ranges by bomb load and airspeed. We use this table but modify it in two ways. The model calculations in the manufacturer's specification sheet give an average range on a basic mission of 873 nautical miles, or 1,617 km. With high altitude, this drops to 788 nm, and with high speed, to 595 nm. Since both were used, we calculate effective range as the product of range ratios, 0.9 and 0.68, respectively, giving 0.62*873 nm, which implies 537 nm (995 km). From this we deduct 10 km for the forming up over England (only on the way out), giving an effective combat range of 985 km.

We illustrate the calculation with the following example. The USAAF 8$^{th}$ manual on tactical development gives the example of an attack on Berlin. The bombers based in St. Neots, UK, first flew to Watton, Norfolk, then from Watton to Cromer, where they formed up for the attack on Berlin. Instead of the straight-line distance to Berlin of 928 km, they had to fly 952 km on the way out, adding 24 km to the distance travelled, or 12 km of combat radius. Since St. Neots is somewhat further West than the majority of East Anglia airfields, we settled on an average adjustment of 10km.

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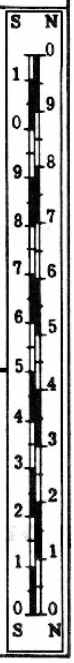
## Loading and Performance - Typical Mission

| CONDITIONS | | | BASIC RADIUS I | BASIC RANGE II | MAX. BOMB RADIUS III | HIGH SPEED RADIUS IV | HIGH ALT. RADIUS V | FERRY RANGE VI |
|---|---|---|---|---|---|---|---|---|
| TAKE-OFF WEIGHT | | (lb) | 67,860 | 67,860 | 67,864 | 67,860 | 67,860 | 64,975 |
| Fuel & Oil | | (gal) | 2570/148 | 2570/148 | 2104/148 | 2570/148 | 2570/148 | 3600/148 |
| Military Load | | (lb) | 10,000 | 10,000 | 12,800 | 10,000 | 10,000 | None |
| Total Ammunition | | (rds/cal) | 5970/.50 | 5970/.50 | 5970/.50 | 5970/.50 | 5970/.50 | 5970/.50 |
| Wing Loading | | (lb/sq ft) | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 45.7 |
| Take-off Power Loading | ① | (lb/bhp) | 14.1 | 14.1 | 14.1 | 14.1 | 14.1 | 13.5 |
| Stall Speed-(power off) | | (kn) | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 87.5 |
| TAKE-OFF DISTANCE SL | ④ | | | | | | | |
| Ground Run (no wind) | | (ft) | 3780 | 3780 | 3780 | 3780 | 3780 | 3350 |
| To Clear 50 ft Obst | | (ft) | 4925 | 4925 | 4925 | 4925 | 4925 | 4400 |
| CLIMB FROM SL | | | | | | | | |
| Rate of Climb at SL | ③ | (fpm) | 630 | 630 | 630 | 630 | 630 | 700 |
| Time To 10,000 Feet | ③ | (min) | 17.0 | 17.0 | 17.0 | 17.0 | 17.0 | 15.4 |
| Time To 25,000 Feet | ③ | (min) | 61.0 | 61.0 | 61.0 | 61.0 | 61.0 | 49.0 |
| Service Ceiling (100 f.p.m.) | ③ | (ft) | 28,250 | 28,250 | 28,250 | 28,250 | 28,250 | 29,900 |
| COMBAT RANGE or RADIUS | | (n.mi) | 873 | 1529 | 689 | 595 | 788 | 2624 |
| Avg. Cruising Speed | | (kn) | 171 | 156 | 172 | 214 | 182 | 154 |
| Total Mission Time | | (hr) | 10.45 | 9.97 | 8.25 | 5.81 | 8.88 | 17.21 |
| Cruising Altitude | | (ft) | 10,000 | 10,000 | 10,000 | 10,000 | 25,000 | 10,000 |
| COMBAT WEIGHT | | (lb) | 48,692 | 43,982 | 47,384 | 49,586 | 48,140 | 45,535 |
| Combat Altitude | | (ft) | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 | 10,000 |
| SPEED | | | | | | | | |
| Max Speed (combat alt) | ② | (kn) | 278 | 280 | 278 | 277 | 278 | 239 |
| Max Speed At 26,700 Ft | ② | (kn) | 282 | 285 | 283 | 282 | 282 | 284 |
| CLIMB | | | | | | | | |
| Rate of Climb (combat alt) | ② | (fpm) | 1250 | 1515 | 1320 | 1210 | 1280 | 1930 |
| Rate of Climb at SL | ② | (fpm) | 1870 | 2140 | 1940 | 1820 | 1895 | 2045 |
| CEILING | | | | | | | | |
| Combat Ceiling | ② | (ft) | 33,500 | 35,200 | 34,000 | 33,200 | 33,700 | 34,700 |
| Service Ceiling | ② | (ft) | 36,950 | 38,450 | 37,400 | 36,650 | 37,150 | 38,000 |
| Service Ceiling | ③ | (ft) | 36,450 | 37,650 | 36,800 | 36,200 | 36,600 | 37,300 |
| LANDING WEIGHT SL | | (lb) | 43,214 | 43,982 | 43,070 | 43,214 | 43,214 | 45,535 |
| Ground Roll | ④ | (ft) | 1265 | 1275 | 1250 | 1265 | 1265 | 1290 |
| From 50' Obst. | ④ | (ft) | 2710 | 2740 | 2700 | 2740 | 2740 | 2770 |




NOTES
① Take-off power
② Max power
③ Normal power
④ Take-off and landing distances are obtainable at sea level using normal technique. For airport planning add 25% to distances shown.
⑤ Detailed descriptions of the RADIUS & RANGE missions are given on page 6.

CONDITIONS:
(a) Performance basis: NACA standard conditions, no wind, single airplane
(b) Fuel consumption used in computing RADIUS & RANGE is based on flight test data increased 5%.
(c) Performance based on powers listed on page 6.

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Figure F.2: Wing and division assembly, 8th USAAF

Source: Boeing (1949)

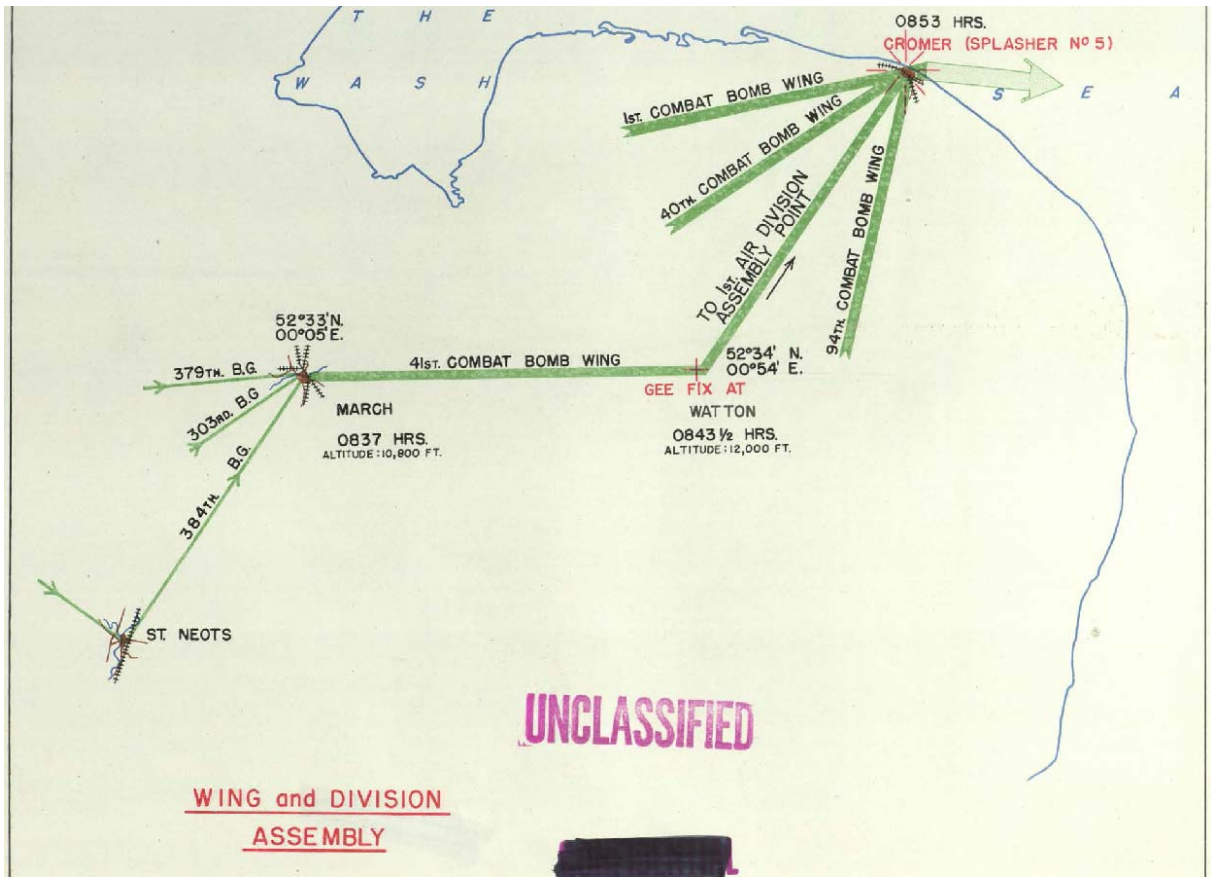


Figure F.2: Wing and division assembly, 8th USAAF

**Source**: USAAF (1945).

**References:**

USAAF (1945), *8th USAAF-Tactical Development: August 1942-May 1945*, Washington 1945.

Boeing (1949), *Standard Aircraft Characteristics*, Washington 1949.