

Does Public Broadcasting Increase Voter Turnout? Evidence from the roll out of BBC Radio in the 1920s*

Accepted at Electoral Studies

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September 2021

Abstract

There is reason to believe that exposure to public broadcasting can positively affect voter turnout, but these effects are hard to empirically disaggregate. This paper examines the geographically delimited roll out of BBC radio in England, which coincided with successive off-cycle general elections in the 1920s. Combining spatially interpolated census data with constituency-level electoral returns, a matched difference-in-differences design finds that turnout increases with radio exposure. This finding is supported by qualitative examination of the roll out alongside a range of robustness checks. The study makes a contribution to the literature on media and voting behaviour, while enhancing our understanding of how the BBC shapes electoral behaviour in Britain.

*I am deeply grateful to Nelson Ruiz, David Rueda, Felicia Rankl, James Maxia, seminar attendants at the University of Gothenburg and IPSA World Congress, and three anonymous peer reviewers. All offered invaluable comments and advice which profoundly improved the paper. This research was supported a Grand Union DTP-ESRC Studentship at the University of Oxford, and an LSE Studentship at the London School of Economics.

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Introduction

The British Broadcasting Corporation, or BBC, is the oldest and most trusted public broadcaster in the world (Ipsos Mori 2011). A hundred years since inception, its content continues to be consumed by millions, with its organisational structure and ethos providing a model for state-funded media outlets globally. Domestically, the BBC's public funding is often justified on the grounds that it maintains an informed British electorate, participating in the political process and capable of effectively holding governments to account (Hajkowski 2013). Despite this normative significance, however, the effects of the BBC on British electorates have been largely neglected by political scientists. This paper fills the gap by asking a simple but important empirical question: did the creation of BBC radio increase voter turnout in British general elections? The analysis leverages the gradual roll out of radio transmitters in the 1920s, finding a robust positive effect across several off-cycle general elections.

Despite its contextual focus, the paper taps into broader debates about how media exposure affects voters. While challenging to causally identify, scholars have used a range of methods to demonstrate the mechanisms by which the media can shape politics. We know that media exposure of varying forms can make voters respond to incumbent performance, reframe social identities and incentivise targeted spending by governments (Prat and Strömberg 2013). We also know that exposure to public broadcasting correlates with higher political knowledge and engagement (Baek 2009; Curran et al. 2009; Soroka et al. 2013; Sørensen 2019), but that the advent of private media is often associated with a detachment from politics (Iyengar 1990; Gentzkow 2006). While the paper is substantively focused on Britain in the 1920s, it has implications that travel to the present day, where the value of public broadcasters is often questioned and where scholars grapple with the political effects of rising internet and social media use (Diamond 2010; Miner 2015; Lelkes, Sood, and Iyengar 2017; Campante, Durante, and Sobbrío 2018; Gavazza, Nardotto, and Valletti 2019).

The early roll out of BBC radio offers unique empirical insight into the effects of public broadcasting in an otherwise low-informational environment. In the space of just three years, 70% of the British population were within range of a BBC radio transmitter, exposing them to impartial news about politics while priming a civic conception of national identity (Hajkowski 2013). Many early radio programmes were relayed from London, such that voters across the country were listening to similar content, irrespective of location (Pepler 1988; Briggs 1995). These years coincided with successive off-cycle general elections, with plebiscites in 1922, 1923 and 1924 (Wrigley 2007; Bentley 2007). Since different parts of the country received transmitters at different times, these elections cross-cut different stages of the national roll out. However, qualitative evidence of the allocation process suggests that this differential timing was based on technical, and not political, considerations (Pawley 1972; Briggs 1995). The effects of radio exposure on political behaviour can hence sidestep concerns of endogeneity that permeate many existing studies of media effects.

This particular coming together of historical circumstance sets the stage for a difference-in-difference design, which finds that voter turnout increases by around 2% per year in areas exposed to BBC radio. The results hold when electoral constituencies are matched on a range of demographic observables, taken from the 1921 census. They are robust to multiple

operationalisations of exposure, simulation-based measures of uncertainty and adjustments for spatial autocorrelation in the data. Overall, the analysis shows that public broadcasting made the British electorate more engaged with the political process at a time of great national flux. The paper lends empirical weight to the importance of the BBC in British political life, whilst contributing to the broader literature on the media, public broadcasting, and voting behaviour. The paper now turns to situating the BBC within this literature, offering a comparative framework through which to understand the electoral behaviour of British voters in days gone by.

Media Exposure and Voting in Comparative Perspective

Does the Media Matter?

A voluminous literature in comparative politics has examined how media exposure shapes voting behaviour. Scholars have used a wide range of empirical techniques to show that exposure to various forms of media can shape electoral outcomes. At an abstract level, we can think of media effects as *directly* influencing voters' behaviour in elections, or *indirectly* affecting the strategies deployed by elites on the supply side of politics (Besley and Burgess 2002; Snyder and Strömberg 2010). In looking at voter turnout, a key measure of political participation in democracies, this paper is concerned with direct effects of media exposure on voting behaviour. The behaviour of elites is taken as somewhat exogenously given.

Many mechanisms have been theorised to account for the effects of media exposure. For this paper, two are of particular significance. The first is the notion that the media matters because of its capacity to convey *information*. By accurately informing voters about policy performance (Ferraz and Finan 2008; Snyder and Strömberg 2010) or the logistics of election day (Gerber, Karlan, and Bergan 2009; Aker, Collier, and Vicente 2017), voters become more responsive to the behaviour of politicians (Prat and Strömberg 2013), in keeping with seminal models of democratic accountability (Przeworski et al. 2000). These arguments depend on the *type* of information to which voters are exposed, which itself varies across different forms of media. For instance, Gentzkow (2006) shows that the advent of private television networks in the US decreased voter turnout, since they promoted entertainment-oriented content and crowded out local newspapers, which spent more time on politics. Olken (2009) makes a related argument, showing that the spread of television in Indonesian villages promotes exposure to entertainment-based programmes and reduces the time spent on social interaction, which in turn disengages citizens from the political process. Nonetheless, a key feature of the BBC and public broadcasters generally is the promotion of impartial news about politics (Briggs 1995). This suggests that exposure should not follow a path of disengagement, a point to which I will return.

The second significant way in which media exposure affects voting is through its interaction with social and political identities. While heightened partisanship or salient in-out group dynamics can bias the way in which political information is processed (Flynn, Nyhan, and Reifler 2017), the construction and maintenance of such groups are themselves shaped by the media. Be it racial attitudes in the United States (Kellstedt 2000), inter-ethnic animosity in

Croatia (DellaVigna et al. 2014), pro-Russia sentiment in Ukraine (Peisakhin and Rozenas 2018) or nationalism in the aftermath of Mali’s military coup (Bleck and Michelitch 2017), scholars have shown that the media has important effects on the creation, salience and continuation of social identities over time. Public broadcasters are an institution of the state, tasked with explicitly constructing a unified sense of nationhood that generally emphasises an inclusive and civic sense of national identity (Hajkowski 2013). This opens up a sociological mechanism by which public broadcast exposure can shape voters’ engagement with the political process.

Irrespective of mechanism, susceptibility to self-selection and external validity constraints make media exposure inherently difficult to measure. Many existing studies deploy individual-level survey data to examine effects, making it unclear whether exposure is merely a function of unobserved characteristics of the exposed (Prat and Strömberg 2013; Guess et al. 2019). For scholars that analyse the media through an “effects of causes” framework (Mahoney and Goertz 2006), one solution is to bring exposure under the control of the researcher, through experiments in the field (Gerber, Karlan, and Bergan 2009; Conroy-Krutz and Moehler 2015), lab (Iyengar and Kinder 1987; Levendusky 2013) or in surveys (Goodwin, Hix, and Pickup 2020; Damstra, Boukes, and Vliegenthart 2021). However the implications of these studies only travel so far. When we speak of media effects we want to generalise to real voters and to larger populations of electorates, but manipulated exposure in experimental designs cannot fully mimic dynamics seen in the real world (Gerber and Green 2012; Prat and Strömberg 2013).

To overcome these constraints, scholars have increasingly turned to roll outs of new media technologies, offering a way to exogenise exposure that is realistic and externally valid (Gentzkow 2006; Schroeder and Stone 2015; Lelkes, Sood, and Iyengar 2017; Campante, Durante, and Sobbrío 2018). By looking at electoral events that cross cut different phases of a roll out, we can reasonably estimate the causal effect of exposure on voting behaviour. For instance, Strömberg (2004) leverages the roll out of radio in the US to find positive effects on voter turnout and New Deal social spending, while DellaVigna and Kaplan (2007) employ the gradual entry of Fox News to understand how biased media shapes support for the Republican Party. In a very different context, Adena et al. (2015) use increasing radio coverage in Germany to analyse variation in support for the Nazis, echoing studies like Miner (2015), which show how the introduction of free media can undermine authoritarian regimes.¹

On balance, then, it is clear that the media plays a role in explaining variation in voting behaviour over time. Yet the media is not homogeneous, and instead represents a diverse range of actors with distinct preferences. Public broadcasters are one particular type of media, which we expect to have particular effects on political engagement. As a paradigmatic public broadcaster, we must examine these effects if we are to rigorously theorise the role played by BBC radio.

¹Again, though, this depends on the particular information conveyed. Kern and Hainmueller (2017), for instance, show that cross-border exposure to West German television actually *increased* regime support in East Germany due to the entertainment-oriented, non political nature of content.

Public Broadcasting and Voter Turnout

While the media has general effects on voters across a variety of settings, public broadcasters are generally expected to increase engagement with politics. This can be explained by the tendency of such broadcasters to prioritise impartiality, and to promote content aimed at constructing a civic sense of national identity.

Firstly, public broadcasters are tasked with offering voters impartial information about the political process (Kropf and Knack 2003). In theory, this gives voters knowledge of political parties and their candidates, what they believe in and what their pledges are. It also provides information about how candidates have performed in office alongside useful procedural items, such as how to register to vote. Given their perceived impartiality and credibility, public broadcasters are often significantly more trusted than their private counterparts (Soroka et al. 2013), indicating that the information they convey carries more weight among voters. Survey data also reveals that consumers of public broadcast media tend to have higher levels of political knowledge, perhaps reflecting the lack of bias in the content to which they are being exposed (Curran et al. 2009; Soroka et al. 2013). This informational story can be applied to the BBC in the 1920s. Daily news programmes regularly discussed political events and put impartial information, such as unemployment figures, into the public domain for the first time in British history (Thorpe 1997). While newspapers moved toward an entertainment focused model, the BBC invited politicians to speak on the radio, particularly around election time (Koss 1981). By making politics more accessible to voters and offering information that may raise the perceived costs of electoral abstention (Aytaç and Stokes 2019), we might expect exposure to public broadcasting generally, and to BBC radio specifically, to increase political engagement. In general election settings, this is reflected in higher levels of voter turnout.

Secondly, delivering content designed to construct and maintain a civic national identity is a core feature of public broadcasting, which in turn primes one's duty to vote. This taps into seminal arguments about the sociological determinants of political participation, which posit that the likelihood of turning out increases as voting becomes seen as a civic duty (Blais 2006) that is embedded and enforced by social networks (Campbell 2013). Historians have discussed the civic aims of the early BBC at length, with radio programmes crafted to bring together a fractured and newly enfranchised post-war electorate in a country seeing its global influence diminish rapidly (Wrigley 2007; Hajkowski 2013). Indeed, archival records show that the BBC's foundational mandate was to explicitly construct a "unified national culture" in Britain (Marr 2011). As a result, BBC radio in the 1920s slots into both informational and sociological mechanisms of media effects, such that we should expect exposure to be associated with higher levels of voter turnout.

Challenges and Unanswered Questions

Despite the existing literature showing us that the media exposure matters, and that public broadcasting should increase political engagement, there remain three key challenges to address. Studies that exogenise exposure to public broadcasting (as opposed to other forms of media) remain rare, many existing research designs don't go far enough in ensuring that media content stays constant over time and space, and the BBC itself remains understudied

by political scientists.

Firstly, while many studies causally identify media exposure in general, few focus on public broadcasting specifically. While many studies use observational data to show that voters exposed to public broadcast media are better informed and more likely to participate in politics, these rarely yield *causal* interpretation (Soroka et al. 2013). We cannot be sure that exposure is independent to politically relevant potential outcomes, and cannot rule out the possibility that better informed voters simply self-select into public broadcast exposure. While this is a general concern about the study of media effects on electoral behaviour, it remains one that is especially pertinent for scholars of public broadcasting.

Secondly, even where exposure can be credibly exogenised, the content to which people are exposed might vary and confound outcomes. Over long periods of time public broadcasters gradually change the nature of their content, such that voters are exposed to different material that may or may not speak to informational and sociological mechanisms of political participation. For instance, Sørensen (2019) studies the roll out of state television in Norway over forty years, showing it to exhibit an informational function that increases voter turnout. Yet the general political climate of Norway - the relevant thing being reported by state television - shifted dramatically across the period of study. In contrast, the introduction of BBC radio took just three years, a timespan short enough that neither content nor society at large could change significantly.

There is a similar problem if people in one part of a country receive different content to those in others. For example, Strömberg (2004) analyses the effect of local radio transmissions about New Deal spending across US states in the 1930s.² Yet local radio stations varied enormously in terms of the content they transmitted, with each operating in US states with their own distinct political dynamics. This raises questions about whether exposure is truly constant and can be meaningfully compared across observations. In the case of 1920s Britain this is not too much of a concern, as subnational elections did not have the same significance as in the US, and the political culture of the country as a whole was more homogeneous. Furthermore, most early BBC content was relayed from London, so remained constant across the country.

Thirdly, despite its position as the world's oldest and most trusted public broadcaster, the BBC remains heavily understudied in the comparative politics discipline. While historians have long emphasised the civic importance of the BBC in understanding the British electorate and society at large, its effects on voting in British general elections have yet to be thoroughly investigated. To the best of my knowledge, this paper is the first that aims to causally identify the effects of exposure to BBC content on electoral outcomes in Britain.

Overall, then, the research design of the paper allows us to overcome each of these three challenges in the literature, with implications for the study of media effects in Britain and beyond. The next step is to outline the particular historical context, to situate the roll out of BBC radio into broader theoretical frameworks and to better understand the assumptions

²Note that it is unclear whether to consider Strömberg's study as one of public broadcasting. While the paper refers to Governor speeches being broadcast, stations were themselves privately organised (Hilmes 2012).

required for causal inference.

Setting the Historical Context

British Politics in the 1920s

British politics in the 1920s was in a state of flux, with repeated off-cycle general elections taking place in a country adapting to a pandemic, a post-war economic downturn and a declining status on the world stage. This paper studies electoral behaviour in English constituencies in the UK general elections of 1918, 1922, 1923 and 1924. Given that there were sharper cultural differences between the constituent nations of the UK at this period in history, and that the BBC approached these differentially (Hajkowski 2013), there is inferential leverage to be gained from focusing on English constituencies alone within the framework of a controlled single-country analysis (Slater and Ziblatt 2013).

The 1918 election, the first since 1910, marked the beginning of a new demographic and political era in British politics, so represents a good baseline for comparison. The war transformed state-society relations, with the state's increased spending and intervention strengthening its capacity dramatically (Tilly 1993). The Labour Party was, thanks to its experience in wartime government, a truly nationalised party for the first time in its history (Thorpe 1997; Tanner 2007). The deaths of countless Britons in the First World War and Spanish Flu pandemic represented stark demographic change.³ Finally, 1918 marked the first election under the Fourth Reform Act, which expanded the franchise and redrew constituency boundaries.⁴ These reforms remained constant across the period of study, and did not change until 1929. This means that election results from 1918 to 1924 can be directly compared with one another with relative ease.

Domestic and foreign policy crises sparked the successive off cycle elections in the early 1920s. In 1922, the “coupon” coalition of the 1918 election had fallen apart, allowing Bonar Law to win a majority for the Conservative Party (Kinnear 1973). Eleven months later, in December 1923, an off-cycle election was called by Stanley Baldwin, the Conservative Prime Minister who took office after Law resigned through ill health. Baldwin sought a mandate to introduce a protectionist tariff system across the British Empire in response to a global economic slowdown, a direct contradiction of the 1922 Conservative Party manifesto (Smart 1996). The election resulted in a tenuous Labour minority government, led by Ramsey MacDonald, with tacit support from the Liberals. However, ten months later the Liberals withdrew their support, leading to another off-cycle election in October 1924 (Bentley 2007). Baldwin and the Conservatives won a landslide majority and the Liberals were decimated. The next election, to be won by Labour, would not take place until 1929 (Thorpe 1997).

³The 1918 election took place in the immediate aftermath of the war. Only the “third wave” of the Spanish Flu occurred after the 1918 election, with the overarching majority of deaths taking place before and affecting every part of the country (Chowell et al. 2008). It hence seems unlikely that the third wave would have an electoral impact in 1922 that was not already established in 1918. This further justifies the use of 1918 as a baseline.

⁴Although incomplete (women under thirty could still not vote), the act was the largest single increase to the franchise in British history (Thorpe 1997).

The Introduction of BBC Radio

BBC radio was rolled out by the British Broadcasting Company, predecessor to the modern-day British Broadcasting Corporation. The aim of the roll out was to provide a regulated broadcasting infrastructure that reached as many consumers as possible (Hajkowski 2013), differing sharply with the market-based approach being taken in the US at the time (Hilmes 2012). The roll out is distinguished by its political independence and the uniform nature of the content transmitted.

A Politically Independent Roll Out

The roll out of BBC radio was driven by technological and geographical factors, which were plausibly independent from politics. From 1922, radio transmitters were gradually installed across the country such that by the end of 1924 an estimated 70% of the population was within range (Briggs 1995). Increased coverage led to increased use, with the number of radio licenses increasing from 36,000 in 1922 to over 1.1 million in 1924 (Terra Media 2021).⁵ Stations were initially installed in London, Manchester and Birmingham, reflecting the high populations of these areas. Yet many other population centres, such as Leeds, Bournemouth, Sheffield, Newcastle, Liverpool or Nottingham, did not receive coverage until later years. As Briggs (1995, 199) points out, the “*the selection of sites depended not only on population [or] distance from existing stations . . . but on technical considerations such as geographical ‘shielding’ or ‘jamming’ by other stations*”.

The initial transmitters had a geographically delimited broadcasting range. Whilst data from the era do not allow us to use precise coverage maps, technical and historical authors consistently estimate the coverage radius to be around 20 to 30 miles (Pawley 1972; Linfoot 2011; Briggs 1995). Hajkowski (2013, 117) writes that “*listeners had to be within twenty miles of a transmitter to listen to the BBC*” and Briggs (1995, 77) contends that early transmitters had a “*normal service of not more than twenty-five miles*”. This implies that vast swathes of the country did not receive coverage immediately, justifying the argument that exposure to the radio content was geographically delimited. Briggs (1995, 197) provides direct evidence that major population centres were initially excluded from coverage, describing how “*in Sheffield, . . . wireless reception sounded like an ‘insurrection in hell’. It was scarcely better in important cities like Leeds, Edinburgh, and Plymouth, which were outside the effective range of the main stations* . From a technical perspective, the former BBC Engineer Edward Pawley writes that “*after all these stations had been commissioned, many parts of the country had poor reception or none at all*” (Pawley 1972, 23).

Collectively, this suggests that an electoral constituency’s exposure to radio was geographically delimited and independent to its politics. In the empirical strategy, this evidence will be used to support the assumption that treatment assignment (transmitter allocation) is independent

⁵The one-off license fee, included in the cost of a radio device, was initially ten shillings, equivalent to around a quarter of the weekly wage at the time (Pawley 1972). It is worth noting, however, that radio licenses only capture *official* radio use. We also know that many users utilised homemade radio sets without a license, or listened communally in pubs or households from one single device (Pawley 1972; Hajkowski 2013), so license estimates are likely to underestimate exposure.

to potential outcomes (voter turnout). The next question is whether the content that each transmitter broadcast was constant across the country, to which I now turn.

Commonality of Treatment

Theorising about common turnout effects from BBC radio exposure rests on there being commonalities in the content that each particular station broadcast. Whilst the BBC did eventually move towards a localised model of content creation, this did not occur until the 1930s, outside the scope of this paper.

The early BBC maintained a centralised character, with minimal content being created locally and programmes typically being drawn from London. From the very outset in 1922, a centralised news programme was broadcast from London each evening (Pawley (1972); Pepler (1988); Briggs (1995)). But even beyond news, many of the cultural programmes that the BBC aired were also drawn from London and transmitted to the rest of the country (Hajkowski 2013; Lyon and Ross 2016). Primary evidence of this can be seen on the BBC’s online archive *BBC Genome*, which records the precise radio schedules initially outlined in the Radio Times magazine, from 1923 onwards.⁶ By way of example, the image below shows the radio schedule in the first edition of the Radio Times.⁷ It demonstrates that every station, irrespective of location, had a daily “General News Bulletin Broadcast from London”.

This is in keeping with the incentives of key actors involved in the roll out itself. John Reith, then general manager and to be first director general of the BBC, argued that the BBC’s responsibility was “*to carry into the greatest possible number of homes everything that is best in every department of human knowledge*”, whilst creating “*a more enlightened and intelligent electorate*” that shared a “*unified national culture*” (Hajkowski 2013; Marr 2011). These words chime with a radio service designed to be informative, civic, and relatively homogeneous across the country.

On balance then, radio content was similar enough across constituencies that making aggregated comparisons is theoretically reasonable. In the empirical strategy, this justifies the stable unit treatment value assumption, by allowing us to compare turnout rates across constituencies to generate estimates. Building on the particular context of the case and the broader theoretical literature, we can now develop specific hypotheses about BBC radio and voter turnout in 1920s England.

Expected Empirical Outcomes

Early BBC radio fits with the informational and sociological mechanisms of media effects identified in the existing literature, such that exposure should increase voter turnout. However, given the historical nature of the case, data constraints mean that these effects must be aggregated away from individuals and toward electoral constituencies.

Firstly, although the existing literature focuses on microfoundational changes to the behaviour

⁶It is available to view here: <https://genome.ch.bbc.co.uk/> (last accessed: 02.04.2021)

⁷Permission to use this image was kindly donated by Immediate Media.

WIRELESS PROGRAMME—MONDAY.

LONDON.

11.30-12.30.—Morning Concert—MR. WILFRED LYNN, leader.
5.0.—Women's Hour—ARIEL'S Society Glee, MRS. C. S. PEEL'S Kitchen Conversation.
5.30.—Children's Stories—'Little Black Sambo,' by HELEN RANNERMAN; 'Jack Hardy,' by HERBERT STRANG. Ch. 2, Part 1.
5.15.—Boys' Brigade and Boys' Life Brigade News.
5.25.—T.G.—Interval.
7.0.—TIME SIGNAL 1st GENERAL NEWS BULLETIN, BROADCAST TO ALL STATIONS, followed by London News and Weather Report.
7.15.—Weekly Book Talk by MR. JOHN STRACHEY.
7.30.—SYMPHONY CONCERT, WITH AUGMENTED ORCHESTRA conducted by MR. PERCY PITT. ORCHESTRA—Overture, 'Pisces' (Widor); 'Dream Children' (Eggar); Concerto in B minor for violin and orchestra (Saint-Saens)—SOLO VIOLIN, MISS DAISY KENNEDY; Symphony in E minor, 'From the New World' (Dvoak).

BIRMINGHAM.

2.30.—MR. JOSEPH LEWIS, Musical Director of the Birmingham Station, will give a Pleyel Piano Recital of Symphony No. 2 by Beethoven and a short exposition on same.
5.30.—Ladies' Corner.
6.0.—Kiddie's Corner.
6.45.—Boys' Brigade and Life Brigade News.
7.0.—1st GENERAL NEWS BULLETIN, BROADCAST FROM LONDON, followed by Midland News, giving Local Weather Report.
7.30.—2nd GENERAL NEWS BULLETIN FROM LONDON, followed by Midland News, giving Local Weather Report. CONTINUATION OF LONDON SYMPHONY CONCERT (see London Programme).
10.30.—CLOSE DOWN. Announcer: H. Coop.

MANCHESTER.

2.30.—Afternoon Concert by the ZZZ TRIO. Vocalist—MISS CONSTANCE SILVESTER, Miss soprano.
5.0.—Maidy Feminine.
5.30.—Farmers' Weather Report.
5.35.—Kiddie's Fairy Stories.
6.30.—Boys' Brigade and Boys' Life Brigade Bulletin.
6.50.—Spanish Talk by MR. W. F. BLEYCHER, Examiner in Spanish to the Lancashire and Cheshire Institutes.

6.45.—A little music.
7.0.—1st GENERAL NEWS BULLETIN, BROADCAST FROM LONDON, followed by Manchester News and Weather Forecast. RELAY TRANSMISSION OF PROGRAMME AS BROADCAST FROM THE LONDON STATION (see London Programme).

8.15.—SPECIAL OPERATIC NIGHT. 'CARMEN' (Bisot). The new organized Chorus of the Manchester Station will cooperate. The lecture, MR. ROSES BARTEL, will introduce each item and review item's life and work. Artists—Don José and Escamillo, WILFRED HINDLE; Escamillo and Escamillo, LEE THISTLETHWAITE; Mouché and Frasquita, MADGE TAYLOR; Micaëla, NELL DAVIES; Carmen, RACHEL HUNT. CHORUS AND AUGMENTED ORCHESTRA—Conductor, DAN GODFREY, Jnr. Prelude, ZZZ Orchestra; Overture, Chorus; Habanera, Rachel Hunt and Chorus; Duet, 'Speak to Me of My Mother,' Madge Taylor and Wilfred Hindle; Seguidilla, Rachel Hunt; Intermezzo, Act II, ZZZ Orchestra; Tambour Solo, Lee Thistlethwaite and Chorus; Quarta, Madge Taylor, Nell Davies, Lee Thistlethwaite and Wilfred Hindle; Flower Song, Wilfred Hindle; Intermezzo, Act III, ZZZ Orchestra; Introduction, Trio, and Oud Song, Act III, Madge Taylor, Rachel Hunt, Nell Davies, and Chorus; Micaëla's Aria, Madge Taylor; Duet, 'I am Escamillo,' Lee Thistlethwaite and Wilfred Hindle; Intermezzo, Act IV, ZZZ Orchestra; Introduction and Duet, Act IV, Rachel Hunt, Lee Thistlethwaite, and Chorus; Final, Rachel Hunt and Wilfred Hindle.

9.30.—The 2nd News Bulletin will be given during an interval at 9.30.
10.30.—Local Weather Forecasts, Announcements. CLOSE DOWN. Announcer: Victor Scaytle.

CARDIFF.

2.30.—FALKMAN and his ORCHESTRA at the Capital Cinema, Cardiff.
5.0.—Women's Hour.
5.30.—Weather Forecast. Children's Stories—UNCLE DONALD and AUNT BETTY. Violin Solo.
6.15.—Boys' Life Brigade and Boys' Brigade Bulletin.
7.0.—1st GENERAL NEWS BULLETIN, BROADCAST FROM LONDON, followed by Cardiff News and Weather Forecast.
7.15.—LONDON SPEAKER.
7.30.—'The married man that draws men on to die.' The RAND OF H.M. GRENADIER GUARDS, by kind permission of Colonel G. C. Hamilton, C.M.B., D.S.O., Conductor, LIEUT. G. MILLER, L.R.A.M.; Vocalist, SIGNOR SILVIO SIDRELL (1) March from 'Tramblant' (Wagner); (2) Overture, 'Tom O'Shaunes' (Joplin); (3) Song (a) 'Torna' (Dvoak); (b) 'Thinking of You' (Grove); (4) Overture, 'Mary' (see, by F. Wood)—MUSICIAN, W. WEST; (5) Selection, 'Eugene Onegin' (Tchaikovsky); (6) Song (a) 'Black' (Foot); (b) 'Ultima Canzone' (Foot); (7) Suite, 'Summer Days' (Dir. Grotto); (8) (a) 'Valse Lyrique' (Schubert); (b) 'Tamatella' (Mozzowski); (9) Song, Schubert; (10) Fantasia, 'A Voyage in a Tompkin' (G. Jell).
8.30.—2nd GENERAL NEWS BULLETIN, BROADCAST FROM LONDON, followed by Cardiff News and Weather Forecast.

9.45.—(1) Variations on the tune 'Havover' (Vivaldi); (2) Selection, 'L'Assommoir' (Schubert); (3) 'Waka Patrol' (A. W. Jones).
10.15.—CLOSE DOWN.

NEWCASTLE.

2.45.—MR. W. A. CROSSE'S BLOU' ORCHESTRA—(a) 'March Piccadilly' (Rossini); (b) Selection, 'Spanish Tuna' (Albani).
4.0.—Children's Hour—MR. W. A. CROSSE, Conductor. No. 2 (Seasonal).
4.15.—MR. W. A. CROSSE'S BLOU' ORCHESTRA—Selection, 'The Peep Show' (700); Selection, 'The Island King' (Grove).
4.25.—Christie Solo—MR. W. A. CROSSE, 'Piano Romance' (St. Clair).
4.30.—MR. W. A. CROSSE'S BLOU' ORCHESTRA—Selection, 'La Grand Duchesse' (Grieg).
4.45.—Women's Transmission.
5.15.—Children's Transmission.
6.0.—Scholar's Half Hour—A Short Talk by MISS JOHNSON.
6.30.—Boys' Brigade News Bulletin.
6.45.—Farmers' Corner.
7.0.—1st GENERAL NEWS BULLETIN, BROADCAST FROM LONDON, followed by Newcastle News, giving Local Weather Report.
7.25.—Talk on 'THE SECOND HOME,' the City of the Pines, by MR. E. AKHURST, Royal Grammar School, Newcastle.
7.30.—SYMPHONY CONCERT, Talk, and 2nd News Bulletin FROM LONDON (see London Programme).
10.30.—CLOSE DOWN. Announcer: R. C. Pratt.

GLASGOW.

2.30.—An Hour of Melody by the WIRELESS TRIO—Overture, 'Morning News, and Night' (Ragge); Selection, 'Duetty'; Waltz, 'Maiden Cello' (Moritz); Fugue, 'When the Leaves Come Tumbling Down' (Holland); Suite, 'Spanish Dances' (Bach); Intermezzo, 'Funiculi' (Hofmann); Selection, 'The Bird of Paradise' (Fauré); Entr'acte, 'On the Way to Kew' (Cliff); March, 'Ritorna Italiana' (Beverly).
4.30.—Close down.
5.0.—A Talk to Women.
5.30.—The Children's Corner.
6.0.—Special Weather Report for Farmers.
6.15.—Boys' Life Brigade Bulletin.
7.0.—1st GENERAL NEWS BULLETIN, BROADCAST FROM LONDON, followed by Glasgow News and Weather Forecast.
7.15.—First Talk.
7.30.—SYMPHONY CONCERT FROM LONDON (see London Programme).
8.15.—Second Talk.
8.30.—2nd GENERAL NEWS BULLETIN, BROADCAST FROM LONDON, followed by Glasgow News and Weather Forecast.
9.45.—MISS CATHERINE AULSEBROOK, contralto.
9.55.—ORCHESTRA—Overture, 'The Siege of Rochelle' (Bizet).
10.0.—MISS CATHERINE AULSEBROOK, contralto.
10.0.—ORCHESTRA—Selection, 'Princess Caprice' (Fall); Entr'acte, 'La Paloma' (Faure); March, 'Cossack' (Liszt).
10.30.—Special Announcements. CLOSE DOWN. Announcer: A. H. Swinton Palmer.

Figure 1: Typical Radio Schedule in a 1923 Radio Times Magazine

of individual voters, there are no reliable sources of data that can be used to measure this in 1920s England. Official turnout statistics are recorded at the constituency level, and to the best of my knowledge there are no representative surveys of public opinion that trace both media use and political participation at this time.⁸ Secondly, data about the take up of radio use is itself sparse. National-level sales of radio licenses and contextual historical work suggest that radio use increased significantly over the period of study, but reliable subnational measures are not possible to obtain. Instead, the paper focuses on the location of transmitters and their broadcasting range to construct constituency-level measures of radio exposure.

This process of aggregation assumes that radio exposure in a constituency is a reasonable proxy for people living in the constituency listening to radio content. This assumption is somewhat supported by evidence that individuals would know about a transmitter being constructed, and hence be incentivised to acquire a license. Transmitters generated a sense of excitement and a rush to acquire radio sets in the affected towns and cities, particularly because the technology was so novel (Briggs 1995) and because local companies were involved in construction (Hajkowski 2013). In addition, the differences-in-differences and matching strategies followed by the paper go a long way to ensuring that similar constituencies are compared to one another. This helps us to account for differences across constituencies that might adversely affect the electoral consequences of radio exposure.

These assumptions mean that interpreting the empirical findings requires nuance. If the arrival of a transmitter itself induces civic pride that affects turnout, rather than the content that the transmitter broadcasts, then turnout effects could represent voters rewarding allocation rather than being affected by media content. If this were to be the case, however, the effects should be a one off. In the period under study transmitters were installed once in each area, such that the associated electoral reward should not obtain beyond the first election for which a transmitter is present. However if, as theorised, it is radio content that is doing the causal work, then we should expect the effects to persist over time. As time passes, more people will acquire licenses and radio sets, increasing the pool of exposed individuals in a constituency. Moreover, existing listeners will have been exposed to content for longer, increasing the likelihood that it shapes their behaviour. This suggests that a constituency's length of exposure is theoretically relevant, and that turnout effects will be magnified in constituencies that have been exposed for more time.⁹

Collectively, therefore, the discussion leads to the following hypotheses. Credibly addressing the “all else being equal” condition is the main aim of the empirical strategy.

H1 (Spatial Effects of Coverage): Constituencies within the coverage zone of BBC radio have higher rates of voter turnout in subsequent general elections, all else being equal.

⁸To this day, the results of UK general elections are only available at the constituency level, precluding more spatially fine-grained analyses.

⁹Note that this general claim doesn't preclude non-linearities in how radio effects change over time. Eventually the effect of exposure will plateau, as new constituency-level equilibria are reached across the country. Empirically, this is tested by using various functional forms of time exposed.

H2 (Temporal Effects of Coverage): The longer a constituency is within the coverage zone of BBC radio, the larger the increase in voter turnout in that constituency, all else being equal.

Empirical Strategy

To measure the effects of BBC radio on voter turnout, the paper uses a matched difference-in-difference design. I first outline how radio exposure is operationalised, before outlining the statistical model and its associated assumptions.

Measuring Radio Exposure

Exposure to BBC radio has a spatial and temporal component: where in the country were people being exposed, and how long had they been exposed for? Spatially, I allocate constituencies to the “treatment” group where they fall within a set radius of a radio transmitter. This is recorded as both a binary measure of being “in” or “out” of range, and a more precise continuous metric of the areal percentage of the constituency that overlaps.¹⁰ Following the aforementioned estimates of coverage in the literature, I run specifications with radii of 20, 25 and 30 miles respectively, based on transmitter coordinates taken from the addresses given in Pawley (1972).¹¹ The spatial dimension of the treatment is visualised in the maps below, for a 20 mile radius.

Temporal exposure is measured in months. There is considerable heterogeneity in the length of time between spatially receiving treatment and the first subsequent general election, as shown in the table below (recreated from Pawley (1972)). For example, while 1923 was the first post-treatment election for Newcastle and Bournemouth, Newcastle had been connected for around ten months longer by this time. This is important, since H2 specifies that treatment effects will aggregate over time, such that Newcastle should see higher turnout than Bournemouth. To account for this, I code the number of months for which a constituency has been in range of a transmitter, providing a standardised metric for use in the statistical models.

¹⁰In general, the quality of a radio signal varies depending on topography too, with reception quality often worsening in hilly areas (Crabtree and Kern 2018). However, early BBC transmitters were distinctively localised due to their comparatively low power, erection in the heart of urban centres, and use of medium range frequencies from which reception is not dependent on “line of sight” to the transmitter (Pawley 1972). This makes them distinctive to their modern counterparts, suggesting that topological variation should have minimal effect on the quality of radio signal, and that measures of distance, rather than of electromagnetic propagation (Crabtree and Kern 2018), are best suited.

¹¹In most cases the address given in Pawley (1972) is exact. In a handful of cases, only a street is given, in which case I take the midpoint of the street.

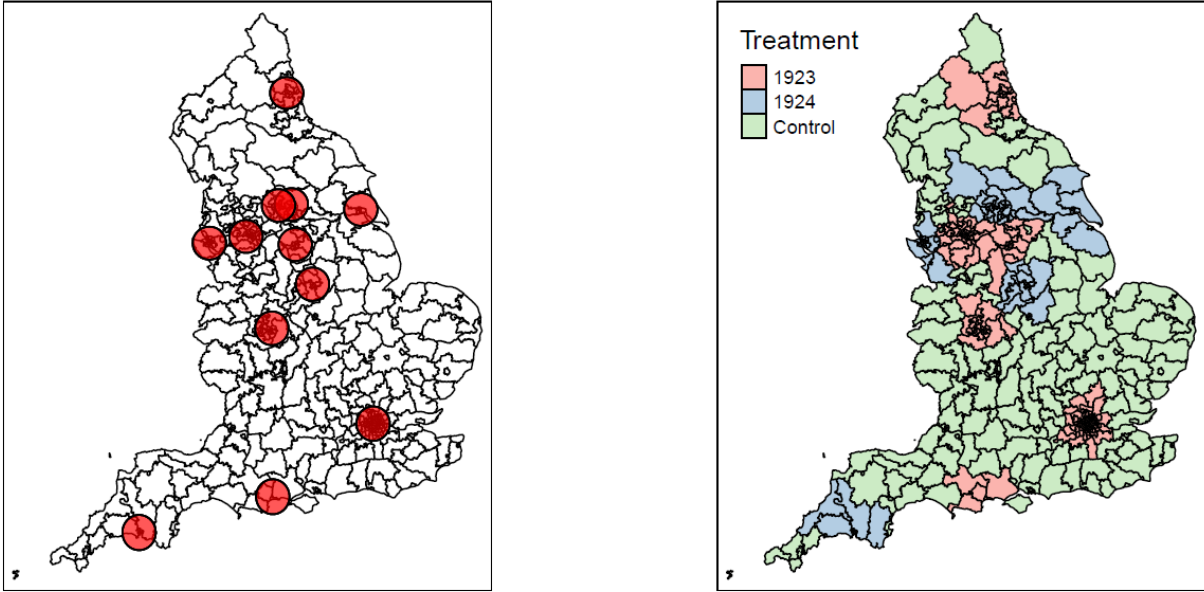


Figure 2: Maps of Radio Coverage and Treatment Allocation (20 Mile Radius)

Table 1: Summary of BBC Radio Rollout, 1922-24

Station	First Connected	Treated Election(s)
London	November 1922	1923, 1924
Manchester	November 1922	1923, 1924
Birmingham	November 1922	1923, 1924
Newcastle	December 1922	1923, 1924
Bournemouth	October 1923	1923, 1924
Sheffield	November 1923	1923, 1924
Plymouth	March 1924	1924
Liverpool	June 1924	1924
Leeds	July 1924	1924
Bradford	July 1924	1924
Hull	August 1924	1924
Nottingham	September 1924	1924

Balancing Treatment and Control

While the earlier discussion highlighted the political independence of the allocation process, there remain some differences between the types of constituencies that are more likely to receive treatment.

Given that transmitters were installed in cities, treated constituencies tend to have higher

population density, a higher proportion of the workforce in the professional and services sectors, and are more likely to be classified as urban. Control constituencies are more likely to be rural and consequently have a higher share of agricultural activity. The control group also has a higher share of manufacturing, perhaps due to the fact that a handful of manufacturing centres, like Leicester or Norwich, were not allocated transmitters in the period of study. On top of this, since urban economies are more diversified, manufacturing in urban treated areas will comprise a lower percentage of overall activity, even if it covers a higher number of workers (see the Appendix for further details). Finally, in line with expected urban-rural biases in political participation, pre-treatment turnout is lower for the control group.

Some of these differences may affect constituency-level responsiveness to BBC radio. Firstly, a higher population density implies that a greater proportion of voters will be exposed to radio content, either by increased access to radiosets or through greater opportunity to engage in community listening (Briggs 1995). Voters in denser areas might also attract heavier mobilisation efforts by political parties (Fieldhouse and Cutts 2008), although it is unclear whether parties would have such capacity in the 1920s (Thorpe 1997). For others, it is not apparent that there should be a bias or in which direction it would run. For instance, the workplace-based mobilisation strategies deployed by the Labour Party extend to both the manufacturing and natural resource industries, which are under and over represented in the treatment group respectively.

Nonetheless, the precision and credibility of causal estimates can be enhanced by reducing the pre-treatment differences between groups. To do this, I use entropy balancing to produce weights that emphasise comparisons between constituencies with similar pre-treatment covariates (Hainmueller 2014).¹² I balance on a range of demographic and political indicators, each taken from the 1921 census and House of Commons Library respectively.¹³

Demographically, I spatially interpolate constituency-level measures of occupational structure, population density and gender distribution based on the 1921 census.¹⁴ I assume that demographic covariates remain constant at their 1921 levels across the sample, between 1918 and 1924. This creates measures of the percentage of a constituency's workers engaged in each sector, the percentage of the population that is female, and the population density.

Politically, I compute the average pre-treatment level of turnout, victory margin and Labour Party vote share. If treatment groups have significantly lower levels of pre-treatment turnout, it suggests that there are greater potential returns to mobilisation, such that a stark increase in after treatment is realised could be confounded by enhanced mobilisation over time. District-level perceptions of electoral competitiveness, proxied by the lagged margin of victory

¹²The entropy balancing algorithm was chosen as it provided the best covariate balance. This is likely due to the small sample size under examination, since many popular matching algorithms, like Genetic or Coarsened Exact Matching, perform less well as sample size diminishes (Huang, Leon, and La Torre 2017). At the same time, however, the results are not model dependent. Section 3 of the Appendix shows that the headline findings are robust when Optimal Full Matching (Hansen and Klopfer 2012), the next best performing algorithm in terms of covariate balance, is used.

¹³Census data was taken from the Vision of Britain Through Time Project, run by the University of Portsmouth.

¹⁴This process is outlined in detail in the appendix.

in a constituency, have been shown to affect voter turnout (Blais 2006), since voters see their vote as mattering more and because parties may invest additional resources. The Labour Party’s organisational strength is proxied by its average pre-treatment share of the vote. A growing organisational presence in a district implies greater capacity for mobilisation and turnout that could confound the effects of radio exposure.

Using balancing techniques with limited historical data is no doubt challenging, due to the small sample sizes and incomplete data involved (Austin 2009). It is also worth noting that constituency-aggregated census measures are an imperfect tool, as the 1921 questionnaire did not ask people about their usual place of residence (Newman 1971). Despite this, the Love plots below show that balance in the sample is significantly improved after adjustment.¹⁵ While some differences in manufacturing and professional services do persist, this is likely to be a function of measurement error rather than fundamental differences in the composition of the constituency, as prior turnout and Labour vote share are well balanced. Furthermore, if manufacturing is higher in rural areas and is positively correlated with voter turnout, it would place a downward bias on the treatment effects anyway. Population density poses more of a challenge, insofar as turnout in treated constituencies could be artificially augmented. Were this to be the case, we would expect treatment effects to be smaller in the balanced sample, since differences in population density are significantly reduced after balancing. Equally, if density is confounding treatment effects entirely, we would expect these effects to disappear when connectivity is interacted with density. Both of these tests are addressed in the results section, and show that the effects of treatment remain robust and in fact increase in the balanced sample.

Overall, then, balancing is relatively successful at reducing the differences between the treatment and control groups. This, coupled with the panel nature of the data and qualitative evidence of the roll out’s independence, lends further credence to the empirical strategy.

Specifying the Model

To estimate the effect of radio exposure on voter turnout, I use a spatial difference-in-differences design. I utilise a two-way fixed effects specification, modelling turnout as a function of monthly exposure, centred around the moment of treatment. α_t and ϕ_c account for election and constituency fixed effects, respectively. Since the data comprises repeated observations of each constituency, standard errors are clustered at the constituency level (Abadie et al. 2017). The causal parameter of interest is β_1 , and is expected to be positive. Results are presented for both the raw and balanced samples, the latter estimated with weighted least squares.

$$turnout_{ct} = \beta_1 treated_{ct} + \alpha_t + \phi_c + \epsilon_{ct} \tag{1}$$

¹⁵Most covariates fall within the conservative recommended standardised mean difference of 0.1, and all but population density and manufacturing fall within the 0.25 threshold often used for smaller samples (Austin 2009; Stuart 2010)

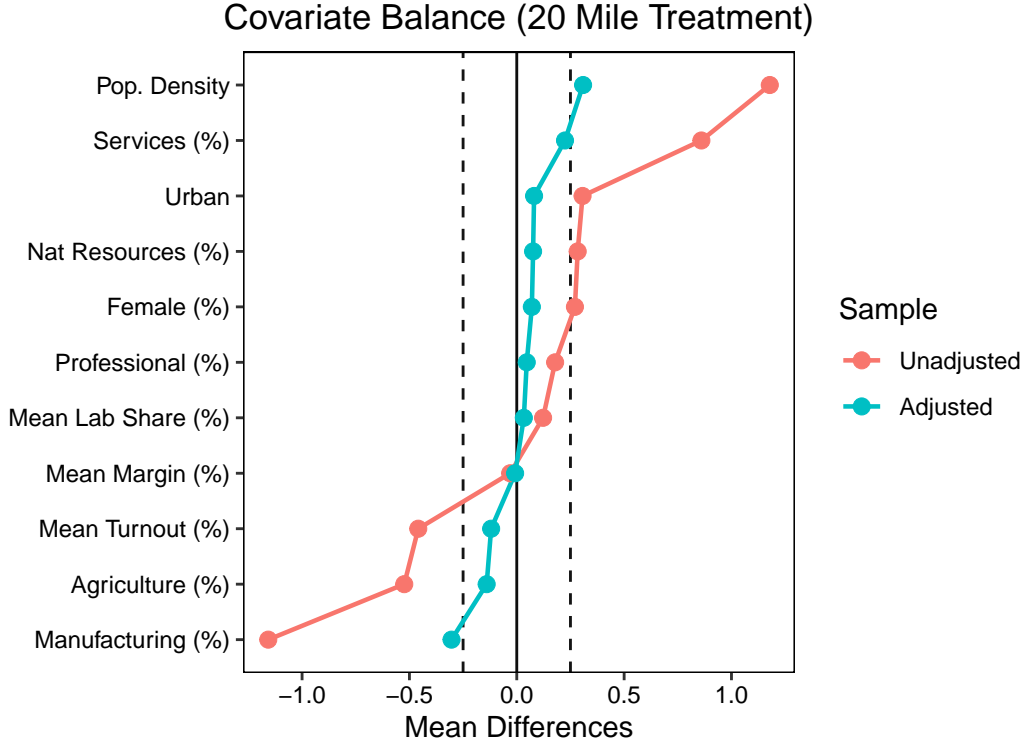


Figure 3: Covariate Balance with Entropy Balancing (20 Mile Radius)

Establishing Treatment Independence and Constancy

A first assumption for inference is that treatment assignment is conditionally independent to potential outcomes. For the current paper, this means that voter turnout Y_i is independent of the assignment of radio connectivity D_i , conditional on the aforementioned constituency-level covariates X_i . This condition is violated in papers that fail to exogenise media exposure.

$$Y_{(1i)}, Y_{(0i)} \perp\!\!\!\perp D_i | X_i \quad (2)$$

In the current context, the assumption is reasonable. On the one hand, the qualitative discussion of the roll out highlighted that decisions were driven by technical and geographical consideration, which are independent to politics. On the other, the difference-in-differences design allows us to account for all time invariant confounders, and is buttressed by balancing across a range of constituency-level covariates. Taking this evidence in combination, it seems reasonable to suggest that treatment assignment is independent to potential outcomes.

A second assumption is that the treatment received is the same for all units. In the present context, this means that everyone exposed to radio will be exposed to the same content, or at least content that drives similar effects on voting. Formally, we can say that the radio content is the treatment received (Z_i), and that this is independent of covariates X_i once we account for treatment assignment D_i . As discussed, this is potentially violated in studies that analyse long periods of time or spatially diverse political environments, with heterogeneity captured

by X_i below. In this study, this assumption is supported by qualitative evidence that the same content was broadcast around the country, and the fact that the paper analyses a short time frame in a geographically small country.

$$Z_i \perp\!\!\!\perp X_i | D_i \tag{3}$$

A final, and related assumption, is that treatment effects stem from the treatment being realised, and *not* by its assignment alone. This means that turnout is affected not by a transmitter being built (D_i), but by the content that the transmitter broadcasts (Z_i). Formally, this suggests that potential outcomes are unchanged by treatment assignment alone, as outlined below. In the current context, this assumption is supported if treatment effects persist over time, rather than being one-off.

$$Y_{(1,d)} = Y_{(0,d)} \tag{4}$$

Establishing Parallel Trends

While the previous assumptions apply to any causal analysis, difference-in-difference designs rests on the identifying assumption of counterfactual parallel trends. In the present context, this entails that post-treatment trends in the control and treatment group would be the same in absence of treatment (Angrist and Pischke 2009). In other words, absent the construction of radio transmitters, turnout would see no differential rate of increase.

A suggestive indicator of parallel trends is to test trends in the pre-treatment period, based on the premise that there should be no significant differences in trends prior to treatment being received. Such a test is neither necessary nor sufficient to confirm post-treatment counterfactuals, which remain assumed and fundamentally untestable (Angrist and Pischke 2009), but is nonetheless a useful heuristic for understanding patterns in the data (Kahn-Lang and Lang 2020). Figure 4 displays pre and post treatment trends in the sample as a lag and lead plot centred around the moment of treatment. Both the raw and balanced samples see a positive treatment effect only once treatment has been received, with pre-treatment differences generally more similar for the balanced panels.

It is also important to consider whether imbalance is theoretically relevant to the outcomes under study (Kahn-Lang and Lang 2020). This ties in with the earlier discussion of balancing, in which it was argued that population density is the most relevant form of imbalance with respect to voter turnout. Differences in density are greatly diminished in the balanced sample and are shown to not confound the effects of radio. This offers further suggestive evidence to support the parallel trends assumption.

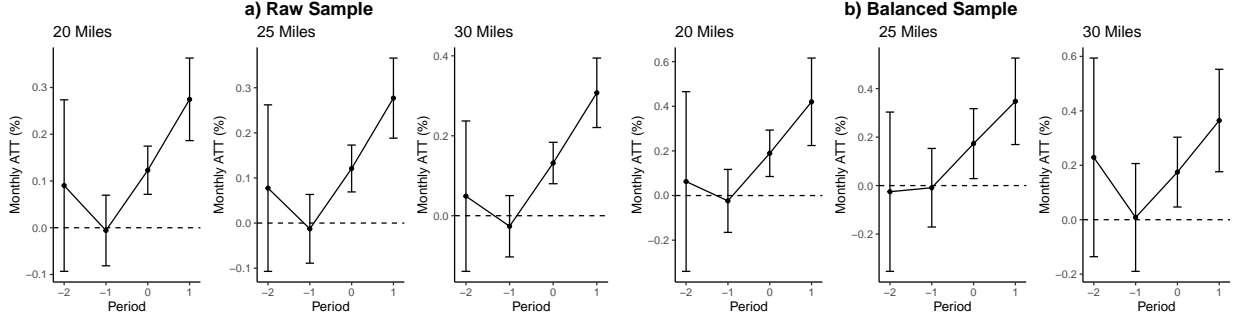


Figure 4: Lag and Lead Plots

Results

Main Effects

The results establish a robust positive treatment effect, implying that exposure to BBC radio is associated with a systematic increase in voter turnout.

The baseline models, shown in Table 2, demonstrate a positive treatment effect across all radii. For the binary measure of treatment exposure, each additional month for which a constituency is connected sees turnout increase by 0.12% to 0.13% per month, equivalent to around 1.5% to 1.6% per year. There is some variance in coefficient size across treatment radii, but in each case the coefficients are within the margin of error, suggesting that results are not overtly affected by the particular radius used.

For the continuous measure, which records the percentage of a constituency within coverage, the coefficients are slightly larger and more similar across each radius, declining slightly as the radius increases. For these models, a constituency moving from zero to full coverage sees an increased turnout of around 1.8% per year, dropping to 1.7% as the radius expands. The enhanced consistency and size of this effect make sense, since the continuous measure of radio exposure is more precise, and reduces the risk of misclassification at larger radii.

Table 3 presents the same specifications in the presence of balancing weights. As can be seen, the results remain positive and significant, with coefficients slightly larger across all six models. A constituency becoming connected sees a yearly turnout increase of around 2%, rising to around 2.5% when a continuous measure is used. There is a larger decline in effect size at a 30 mile radius in the continuous specifications, but this remains well within the margin of error. Reassuringly, the findings suggest that imbalance in the raw sample was exhibiting a *downward bias* on the results, with higher effects ensuing when treated and control units are more similar.

Robustness

Although the baseline results are strong and there is qualitative reason to suggest that treatment assignment is independent, a range of statistical and theoretical challenges to the model remain.

Table 2: Main Findings (Raw Sample)

	<i>Dependent variable:</i>					
	Monthly Change in Turnout					
	20 miles		25 miles		30 miles	
	(1)	(2)	(3)	(4)	(5)	(6)
Connected (Months)	0.124*** (0.025)	0.149*** (0.026)	0.121*** (0.025)	0.143*** (0.026)	0.132*** (0.025)	0.142*** (0.026)
Continuous	No	Yes	No	Yes	No	Yes
Election FEs	Yes	Yes	Yes	Yes	Yes	Yes
Constituency FEs	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.92	0.92	0.92	0.92	0.92	0.92
Observations	1691	1691	1691	1691	1691	1691

Note:

*p<0.1; **p<0.05; ***p<0.01
Standard errors clustered at the constituency level

Table 3: Main Findings (Balanced Sample)

	<i>Dependent variable:</i>					
	Monthly Change in Turnout					
	20 miles		25 miles		30 miles	
	(1)	(2)	(3)	(4)	(5)	(6)
Connected (Months)	0.189*** (0.053)	0.213*** (0.052)	0.173** (0.074)	0.225*** (0.062)	0.175*** (0.065)	0.196*** (0.073)
Continuous	No	Yes	No	Yes	No	Yes
Election FEs	Yes	Yes	Yes	Yes	Yes	Yes
Constituency FEs	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.94	0.94	0.92	0.92	0.92	0.92
Observations	1691	1352	1691	1352	1691	1352

Note:

*p<0.1; **p<0.05; ***p<0.01
Standard errors clustered at the constituency level

Firstly, from a statistical perspective, we can rule out the possibility that results spuriously arise from an underlying time trend in the data generating process. Table 4 shows that the treatment effects remain broadly robust when a linear time trend is included and interacted with each constituency.¹⁶

Table 4: Time Trends Specifications

	<i>Dependent variable:</i>					
	Monthly Change in Turnout					
	20 miles		25 miles		30 miles	
	(1)	(2)	(3)	(4)	(5)	(6)
Connected (Months)	0.167*** (0.050)	0.226* (0.130)	0.171*** (0.050)	0.242** (0.119)	0.196*** (0.050)	0.134 (0.111)
Matching	No	Yes	No	Yes	No	Yes
Election FEs	Yes	Yes	Yes	Yes	Yes	Yes
Constituency FEs	Yes	Yes	Yes	Yes	Yes	Yes
Trends	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.96	0.97	0.96	0.96	0.96	0.95
Observations	1691	1352	1691	1352	1691	1352

Note:

*p<0.1; **p<0.05; ***p<0.01

Standard errors clustered at the constituency level

Another statistical concern may arise with how we measure uncertainty. The specifications above use asymptotic standard errors clustered by constituency, as is standard in the literature (Angrist and Pischke 2009). Nonetheless, given that the number of constituencies is relatively small, there is a possibility that treatment effects arise by chance and are in fact unrelated to radio exposure. We can address this with a permutation test, in which treatment is randomly reassigned to produce a baseline distribution of treatment coefficients against which the identified treatment effect can be compared (Gerber and Green 2012; Cooperman 2017).¹⁷ These are plotted in Section 4 of the appendix, and show that the identified effects are far to the right of the distribution. This provides confidence that the results are a function of radio exposure, rather than chance alone.

Thirdly, while results are broadly similar in the raw and balanced samples, this could be misleading if the results are model-dependent on the particular matching algorithm used. As

¹⁶For most specifications the results remain strongly significant. For a handful, the significance level drops. However this is not too much of a concern, given that there are only four time periods and that the models are hence relatively underpowered, compared to longer run time trends tests (Angrist and Pischke 2009).

¹⁷The specific randomisation procedure is complicated by the use of a dynamic treatment measured for the same constituencies over time. Constituencies are assigned to one of ten groups, based on when they first receive a transmitter. This group is then randomised, before being used to create a time-variant treatment score for each election based on the amount of time that passes between each. This process is outlined in full in the appendix.

previously discussed, entropy balancing was selected because it offered the best covariate balance. The next best performing algorithm was optimal full matching (Hansen and Klopfer 2012), and the appendix presents results of the main specifications when this algorithm is used. The results remain almost entirely unchanged, suggesting that model dependency is not driving the headline findings.

Moving on to theoretical issues, one concern is that the effects of radio exposure are nonlinear, and exhibit diminishing marginal trends over time. This would make sense if we think of radio exposure as a “dosage” with a given half-life, as has been shown in studies of media effects elsewhere (Levendusky 2013). The main models presented opted for a linear operationalisation due to ease of interpretation and the short time span under study, but it is nonetheless important to ensure that results remain robust to nonlinear specifications. Section 3 of the appendix presents results from several specifications in which nonlinear treatment variables are used, and shows that the results remain consistent throughout.

Another concern may be that the spatial character of the design poses a threat to inference, with the political effects of radio exposure spilling over into neighbouring unexposed constituencies. For instance, if some voters live and work in different constituencies, and are exposed to radio in one but not the other, this would undermine the way in which treatment and control are measured.¹⁸ To address this, each of the main specifications are rerun with spatial autoregressive and spatial error models, explicitly accounting for spatial autocorrelation in the dependent variable and its residuals. The results are presented in the appendix, and find that the headline effect of radio exposure remains robust.

Finally, the continued (although significantly reduced) imbalance in population density, with treated constituencies generally more dense, raised concerns that radio effects were being confounded. Density might encourage alternative forms of political mobilisation or social networking, which increase turnout independent of radio exposure. One way to test this is to interact density with the treatment to see if radio continues to have an effect. If the headline results were driven by population density alone, then we should expect density to exhibit a significant effect while treatment and its interaction turn up null.

Figure 5 below plots the coefficients of these models, which show mixed results. While the baseline treatment coefficient does lose significance, its interaction with density remains positive and significant. This suggests that each additional month of treatment continues to positively affect turnout as population density increases. Were the results being driven solely by density, there is no reason why this interaction should have any effect. Instead, it suggests that the effect of treatment is concentrated in areas with higher population density, but that there is an additional effect of treatment on top of that which stems from density alone.¹⁹ While this adds nuance to the findings, it also provides further confidence that radio exposure exhibits a positive effect on voter turnout.

¹⁸Specifically, this would represent a violation of the Stable Unit Treatment Value Assumption (SUTVA), since the treatment realised by some voters would be determined by the treatment assigned to a different constituency unit (Gerber and Green 2012)

¹⁹It is noted, however, that the moderator variable in this case is not exogenous, so this test cannot yield causal interpretation in the same manner as the baseline models. Instead it should be seen as a suggestive test, necessary but not sufficient for the robustness of the main specifications.

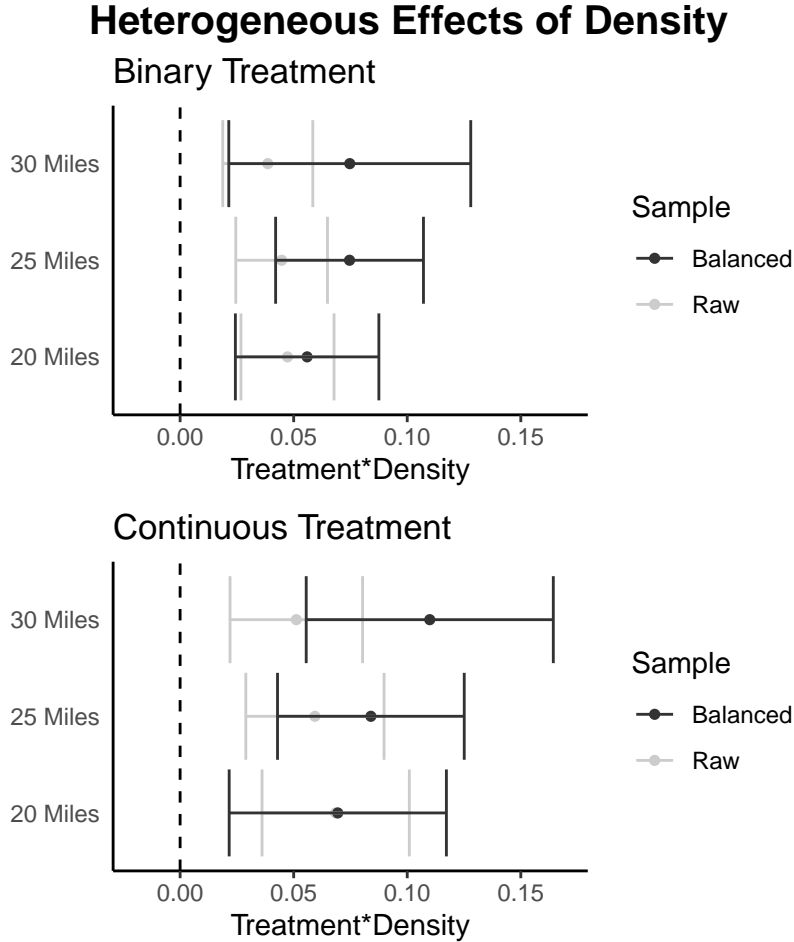


Figure 5: Heterogeneous Treatment Effects by Density

Discussion and Conclusion

The results show that the roll out of BBC local radio has a robust, positive average causal effect on voter turnout in English constituencies between 1918 and 1924. The paper contributes to the literature on public broadcasting, media exposure and voting behaviour by leveraging evidence from a historical natural experiment. Methodologically, the research design uses qualitative and quantitative methods to overcome the problems of endogenous media exposure and heterogeneous public broadcasting content. It hence offers causal estimates that are identified in a historical and econometric sense.

The headline result, that every year of connectivity increases turnout by around 2%, has substantial significance for British politics. Given the majoritarian nature of the electoral system and the marginal nature of some constituencies, a 2% increase in turnout might plausibly affect the winner in close races. In particular, the 1923 election saw the Labour Party form a minority government with a narrow 191 seats, which many historians see as a turning point for the demise of the Liberal Party and subsequent realignment of the party system (Bentley 2007). Had the Liberals won a handful more constituencies, this realignment

might not have precipitated in quite the same fashion. More broadly, by focusing on the mobilising power of the radio the paper offers an account of 1920s British elections that stresses the importance of technological change. This adds colour to existing explanations, which tend to focus predominantly on the rising Labour Party (Thorpe 1997). Overall, the findings make a contribution to our understanding of British politics at an important historical juncture.

Looking beyond the British case, the findings have implications for our general understanding of how the media affects politics. In particular, it contributes to existing research on how private and public broadcast media have differential effects on political outcomes, adding to a growing body of work that affirms the mobilising power of public media across time and space (Soroka et al. 2013; Sørensen 2019). By leveraging an independent historical roll out over which content stayed relatively constant, the paper overcomes some of the empirical weaknesses present in much existing work.

Beyond the private-public divide, the paper also has insights for scholars of mass media in contexts very different to 1920s Britain. On the one hand, the roll out of BBC radio took place in an era of low information and high political uncertainty, a state of affairs that characterises many new democracies today (Riedl and Lupu 2012) in which access to mass media is rapidly increasing (Kosec and Wantchekon 2020). On the other, the paper adds to our understanding of how media *content* shapes electoral outcomes. This theoretical distinction can be useful for scholars of social media, particularly in understanding the political effects of fake news (Duyn and Collier 2019; Zhuravskaya, Petrova, and Enikolopov 2020) and for policymakers looking to ameliorate them (Clayton et al. 2020).

Nonetheless, despite the cautious and calibrated empirical approach taken, the paper still comes up against some theoretical and empirical limitations. From an empirical perspective, there are ways in which the measurement of certain variables might be improved if better data were to become available. When operationalising radio exposure, future work should investigate the availability of subnational data on radio uptake, perhaps by looking at archival records, as to better understand constituency-level variation in use. Similar data for other media sources, such as newspaper readership, would be useful when analysing mechanisms. The current empirical strategy cannot say whether positive turnout effects are a direct function of radio content, or an indirect crowding out effect as the radio replaced entertainment-oriented media (Gentzkow 2006; Schroeder and Stone 2015).

The paper would also benefit from more precise estimates of electoral outcomes. Many papers in this field use precinct, ward or polling booth level returns, data which could make the most of the census' fine spatial resolution were it to be available in the UK. While general elections are by far the biggest electoral events in Britain and results are only available at the constituency level, scholars might wish to examine whether media effects remain visible in lower level elections, such as those to local councils.

From a theoretical standpoint, the paper opens a variety of paths for future research to address. The paper worked with the assumption that BBC content remained impartial, informative and relatively homogeneous for the period under study. Scholars may wish to empirically validate this assumption through analysing BBC Genome data more thoroughly,

perhaps using text-as-data techniques to assess the electoral implications of different types of BBC content over time. This might be especially relevant for episodes in which the BBC's impartiality has been questioned, such as its coverage of the 1926 miners' strike (McIntyre 1993).

This ties into a separate strand of theoretical work not addressed in this paper; how media roll outs affect the supply side of politics. From the US (Strömberg 2004) to India (Besley and Burgess 2002), we know that media provision can shape the distributional choices made by politicians, acting on the *perception* that they will be held more accountable by informed voters (Snyder and Strömberg 2010). It would be interesting to study patterns of public spending and elite decision-making in 1920s Britain, seeing if the advent of BBC radio had similar effects.

Despite these limitations, the paper addresses an important research question with a robust empirical strategy, and in so doing makes a firm contribution to the literature. The finding that BBC radio increased voter turnout in the 1920s has implications for scholars of British politics and of media effects in general, and the substantive focus on the BBC fills a lacuna in existing work. The BBC continues to dominate the British media market and to exert profound influence on the country's politics. This paper shows that the aim of its founders - to create a politically engaged electorate - appears to have had some success.

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