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THE EFFECT OF SOCIAL MEDIA ON ELECTIONS: EVIDENCE FROM THE UNITED STATES

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ABSTRACT

We study how social media affects election outcomes in the United States. We use variation in the number of Twitter users across counties induced by early adopters at the 2007 South by Southwest (SXSW) festival, a key event in Twitter's rise to popularity. We show that this variation is unrelated to observable county characteristics and electoral outcomes before the launch of Twitter. Our results indicate that Twitter lowered the Republican vote share in the 2016 and 2020 presidential elections, but had limited effects on Congress elections and previous presidential elections. Evidence from survey data, primary elections, and a text analysis of millions of tweets suggests that Twitter's relatively liberal content may have persuaded voters with moderate views to vote against Donald Trump.

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1 Introduction

Does social media affect election outcomes? A popular narrative holds that Twitter played a decisive role in both recent American presidential elections and the United Kingdom's "Brexit" referendum. Many see this as part of social media's broader influence on political polarization and the re-emergence of populist politicians in many countries. The U.S. Federal Election Commissioner, for example, has argued that Facebook "has no idea how seriously it is hurting democracy" (NPR, 2020a).[1]

An alternative view suggests that social media platforms are biased against conservatives (e.g., NPR, 2020b; Wall Street Journal, 2020) and that its younger, relatively left-leaning user base unlikely to tilt elections towards right-wing politicians (e.g., Boxell et al., 2017, 2018). However, there is limited evidence that can be used to evaluate these contrasting (causal) claims.

This paper focuses on the effects of Twitter, a platform used by almost a quarter of American adults. We estimate how a county's number of Twitter users affects election results by exploiting a persistent network effect sparked by early Twitter adoption, building on Müller and Schwarz (2019). Although it was launched in March 2006, Twitter's popularity increased rapidly after its advertising campaign at the South by Southwest festival (SXSW) in March 2007. The SXSW festival was also key for Twitter's geographical diffusion: counties with more SXSW followers who joined during the 2007 festival saw disproportionately higher growth of Twitter adoption compared to counties with SXSW followers who already joined before the festival. Consistent with path dependence in technology adoption, this difference in Twitter use across counties persists.

Our identification strategy leverages the 2007 SXSW festival as a shock to early Twitter adoption that is uncorrelated with pre-existing election results. Conditional on geographic controls and previous interest in the SXSW Twitter account, a county's number of SXSW followers who joined in March 2007 is essentially uncorrelated with a host of county characteristics. It is also unrelated to election outcomes before Twitter's launch (going back as far as 1924) and during the period it had fewer users (between 2006 and 2012). However, the number of SXSW followers who joined in March 2007 is correlated with Twitter usage in 2016, and has predictive power for the 2016 and 2020 presidential election results.

[1]See, for example, The New Yorker (2016); New York Times (2017); Allcott and Gentzkow (2017); The Guardian (2018); UK Parliament (2019).

We estimate that a 10% increase in a county's number of Twitter users lowered the vote share of Republican presidential candidate Donald Trump by 0.2 percentage points (p.p.) in both the 2016 and 2020 presidential elections. The implied persuasion rates are 8.6% and 9.4%, respectively, which are smaller than the estimated pro-Republican effect of Fox News (DellaVigna and Kaplan, 2007; Martin and Yurukoglu, 2017), the pro-Democrat effect of the Washington Post (Gerber et al., 2009), or the effect of get-out-the-vote canvassing on turnout (Gerber and Green, 2000).

For presidential elections before 2016, we find effects that are small and statistically indistinguishable from zero. The same holds true for House and Senate races, including the 2016 and 2020 elections. Twitter adoption thus lowered Trump's vote share but did not do so for Republican candidates in congressional races in the same election. Together with other "placebo tests," this pattern bolsters confidence that our estimates are capturing the effect of Twitter, which contains more content on presidential than congressional candidates.

An earlier draft of this paper, using only data up to the 2018 election, was posted online on October 2020. When updating it to include November 2020 election results, we made no revisions to the research design and regression specifications. In other words, the sample selection, choice of controls, and variable definitions in the regressions we report were all decided before the 2020 election results became available. Hence, our 2020 results can be interpreted as a "pre-registered" research design.[2]

To shed light on the mechanisms behind these results, we estimate Twitter's effect on vote choices reported in the 2016 Cooperative Congressional Election Survey (CCES), primary presidential candidates' approval in the Gallup Daily Tracker, and county-level results in the 2016 and 2020 presidential primaries. Further, we explore data on the partisanship of political content on Twitter.

These exercises yield three findings. First, the CCES results indicate that Twitter's effect is driven by independents and moderates switching their votes towards the Democratic candidate (Hillary Clinton). This is consistent with Bayesian updating, since moderates presumably have weaker priors and are thus more likely to be persuaded.

Second, we find that Twitter also lowered Trump's vote share during the 2016 primaries, a finding we confirm using individual-level Gallup candidate approval ratings.

[2]The "pre-registration" document being the October 2020 draft, which is available and "time-stamped" at Social Science Research Network (SSRN):
`https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3719998`.

We find that Twitter decreased Trump's approval ratings and increased Clinton's with only small effects on relatively more moderate Republican candidates.[3]

Third, we document that political content on Twitter has a pro-Democratic slant. We classify the slant of tweets based on two complementary approaches: one based on the network of users and one using text of tweets in a machine learning approach in the spirit of Gentzkow and Shapiro (2010). We apply these methods to the over 460 million tweets mentioning the presidential candidates in the 2012, 2016, and 2020 elections. We find a that the number and attention (proxied by "likes") of tweets mentioning Trump was substantially larger than that of those mentioning Clinton and Joe Biden. Moreover, tweets about Trump in 2016 and 2020 70% more more likely to have Democratic rather than Republican slant. Overall, our results are consistent with Twitter and its relatively pro-Democratic content persuading voters with moderate views to not vote for Trump without inducing a more general negative effect on Republicans.

From the outset, we stress what our findings do *not* imply. First, they cannot speak about social media platforms other than Twitter, such as Facebook. Our empirical strategy exploits a "shock" specific to early Twitter adoption and we do not have a credible research design to estimate the effects of other platforms. While many other platforms share similarities with Twitter, such as being popular among younger and more educated people in urban areas (Pew Research Center, 2019c), other platforms may have different effects on political outcomes. Second, our research design cannot separate the effect of particular types of social media content on Twitter (e.g foreign governments or misinformation), but rather speaks to the overall effect of Twitter exposure. Third, given our research design, we estimate a "partial equilibrium" effect of adding Twitter users to a county while keeping constant other counties' Twitter use. We thus cannot address whether Twitter had a national-level effect on the election (e.g., Trump's tweets driving traditional media content).

Our work contributes to the literature on the impact of media on political outcomes. Expansions of traditional media such as newspapers, radio, broadcast television, and cable news have been associated with changes in voter turnout, polarization, and electoral outcomes.[4] While a set of papers studies the effect of overall internet access, the effects

[3]We also estimate effects for the 2016 and 2020 Democratic primaries, detecting a (positive) effect for Bernie Sanders in 2020.

[4]See, for example, Gentzkow (2006); Huber and Arceneaux (2007); DellaVigna and Kaplan (2007); Gerber et al. (2009, 2011); Gentzkow et al. (2011); Enikolopov et al. (2011); DellaVigna et al. (2014); Larcinese and Miner (2017); Martin and Yurukoglu (2017); Spenkuch and Toniatti (2018); Chen and Yang (2019).

of social media *per se* received less attention.[5]

A nascent literature studies the political effects of social media on protest participation (Howard et al., 2011; Enikolopov et al., 2020; Acemoglu et al., 2017; Fergusson and Molina, 2021) and xenophobia (Müller and Schwarz, 2020; Müller and Schwarz, 2019; Bursztyn et al., 2019).[6] Additionally, a burgeoning field of experimental research focuses on social media. Bond et al. (2012) and Jones et al. (2017) provide evidence that online messages on social networks affect voter turnout. Allcott et al. (2020) and Mosquera et al. (2020) find that individuals who deactivate Facebook react along many dimensions, including some measures of political polarization. Levy (2021) studies the effect of randomly assigning Facebook users subscriptions to conservative or liberal media outlets. Bail et al. (2018) estimate the effect of paying Twitter users to follow a bot with messages of the opposing political ideology. Perhaps the most related to our paper is recent work by Rotesi (2019), who finds social media negatively affected the Democratic vote share in 2012 and 2016 using variation in Twitter adoption resulting from transfers of NBA players with Twitter accounts.[7]

Existing research thus provides an incomplete picture. On one hand, social media has been painted as a key force behind political change and experimental studies indeed suggest that social media affects individuals' self-reported political beliefs. On the other hand, it remains unclear whether social media can indeed persuade voters and affect elections results at a larger scale. Our paper sheds light on this question by focusing on how Twitter affects federal elections in the United States.

2 Background: Social Media and Politics

Most Americans use social media platforms or messaging applications. Data from the Pew Research Center suggest that the most popular services are YouTube (used by 73% of adults in the U.S.), followed by Facebook (69%), and Instagram (37%) (Pew

[5]There is evidence that broadband internet (Falck et al., 2014; Gavazza et al., 2019; Campante et al., 2017; Lelkes et al., 2017) and mobile internet (Manacorda and Tesei, 2016; Guriev et al., 2020) exert political effects.

[6]For reviews, see DellaVigna and Gentzkow (2010), Napoli (2014), Strömberg (2015), Enikolopov and Petrova (2015), and DellaVigna and Ferrara (2015) and in particular Zhuravskaya et al. (2020) for the case of social media.

[7]The difference between Rotesi's results and ours is likely driven by the difference in the local average treatment effect (LATE). Rotesi relies on variation in Twitter users who follow NBA players. In contrast, our methodology holds selection into social media constant under arguably milder identifying assumptions. Our paper also covers a larger set of elections, including 2020.

Research Center, 2019c). 22% of adults in the U.S. use Twitter, a rate similar to that of Snapchat (24%) and Whatsapp (20%) users. On average, adult users spend more than an hour a day using social networks (eMarketer, 2019).[8]

One popular perspective is that online networks, and social media in particular, may give rise to so-called "filter bubbles" (Pariser, 2011) or "echo chambers" (Sunstein, 2017). The idea is that social media—unlike traditional mass media outlets—may facilitate the provision and consumption of one-sided information, either through the use of algorithms or by allowing individuals to self-select into preferred content. While there is considerable empirical evidence supporting this idea (e.g. Conover et al., 2011; Weber et al., 2013; Bessi et al., 2015; Del Vicario et al., 2016; Halberstam and Knight, 2016; Schmidt et al., 2017; Levy, 2021), other studies have found that individuals are exposed to a wide range of political opinions on social media (Barberá, 2014; Bakshy et al., 2015; Nelson and Webster, 2017; Beam et al., 2018), perhaps even more so than via traditional media outlets or personal interactions (Gentzkow and Shapiro, 2011). Some work also challenges the notion that increased polarization due to online channels is quantitatively important (Flaxman et al., 2016; Guess, 2018; Boxell et al., 2019).

Much of the recent public discussion about the role of social media platforms has been shaped by controversies, including the consulting firm Cambridge Analytica's involvement in multiple political campaigns (e.g., The Guardian, 2018); the Russian Internet Research Agency's efforts to support Trump's election campaign (e.g., New York Times, 2017); and the role of widely shared false information ("fake news") in both the 2016 U.S. elections (e.g., Allcott and Gentzkow, 2017) and the Brexit referendum in the United Kingdom (e.g., UK Parliament, 2019). Both Hillary Clinton and Donald Trump have argued that these factors were instrumental in the 2016 election outcome, as has former president Barack Obama (The New Yorker, 2016). As Brad Parscale, Trump's digital media director in 2016, put it: "Facebook and Twitter were the reason we won this thing. Twitter for Mr. Trump. And Facebook for fundraising" (Wired, 2016). In Appendix Figure A.3, we document that discussions of social media have become increasingly frequent in major American news outlets. Mentions of Twitter in particular spiked with the 2016 presidential election when compared to 2012 levels.

Despite its prominence in the political discourse, the empirical relevance of social media for electoral outcomes is largely unknown, and some have suggested that concerns

[8]Pew bases its usage measures on the share of respondents who state they have ever used one of the online platforms. Twitter reported around 69 million monthly active users in 2019 (see Statista, 2019), which yields a slightly higher share of around a third of the 210 million adults in the U.S.

may be overblown. As one example, in the 2016 presidential election, Trump received fewer votes from demographic groups with higher propensities to use social media or the internet more broadly (The Hill, 2016; Boxell et al., 2017, 2018). Indeed, Trump's broadest support came from older white voters without college education in rural areas, who are among the least likely people to use social media actively (Hargittai, 2015; Pew Research Center, 2015, 2018). These patterns seem difficult to square with the idea that online channels were an important driver of the 2016 presidential election result, although such observations also do not rule this out.

Further, the content on social media platforms—particularly on Twitter—is disproportionately left-leaning. While there appears to be a cluster of right-wing networks, Pew Research Center (2019d) estimates that, in 2018, 60% of Twitter users identified as Democrat and only 35% as Republican. Among Democrats, those on Twitter are considerably more liberal and focus less on finding common ground with Republicans (Pew Research Center, 2020). In 2019, 26% of American Twitter users followed Obama and 19% followed Trump (Pew Research Center, 2019a). Survey evidence suggests that 80% of Twitter content is produced by people who strongly disapprove of Trump (Pew Research Center, 2019b). "Liberals" are also more likely to get political news on Twitter or Facebook and follow more media and political accounts compared to "conservatives" (Pew Research Center, 2014; Eady et al., 2019). Twitter and Reddit, which are often said to be pro-Trump factors, were considerably more popular among Clinton supporters before the 2016 election (Hargittai, 2015). Although social media allows users to partially select which content they see, Twitter content disproportionately leans toward the Democratic party.

We provide additional evidence for the composition of political content on Twitter by analyzing the Twitter reach of Democratic and Republican politicians. We collected data on the Twitter accounts of all Senators and House Representatives from the 110th to the 115th Congresses (2007-2019). In Figure 1, we plot the average number of tweets and followers that members of each party have on Twitter, as well as the average number of retweets and "likes" their tweets receive. The patterns here again clearly indicate that Democratic politicians are more active on Twitter and have larger follower bases than their Republican counterparts. Tweets by Democrats also receive, on average, three times the number of "likes."[9]

[9] In Appendix Figure A.2, we confirm that these patterns are not driven by a small group of Congress members by showing that they also hold when we compare the median Twitter reach of Democrats and Republicans.

[Figure 1 about here.]

3 Data

The main analysis is based on a county-level dataset on election outcomes, political opinions, and Twitter use. It covers 3,065 counties in 48 states (we exclude Alaska and Hawaii) and the District of Columbia (except in congressional elections). County-level election results are from Dave Leip's Atlas of U.S. Presidential Elections and the MIT Election Lab. We complement our analysis with individual-level survey data on approval ratings from the Gallup Daily Tracker and voting data from the Cooperative Congressional Election Study (CCES). Our measure of Twitter usage is derived from an archive of 475 million geo-located tweets compiled by Kinder-Kurlanda et al. (2017). We combine this with newly collected data on Twitter's early adopters at the 2007 SXSW festival; data on the Twitter activity of U.S. Congress members; and a large corpus of tweets related to the 2012, 2016, and 2020 presidential elections. Additional county characteristics were obtained from the U.S. Census, the U.S. Religious Census, the American Community Survey (ACS), and the Bureau of Labor Statistics (BLS). We describe the individual data sources in more detail below. Appendix Table A.2 provides additional details and summary statistics.

Election Outcomes. We use county-level data on presidential election outcomes between 1924 and 2020 from Dave Leip's Atlas of U.S. Presidential Elections. From the same source, we also obtained county-level voting data for the Republican and Democratic primaries in 2016 and 2020. We complement this with county-level results on Senate and House elections from the MIT Election Lab for the 1996-2020 period. In all cases, we focus on two-party vote shares. Figure 2 visualizes the Republican party's vote share in the 2016 presidential elections.[10]

[Figure 2 about here.]

[10]While senatorial and presidential elections are decided at the state level and House elections at the congressional district level, counties are usually smaller geographic units and far more numerous. Additionally, unlike congressional districts, county boundaries are fixed over our sample period, allowing us to observe changes across years.

Individual-Level Voting Decisions. The Cooperative Congressional Election Study (CCES) is a nationwide survey that collects information on voter behavior in two waves (before and after the election). We focus on votes for Trump and Clinton in 2016.[11] The CCES contains a rich set of individual characteristics, including political affiliation, family income (in 12 bins), gender, race, education (in 6 bins), marital status, age, and interest in the news. Table A.3 provides summary statistics (weighted by sample weights). The CCES also uses administrative data on turnout records to verify its respondents have voted.

Presidential Candidate Approval. The Gallup Daily Tracker provides individual-level survey data for a sample of 1,000 individuals per day since 2009.[12] During the 2016 presidential campaign, it fielded survey items regarding approval of Republican and Democratic presidential candidates. This allows us to investigate Trump's pre-election approval relative to other candidates (e.g. Clinton or Ted Cruz). The data also include a rich set of individual characteristics, including political affiliation, county of residence, income (in 10 bins), gender, race, marital status, age, and education (in 6 bins). Table A.4 in the Appendix provides summary statistics.[13]

Twitter Usage. We construct a measure of county-level Twitter usage based on a sample of 475 million geo-coded tweets collected by Kinder-Kurlanda et al. (2017). The tweets were collected between 2014 and 2015 using the Twitter Streaming API, which continuously returns a 1% sample of all Tweets as long as it is called. The individual tweets from this dataset are already assigned to counties. Additionally, we collected the underlying user profiles for each tweet in the database. This allows us to construct a user-based measure by assigning users to the county from which they tweet most frequently.[14]

The resulting measure, which we use throughout the paper, is a proxy for the number of Twitter users per county, based on 3.7 million individual users (around 7% of the Twitter population). Figure 3a plots the number of Twitter users per capita across counties. Each user profile further provides us with a short biography and the date that

[11] At the time of writing, the CCES for the 2020 election was not yet available.

[12] The Gallup Daily Tracker for the 2020 election is not available at the time of writing.

[13] For some auxiliary estimations in the Online Appendix, we also collapse responses about presidential approval of Trump on the county-level using weighted averages based on the number of survey respondents in each county.

[14] Data is available in the Gesis Datorium at https://datorium.gesis.org/xmlui/handle/10.7802/1166.

each user joined Twitter.[15] We use the join dates to construct a time-varying proxy of Twitter usage based on how many of the Twitter users had opened an account at each point in time. To validate this measure, Appendix Figure A.1a shows that our Twitter usage measure's evolution closely tracks the number of daily Twitter users from Statista (2019). Our measure of county-level measure of Twitter usage also strongly correlates with the number of Twitter users in a county based on the GfK Media Survey (see Figure A.1b).

Twitter Data for the South by Southwest Festival. We collected data for our instrument for Twitter usage, based on early adoption during the SXSW festival, through the Twitter API. More specifically, we scraped the account data for 658,240 users who followed the Twitter account of SXSW Conference & Festivals (@SXSW) at the time of collection (January 2019). We assign these users to counties based on the location people report in their user profile.[16]

A user profile contains the month and year that they joined Twitter, which allows us to determine the number of SXSW followers in each county that joined Twitter in a particular month. The two key variables in our analysis are: i) the number of SXSW followers that joined Twitter in the month of March 2007 and ii) the number of SXSW followers that joined Twitter during 2006 (the year the platform was launched). We refer to (ii) as the number of SXSW followers who joined before the March 2007 festival. We also scraped the follower lists of SXSW followers who joined in March 2007, which allows us to investigate the connections of Twitter users to the SXSW festival. Further, we additionally collected tweets mentioning the festival, based on the term "SXSW," as well as a proxy for overall Twitter activity based on the 100 common English words.[17] We use these measures to document the SXSW festival's impact on local Twitter adoption.

[Figure 3 about here.]

[15]Note that Kinder-Kurlanda et al. (2017) restrict the data to the sample of tweets that are geo-located. In principle, users can opt out of allowing the platform to determine their location. However, at the time the tweets were collected, the default option was to allow geo-location (i.e., users had to take an action to disable location tagging). As a result, the number of geo-located tweets at this point in time was far larger than today.

[16]Of the 44,625 SXSW followers who joined between 2006 and 2008, we are able to geo-code 25,830 (58%).

[17]We report the full list of words in Table A.7.

Data on Political Twitter Activity. We scraped the tweets and user profiles and followers of the 901 Senators and House Representatives from the 110th to 115th (2007-2019) Congress who have Twitter accounts. This includes 424 Democrats and 465 Republicans.[18] In total, the data contain 4,300,579 tweets, which we use to analyze the Twitter reach of Democratic and Republican Congress members. Appendix Table A.1 lists the 20 Congress members with the most Twitter followers.

We complement this dataset with election-related tweets to shed light on the overall partisan slant of Twitter activity during the 2012, 2016, and 2020 elections. For each election, we obtained the universe of tweets mentioning the last name of a Democrat and Republican presidential candidates.[19]

To determine the likely political affiliation of Twitter users, we create two measures of political slant. The first measure is based on the political accounts a user is following. In particular, we check whether a user follows more Democrat or Republican Congress members on Twitter. If they follow more Republican than Democrats, all their tweets would be classified as Republican. In case a user either does not follow any Congress members or an equal number of Congress members from either party, their tweets are classified as neutral.[20]

The second measure of political slant is based on the similarity of the text of tweets to those sent by Republican or Democratic Congress members. We train a L2 regularized logistic regression model separately for each election based on 901 Congress members Twitter accounts to classify whether a tweet contains language frequently used by either Republican or Democratic politicians.[21] We then use this classifier to predict a partisan score between 0 and 1 for each of our election-related tweets. These scores

[18]The remaining 12 politicians are either Independents or switched their party affiliation.

[19]For the 2012 election, we use data collected by Diaz et al. (2016), comprising 24 million tweets containing either "Obama" or "Romney" for the period from July 1, 2012 through November 7, 2012. For 2016, we use the archive from Littman et al. (2016), which contains 280 million tweets, collected between July 13, 2016, and November 10, 2016. The 2020 election tweets are based on the archive from Chen et al. (2020), which covers the period from March 2020 to November 2020. To make these datasets comparable, we restrict the 2016 election sample to tweets mentioning either "Clinton" or "Trump" (112 million tweets). Similarly, we restrict the 2020 data set to the time period from July 1, 2020 through November 3, 2020 and tweets mentioning either "Biden" or "Trump" (339 million tweets).

[20]The idea of using the Twitter network to determine a user's ideology is inspired by Barberá (2015).

[21]We clean the text of the tweets by removing common words (stopwords) and by reducing the words in each tweets to their morphological roots (lemmatizing). The input is based on unigrams, bigrams, and trigrams from these tweets. We choose the optimal normalization strength using 10-fold cross-validation. The resulting classifier achieves high out-of-sample F1-scores, e.g. 0.904 for the tweets during the 2020 presidential election. We provide additional details regarding the machine learning classifier in Online Appendix A.1.1, which also visualizes the most predictive terms identified by the classifiers.

can be interpreted as the probability of a tweet with the same content being sent by a Republican. As such, our approach is similar to how Gentzkow and Shapiro (2010) measure newspaper slant. Both approaches lead to similar overall slant classifications for the elections tweets in our data.

Additional County Characteristics We collect county-level demographic control variables from the U.S. Census and the ACS. In particular, we use information on population, population share by age group and ethnicity, poverty rates, and education levels. We also obtained industry-level employment shares and unemployment rates from the BLS. Additional controls on county media usage patterns are from Simply Analytics. We also construct geographical controls such as the distance from Austin, TX, where SXSW takes place every year; population density; and county size (in square miles). For one set of results we also use donation data from OpenSecrets. Appendix Table A.6 provides a description of the variables.

4 The 2007 South by Southwest Festival and Early Twitter Adoption

The empirical strategy behind our main results exploits a shock to early-stage Twitter adoption connected to the 2007 SXSW festival, as in Müller and Schwarz (2019). This section discusses the key role of the festival in boosting the platform's popularity and documents how it created a persistent effect on its spatial diffusion.[22]

Founded in March 2006, Twitter was largely unknown before SXSW 2007. Twitter's popularity increased dramatically after the festival, where Twitter strategically placed screens in the conference hallways and allowed users to sign-up by simply sending a text message to a predefined number. As a result, speakers and bloggers in attendance broadcasted the platform to the outside world, and Twitter went on to win the South by Southwest Interactive Web Award Prize.

The importance of SXSW 2007 has also been stressed by the platform's founders. As co-founder Evan Williams explained in a post on Quora (Quora, 2011):

> "We didn't actually launch Twitter at SXSW – SXSW just chose to blow it up. We launched it nine months before – to a whimper. By the time SXSW

[22]SXSW is an annual conglomeration of parallel film, interactive media, and music festivals and conferences organized jointly that take place in March in Austin, TX.

> 2007 rolled around, we were starting to grow finally and it seemed like all of our users (which were probably in the thousands) were going to Austin that year ... I don't know what was the most important factor, but networks are all about critical mass, so doubling down on the momentum seemed like a good idea. And something clicked."[23]

SXSW's immediate impact on Twitter's popularity in early 2007 can be seen in Figure 4a, which plots our proxy for the daily number of tweets as well as the number of tweets explicitly mentioning SXSW. The figure shows that Twitter's growth rate accelerated during the festival, visible as the spike in SXSW-related tweets. The month-to-month growth rate of Twitter quadrupled with the start of the SXSW festival.[24] After SXSW 2007, Twitter experienced further rapid growth (Venture Beat, 2008). The platform went from an average of 5,000 tweets a day in 2007 to 300,000 in 2008, and 2.5 million in 2009 (Twitter, 2010). In 2019, users sent roughly 500 million tweets a day.

[Figure 4 about here.]

We exploit that the SXSW festival had persistent effects on Twitter's spatial diffusion. This is likely the result of network effects that are key to the social media experience, as a larger number of users makes it more interesting for potential new users to join. Such a mechanism also applies at the local level. For example, a boost in the number of neighbors, personal connections, and/or people who play a prominent role in an area should also boost the value of joining the platform for those living there. Anecdotal evidence suggests that users who joined during SXSW 2007 spread Twitter to their counties of residence.

We provide further support for this hypothesis by investigating whether the inflow of early-stage adopters put these counties on a differential growth path of Twitter usage. Figure 4b plots the estimates of β_τ from the following panel event study regression at the county (c) and week (t) level:

$$tweets_{ct} = \sum_{\tau} \beta_\tau SXSW_c^{March2007} \times 1(t=\tau) + \sum_{\tau} \delta_\tau SXSW_c^{Pre} \times 1(t=\tau) + \theta_c + \gamma_t + \varepsilon_{ct}.$$

[23]Appendix Figure A.5 provides Williams' full post describing the role of SXSW 2007.

[24]Our proxy for Twitter usage is created by scraping tweets that contain any of the 100 most common English words listed in Table A.7. Our data contain any tweet that contains at least one of these words. We should therefore obtain a large fraction of the English speaking tweets at that point in time.

where $tweets_{ct}$ is the log of (one plus) the number of tweets in county c on week t, $SXSW_c^{March2007}$ is the logarithm of (one plus) the number of SXSW followers in county c that joined Twitter on March 2007 and $SXSW_c^{Pre}$ is a similarly defined variable for followers that joined Twitter before March 2007. β_τ thus illustrates, conditional on county and week fixed effects, the difference in the number of tweets sent from counties with relatively larger numbers of SXSW followers that joined on March 2007. The variables are standardized to have a mean of zero and standard deviation of one. The whiskers represent 95% confidence intervals based on standard errors clustered at the state level. The sample includes the period between the third and fourteenth week of 2007.

Figure 4b illustrates that home counties of SXSW followers who joined during the festival in March 2007 saw a rapid, disproportionate increase in Twitter usage around the time of SXSW. Importantly, however, this increase came only after the SXSW festival, and we find no evidence for pre-existing trends. This is consistent with the idea that SXSW was a catalyst for the spread of Twitter in the United States.

Appendix Figure A.6a presents additional evidence on the long-term adoption effect of the 2007 SXSW festival. It plots estimates from a similar regression as the one in Figure 4b but in a county-quarter panel covering the period from Twitter's launch in 2006 to 2016. The dependent variable is substituted by the number of Twitter users per capita in a county based on our baseline measure. The resulting S-shaped pattern in the figure is consistent with models of technology adoption in the presence of network effects. More importantly, we find that the amount of early adopters in a county still matters for the amount of Twitter usage today.[25]

5 Empirical Framework

Our identification strategy leverages the 2007 SXSW festival as a shock to early Twitter adoption. We show that, conditional on a set of controls (described in further detail below), a county's number of SXSW followers that joined Twitter in March 2007 is uncorrelated with levels and trends in election outcomes before Twitter's launch

[25] Additionally, Figure A.6b shows just how dominant Twitter users connected to the SXSW festival were among early adopters. In 2007, we estimate that around 60% of Twitter users either followed the SXSW festival or followed someone who followed SXSW and joined in March 2007. As the number of Twitter users increased over time, the importance of SXSW followers in the platform declined. But as Figure A.6a shows, the festival created persistent differences at the county level. The next section outlines how we use the SXSW festival in our 2SLS estimates.

and during its early years. It is also uncorrelated with a host of observable county characteristics. This feature of the data can be interpreted as idiosyncratic factors (e.g., who attended the 2007 SXSW, who decided to join Twitter at the time), giving us a "natural experiment" or "exogenous shock" in Twitter adoption that allows to estimate its effect on election outcomes. This interpretation is, of course, not self-evident, and we provide several pieces of evidence in its support.

An important concern is that counties whose population are more interested in the SXSW festival (and its Twitter account) may be systematically different from other counties. To address this issue, our empirical strategy exploits variation in the exact timing of when Twitter users interested in SXSW joined the platform across counties. In particular, our regressions control for the number of SXSW followers who joined in the months *before* the festival. Intuitively, our empirical strategy compares a "treatment" group of counties with SXSW followers that joined in March 2007 (during the festival) against a "control" of counties with followers that joined before. While both groups of followers were interested in SXSW, we show that only the number of followers that joined on March 2007 are predictive of later Twitter adoption, consistent with the evidence that users that joined during the festival were key in the platform's diffusion. In contrast, counties with more users that joined *before* the festival do not have more additional Twitter users in subsequent years.[26]

The "treatment" and "control" counties are similar along several characteristics. Table A.5 compares the average characteristics of three types of counties relevant for our identification strategy: 1) the 47 counties with SXSW followers that joined Twitter both in March 2007 and the "pre-period;" 2) the 108 counties with SXSW followers that joined in March 2007 (but none in the "pre-period"'); and 3) the 20 counties with SXSW that joined in the "pre-period" (but none in March 2007). Differences in vote shares in the 1996 presidential election, demographics (e.g., race, age, education), and media consumption (e.g., share that watches Fox News) are quantitatively small or zero. This is particularly true for groups (2) and (3) — which are key to the identification — with t-tests indicating that differences between the two groups are not statistically different from zero.[27] The geographical variation in the three groups of counties is shown in

[26]An alternative approach is to compare the counties of users who signed up for Twitter during SXSW 2007 with those of users who signed up during *other* festivals in the same year. We discuss the results from such an exercise in the robustness section below.

[27]Given the large number of county characteristics, we report Šidàk-corrected t-statistics, which are smaller than those generated by applying the Bonferroni correction.

Figure 3b. As the results in Table A.5 suggest, the counties do not differ systematically in size and how distant they are from major American cities.

Moreover, observable individual characteristics of SXSW followers who joined Twitter in March 2007 and the "pre-period" are also similar. We validate this using data on Twitter user profiles we obtained from the platform. Table A.8 shows that followers who joined in March 2007 have similar first names and profile descriptions compared to those that joined before: users in both groups tend to have common names (e.g., "Michael" or "Chris") and use words such as "founder" or "tech" to describe themselves in their profiles. The correlations of the frequency of first names and terms used in their bios between the two groups are 0.63 and 0.89, respectively. We also investigate differences in the political leanings of the two groups using the network-based methods we outline in Section 3. In particular, we test whether the users in March 2007 follow more Democrats or Republicans than the users in the "pre-period". We find that the political leanings of the two groups are nearly identical. A t-test rejects differences in the average political slant with a p-value of 0.93.

Specification. Motivated by the evidence above, our main results are based on estimating the following two equations:

$$Twitter\ users_c = \alpha + \beta \cdot SXSW_c^{March2007} + \gamma \cdot SXSW_c^{Pre} + \mathbf{X_c}\delta + \xi_c \tag{1}$$

$$y_c = \alpha' + \beta' \cdot SXSW_c^{March2007} + \gamma' \cdot SXSW_c^{Pre} + \mathbf{X_c}\delta' + \zeta_c, \tag{2}$$

where c indexes counties, $SXSW_c^{March2007}$ is the logarithm of (one plus) the number of SXSW followers in county c that joined Twitter on March 2007, and $SXSW_c^{Pre}$ is a similarly defined variable for followers who joined Twitter before March 2007. $\mathbf{X_c}$ is a vector of control variables. Note that the right-hand side of both equations is similar. $Twitter\ users_c$ is the logarithm of the number of Twitter users in the county (during 2014-2015). y_c are election outcomes (e.g., vote shares), which we estimate in both levels and changes (e.g., y_c can be the vote share in 2016 or the change in vote shares between 2000 and 2016).

In a 2SLS framework, equations (1) and (2) are the first-stage and reduced form, while the second stage is

$$y_c = \phi + \theta \cdot \widehat{Twitter\ users}_c + \pi \cdot SXSW_c^{Pre} + \mathbf{X_c}\rho + \varepsilon_c, \tag{3}$$

where $\widehat{Twitter\ users}_c$ is predicted from the first stage regression in equation (1). We weigh observations by turnout (total number of votes cast) in the 2000 presidential election and cluster standard errors at the state level.[28]

Identification. Formally, the identification condition for the effect of Twitter users (θ) is that $E(SXSW_c^{March2007} \cdot \varepsilon_c) = 0$ holds. Intuitively, this states that, conditional on the $SXSW_c^{Pre}$ and other controls ($\mathbf{X_c}$), the number of SXSW followers who joined in March 2007 is uncorrelated with other determinants of political outcomes y_c, implying that it only affects political outcomes via Twitter usage (the "exclusion restriction").

We provide five pieces of evidence in support of this condition. First, as discussed above, including the $SXSW_c^{Pre}$ control implies that the identifying variation comes from comparing counties with similar observable characteristics.

Second, the coefficient of $SXSW_c^{Pre}$ is small and statistically insignificant in our first stage regressions. This provides us with a "placebo" test based on checking if it is also unrelated to political outcomes in the reduced form and 2SLS regressions. Intuitively, we have two variables that are correlated with interest in the SXSW festival among early Twitter adopters, but only one predicts Twitter users in later years, allowing us to disentangle interest in the festival from its effect via more Twitter users.

Third, estimating equations (2) and (3) for different time periods shows that $SXSW_c^{March2007}$ does not correlate with both levels and trends in election outcomes before Twitter's launch in 2006 and in its early years, when the platform had few users and was unlikely to affect election outcomes. Intuitively, outcomes in "treatment" and "control" counties behaved similarly before Twitter could plausibly affect elections.

Fourth, we find an effect of $SXSW_c^{March2007}$ on Trump's vote share in 2016 and 2020 but not on House and Senate elections (neither in 2016 nor 2020 or other periods between 2000 and 2018). This pattern is consistent with an effect of Twitter, since there is more content on presidential candidates than on congressional elections in the platform.

Fifth, results based on survey data suggest the effects are concentrated among moderate or independent voters, which is also the expected pattern from Twitter having a causal effect due to voter persuasion.

Stated differently, a violation of the identification condition would require an omitted variable that correlates with $SXSW_c^{March2007}$, $Twitter\ users_c$, and y_c but is

[28]We consider spatial standard errors using the methods described in Colella et al. (2019) for robustness.

uncorrelated with: i) $SXSW_c^{Pre}$, ii) levels and trends in election results before Twitter's launch and rise to popularity, iii) the observable variables presented in Table A.5, and iv) election results in congressional elections both during the Trump elections and before, while also v) being correlated with vote choices of moderate voters. Our argument is that the existence of such an omitted variable is implausible to an extent that allows us to interpret θ as the effect of Twitter users on election outcomes.

Measurement error in county-level Twitter usage and $SXSW_c^{March2007}$ is also unlikely to explain an effect in 2016 and 2020 presidential elections, but not in previous presidential elections or any other congressional election. Moreover, $SXSW_c^{Pre}$ is constructed similarly as $SXSW_c^{March2007}$ and should thus have similar measurement error. However, $SXSW_c^{Pre}$ is uncorrelated with Twitter usage and election outcomes.

Lastly, another possible concern is that the SXSW adoption shock led to differences in the *composition* of Twitter users when compared to other U.S. counties. In particular, one might be concerned that the SXSW festival lead to a more liberal Twitter population in the treated counties. While this would not influence the causal interpretation of our findings, it could make the local average treatment effect harder to interpret. Three pieces of evidence suggest that this appears to be an unlikely concern. First, as we show in Appendix Figure A.6b, Twitter's user base became less connected to the SXSW festival over time and, in this process, likely reached people from diverse backgrounds. Second, the findings of Müller and Schwarz (2019) indicate that the SXSW adoption shock was associated with an increase in hate crime with Trump's presidential run. This suggests that the shock eventually reached even the right-wing fringes of the political spectrum. Third, we can directly address this concern by comparing the profiles of Twitter users in SXSW home counties with those in the rest of the country. The results are presented in Appendix Table A.9. We find that the user profiles in SXSW counties are highly similar to the general Twitter population. If the Twitter population in SXSW counties was significantly more liberal, their Twitter biographies should also be different. We find similar results when we look at which politicians users in the different counties follow. If anything, Twitter users in the "pre-period" counties appear to have a slightly more liberal Twitter network.

6 Results

6.1 Main results

First-stage. Table 1 reports results from estimating equation (1) with different sets of control variables (described in Appendix Table A.6). The results indicate that counties with more SXSW followers who joined Twitter in March 2007 have higher numbers of Twitter users during 2014-2015. Since the variables are in logs, the coefficients can be interpreted as elasticities. A one standard deviation increase in SXSW followers in March 2007 (0.32) is associated with around 16% more Twitter users. The results do not seem to be sensitive to the set of included covariates. In contrast, the coefficients for SXSW followers before the 2007 festival are statistically insignificant and small in size: Twitter usage in 2014-2015 is not higher in areas with more SXSW followers who joined Twitter before March 2007.

Figure 5 presents the graphical representation of the estimates in column (5) of Table 1. Specifically, we show a binned scatter plot of $Twitter\ users_c$ against $SXSW_c^{March2007}$ after both variables are "residualized" by partialling out the control variables. The figure is constructed by dividing the x-axis variable into 40 equal-sized bins and plotting the average values of both variables in each bin.[29]

[Table 1 about here.]

[Figure 5 about here.]

Reduced Form and 2SLS Estimates. Table 2 shows the reduced form estimates from equation (2) and both OLS and 2SLS estimates of equation (3), focusing on the Republican vote share in the 2016 and 2020 presidential elections. The specifications across columns match those in Table 1. Panel B indicates that the number of SXSW followers who joined Twitter in March 2007 is associated with a lower Republican vote share. Panel C presents the 2SLS effects of Twitter usage on vote shares. The 2SLS estimate in column (5) indicates that a 10% increase in the number of Twitter users in a county lowers Trump's vote share by 0.21 p.p. (e.g., a reduction from a 46.1%

[29]The fitted line is based on the unbinned data. Observations are weighted by turnout in the 2000 presidential election. This procedure guarantees the slope of the fitted line matches the estimate on column (5) of Table 1.

vote share to 45.8%).[30] The results for the 2020 presidential election shown in Table 2 column (6)-(10) are nearly identical.

A first draft of this paper, using only data up to the 2016 election, was posted online on October 2020. When updating it to include the November 2020 election results, we made no revisions to the research design and regression specifications (e.g., sample selection, choice of controls, and variable definitions). In the case of Table 2, columns (1)-(5) are exactly the same in this version and in the October 2020 version. Since columns (6)-(10) replicate the same specifications ("right hand sides") using 2020 election outcomes, this can be interpreted as a "pre-registered" research design. We followed the same approach throughout this draft: every figure or table presenting results for the 2020 election exactly replicates the specifications used for previous elections in our October 2020 draft.[31]

Although the estimated effects are always negative and significant at the 1% level, comparing columns shows that the effect sizes vary somewhat with the inclusion of controls, especially demographic and socioeconomic ones. This sensitivity to controls is perhaps expected given their explanatory power over vote shares. The results in other papers that explore effects on vote shares in similar frameworks, such as DellaVigna and Kaplan (2007), Martin and Yurukoglu (2017), and Autor et al. (2020), show a similar sensitivity to controls. We also apply the Oster (2019) approach of using coefficient stability to gauge the potential importance of unobservable variables in driving the results. We compare our specifications with all controls (columns 5 and 10) to those with the fewest controls (columns 1 and 6) and obtain an "Oster-δ" of approximately seven for both 2016 and 2020. This suggests, in order for the true effect to be zero, unobservable variables would have to be seven times as "important" as the (numerous) controls added in columns (5) and (10) in driving selection into "treatment."[32]

Figure 6a shows the graphical representation of the estimates in column (5) of Panel B of Table 2. Similarly, Figure 6c visualizes the relationship underlying the estimates in column (5) of Panel B of Table 2. Both figures are constructed similarly to Figure 5 but using the 2016 Republican vote share as the y-axis variable. The OLS

[30]The F-statistic of our estimated first-stage range from 70 to 120. This suggests that estimation and inference concerns related to weak instruments are unlikely to apply in our case.

[31]The October 2020 draft is available at Social Science Research Network (SSRN): `https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3719998`.

[32]The R^2 of regressions with the fewest controls (columns 1 and 6) is approximately 0.6, while it is 0.94 for the regressions with the most controls (columns 5 and 10). Intuitively, the observable controls explain a large part of the variation in vote shares but only generating a relatively modest change in coefficient sizes. This is what generates a large "Oster-δ."

(non-instrumented) relationship between Twitter users and the Republican vote share from Panel A of Table 2 are shown in Figure 6b and Figure 6d. Both are also negative but slightly smaller in magnitude than the 2SLS estimates.

Magnitudes and Persuasion Rates. To interpret the magnitudes of our estimates, we calculate a persuasion rate following DellaVigna and Gentzkow (2010). It can be approximated as $\theta \cdot \frac{t}{e(1-y)}$, where θ is the 2SLS estimate, y is average Republican vote share, e is the average exposure of American adults to Twitter, and t is the share of adults that turn out to vote. Using the estimate for θ from columns (5) and (10) of Table 2, the persuasion rate is 8.6% and 9.4% for 2016 and 2020, respectively. It implies that, in 2016, one out of every twelve active Twitter users that voted for Clinton would not have done so if they had not been exposed to the platform.[33]

This rate is smaller than the estimated pro-Republican persuasion rate of Fox News, which Martin and Yurukoglu (2017) estimate to range between 27% and 58% (depending on the year).[34] It is also smaller than the 19.5% pro-Democrat persuasion rate that Gerber et al. (2009) estimate for the Washington Post. As a further comparison, Gentzkow et al. (2011) estimate a persuasion rate of 12.9% for the effect of reading a local newspaper in the 1869-1928 period on voter turnout. DellaVigna and Gentzkow (2010) report that randomized get-out-the-vote canvassing experiments have estimated persuasion rates in the 10-15% range.

Further Robustness and Additional Tests. The Online Appendix presents a number of additional sensitivity checks. In Table A.10, we consider changes to the baseline regression specification. In particular, we allow for unweighted regressions; alternative functional forms of the pre-SXSW user variable; restrict the sample to the sub-sample of counties where we observe either SXSW followers who joined in March 2007 or the pre-period; and allow for flexible spatial correlation in the standard errors.

[33]The persuasion rate re-scales effect sizes by how many individuals are exposed to the platform and how many are not already persuaded. For marginal changes in exposure, the formula is $f = \frac{dy}{de} \cdot \frac{t}{1-y}$ (DellaVigna and Gentzkow, 2010). Since our estimate θ is the semi-elasticity $\frac{dy}{de} \cdot e$, we obtain $f = \theta \cdot \frac{t}{e(1-y)}$. In 2016, $y = 0.46$, $t = 0.55$, while $y = 0.47$ and $t = 0.62$ in 2020. We assume $e = 0.25$ for both periods, based on roughly a quarter of American adults being active Twitter users (Pew Research Center, 2019c). This implicitly assumes that Twitter usage among voters is the same as the overall population. If voters are over-represented among Twitter users, the persuasion rate would be smaller. On one hand, Twitter users are younger (which is associated with lower turnout) but more educated (which is associated with higher turnout) than the general population. Note also that we estimate county-level effects, which may also capture local spillovers and social interaction effects.

[34]DellaVigna and Kaplan (2007) estimate a smaller persuasion rate of 11.6% for Fox News.

We also allow for an alternative approach to control for selection into the SXSW festival by controlling for the number of users from each county that tweeted about other festivals in 2007 (Burning Man, Coachella, and Lollapalooza) in column (6). Further, Table A.12 replaces our baseline time-invariant measure of Twitter usage (making use of all available user data) with a time-varying measure based on how many users were using the platform in a given year. None of these adjustments make a substantial difference in the magnitudes or statistical significance of the estimates.

Figure A.10 provides additional robustness checks for our baseline results for the 2016 and 2020 presidential vote shares. Here, we plot the estimated θ of our 2SLS equation (3) while flexibly allowing the included control variables to vary. The resulting "specification curves" suggest that our results are robust to how our regressions are specified. The estimated coefficients are always negative, almost always statistically significant at the 5% level, and in the overwhelming number of specifications considerably more negative than our "baseline estimates", which is marked by the vertical line.

Online Appendix Table A.16 reports results for additional outcome variables, all of which support the idea that Twitter exerts a pro-Democrat effect. In column (1), we use a probit IV model to investigate the likelihood of a county switching from Obama in 2008 to Trump in 2016. The coefficient suggests that a one standard deviation increase in Twitter usage is associated with a 24% lower probability of a county electing Obama in 2008 and Trump in 2016. Columns 2 and 3 look at changes in campaign donations to Democrats and Republicans between 2000 and 2016. We find a positive and statistically significant effect for donations to Democrats, and no effect for Republicans. Lastly, columns 4 and 5 look at approval ratings for President Trump in 2017 based on data from the Gallup Daily Poll. We find that exposure to social media is associated with a decrease in Trump's popularity, and more so among Republicans.

[Figure 6 about here.]

[Table 2 about here.]

Placebo Test. The coefficients on $SXSW_C^{Pre}$ in Table 2 are statistically insignificant and substantially smaller than those on $SXSW_c^{March2007}$. As discussed in Section 5, this provides support for our identification condition (exclusion restriction). Suppose that our instrument merely captured that counties with an interest in SXSW's Twitter account during the platform's early years also differ in (unobservable) characteristics that predict the 2016 election outcome. If this was the case, the coefficients on $SXSW_C^{Pre}$ should be similar in size to those on $SXSW_c^{March2007}$. Intuitively, we have two variables that are correlated with interest in the SXSW festival, but only one predicts Twitter users in later years, allowing us to disentangle interest in the festival (and its correlates) from its effect via more Twitter users.

The 2007 SXSW Shock and Previous Election Outcomes Table 3 repeats the analysis from column (5) of Table 2 using Republican vote share in the previous presidential elections of 2000, 2004, 2008, and 2012 as the dependent variable. All estimates for those years are substantially smaller than the ones for 2016 and 2020 and statistically insignificant. For 2000, 2004 and 2008, this can be interpreted as a placebo or pre-trends test: conditional on the covariates, our instrument is uncorrelated with outcomes before Twitter's launch (2000 and 2004) and when the platform had few users (2008). We return to the comparison to 2012, during which Twitter use was more widespread, in Section 6.3. In Appendix Figure A.7, we further show the reduced form estimates for presidential election going back as far as 1924. We find that our instrument is also uncorrelated with any of the earlier presidential election results. As discussed in Section 5, this result lends additional support for our exclusion restriction. If our instrument merely captured uncontrolled differences across counties, these should also correlate with vote shares in previous elections.

While these findings make it unlikely that our instrument is correlated with pro-Democratic attitudes at the county level, a possible concern could be that we are picking up "anti-populist" attitudes, which could have harmed Trump's electoral results. To address this concern, we turn to the historical case study of Ross Perot's political campaign in 1992 and 1996. Perot, a billionaire businessman, also ran as a "third-party candidate" on a populist platform. However, when we replace the dependent variable with the third party vote share in the 1992 and 1996 presidential election (see Appendix Table A.13), we find no evidence that our instrument is associated with lower vote shares for Ross Perot. This makes it unlikely we are capturing differences in "demand for populism" across counties.[35]

[35]In Appendix Table A.14, we also investigate the vote shares in the 2020 democratic primaries. Here we find a positive association between Twitter exposure and the vote share of Bernie Sanders, often described as a left-wing populist. This further speaks against the hypothesis of "anti-populist" sentiment.

Effects on Vote Share Changes. We also consider specifications of equations (2) and (3) using vote share *changes* instead of *levels* as the dependent variable. All our estimates based on changes take differences relative to the base year 2000 (akin to the approach in Autor et al. (2020)) and use the full set of controls (as in columns 5 and 10 of Table 2). Figure 7a plots the reduced form estimates for changes in the Republican vote share in presidential elections.

The results corroborate the previously presented evidence based on specification in levels. Our instrument is essentially uncorrelated not only with *levels* but also with *changes* (or *trends*) in election outcomes during the 2000-2012 period. Given our arguments above, this also lends support for our identification strategy. The reduced form effects for 2016 and 2020 are similar to the one estimated using levels. For example, the estimated effect (θ) for 2016 using *changes* is -0.017, similar to the one estimated in levels (-0.021).[36]

Effects on Turnout and Congressional Elections. Figure 7b, Figure 8a, and Figure 8b replicate the exercise in Figure 7a using voter turnout and vote shares in House and Senate elections as the outcomes. We do not find a statistically significant association between our instrument and election turnout except for 2020. Before 2020, the estimated point effects are usually small. For example, the upper bound on the 95% confidence interval of the 2SLS estimate for the effect of turnout in the 2016 election implies that a 10% increase in Twitter users raises turnout by 0.036 p.p. (Appendix Table A.17).

In the 2020 election, which saw the highest turnout rate in more than a century (NPR, 2020c), we find that Twitter is associated with a larger fraction of the voting age population casting their ballot. However, given the small and insignificant effect on turnout in 2016, turnout alone is unlikely to explain the effect on Republican vote shares. Why Twitter had an effect on 2020 turnout but not in the previous election is not clear. One possible explanation could be that calls to turn out and vote were widespread on the platform, partially because of an initiative by Twitter itself (Twitter, 2020). The 2020 elections were also not only unique in its high turnout, but also in the prevalence of mail and early voting because of the Covid-19 pandemic.

The coefficients for House and Senate races are more noisily estimated, particularly for the smaller sample of Senate races (where only a third of seats is renewed every two

[36]Appendix Table A.11 present the OLS and 2SLS estimates.

years). Overall, there is little evidence suggesting an effect of Twitter on congressional elections, including in 2016, the 2018 midterm election, and 2020. Finding an effect on presidential vote shares but not in these "down-ballot" races is perhaps expected since content on presidential candidates (and in particular on Trump in 2016 and 2020) is more common on Twitter than content on congressional races.[37]

Discussion of Identification Condition. As discussed in more detail in Section 5, there are five pieces of evidence supporting our identification condition: i) our empirical strategy compares relatively similar counties (Section 5); ii) the placebo test based on the coefficient on $SXSW_c^{Pre}$; iii) the instrument being uncorrelated with election outcomes in the 1924-2012 period; and iv) evidence suggesting Twitter has not affected House and Senate races; while at the same time v) the instrument being correlated with vote choices of moderate voters in particular.

Given this, a violation of the identification condition would require an omitted variable that correlates with the instrument, Twitter usage, and Trump's vote share in 2016 and 2020 but is uncorrelated with: i) $SXSW_c^{Pre}$, ii) levels and trends in election results before Twitter's launch and rise to popularity, iii) the observable variables presented in Table A.5, and iv) election results in congressional elections. At the same time, such omitted variable would also v) be more strongly correlated with the vote choices of moderates and independents than "partisans." Our argument that is the existence of such omitted variable is unlikely.

[Table 3 about here.]

[Figure 7 about here.]

[Figure 8 about here.]

[37]Appendix Table A.18 presents the 2SLS estimates for House and Senate races. To accommodate the Senate's six-year terms, we take changes relative to 2000, 1998, and 1996, instead of always using 2000 (as we do for other outcomes).

Towards an Average Treatment Effect As with any instrument, our 2SLS results identify a local average treatment effect (LATE). In our setting, the "compliers" are counties with higher Twitter usage as a result of the inflow of SXSW attendees. While the negative treatment effect of Twitter usage for these counties is in itself an interesting finding, the ATE for the US overall—and therefore the overall impact of Twitter on elections—may differ. However, two pieces of evidence suggest that our estimates, despite this concern, allow us to infer information about the ATE.

A first indication that our estimates comes from comparing the OLS and 2SLS results in Table 2. Both estimates are always negative and relatively similar in magnitude. Second, we build on the approach suggested by Andrews and Oster (2019) and more formally investigate the external validity bias of our estimates. For experimental settings, Andrews and Oster (2019) suggest using the observable heterogeneity in estimated treatment effects within the experimental sample to learn about the ATE in the overall population. Similarly, we can use the heterogeneity of treatment effects within counties that provide the variation that identify our results to approximate the ATE for the United States as a whole. Using all included control variables from our main specification for the prediction of heterogeneity of the treatment effect, the Andrews and Oster (2019) approach suggests that the ATE should, if anything, be *larger* than the LATE we estimate in our baseline results. This seems plausible as the more urban counties for which we have variation in our instrument tend to be Democratic strongholds, and thus likely have fewer independents and moderate Republicans, for which we find the largest persuasion effects (in survey data). We provide additional details on our approach in Appendix A.5.[38]

6.2 Effects Are Concentrated Among Moderate Voters

If social media indeed matters for election outcomes, we would expect there to be heterogeneous effects across groups of voters. In particular, Bayesian updating suggest that voters who do not hold strong priors about a particular party should be more likely persuaded. We test this prediction using individuals' voting decision from the 2016

[38] As our setting differs from the one discussed in Andrews and Oster (2019), some adjustments to our baseline estimation were required. We estimate the treatment effect exclusively in the subset of counties for which either $SXSW_c^{March\ 2007}$ or $SXSW_c^{Pre}$ are not equal to zero. Then, we define a treatment indicator variable equal to 1 for counties with SXSW followers who joined in March 2007.

CCES. In particular, we estimate the following instrumental variable Probit regression:

$$y_{ic} = \phi + \theta \cdot \widehat{Twitter\ users}_c + \pi \cdot SXSW_c^{Pre} + \mathbf{X}_{ic}\rho + \varepsilon_{ic}, \tag{4}$$

where y_{ic} is an indicator variable equal to 1 if an individual i living in county c voted for Trump in the 2016 election and 0 for Clinton.[39] The definition of the county-level variables $Twitter\ usage_c$ and $SXSW_c^{Pre}$ remains unchanged. $\mathbf{X}_{ic}$ is now a vector of individual-level control variables including age, gender, race, family income, and education. We again instrument for county-level Twitter usage based on the SXSW followers who joined in March 2007.

Table 4 presents results from estimating equation (4). In Panel A, Column (1) suggests county-level Twitter usage has a statistically significant negative effect on the likelihood to vote for Trump. The marginal effect implies that a 10% increase in the number of Twitter users in a county would lower Trump's vote share by 0.47 p.p..[40]

Columns (2)-(6) report results estimated separately by voters' reported party affiliation. The effect is strongest for voters who identify as independents, and thus likely to not hold strong priors. We also find a negative coefficient for moderate Republicans, which is statistically significant at the 10% level. The results suggest weaker or zero effects for those with stronger political views, whether Republican or Democrat.

These results on party affiliation further vary with age in a way that may be suggestive of a role for social media. In particular, Panels B and C repeat the exercise of splitting CCES respondents by their party affiliation, but further divide voters into those below and above 40. Since Twitter users tend to be younger than the general population (Section 2), one may expect a larger effects on vote outcomes among voters below 40.

Indeed, we find larger marginal effects for $Log(Twitter\ users)$ among younger voters. For independents, the estimate for young voters is 20% larger than for older voters (-0.071 compared to -0.059). Among moderate Republicans and Democrats, the estimated coefficients are close to zero for voters aged 40+ but sizeable for younger voters (although they are not statistically significant at conventional levels). Because young voters are less likely to vote for Trump, this implies larger elasticities of Twitter on vote outcomes for those below 40 relative to the baseline probabilities.

[39] In unreported regressions, we do not find that votes for Jill Stein varied with Twitter usage.

[40] This effect size is within the range of the county-level estimates presented in Table 2. Appendix Table A.15 shows this baseline result is robust to using only individuals with validated turnout and/or who stated that they originally intended to vote for Trump in the pre-election wave of the CCES.

We present further support for Twitter having persuasion effects on moderates using county-level data in Appendix Table A.19. We estimate our county-level specification (equation 3) for the 2016 elections, but split counties based on how consistently they voted for either the Republican or the Democratic party. Specifically, we define "swing counties" as counties that were not consistently won by one party in the presidential elections from 2000 to 2012. For the 2016 presidential elections, we find that Twitter usage only negatively impacts the Republican vote share in "swing" counties. We find no evidence for Republican or Democratic strongholds, where people likely have the strongest priors. The patterns are similar in 2020. But here, we also find a small effect on counties that usually vote Republican, which could suggest that the effect on moderate Republicans we find in the CCES also apply to the county level.

[Table 4 about here.]

6.3 Potential Mechanisms

The findings above suggest that Twitter had an effect in 2016 and 2020, but not during previous presidential elections. We address three potential explanations for this pattern: lack of familiarity with social media (a *learning channel*), changes in social media's "slant" (a *content channel*), and Trump's role as an outsider candidate (a *political shock channel*).

The first factor could be the reach of and familiarity with social media content. In 2008, social media was a relatively new type of technology. Only a quarter of American adults used *any* social media platform and only 10% of internet users posted political commentary on social media (Pew Research Center, 2009, 2011). Figure A.1a shows that Twitter, which was founded in 2006, only had around one million users during the 2008 elections, compared to 40 million in 2012, 67 million in 2016, and 69 million in 2020 (Statista, 2019, 2020). Twitter's limited reach and novelty might have initially restricted its impact on voters.

The second possible explanation is that social media's content changed between 2008 and 2016. It is conceivable that, in line with changes in the slant of cable news (e.g., Martin and Yurukoglu, 2017), the typical content to which Twitter users are exposed has become more left-leaning over time.

A third reason is that Trump's political rise constituted a considerable shock to the U.S. political system. In this view, Twitter may not have partisan effects *per se*. Instead, the platform may have served as a conduit for spreading sentiments or information about Trump.

Two pieces of evidence presented above are consistent with the political shock channel. First, if Twitter had little effect before 2016 because it was not widely used, its effect on vote shares should systematically increase over time. We do not find evidence supporting this idea in effects for presidential, House, and Senate elections (Figures 7 and 8). Instead, we find a discontinuous negative effect in the 2016 presidential election that persists in 2020. Second, we do not find substantial effects for the 2016, 2018, and 2020 House and Senate elections. This implies that Twitter usage lowered Trump's vote share without substantially affecting other Republican candidates *on the same election day.*

Results from the 2016 Republican Primaries. We provide additional evidence for a Trump-specific effect of Twitter exposure by investigating the 2016 county-level Republican primaries results. The primaries allow us to focus on the favorability of different candidates among Republican voters. The results from this exercise are presented in Table 5. We find that Twitter usage is associated with a lower vote share for Trump. We also find a positive effect on the vote share of John Kasich, the most moderate of the major Republican candidates.[41]

[Table 5 about here.]

Results from Gallup Approval Ratings. A similar pattern emerges when we use data from the Gallup Daily Tracker, which contains approval ratings for three other Republican presidential candidates who ran alongside Trump during the primaries (Ted Cruz, Marco Rubio, and Kasich). Table 6 shows the results of running individual-level IV probit regressions as in equation (4), where the dependent variable is an indicator variable equal to one if the respondent approved of a specific candidate. As in Table 4, we differentiate between respondents' political affiliation.[42]

Table 6 confirms our main county-level result from general elections and primaries: Twitter usage is associated lower approval of Trump, especially among independents

[41] In Appendix Table A.14, we also investigate the voting behavior in the 2016 and 2020 Democratic primaries. Twitter usage appears to be associated with a higher support for Bernie Sanders in 2020.

[42] We pool people who identify as leaning Republicans or Democrats with independents, because—in contrast to the CCES data—only a few individuals in the survey are classified as "leaners."

(who are presumably more likely to be persuaded by social media content). We also find lower approval of Cruz, who is substantially more right-wing than other presidential primary candidates in recent years (FiveThirtyEight, 2015). We find no link between Twitter use and approval of the more moderate Republican candidates, Rubio and Kasich. For the Democrat candidates, we find an effect for Clinton's but not Sanders' approval.[43]

Taken together, these results are consistent with Twitter turning voters against voting for Trump in particular and not against the Republican party more generally. Our results may also explain the absence of an effect in the 2008 and 2012 elections: Obama's opponents John McCain and Mitt Romney were widely considered to be moderate Republicans (e.g., more similar to Kasich than Trump or Cruz).[44]

[Table 6 about here.]

Slant of Election-Related Tweets. We provide further support for the hypothesis that Trump's 2016 campaign and presidency triggered opposition on Twitter by analyzing the content of more than 460 million tweets mentioning the last name of presidential candidates during the 2012, 2016, and 2020 presidential campaigns.

First, we classify the tweets' slant as Republican, Democrat, or neutral using two approaches described in Section 3. In the first case, we classify the political affiliation of Twitter users by counting the number of Democrat and Republican Congress members they follow. If a user follows more Democrats than Republicans, they are classified as Democrat, and vice-versa. Tweets sent by a user classified as Democrat are classified as Democrat, and so forth.[45] In the second case, we classify individual tweets (not users) following an approach in the spirit of Gentzkow and Shapiro (2010) and train a L2

[43]Note that Appendix Table A.14 reports a significant positive effect for Sanders county-level primary vote share in 2020, but not in 2016. As mentioned earlier, Gallup Daily Tracker data is not available for 2020 at the time of writing. Note also that Gallup collects data on candidate approval (as opposed to vote choice) for the entire population (as opposed to Democratic primaries votes), which may explain some differences between these results and the ones based on county-level primaries results.

[44]As previously discussed, the number of Twitter users in 2008 was relatively small, but by 2012, it was relatively close to its 2016 level (Figure A.1a).

[45]Users who follow an equal number of Democrats and Republican or no Congress members are classified as neutral. This approach is similar in spirit to Barberá (2015), who uses the network of Twitter users to create a measure of ideology. Because we are only interested in a binary measure of partisan slant and not the ideological distance of users, we do not estimate the full Bayesian ideal point mode. The advantage of our simplified approach is that it is faster to compute and the resulting measure is easier to interpret.

regularized logistic regression classifier to predict whether a tweet is more likely to have a Democrat or Republican slant, depending on its content's similarity to tweets sent by Congress members. If a tweet's content has higher similarity with those of Democratic Congress members, it is classified as Democratic, and as Republican otherwise.[46]

Figure 9 plots the amount of Twitter attention directed at the Republican and Democratic presidential candidates in the 2012, 2016, and 2020 elections, as well as the tweets' estimated slant based on users' following of Congress members. To account for the attention and popularity of tweets, we base the graphs on the number of "likes" the tweets mentioning the last name of candidates received. In Appendix Figure A.8, we confirm that the results are similar using the number of tweets and when we base the slant classification on the text of the tweets (Figure A.9).[47]

Panel A shows the number of "likes" for tweets mentioning the Republican presidential candidate (Romney and Trump), while Panel B provides similar evidence for the Democrats (Obama, Clinton, and Biden). There are three noteworthy facts presented in the figure. First, there was a sizable growth in the overall volume of Twitter content mentioning presidential candidates. Second, the number of "likes" for tweets mentioning Trump is larger than those mentioning his opponents (the difference is fourfold in 2016 and almost threefold in 2020). Note that a "like" for a tweet mentioning a candidate can occur for tweets that are positive or negative about the candidate, so the overall size of the bars are not informative about slant or sentiments of Twitter content.

Third, Figure 9 also breaks down the share of tweets mentioning the candidates by slant. The content sent by users classified as Democrats are more sizable than that from those classified as Republicans. In particular, the amount of attention (proxied via "likes") on Twitter content mentioning Trump posted by Democrats is almost twice as large as the amount posted from Republicans (for both 2016 and 2020). On the other hand, content on Biden was more likely to have a Democrat slant and content on Clinton was almost equally likely to have a Democrat or Republican slant.

[46]See Section 3 and Appendix A.1.1 in the Appendix for more details. In unreported robustness checks, we confirm that these findings are robust using different slant cutoffs for classifying Republican and Democratic tweets, such as only classifying tweets for which the class probabilities are above 75% or 90%.

[47]Twitter users can choose to "like" each tweet they see in their "timeline." A user can only "like" a particular tweet once. "Likes" thus provide an useful metric since they capture the popularity and attention that the content received. For example, if an account sent millions of Republican-slanted tweets about Clinton, but such account had few followers and thus few users who can "like" the message, it would not meaningfully affect measures based on "likes," but could potentially do so for measures based on number of tweets.

Overall, a potential interpretation of these results is as follows. Twitter users, and users of other social media platforms, are more likely to be young, well-educated, live in dense urban areas, and support the Democratic party (see discussion in Section 2). Perhaps as a result, Democratic politicians are more popular on Twitter than Republicans (Figure 1). In 2016 and 2020, Twitter became a vehicle for spreading opinions, particularly from Democratic-slanted users, on Trump. This may, in turn, have persuaded voters with weaker priors—independents and perhaps more moderate Republicans—to vote against Trump in the presidential election.[48]

[Figure 9 about here.]

7 Conclusion

Election officials around the globe are concerned about social media's increasing influence on voting decisions (e.g. NPR, 2020a). At the time of writing, there is a heated debate about whether platform providers should "moderate" election-related content in the U.S. (e.g. Politico, 2020). Exploiting variation based on a shock to Twitter's initial rise to popularity, our paper provides some of the first empirical evidence that social media can affect election outcomes.

We find that Twitter lowered the Republican party's vote share in the 2016 and 2020 presidential elections. While this finding runs counter to a popular narrative that places social media at the heart of Trump's election win, it is consistent with a growing body of evidence showing that social media users were less, not more likely to vote for Trump in 2016 or hold polarized views (Boxell et al., 2017, 2018).

We also provide support for the idea that the demographics of Twitter users may account for the platform's partisan effects. People who use Twitter are 25 percentage points more likely to identify as Democrats rather than Republican, and Democratic politicians are more popular on Twitter than Republican ones. Our work suggests that this environment not only reflects selection of like-minded individuals, but also affects voting decisions, particularly for people with more moderate views.

[48]Note that the 2012 election differed from 2016 and 2020 both in terms of having less twitter content referring to it (as Figure A.9 indicates) and also for having a more moderate Republican candidate (Romney) that may not have attracted as much Democrat-slanted content.

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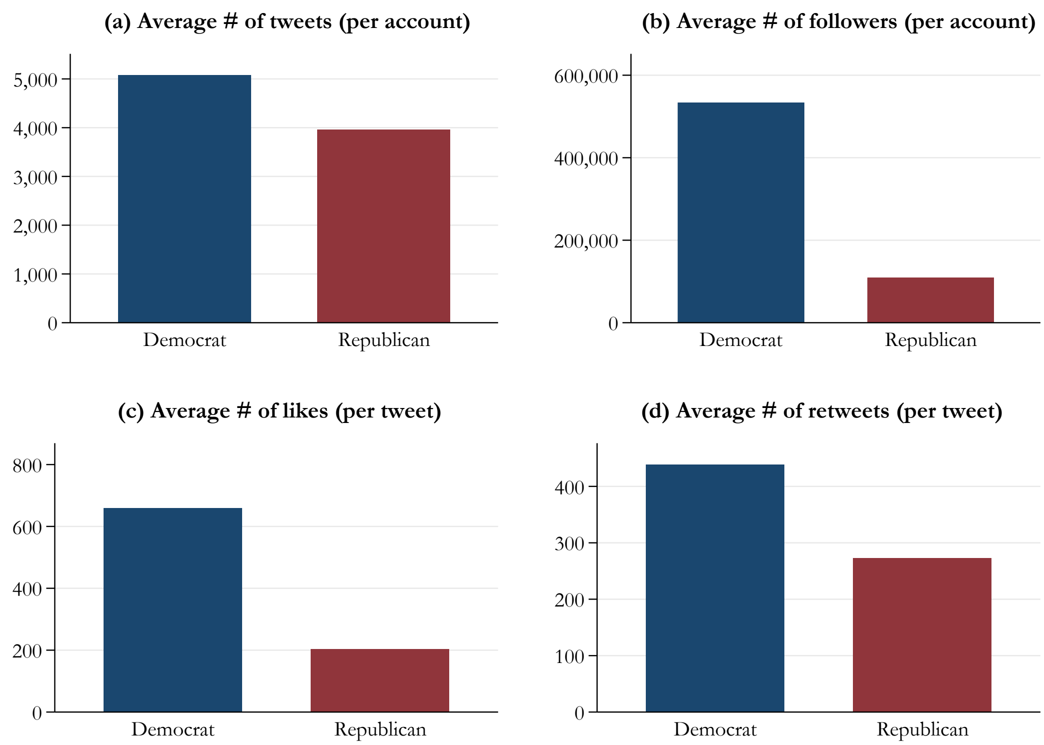
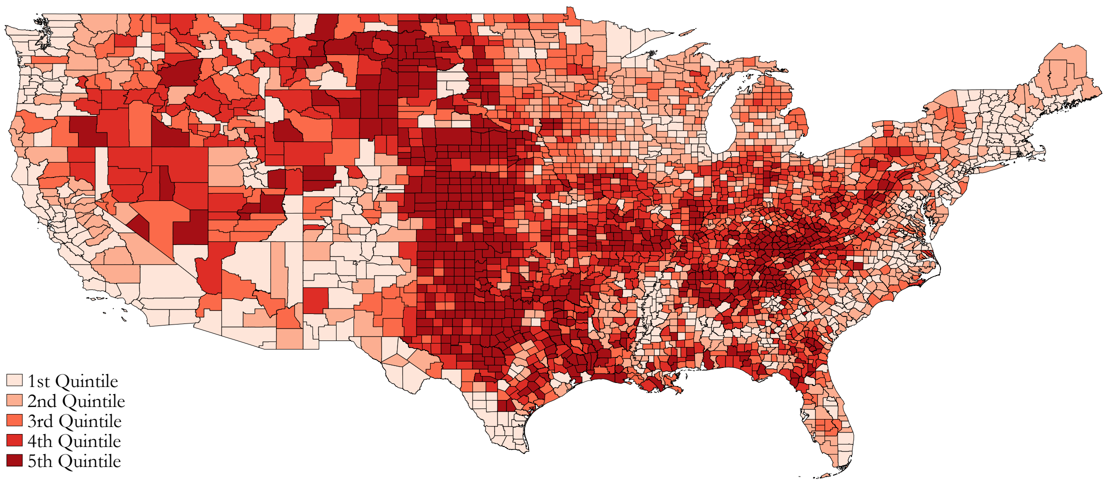
Figure 1: Twitter Reach by Party



Notes: This figure plots data on the Twitter reach of Congress members. The sample includes all 901 senators and House representatives who were in office between 2007 and 2019 for whom we could identify a Twitter account. For each account, we plot the average number of tweets and followers, and the average number of "likes" and retweets of their tweets. Appendix Figure A.2 replicates the figure using medians instead of averages. The data were collected from Twitter in November 2019.

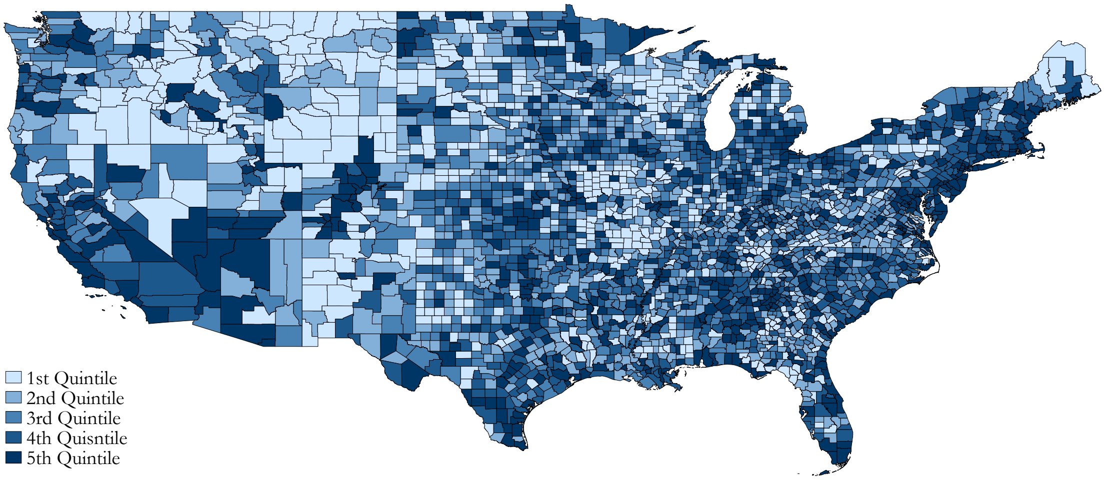
Figure 2: Republican Vote Share in the 2016 Presidential Election



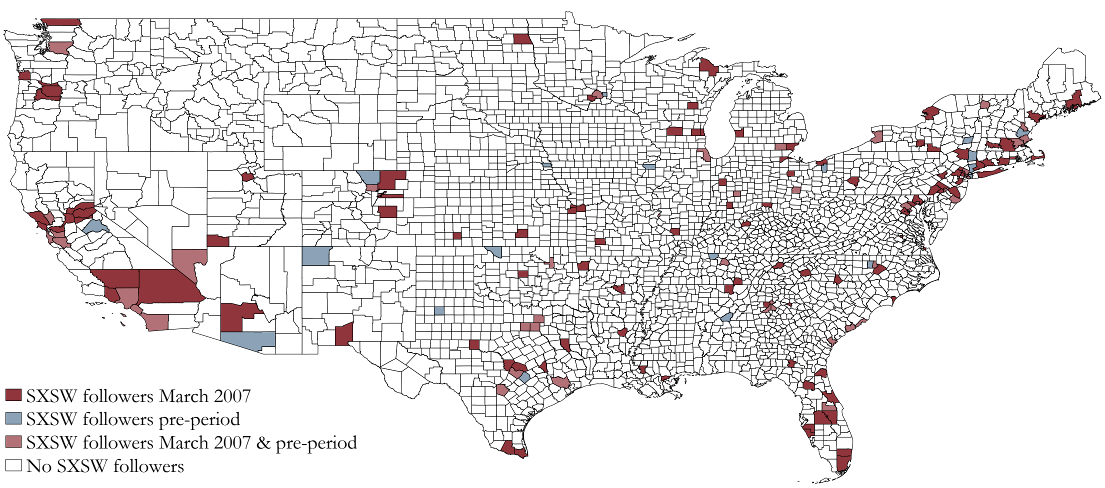
Notes: This map plots the geographical distribution of the Republican two-party vote share in the 2016 presidential election.

Figure 3: Twitter Usage and Identifying Variation

(a) Twitter Usage per Capita



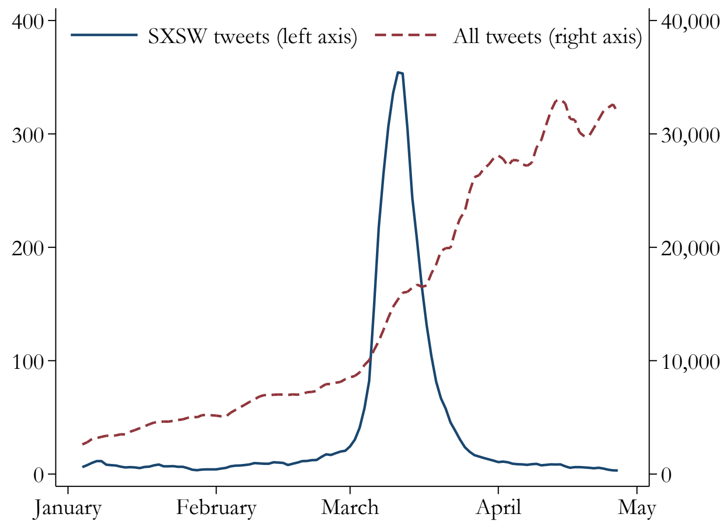
(b) Identifying Variation



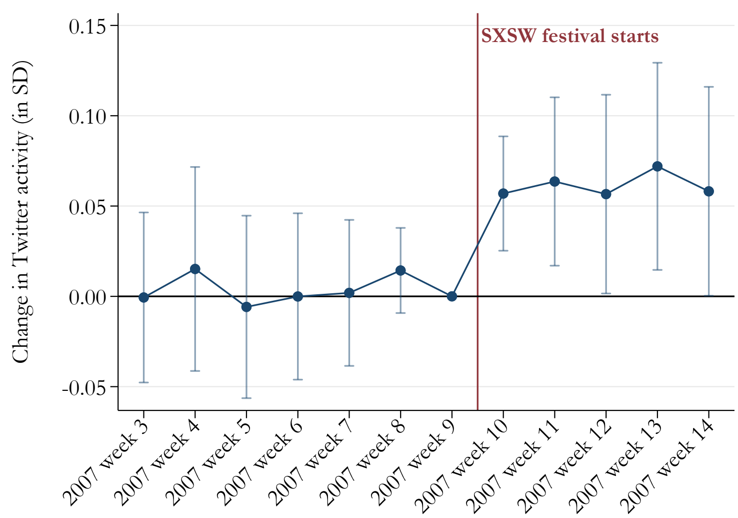
Notes: This map plots the proxy for social media usage based on data from Twitter and the identifying variation of our instrument. Panel (a) plots quintiles of the number of Twitter users per capita. Panel (b) plots the three types of counties relevant for our identification strategy: 1) the 47 counties with SXSW followers that joined Twitter both in March 2007 and the "pre-period" (light red); 2) the 108 counties with SXSW followers that joined in March 2007, but none in the "pre-period" (dark red); and 3) the 20 counties with SXSW that joined in the "pre-period," but none in March 2007 (blue).

Figure 4: South by Southwest (SXSW) 2007 and the Spread of Twitter

(a) Twitter Activity Around SXSW 2007

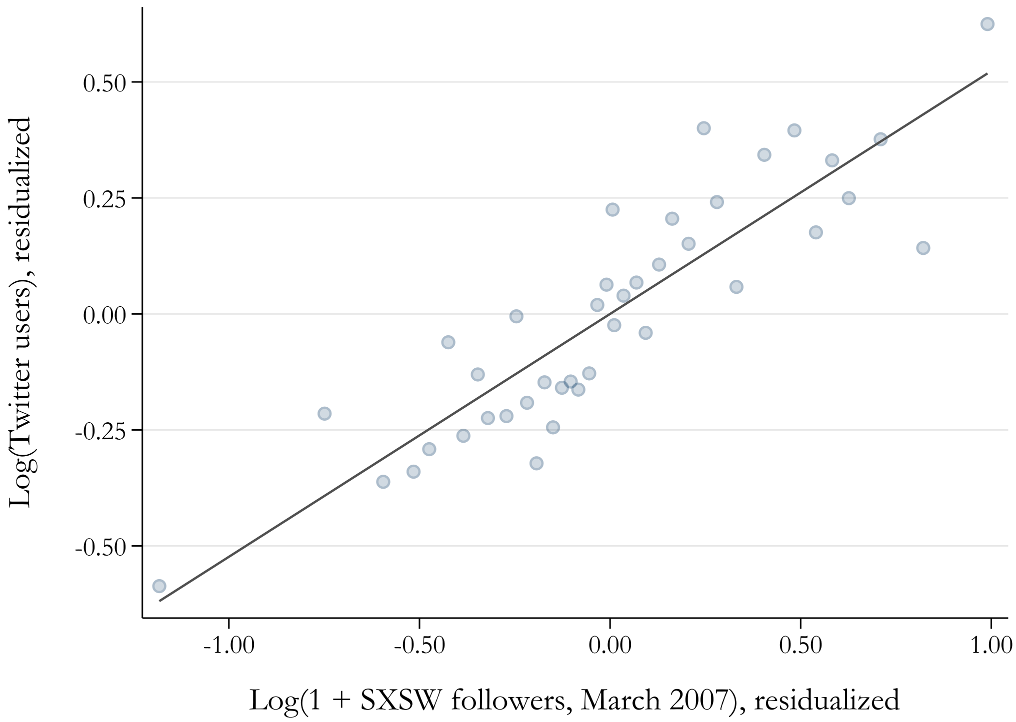


(b) SXSW and Local Twitter Adoption



Notes: Panel (a) plots the total number of tweets and the number of tweets containing the term "SXSW" over time, smoothed using a 7-day moving average. Panel (b) plots the estimates of β_τ from the panel event study regression $tweets_{ct} = \sum_\tau \beta_\tau SXSW_c^{March2007} \times 1(t = \tau) + \sum_\tau \delta_\tau SXSW_c^{Pre} \times 1(t = \tau) + \theta_c + \gamma_t + \varepsilon_{ct}$ where $tweets_{ct}$ is the log of (one plus) the number of tweets in county c on week t, $SXSW_c^{March2007}$ is the logarithm of (one plus) the number of SXSW followers in county c that joined Twitter on March 2007 and $SXSW_c^{Pre}$ is a similarly defined variable for followers that joined Twitter before March 2007. We standardize the variables to have a mean of zero and standard deviation of one. The whiskers represent 95% confidence intervals based on standard errors clustered by state.

Figure 5: First Stage – South by Southwest (SXSW) and Twitter Usage

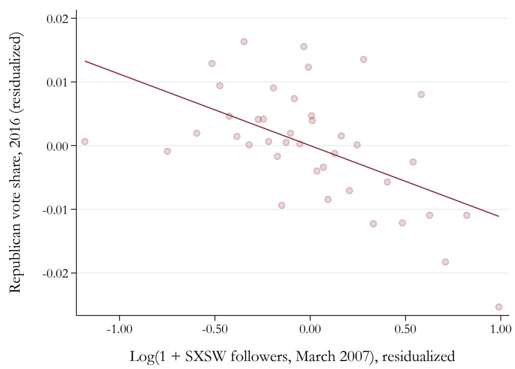


Notes: This figure presents a binned scatter plot of the relationship between Twitter users in 2014-2015 and the number of SXSW followers who joined Twitter in March 2007. Variables are residualized by partialling out SXSW followers who joined before March 2007, population deciles, Census region fixed effects, as well as geographical, demographic, socioeconomic, China shock, and 1996 election control variables (see Online Appendix for control variable definitions). The figure is constructed by dividing the x-axis variable into 40 equal-sized bins and plotting the average values of both variables in each bin. The fitted line is estimated using the unbinned data.

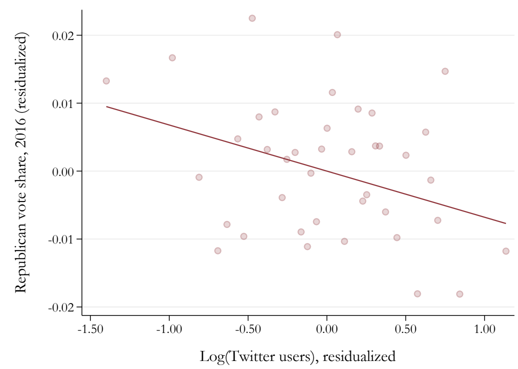
Figure 6: South by Southwest, Twitter, and the Republican Vote Share

2016 Election

(a) Reduced Form

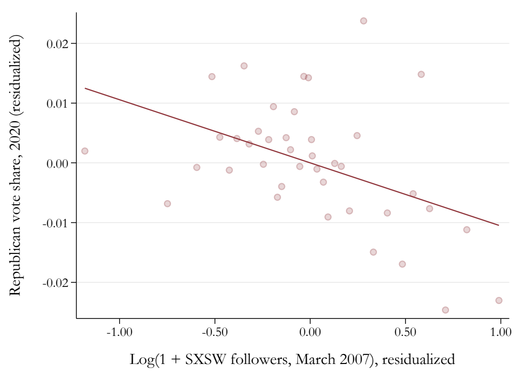


(b) OLS

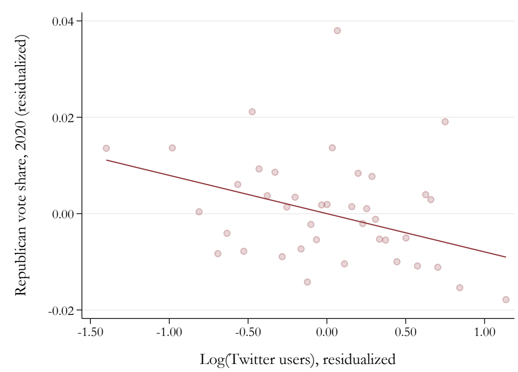


2020 Election

(c) Reduced Form



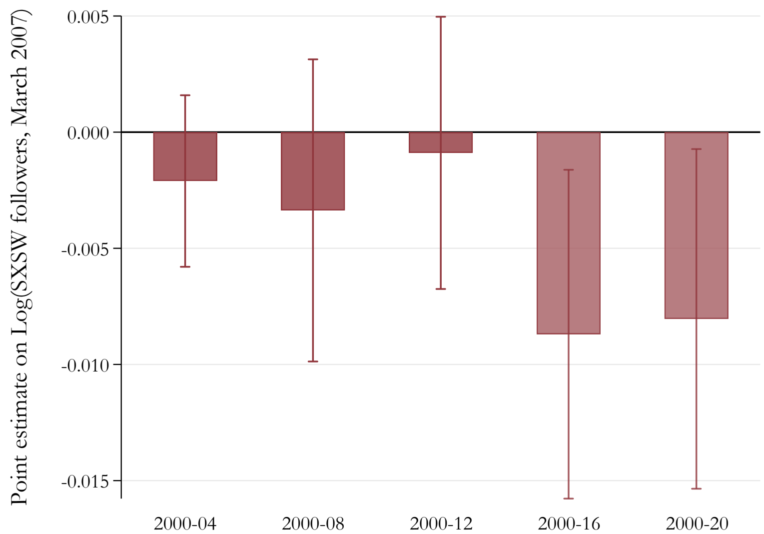
(d) OLS



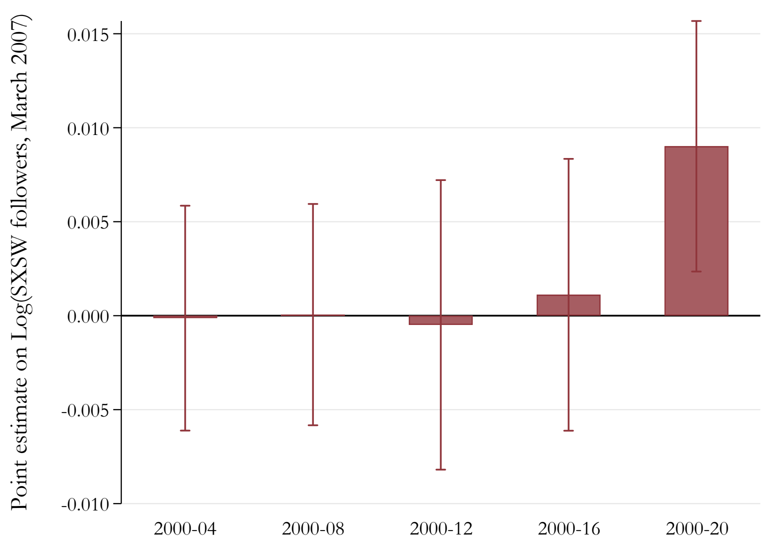
Notes: Panel (a) presents a binned scatter plot of the relationship between the Republican vote share in the 2016 presidential election and the number of SXSW followers who joined Twitter in March 2007. Variables are residualized with respect to SXSW followers who joined before March 2007, population deciles, Census region fixed effects, as well as geographical, demographic, socioeconomic, China shock, and 1996 election control variables. The figure is constructed by dividing the x-axis variable into 40 equal-sized bins and plotting the average values of both variables in each bin. The fitted line is estimated using the unbinned data. Panels (b) and (d) replicate the exercise using Twitter users in 2014-2015 as the x-axis variable. Panel (c) and (d) show results for the 2020 election.

Figure 7: Twitter and Presidential Elections – Reduced Form

(a) Changes in Republican Vote Share



(b) Change in Voter Turnout

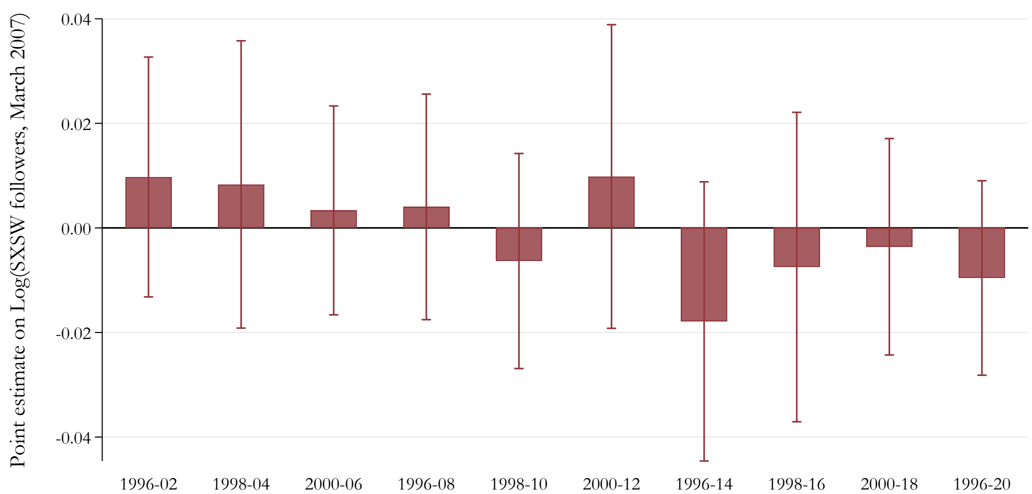


Notes: These figures plot reduced form estimates $\hat{\beta}'$ from county-level regressions as in equation (2). They measure the effect of *Log(1 + SXSW followers, March 2007)*, while controlling for *Log(1 + SXSW followers, Pre)*, on changes in the Republican vote share in presidential elections relative to the year 2000 in Panel (a), and changes in the ratio of voter turnout to voting-age population relative to 2000 in Panel (b). All regressions control for population deciles and Census region fixed effects, and the full set of controls (as in columns 5 and 10 of Table 2). Regressions are weighted by turnout in the 2000 presidential election. Whiskers represent 95% confidence intervals based on standard errors clustered by state.

Figure 8: Twitter and Congressional Election Results – Reduced Form

(a) House Elections

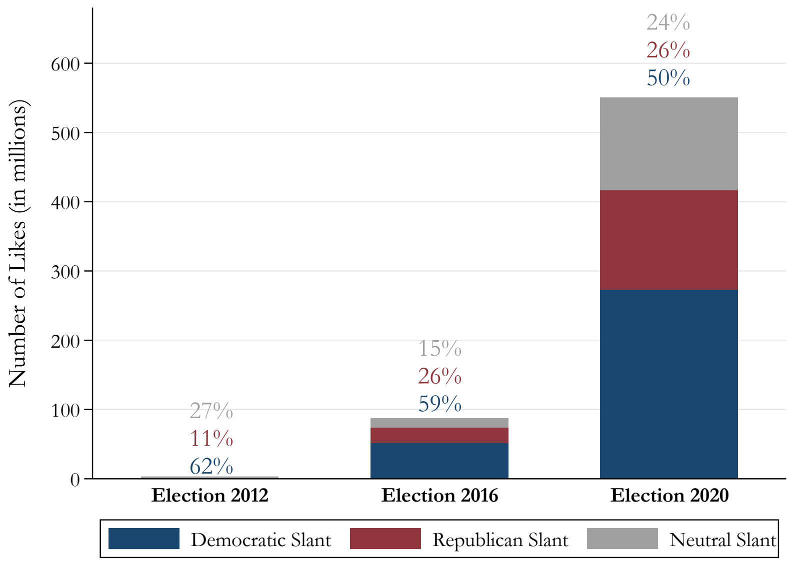
(b) Senate Elections



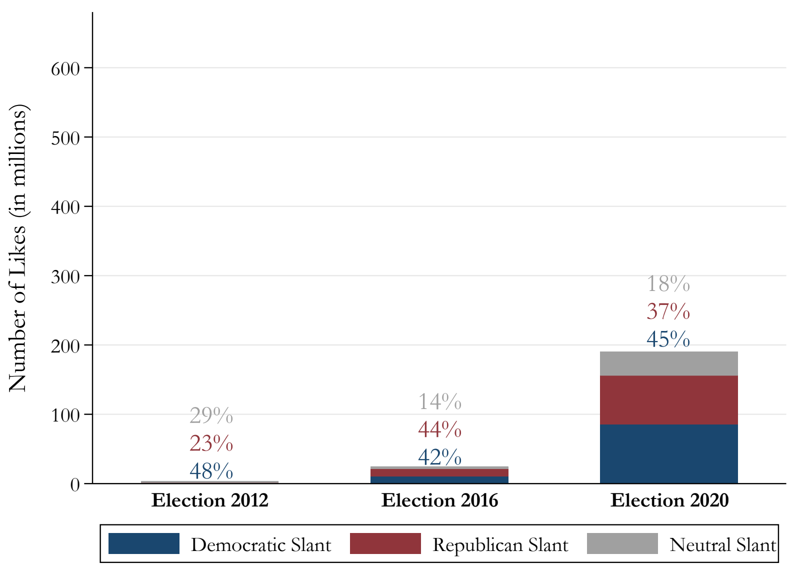
Notes: These figures plot reduced form estimates $\hat{\beta}'$ from county-level regressions as in equation (2). They measure the reduced form effect of *Log(1 + SXSW followers, March 2007)*, while controlling for *Log(1 + SXSW followers, Pre)*, on the Republican vote share in House and Senate elections since 2000. For House elections in Panel (a), the dependent variable is the change in the Republican vote share since 2000. For Senate elections in Panel (b), the dependent variable is the change in the Republican vote share from six, twelve, or eighteen years ago (to accommodate senators' 6-year terms). All regressions control for population deciles and Census region fixed effects and the full set of controls (as in columns 5 and 10 of Table 2). Regressions are weighted by turnout in the 2000 presidential election. The whiskers represent 95% confidence intervals based on standard errors clustered by state.

Figure 9: Twitter's Partisan Slant Across Presidential Elections

(a) Tweets about Republican Presidential Candidates



(b) Tweets about Democratic Presidential Candidates



Notes: These figures present the number of "likes" received by tweets that contain the last name of the candidates in the 2012, 2016 and 2020 presidential elections, depending on whether the tweet was classified as having a Republican, Democratic, or neutral slant. We classify the slant of a tweet based on the Twitter network of the user who sent the tweet. If the user follows more Democratic than Republican Congress members, they will be classified as a Democrat, and vice versa. Users who follow an equal number of Democrats and Republican or no Congress members are classified as neutral.

Table 1: **South by Southwest 2007 and Twitter Usage**

	Dep. var.: Log(Twitter users)				
	(1)	(2)	(3)	(4)	(5)
Log(SXSW followers, March 2007)	0.726***	0.683***	0.563***	0.524***	0.523***
	(0.087)	(0.079)	(0.055)	(0.048)	(0.048)
Log(SXSW followers, Pre)	0.104	0.110	0.059	0.059	0.058
	(0.101)	(0.076)	(0.098)	(0.082)	(0.082)
Population deciles	Yes	Yes	Yes	Yes	Yes
Census region FE	Yes	Yes	Yes	Yes	Yes
Geographical controls		Yes	Yes	Yes	Yes
Demographic controls			Yes	Yes	Yes
Socioeconomic controls			Yes	Yes	Yes
China shock controls				Yes	Yes
1996 election control					Yes
Observations	3,065	3,065	3,064	3,064	3,064
R^2	0.92	0.93	0.95	0.95	0.95
Mean of DV	8.22	8.22	8.22	8.22	8.22
p-value: March 2007 = Pre	0.00	0.00	0.00	0.00	0.00

Notes: This table presents county-level regressions where the dependent variable is the number of Twitter users (in natural logarithm). *Log(SXSW followers, March 2007)* is the number of Twitter users (in logs, with 1 added inside) who joined in March 2007 and follow South by Southwest (SXSW). *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006, defined similarly. The bottom row reports p-values from F-tests for the equality of these coefficients. Regressions include the indicated control variables (see the Online Appendix for their descriptions). Observations are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2: Twitter and the 2016/2020 Republican Vote Share

	Dep. var.: Republican vote share in 2016					*Dep. var.: Republican vote share in 2020*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: OLS										
Log(Twitter users)	-0.065***	-0.067***	-0.013***	-0.011***	-0.007**	-0.058***	-0.064***	-0.012***	-0.011***	-0.008***
	(0.009)	(0.008)	(0.004)	(0.003)	(0.003)	(0.009)	(0.009)	(0.004)	(0.003)	(0.003)
Panel B: Reduced form										
Log(SXSW followers, March 2007)	-0.053***	-0.058***	-0.019***	-0.014***	-0.011***	-0.046***	-0.055***	-0.017***	-0.013***	-0.011**
	(0.011)	(0.012)	(0.005)	(0.004)	(0.004)	(0.009)	(0.010)	(0.006)	(0.005)	(0.005)
Log(SXSW followers, Pre)	-0.021	-0.003	-0.000	-0.002	0.001	-0.022	-0.005	-0.002	-0.004	-0.001
	(0.016)	(0.013)	(0.006)	(0.006)	(0.004)	(0.016)	(0.013)	(0.007)	(0.007)	(0.005)
Panel C: 2SLS										
Log(Twitter users)	-0.072***	-0.085***	-0.034***	-0.027***	-0.021***	-0.064***	-0.080***	-0.031**	-0.025***	-0.020**
	(0.016)	(0.018)	(0.010)	(0.008)	(0.008)	(0.015)	(0.017)	(0.011)	(0.009)	(0.009)
Log(SXSW followers, Pre)	-0.014	0.007	0.002	-0.001	0.002	-0.015	0.004	-0.000	-0.002	0.000
	(0.020)	(0.016)	(0.007)	(0.006)	(0.005)	(0.020)	(0.015)	(0.008)	(0.007)	(0.006)
Population deciles	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical controls		Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Demographic controls			Yes	Yes	Yes			Yes	Yes	Yes
Socioeconomic controls			Yes	Yes	Yes			Yes	Yes	Yes
China shock controls				Yes	Yes				Yes	Yes
1996 election control					Yes					Yes
Observations	3,065	3,065	3,064	3,064	3,064	3,065	3,065	3,064	3,064	3,064
Mean of DV	0.46	0.46	0.46	0.46	0.46	0.47	0.47	0.47	0.47	0.47
Robust F-stat.	69.57	74.65	106.08	118.21	121.18	69.57	74.65	106.08	118.21	121.18

Notes: This table presents county-level regressions where the dependent variable is the Republican vote share in the 2016 or 2020 presidential election. *Log(SXSW followers, March 2007)* is the number of Twitter users (in logs, with 1 added inside) who joined in March 2007 and follow South by Southwest (SXSW). *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006, defined similarly. *Twitter users* are the number of users in 2014-2015. Regressions include the indicated control variables (see the Online Appendix for their descriptions). The first-stage regressions for 2SLS results (Panel B) are presented in Table 1, with the F-stat for the excluded instrument in the bottom row. Observations are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3: Twitter and the Republican Vote Share, 2000-2020

	Dep. var.: Republican vote share in...					
	2000	2004	2008	2012	2016	2020
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Reduced form						
Log(SXSW followers, March 2007)	-0.003	-0.005	-0.006	-0.003	-0.011***	-0.011**
	(0.002)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)
Log(SXSW followers, Pre)	0.001	0.001	-0.000	-0.002	0.001	-0.001
	(0.004)	(0.003)	(0.006)	(0.005)	(0.004)	(0.005)
Panel B: 2SLS						
Log(Twitter users)	-0.005	-0.009	-0.011	-0.007	-0.021***	-0.020**
	(0.004)	(0.006)	(0.009)	(0.008)	(0.008)	(0.009)
Log(SXSW followers, Pre)	0.001	0.001	0.000	-0.001	0.002	0.000
	(0.004)	(0.004)	(0.006)	(0.005)	(0.005)	(0.006)
Observations	3,064	3,064	3,064	3,064	3,064	3,064
Mean of DV	0.48	0.51	0.46	0.47	0.46	0.47
Robust F-stat.	121.18	121.18	121.18	121.18	121.18	121.18

Notes: This table presents county-level regressions where the dependent variable is the Republican vote share in presidential elections. *Log(SXSW followers, March 2007)* is the number of Twitter users (in logs, with 1 added inside) who joined in March 2007 and follow South by Southwest (SXSW). *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006, defined similarly. *Twitter users* are the number of users in 2014-2015. All regressions control for population deciles, Census region fixed effects, and the full set of controls (as in columns 5 and 10 of Table 2). The first-stage regression for 2SLS results (Panel B) are presented in column (5) of Table 1, with the F-stat for the excluded instrument in the bottom row. Observations are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4: Twitter and Individuals' Vote Decisions in 2016

	Dep. var.: Voted for Trump in 2016					
	Full Sample	Strong Dem.	Mod. Dem.	Indep.	Mod. Rep.	Strong Rep.
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Full Sample						
Log(Twitter users)	-0.129***	0.034	-0.062	-0.186***	-0.073*	0.029
	(0.048)	(0.061)	(0.081)	(0.069)	(0.044)	(0.065)
Marginal effect	[-0.047]	[0.002]	[-0.011]	[-0.064]	[-0.010]	[0.001]
Observations	94,523	27,572	20,447	9,142	18,863	17,304
Mean of DV	0.491	0.027	0.114	0.627	0.918	0.981
Panel B: Age Group 18-39						
Log(Twitter users)	-0.146***	0.080	-0.171	-0.198**	-0.118	0.115
	(0.047)	(0.103)	(0.119)	(0.090)	(0.076)	(0.111)
Marginal effect	[-0.051]	[0.006]	[-0.026]	[-0.071]	[-0.024]	[0.009]
Observations	25,177	8,420	7,317	2,050	3,732	3,042
Mean of DV	0.376	0.043	0.089	0.466	0.859	0.956
Panel C: Age Group 40+						
Log(Twitter users)	-0.122**	-0.028	0.013	-0.176**	-0.055	-0.035
	(0.052)	(0.069)	(0.079)	(0.074)	(0.050)	(0.068)
Marginal effect	[-0.045]	[-0.001]	[0.003]	[-0.059]	[-0.007]	[-0.001]
Observations	69,346	19,102	13,130	7,091	15,108	14,211
Mean of DV	0.535	0.020	0.128	0.679	0.934	0.987

Notes: This table presents results estimated using IV probit models, as in equation (4). The dependent variable is a dummy for individuals in the CCES who voted for Trump in 2016. *Log(Twitter users)* is instrumented using the (log) number of SXSW followers that joined Twitter in March 2007. All regressions control for the (log) number of SXSW followers that joined Twitter at some point in 2006, family income, gender, education levels, marital status, news interest, and age, as well as county-level population deciles and Census region fixed effects. Regressions are weighted by survey weights. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 5: Twitter and Vote Shares in Republican Primaries 2016

	Dep. var.: Vote share in Republican Primary of...				
	Trump (1)	Cruz (2)	Rubio (3)	Bush (4)	Kasich (5)
Panel A: Reduced form					
Log(SXSW followers, March 2007)	-0.030**	0.004	0.016	-0.002	0.017**
	(0.012)	(0.009)	(0.010)	(0.001)	(0.008)
Panel B: 2SLS					
Log(Twitter users)	-0.044**	0.005	0.024	-0.003	0.025**
	(0.017)	(0.013)	(0.015)	(0.002)	(0.011)
Observations	2,831	2,831	2,831	2,831	2,831
Mean of DV	0.48	0.23	0.09	0.01	0.15
Robust F-stat.	69.54	69.54	69.54	69.54	69.54

Notes: This table presents county-level regressions where the dependent variable is the vote share of the indicated candidate in the Republican party primaries in 2016. *Log(SXSW followers, March 2007)* is the number of Twitter users (in logs, with 1 added inside) who joined in March 2007 and follow South by Southwest (SXSW). *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006, defined similarly. *Twitter users* are the number of users in 2014-2015. All regressions control for population deciles, Census region fixed effects, and the full set of controls (as in columns 5 and 10 of Table 2). The first-stage regressions for 2SLS results (Panel B) are analogous to the one presented in Table 1, except for the different sample of counties for which primary results are available. The F-stat for the excluded instrument is provided in the bottom row. Observations are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6: Twitter and Candidate Approval during the 2016 Primaries

	Dep. var.: Approved of candidate during primaries					
	Trump	Cruz	Rubio	Kasich	Sanders	Clinton
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Republicans						
Log(Twitter users)	-0.108***	-0.086**	-0.051	0.018	0.031	0.148***
	(0.030)	(0.035)	(0.060)	(0.050)	(0.039)	(0.041)
Marginal effect	[-0.038]	[-0.029]	[-0.014]	[0.006]	[0.009]	[0.022]
Observations	19,974	11,959	8,344	8,995	16,099	20,983
Mean of DV	0.647	0.698	0.779	0.665	0.238	0.092
Panel B: Independents and Leaners						
Log(Twitter users)	-0.065**	-0.006	-0.015	0.050	0.059	0.154***
	(0.028)	(0.035)	(0.043)	(0.042)	(0.043)	(0.036)
Marginal effect	[-0.021]	[-0.002]	[-0.006]	[0.019]	[0.021]	[0.054]
Observations	22,852	12,135	8,080	8,280	17,356	23,813
Mean of DV	0.329	0.392	0.516	0.581	0.595	0.380
Panel C: Democrats						
Log(Twitter users)	-0.052	-0.116**	-0.036	0.076	0.004	0.081**
	(0.051)	(0.054)	(0.056)	(0.051)	(0.050)	(0.038)
Marginal effect	[-0.009]	[-0.030]	[-0.012]	[0.029]	[0.001]	[0.021]
Observations	20,866	11,098	7,460	7,547	16,059	21,454
Mean of DV	0.107	0.195	0.271	0.502	0.808	0.807

This table presents results estimated using IV probit models, as in equation (4). The dependent variable is a dummy for individuals who approved the respective presidential candidate during the presidential primaries in 2015 and 2016. We restrict the sample to the period before Trump became the presumptive nominee in June 2016. *Log(Twitter users)* is instrumented using the number of SXSW followers that joined Twitter in March 2007. All regressions control for the (log) number of SXSW followers that joined Twitter at some point in 2006, income, gender, education, and marital status, as well as county-level population deciles and Census region fixed effects. Regressions are weighted by survey weights. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

A Online Appendix

A.1. Appendix 1: Additional Details on Data

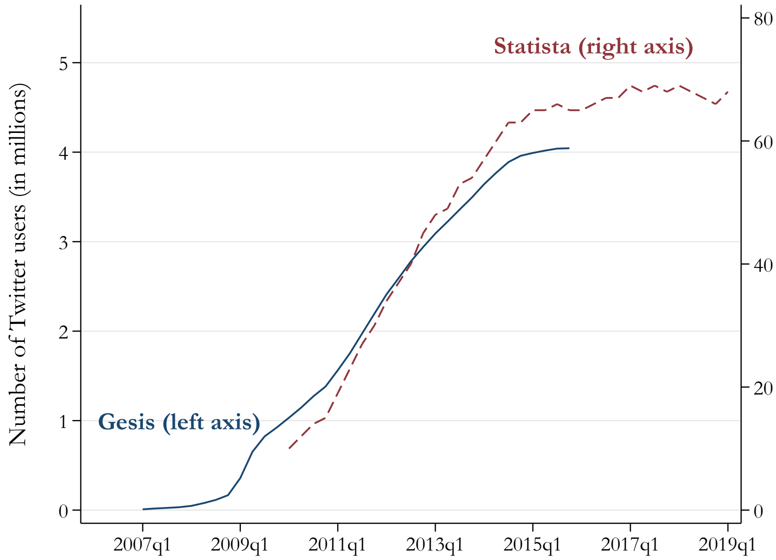
Table A.1: List of Congress Members with the Most Twitter Followers

Rank	Name	Twitter Handle	Party	Tweets	Followers	Likes	Retweets
1.	Barack Obama	barackobama	D	15,754	114,369,395	38,496	8,475
2.	Hillary Rodham Clinton	hillaryclinton	D	11,491	27,026,749	22,413	6,780
3.	Bernard Sanders	BernieSanders	D	17,667	11,436,732	19,324	3,625
4.	Alexandria Ocasio-Cortez	AOC	D	10,087	6,596,922	30,668	8,634
5.	Elizabeth Warren	SenWarren	D	5,345	5,743,064	5,845	1,863
6.	Joseph R. Biden Jr.	joebiden	D	4,228	4,507,744	11,789	2,472
7.	Cory A. Booker	CoryBooker	D	65,242	4,468,595	2,802	798
8.	Mike Pence	mike_pence	R	8,069	4,397,219	2,768	4,176
9.	Nancy Pelosi	SpeakerPelosi	D	10,154	4,149,922	9,022	2,693
10.	Marco Rubio	MarcoRubio	R	12,789	4,098,788	2,642	1,608
11.	Paul D. Ryan	SpeakerRyan	R	14,755	3,646,397	781	260
12.	Kamala D. Harris	KamalaHarris	D	13,119	3,476,952	10,366	2,229
13.	John F. Kerry	johnkerry	D	2,608	3,360,092	773	328
14.	John McCain	SenJohnMcCain	R	14,409	3,075,281	2,551	721
15.	Rand Paul	randpaul	R	13,642	2,700,813	3,926	1,491
16.	Charles E. Schumer	SenSchumer	D	17,004	2,145,147	6,457	2,171
17.	Adam B. Schiff	RepAdamSchiff	D	5,623	2,087,003	19,009	6,849
18.	Ilhan Omar	IlhanMN	D	14,678	1,947,411	6,644	2,649
19.	Lindsey Graham	LindseyGrahamSC	R	10,872	1,535,623	5,698	1,616
20.	Mike Pompeo	SecPompeo	R	2,148	1,503,151	4,936	1,711

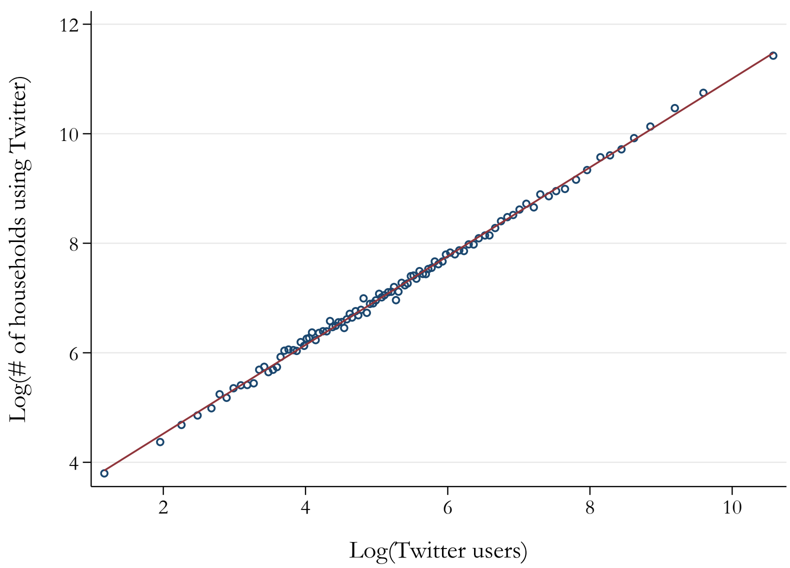
Notes: This table lists the 20 Congress members who were in office between 2007 and 2019 with the most Twitter followers at the time of data collection. Likes and retweets refer to the average number of interactions the Congress members receive for their average tweet. The data were collected from Twitter in November 2019.

Figure A.1: Validation of Twitter usage measure

(a) Twitter Usage over Time

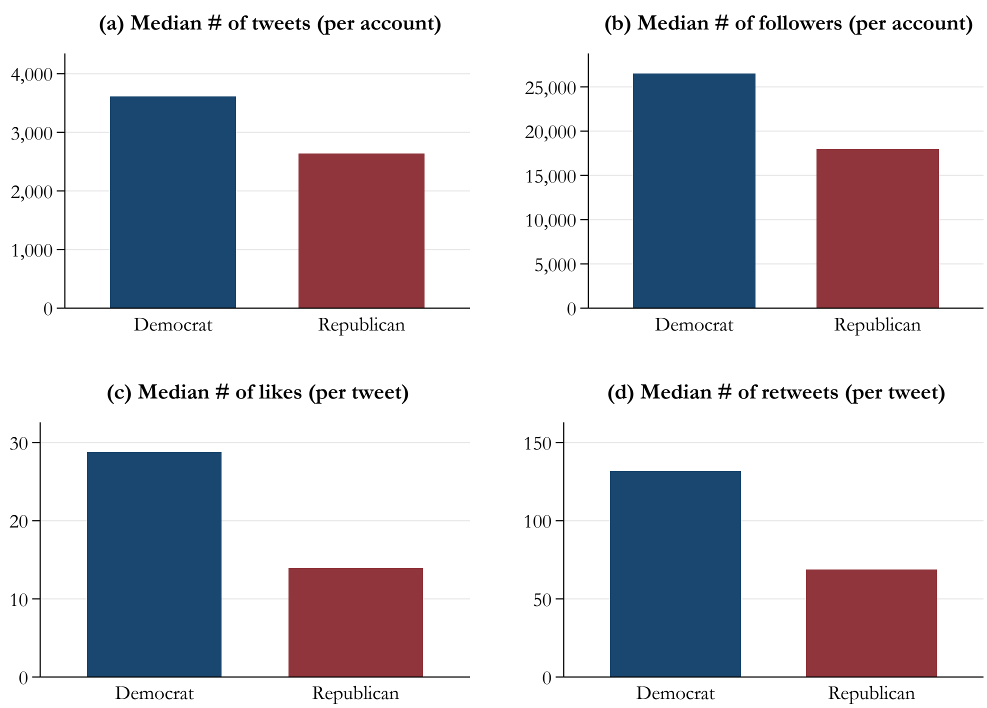


(b) Twitter Usage by County (Gesis vs GfK)



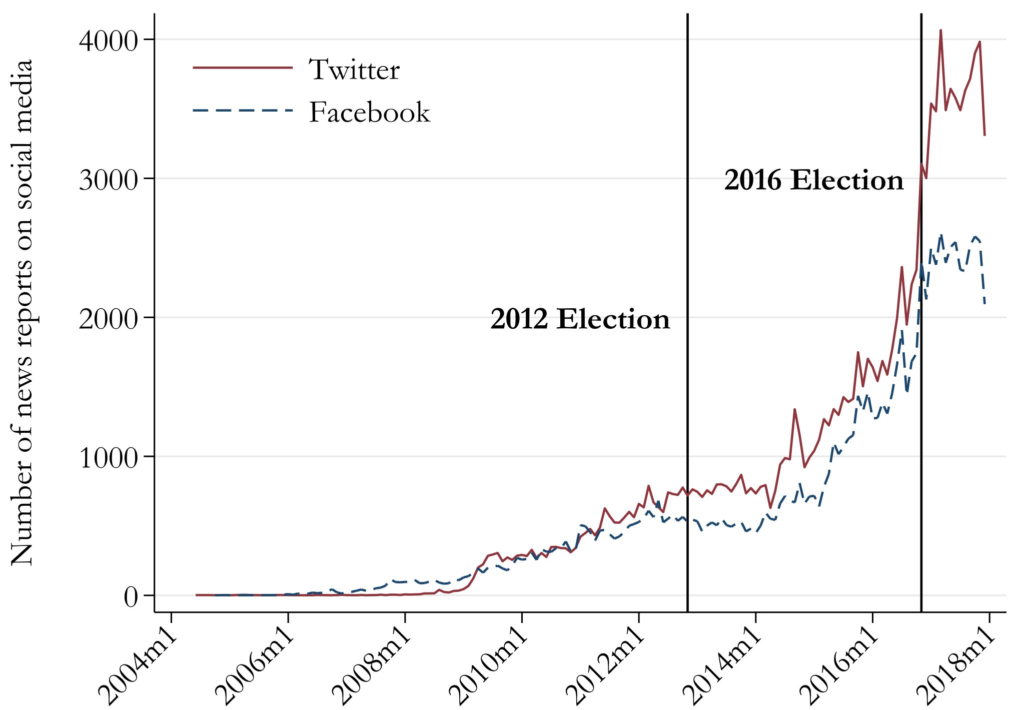
Notes: This graph shows two validation exercises for the Twitter usage measure in the Gesis data (Kinder-Kurlanda et al., 2017). Panel (a) plots the number of Twitter users in the Gesis data and the number of active monthly users reported by Statista based on Twitter's own reporting. Panel (b) plots the percentiles of the number of Twitter users in the Gesis data at the county-level against the number of users based on the GfK Media Survey.

Figure A.2: Twitter Reach by Party (Median)



Notes: This figure plots data on the Twitter reach of Congress members. The sample includes all 901 senators and House representatives who were in office between 2007 and 2019 for whom we could identify a Twitter account. For each account, we plot the median number of tweets and followers, and the median number of "likes" and retweets of their tweets. The data were collected from Twitter in November 2019.

Figure A.3: News Reports About Social Media



Notes: This graph plots the number of times the terms "Twitter" and "Facebook" are mentioned in USA Today, The Washington Post, The New York Post, and The New York Times based on data from Nexis.

Table A.2: Summary Statistics (County-Level)

	Mean	Std. Dev.	Min.	Median	Max.	N
Vote outcomes and Twitter data						
Republican two-party vote share (2016)	0.46	0.17	0.08	0.45	0.95	3,065
Change in Republican two-party vote share, 2000-2016	-0.02	0.10	-0.33	-0.03	0.45	3,065
Republican two-party vote share (2020)	0.47	0.17	0.09	0.45	0.96	3,065
Change in Republican two-party vote share, 2000-2020	-0.01	0.10	-0.34	-0.02	0.48	3,065
Log(Twitter users)	8.22	1.99	0.00	8.45	12.35	3,065
Log(SXSW followers, March 2007)	0.69	1.13	0.00	0.00	4.98	3,065
Log(SXSW followers, Pre)	0.33	0.73	0.00	0.00	3.61	3,065
Geographical controls						
Population density	1925.15	6342.94	0.10	508.30	69468.40	3,065
Log(County area)	6.72	0.92	3.26	6.64	9.91	3,065
Distance from Austin, TX (in miles)	1731.21	653.61	5.04	1750.86	3098.88	3,065
Distance from Chicago (in miles)	1246.18	813.51	7.16	1103.75	3040.38	3,065
Distance from NYC (in miles)	1600.47	1255.14	6.48	1285.98	4191.67	3,065
Distance from San Francisco (in miles)	2841.16	1231.98	41.11	3157.16	4565.01	3,065
Distance from Washington, DC (in miles)	1448.51	1175.55	7.88	1047.13	3983.08	3,065
Demographic controls						
% aged 20-24	0.07	0.02	0.01	0.06	0.27	3,065
% aged 25-29	0.07	0.01	0.03	0.07	0.15	3,065
% aged 30-34	0.07	0.01	0.03	0.06	0.12	3,065
% aged 35-39	0.06	0.01	0.03	0.06	0.10	3,065
% aged 40-44	0.06	0.01	0.02	0.06	0.10	3,065
% aged 45-49	0.06	0.01	0.02	0.06	0.09	3,065
% aged 50+	0.36	0.06	0.11	0.35	0.75	3,065
Population growth, 2000-2016	0.14	0.19	-0.43	0.10	1.32	3,065
% white	0.65	0.21	0.03	0.68	0.98	3,065
% black	0.12	0.12	0.00	0.08	0.85	3,065
% native American	0.01	0.03	0.00	0.00	0.90	3,065
% Asian	0.05	0.06	0.00	0.03	0.37	3,065
% Hispanic	0.15	0.15	0.01	0.09	0.96	3,065
% unemployed	5.31	1.42	1.80	5.10	24.10	3,065
Socioeconomic controls						
% below poverty level	15.11	5.34	1.40	15.10	53.30	3,065
% employed in IT	0.02	0.02	0.00	0.02	0.21	3,065
% employed in construction/real estate	0.07	0.03	0.00	0.07	1.00	3,065
% employed in manufacturing	0.11	0.08	0.00	0.08	0.72	3,065
% adults with high school degree	28.13	7.41	8.30	27.50	54.80	3,065
% adults with college degree	20.98	3.66	8.70	20.90	35.60	3,065
% watching Fox News	0.26	0.01	0.23	0.26	0.30	3,064
% watching prime time TV	0.43	0.01	0.40	0.43	0.47	3,064
China shock controls						
Exposure to Chinese import competition	2.63	2.02	-0.63	2.10	43.08	3,065
Share of routine occupations	31.87	2.36	22.23	32.14	36.66	3,065
Average offshorability index	-0.02	0.50	-1.64	0.09	1.24	3,065
1996 election control						
Republican two-party vote share (1996)	0.41	0.11	0.10	0.41	0.79	3,065

Notes: This table presents descriptive statistics for the main estimation sample, weighted by the turnout in the 2000 presidential elections.

Table A.3: Summary Statistics (2016 CCES Individual-Level)

	Mean	Std. Dev.	Min.	Median	Max.	N
Vote outcome						
Voted for Trump	0.49	0.50	0.00	0.00	1.00	94,523
Twitter data						
Log(Twitter users)	8.31	1.92	0.69	8.45	12.35	94,523
Log(SXSW followers, March 2007)	0.69	1.13	0.00	0.00	4.98	94,523
Log(SXSW followers, Pre)	0.32	0.71	0.00	0.00	3.61	94,523
Individual control variables						
Log(Age)	3.88	0.37	2.89	3.99	4.55	94,523
Family income dummies	7.08	3.62	1.00	7.00	13.00	94,523
Female dummy	1.53	0.50	1.00	2.00	2.00	94,523
Education dummies	3.50	1.54	1.00	3.00	6.00	94,523
Marital status dummies	2.34	1.71	1.00	1.00	5.00	94,523
Interest in news dummies	1.59	0.92	1.00	1.00	7.00	94,523

Notes: This table presents descriptive statistics for the CCES estimation sample, weighted by survey weights.

Table A.4: Summary Statistics (Gallup Individual-Level)

	Mean	Std. Dev.	Min.	Median	Max.	N
Candidate approval outcomes						
Approve of Trump?	0.34	0.48	0.00	0.00	1.00	64,764
Approve of Kasich?	0.60	0.49	0.00	1.00	1.00	8,735
Approve of Rubio?	0.50	0.50	0.00	1.00	1.00	6,201
Approve of Cruz?	0.41	0.49	0.00	0.00	1.00	11,504
Approve of Sanders?	0.57	0.50	0.00	1.00	1.00	27,137
Approve of Clinton?	0.43	0.50	0.00	0.00	1.00	36,367
Twitter data						
Log(Twitter users)	8.29	1.97	0.00	8.48	12.35	64,764
Log(SXSW followers, March 2007)	0.72	1.15	0.00	0.00	4.98	64,764
Log(SXSW followers, Pre)	0.34	0.73	0.00	0.00	3.61	64,764
Individual control variables						
Income dummies	6.99	2.38	1.00	7.00	10.00	64,764
Female dummy	1.50	0.50	1.00	2.00	2.00	64,764
Education dummies	3.58	1.60	1.00	4.00	6.00	64,764
Marital status dummies	1.98	0.94	1.00	2.00	5.00	64,764
Age deciles	4.45	2.68	1.00	4.00	10.00	64,764

Notes: This table presents descriptive statistics for the Gallup estimation sample, weighted by survey weights.

Table A.5: Instrument Balancedness

	March 2007 *and* Pre (1)	March 2007 *only* (2)	Pre *only* (3)	Difference in means (2) - (3)	p-value	Šidàk p-value
Population density	5192.27	1021.39	1998.35	-976.96	0.07*	0.91
Log(County area)	6.30	6.63	6.54	0.09	0.73	1.00
Distance from Austin, TX (in miles)	1775.99	1749.38	1626.64	122.74	0.48	1.00
Distance from Chicago (in miles)	1439.45	1329.47	1214.42	115.05	0.53	1.00
Distance from NYC (in miles)	1685.31	1594.99	1510.05	84.94	0.78	1.00
Distance from San Francisco (in miles)	2751.83	2900.11	2833.01	67.10	0.83	1.00
Distance from Washington, DC (in miles)	1558.55	1450.23	1397.05	53.18	0.85	1.00
% aged 20-24	0.07	0.08	0.08	0.00	0.92	1.00
% aged 25-29	0.09	0.07	0.07	-0.00	0.51	1.00
% aged 30-34	0.08	0.07	0.07	-0.00	0.58	1.00
% aged 35-39	0.07	0.06	0.06	-0.00	0.82	1.00
% aged 40-44	0.06	0.06	0.06	0.00	0.82	1.00
% aged 45-49	0.07	0.06	0.06	0.00	0.89	1.00
% aged 50+	0.32	0.35	0.35	-0.00	0.97	1.00
Population growth, 2000-2016	0.18	0.18	0.15	0.03	0.56	1.00
% white	0.50	0.65	0.67	-0.02	0.62	1.00
% black	0.18	0.12	0.08	0.04	0.20	1.00
% native American	0.01	0.01	0.02	-0.02	0.02**	0.45
% Asian	0.10	0.05	0.05	-0.01	0.55	1.00
% Hispanic	0.20	0.16	0.15	0.01	0.80	1.00
% unemployed	4.86	5.05	4.51	0.54	0.07*	0.91
% below poverty level	15.71	15.82	13.69	2.14	0.17	1.00
% employed in IT	0.04	0.02	0.02	-0.00	0.98	1.00
% employed in construction/real estate	0.06	0.07	0.07	0.01	0.39	1.00
% employed in manufacturing	0.07	0.09	0.07	0.02	0.16	0.99
% adults with high school degree	21.76	25.99	25.77	0.22	0.88	1.00
% adults with college degree	18.89	21.16	21.20	-0.04	0.97	1.00
% watching Fox News	0.25	0.26	0.26	-0.00	0.91	1.00
% watching prime time TV	0.42	0.43	0.43	0.00	0.91	1.00
Exposure to Chinese import competition	2.55	2.46	2.79	-0.32	0.54	1.00
Share of routine occupations	32.47	31.38	31.25	0.13	0.82	1.00
Average offshorability index	0.37	-0.07	-0.05	-0.02	0.84	1.00
Republican two-party vote share (1996)	0.36	0.42	0.42	-0.00	0.90	1.00

Notes: This table presents the averages for the main control variables separately for the three types of counties relevant for our identification strategy: 1) the 47 counties with SXSW followers that joined Twitter both in March 2007 and the "pre-period"; 2) the 108 counties with SXSW followers that joined in March 2007 (but none in the "pre-period"); and 3) the 20 counties with SXSW that joined in the "pre-period" (but none in March 2007). We report p-values from a two-sided t-test for the equality of means between the counties with the key identifying variation, as well as Šidàk-corrected values to account for multiple hypothesis testing. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.6: Description of Main Variables

Variable	Description	Source
Vote outcomes		
Republican vote share (2016/2020)	The vote share of the Republican party in the 2016 or 2020 presidential election.	Dave Leip Election Atlas
ΔRepublican vote share, 2000-2016/2020	Change in the vote share of the Republican party between the 2000 and 2016 (or 2020) presidential elections.	Dave Leip Election Atlas
Twitter data		
Twitter users	The number of Twitter users per county (in natural logarithm), based on tweets collected using the Twitter streaming API in a 12 month period from June to November 2014 and June to November 2015.	Gesis Datorium
SXSW followers, March 2007	The number of Twitter users following the @SXSW account in each county that joined Twitter in March 2007.	Twitter Search API
SXSW followers, Pre	The total number of Twitter users following the @SXSW account in each county that joined Twitter at any point in 2006.	Twitter Search API
County-level control variables		
Geographical controls	Include the distance (in miles) from the country centroid from Austin (TX), Chicago, NYC, San Francisco, and Washington, DC, population density, and the logarithm of the land area for each county.	U.S. Census Tigerline File
Demographic controls	Include the share of people in the age buckets 20-24, 25-29, 30-34, 40-44, 45-49 and 50+, as well as the percentage change in county population between 2000 and 2016.	
Socioeconomic controls	Include a county's poverty rate; unemployment rate; the share of the population employed in construction/real estate, manufacturing, and information technology; the share of adults over 25 with at least a high school degree or some college education; as well as prime time TV viewership and the share of Fox News viewership.	U.S. Census/BLS/SimplyAnalytics
China shock controls	Include the measure of import competition from China, routine tasks, and offshorability from Autor et al. (2013).	
Election control	Contains the vote share of the Republican party in the 1996 presidential election.	Dave Leip Election Atlas

Table A.7: Search Terms Used to Create a Proxy for Total Tweets

0	but	his	one	these	would
1	by	how	only	they	year
2	can	if	or	think	you
3	come	in	other	this	your
4	could	into	our	time	
5	day	it	out	two	
6	do	its	over	up	
7	even	just	people	us	
8	first	know	say	use	
9	for	like	see	want	
I	from	look	she	way	
about	get	make	so	we	
after	give	me	some	well	
all	go	most	take	what	
also	good	my	than	when	
any	have	new	that	which	
as	he	no	their	who	
at	he	not	them	with	
back	her	now	then	with	
because	him	on	there	work	

Notes: This table lists the 100 most common English words that were used as search terms to generate a proxy of "total tweets" used in Figure 4b.

A.1.1 Additional Details on the Logistic Regression Classifier

We train a seperate machine learning classifier for each of the three election years in our data using the Python sci-kit package (Pedregosa et al., 2011). These classifiers help us to determine whether tweets are more likely to be sent by Democratic-leaning or Republican-leaning users. The classification process starts with the preparation of the underlying Twitter data. The inputs are the text of each of the 4,300,579 tweets from U.S. Congress members. To focus on election-related tweets, we restrict the sample to tweets that were sent either in the election year or in the year leading up to the election (e.g. 2011 and 2012 for the 2012 election) and mention at least one of the presidential candidates.

The target variable y for the classifier is an indicator variable equal to one for tweets sent by Republicans and zero otherwise. The feature matrix X for the classifier are created by count-vectorizing the texts of the tweets. In other words, we transform the text of the tweets into $n \times v$ matrix, where n is the number of tweets and v is the number of unique 1,2-grams that occur in the tweets. In preparation for this step, we removed common words (stopwords), links, and special characters from the tweets. Additionally, we reduced the words in the tweets to their morphological roots using a lemmatizer, which improves the performance of the classifier. As an example, the lemmatizer changes words like "walking" and "walked" to "walk". Lastly, we reweight the n-grams v of tweet i using term frequency–inverse document frequency (tf-idf):

$$tfidf(f_{i,v}) = (1 + \ln(f_{i,v}) \cdot (\ln(\frac{1+T}{1+d_v}) + 1) \tag{A.1}$$

where d_v is the number of tweets n-gram v appears in. This reweighting reduces the importance of words that appear frequently in many tweets, which help little to discriminate between tweets. The tf-idf vectorizer also normalizes the feature matrix by its L2-norm.

The vector y and the matrix X then serve as the input for a $L2$ regularized logistic regression classifier. The optimization of the classifier involves the minimization of the following cost function[49]:

$$\min_{w,c} C \sum_{i=1}^{n} \log(\exp(-y_i(X_i^T w + c) + 1) + \frac{1}{2} w^T w \tag{A.2}$$

[49] Note that this formulation of the cost function assumes that y_i takes values $-1; 1$. We use this formulation in line with the sci-kit documentation.

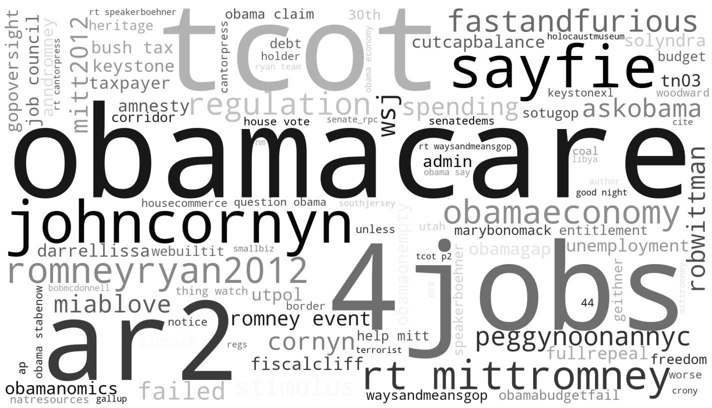
where w are the weights (coefficients) of the logistic regression, c is a constant (intercept), and C is the inverse of the regularization strength. Larger values of C imply weaker regularization. For $C \longrightarrow \infty$, the classifier converges towards a normal logistic regression. As is standard in most machine learning applications, we choose the optimal regularization strength C using 10-fold cross-validation. This involves randomly splitting the training data into ten equal slices. Nine of the ten slices are then used to train the classifier, while the out-of-sample performance is evaluated against the remaining slice using F1-scores.

The final classifiers achieves an out-of-sample F1-score of 0.916 in 2012, of 0.843 in 2016 and of 0.904 in 2020. The classifiers, therefore, accurately predict the party affiliation of Congress members. We then take these classifiers and apply it to the universe of tweets sent during the 2012, 2016 and 2020 presidential election. For each tweet in the election data, the classifiers provides us with a predicted class (either Democrat or Republican) and a probability for this class label. To avoid that our results are driven by tweets for which the classifier is "uncertain", we code tweets with a predicted class probability below 60% as neutral. This adjustment has no bearing on our findings. In spirit, this approach is similar to the work of Gentzkow and Shapiro (2010). While they identify expressions that are more frequently used by Democrats and Republicans by hand, we use a machine learning classifier to identify n-grams in the tweets of Congress members that help us to differentiate between the two parties.

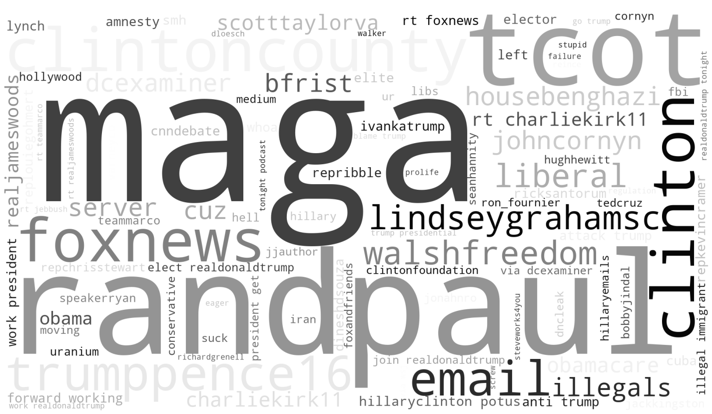
We visualize the most predictive n-grams identified by the classifiers for each election cycle in Figure A.4. Overall, the classifiers identifies words, hashtags, and Twitter handles that are intuitively associated with a Republican slant for each election year. Among the most predictive term are the hashtags "tcot" (Top Conservatives on Twitter) and "maga" (Make America great again) and particularly in 2020 many references to Donald Trump's Twitter account ("realdonaldtrump").

Figure A.4: Most Predictive Terms Of "Republican" Tweets by Election

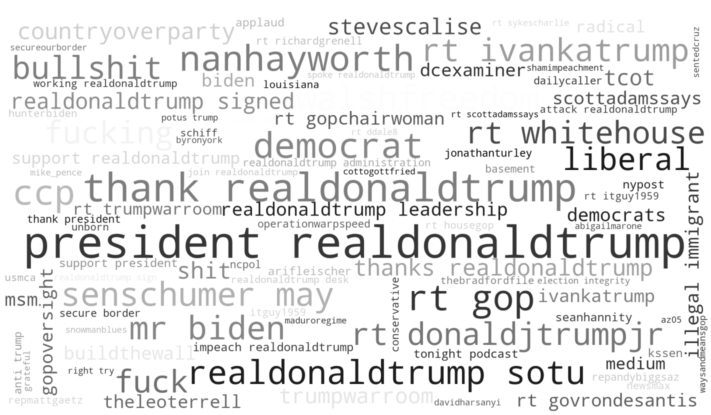
(a) 2012 Election



(b) 2016 Election



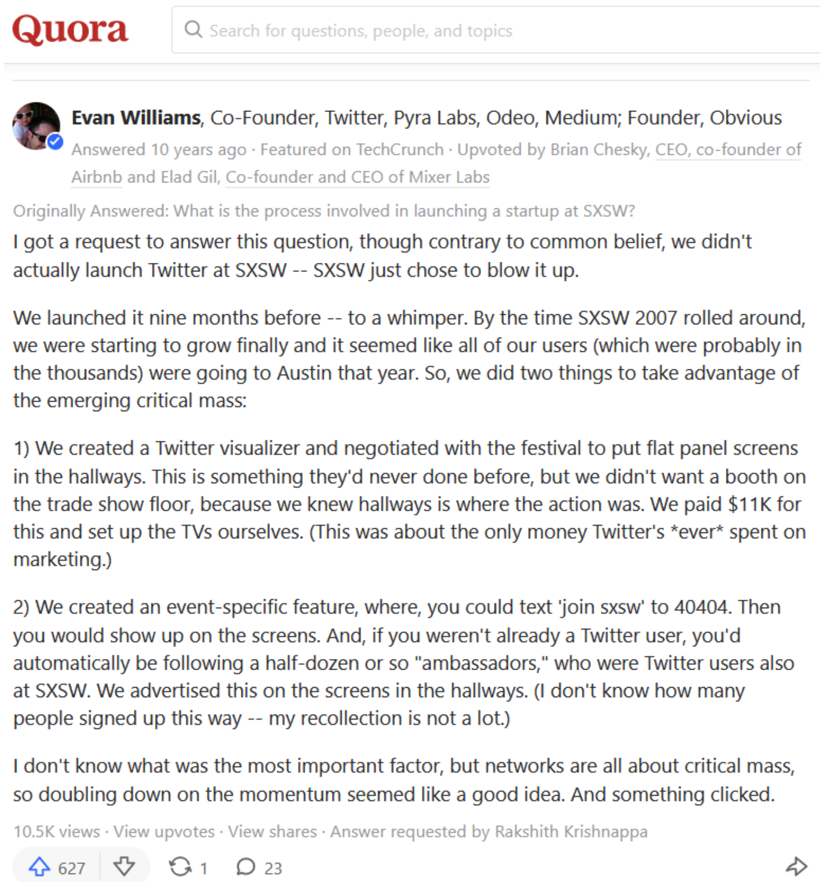
(c) 2020 Election



Notes: This word cloud plots the n-grams most predictive of tweets sounding like those of Republican Congress members, as identified by the logistic regression classifier for each election cycle. The size of the word represents the magnitude of the coefficients.

A.2. Appendix 2: Additional Details on the SXSW Festival

Figure A.5: Screenshot Quote from Twitter Founder


Quora

Search for questions, people, and topics

Evan Williams, Co-Founder, Twitter, Pyra Labs, Odeo, Medium; Founder, Obvious

Answered 10 years ago · Featured on TechCrunch · Upvoted by Brian Chesky, CEO, co-founder of Airbnb and Elad Gil, Co-founder and CEO of Mixer Labs

Originally Answered: What is the process involved in launching a startup at SXSW?

I got a request to answer this question, though contrary to common belief, we didn't actually launch Twitter at SXSW -- SXSW just chose to blow it up.

We launched it nine months before -- to a whimper. By the time SXSW 2007 rolled around, we were starting to grow finally and it seemed like all of our users (which were probably in the thousands) were going to Austin that year. So, we did two things to take advantage of the emerging critical mass:

1) We created a Twitter visualizer and negotiated with the festival to put flat panel screens in the hallways. This is something they'd never done before, but we didn't want a booth on the trade show floor, because we knew hallways is where the action was. We paid $11K for this and set up the TVs ourselves. (This was about the only money Twitter's *ever* spent on marketing.)

2) We created an event-specific feature, where, you could text 'join sxsw' to 40404. Then you would show up on the screens. And, if you weren't already a Twitter user, you'd automatically be following a half-dozen or so "ambassadors," who were Twitter users also at SXSW. We advertised this on the screens in the hallways. (I don't know how many people signed up this way -- my recollection is not a lot.)

I don't know what was the most important factor, but networks are all about critical mass, so doubling down on the momentum seemed like a good idea. And something clicked.

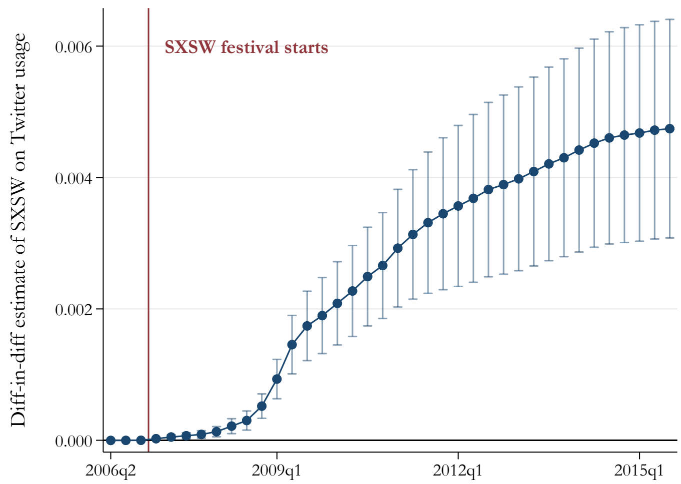
10.5K views · View upvotes · View shares · Answer requested by Rakshith Krishnappa

627 1 23

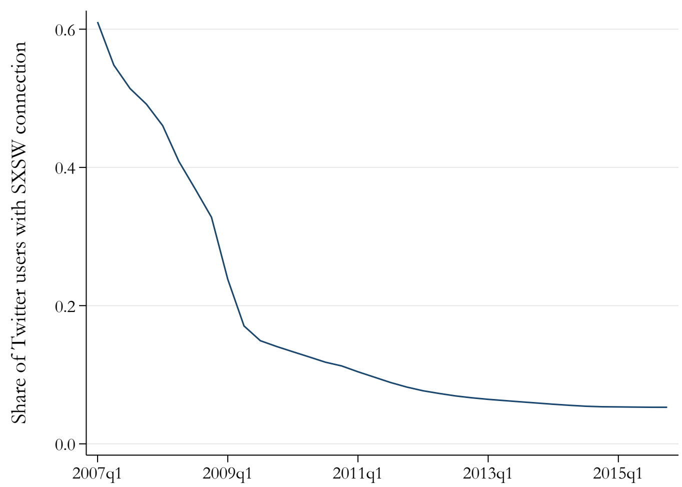
Notes: This screenshot shows the full post of Twitter co-founder Evan Williams posted on Quora on January 4, 2011 describing the role of the SXSW festival in the platform's rise to popularity (Quora, 2011).

Figure A.6: Additional Evidence for the Impact of the SXSW Festival

(a) Long-term Effects of the 2007 SXSW on Twitter Adoption



(b) Connections to the SXSW festival



Notes: The figures provide evidence on the long-term impact of the SXSW festival on Twitter usage across the United States. Panel (a) plots the β_τ from the panel event study regression $users_{ct} = \sum_\tau \beta_\tau SXSW_c^{March2007} \times 1(t = \tau) + \sum_\tau \delta_\tau SXSW_c^{Pre} \times 1(t = \tau) + \theta_c + \gamma_t + \varepsilon_{ct}$ where $users_{ct}$ is the number of Twitter users per capita in county c on quarter t, $SXSW_c^{March2007}$ is the logarithm of (one plus) the number of SXSW followers in county c who joined Twitter in March 2007 and $SXSW_c^{Pre}$ is a similarly defined variable for followers who joined Twitter before March 2007. We standardize the variables to have a mean of zero and standard deviation of one. The whiskers represent 95% confidence intervals based on standard errors clustered by state, where 2006q4 serves as excluded period. While the confidence intervals for 2006q2 and 2006q3 cannot be seen, they include zero. Panel (b) plots the share of Twitter who either follow SXSW or follow an user that follows SXSW.

Table A.8: Balancedness of SXSW Counties' User Characteristics

First names (Corr. = 0.63)		Terms used in bio (Corr. = 0.89)	
Pre-period	March 2007	Pre-period	March 2007
michael	michael	http	http
paul	john	founder	com
mike	chris	com	digital
chris	jeff	tech	founder
eric	matt	product	medium
justin	brian	co	director
ryan	david	digital	tech
kevin	alex	director	music
jeff	jason	design	social
david	kevin	social	marketing

Notes: This table presents the ranking of the most common first names and terms used in a Twitter user's "bio" among users who follow "South by Southwest" on Twitter, depending on whether they joined during March 2007 or in the pre-period.

Table A.9: Are Twitter Users in Counties With SXSW Followers Different?

User first names (Corr. = 0.97)		Terms used in user bio (Corr. = 0.94)	
Other counties	SXSW counties	Other counties	SXSW counties
michael	michael	love	co
chris	david	life	love
john	chris	co	life
david	john	http	http
sarah	alex	http co	http co
mike	mike	god	music
emily	matt	ig	lover
ryan	sarah	music	ig
matt	ryan	university	de
alex	andrew	like	like

Notes: This table compares the individual characteristics of Twitter users from counties with "South by Southwest" followers who joined in March 2007 ("SXSW counties") to Twitter users from all other U.S. counties ("Other counties"). We plot the ranking of the most common first names and terms used in a Twitter user's "bio".

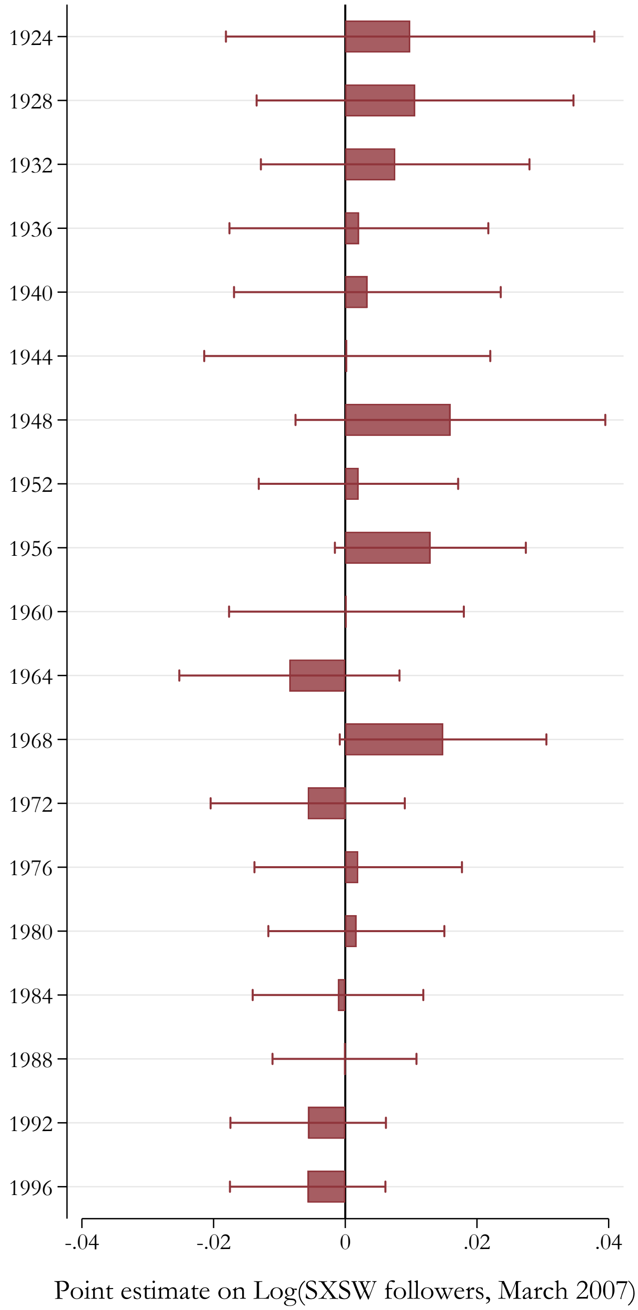
A.3. Appendix 3: Additional Robustness Checks

Table A.10: Twitter and the Republican Vote Share – Robustness

	No regression weights (1)	Pre-period control polynomial (2)	Pre-period control deciles (3)	No zero SXSW user counties (4)	Spatial standard errors (5)	Other festival controls (6)
Panel A: Republican vote share in 2016						
Log(Twitter users)	-0.037***	-0.019***	-0.020***	-0.030**	-0.037***	-0.025***
	(0.011)	(0.007)	(0.007)	(0.012)	(0.011)	(0.008)
Observations	3,064	3,064	3,064	165	3,064	3,064
Mean of DV	0.64	0.46	0.46	0.34	0.64	0.46
Robust F-stat.	72.94	125.40	114.91	23.46	54.13	183.69
Panel B: Republican vote share in 2020						
Log(Twitter users)	-0.036**	-0.018**	-0.019**	-0.033**	-0.036***	-0.026***
	(0.014)	(0.008)	(0.009)	(0.016)	(0.012)	(0.010)
Observations	3,064	3,064	3,064	165	3,064	3,064
Mean of DV	0.65	0.47	0.47	0.35	0.65	0.47
Robust F-stat.	72.94	125.40	114.91	23.46	54.13	183.69

Notes: This table presents 2SLS results estimated using equation (3). The dependent variable is the vote share of the Republican party in the 2016 and 2020 presidential elections in panel A and B, respectively. *Log(Twitter users)* is instrumented using the number of users who started following SXSW in March 2007 (in logs with 1 added inside). All regressions include the controls from columns 5 and 10 in Table 2. All regressions except columns 1 and 5 are weighted by turnout in the 2000 presidential election. Columns 2 and 3 control for a fifth-order polynomial or deciles of SXSW followers who joined Twitter before the SXSW 2007 event. Column 4 drops all counties that had no SXSW followers joining Twitter in March 2007 or in the period before. Column 5 uses spatial standard errors based on the method proposed in Colella et al. (2019), implemented in Stata as *acreg*, using a 200 miles cutoff. Column 6 replaces *SXSW followers, Pre* with the number of users who tweeted about the festivals Burning Man, Coachella, and Lollapalooza in the festival month in 2007 (in logs with 1 added inside). In columns 1 to 4, standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure A.7: Twitter and the Republican Vote Share, 1924-1996 (Reduced Form)



Notes: This figure plots reduced form estimates $\hat{\beta}'$ from county-level regressions as in equation (2). These estimates reflect the correlation of *Log(1 + SXSW followers, March 2007)* with the Republican vote share in presidential elections while controlling for *Log(1 + SXSW followers, Pre)*. All regressions control for population deciles and Census region fixed effects, and the full set of controls except 1996 Election controls (same as columns 4 and 9 of Table 2). Regressions are weighted by turnout in the 2000 presidential election. Whiskers represent 95% confidence intervals based on standard errors clustered by state.

Table A.11: Twitter and Changes in the Republican Vote Share, 2004-2020

	Dep. var.: Δ*Republican vote share between...*				
	2000-04	2000-08	2000-12	2000-16	2000-20
	(1)	(2)	(3)	(4)	(5)
Panel A: Reduced form					
Log(SXSW followers, March 2007)	-0.002	-0.003	-0.001	-0.009**	-0.008**
	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)
Log(SXSW followers, Pre)	-0.000	-0.001	-0.002	0.000	-0.002
	(0.003)	(0.005)	(0.003)	(0.004)	(0.005)
Panel B: 2SLS					
Log(Twitter users)	-0.004	-0.006	-0.002	-0.017**	-0.015**
	(0.004)	(0.006)	(0.006)	(0.007)	(0.007)
Log(SXSW followers, Pre)	0.000	-0.001	-0.002	0.001	-0.001
	(0.003)	(0.005)	(0.003)	(0.005)	(0.005)
Observations	3,064	3,064	3,064	3,064	3,064
Mean of DV	0.03	-0.02	-0.01	-0.02	-0.01
Robust F-stat.	121.18	121.18	121.18	121.18	121.18

Notes: This table presents county-level regressions where the dependent variable is the change in the vote share of the Republican party between 2000 and the indicated year. *Log(SXSW followers, March 2007)* is the number of Twitter users (in logs, with 1 added inside) who joined in March 2007 and follow South by Southwest (SXSW). *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006, defined similarly. *Twitter users* are the number of users in 2014-2015. All regressions control for population deciles, Census region fixed effects, and the full set of controls (as in columns 5 and 10 of Table 2). The first-stage regressions for 2SLS results (Panel B) are presented in Table 1, with the F-stat for the excluded instrument in the bottom row. Observations are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.12: Time-Varying Twitter Usage and Changes in Vote Shares

	Dep. var.: Δ*Republican vote share between...*				
	2000-04 (1)	2000-08 (2)	2000-12 (3)	2000-16 (4)	2000-20 (5)
Panel A: First stage					
Log(SXSW followers, March 2007)	0.644***	0.644***	0.546***	0.523***	0.523***
	(0.055)	(0.055)	(0.047)	(0.048)	(0.048)
Panel B: Reduced form					
Log(SXSW followers, March 2007)	-0.002	-0.003	-0.001	-0.009**	-0.008**
	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)
Log(SXSW followers, Pre)	-0.000	-0.001	-0.002	0.000	-0.002
	(0.003)	(0.005)	(0.003)	(0.004)	(0.005)
Panel C: 2SLS					
Log(Twitter users)	-0.003	-0.005	-0.002	-0.017**	-0.015**
	(0.003)	(0.005)	(0.005)	(0.007)	(0.007)
Log(SXSW followers, Pre)	0.000	-0.001	-0.002	0.001	-0.001
	(0.003)	(0.005)	(0.003)	(0.005)	(0.005)
Observations	3,064	3,064	3,064	3,064	3,064
Mean of DV	0.03	-0.02	-0.01	-0.02	-0.01
Robust F-stat.	135.88	135.88	134.88	121.18	121.18
Twitter usage measured in	*2008*	*2008*	*2012*	*2016*	*2016*

Notes: This table presents county-level regressions where the dependent variable is the change in the vote share of the Republican party between 2000 and the indicated year (except for Panel B, where the dependent variable is *Twitter users*. *Log(SXSW followers, March 2007)* is the number of Twitter users (in logs, with 1 added inside) who joined in March 2007 and follow South by Southwest (SXSW). *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006, defined similarly. Differently from other tables, *Twitter users* varies over time, as opposed to being fixed to 2014-2015. All regressions control for population deciles, Census region fixed effects, and the full set of controls (as in columns 5 and 10 of Table 2). Observations are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.13: **Twitter and the Ross Perot Vote**

	Dep. var.: Vote share Ross Perot in...			
	1992		1996	
	(1)	(2)	(3)	(4)
Panel A: Reduced form				
Log(SXSW followers, March 2007)	0.000	-0.000	0.003	0.003
	(0.002)	(0.002)	(0.003)	(0.003)
Panel B: 2SLS				
Log(Twitter users)	0.000	-0.001	0.006	0.007
	(0.003)	(0.003)	(0.006)	(0.006)
Population deciles	Yes	Yes	Yes	Yes
Census region FE	Yes	Yes	Yes	Yes
Geographical controls	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
Socioeconomic controls	Yes	Yes	Yes	Yes
China shock controls	Yes	Yes	Yes	Yes
1996 election control		Yes		Yes
Observations	3,064	3,064	3,064	3,064
Mean of DV	0.10	0.10	0.20	0.20
Robust F-stat.	118.21	121.18	118.21	121.18

Notes: This table presents county-level regressions where the dependent variable is the third party vote share in the 1992 or 1996 presidential election. *Log(SXSW followers, March 2007)* is the number of Twitter users (in logs, with 1 added inside) who joined in March 2007 and follow South by Southwest (SXSW). *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006, defined similarly. *Twitter users* are the number of users in 2014-2015. The first-stage regressions for 2SLS results (Panel B) are presented in Table 1, with the F-stat for the excluded instrument in the bottom row. Observations are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.14: Twitter and Vote Shares in Democratic Primaries

	Dep. var.: Vote share in Democratic Primary of...							
	Clinton 2016	Sanders 2016	Warren 2020	Biden 2020	Sanders 2020	Buttigieg 2020	Bloomberg 2020	Klobuchar 2020
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Reduced form								
Log(SXSW followers, March 2007)	0.005	-0.004	0.002	-0.009	0.017***	-0.003	0.001	-0.003
	(0.010)	(0.010)	(0.006)	(0.014)	(0.006)	(0.002)	(0.004)	(0.002)
Panel B: 2SLS								
Log(Twitter users)	0.008	-0.006	0.003	-0.014	0.025**	-0.004	0.001	-0.004
	(0.014)	(0.014)	(0.009)	(0.021)	(0.010)	(0.003)	(0.006)	(0.002)
Observations	2,656	2,656	2,769	2,769	2,769	2,769	2,769	2,769
Mean of DV	0.55	0.43	0.06	0.56	0.24	0.02	0.06	0.01
Robust F-stat.	67.94	67.94	73.68	73.68	73.68	73.68	73.68	73.68

Notes: This table presents county-level regressions where the dependent variable is the vote share of the indicated candidate in the Democratic party primaries in 2016 or 2020. *Log(SXSW followers, March 2007)* is the number of Twitter users (in logs, with 1 added inside) who joined in March 2007 and follow South by Southwest (SXSW). *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006, defined similarly. *Twitter users* are the number of users in 2014-2015. All regressions control for population deciles, Census region fixed effects, and the full set of controls (as in columns 5 and 10 of Table 2). The first-stage regressions for 2SLS results (Panel B) are analogous to the one presented in Table 1, except for the different sample of counties for which primary results are available. The F-stat for the excluded instrument is provided in the bottom row. Observations are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.15: Twitter and Vote Decisions in the 2016 CCES – Robustness

	Dep. var.: Voted for Trump in 2016				
	(1)	(2)	(3)	(4)	(5)
	Baseline	Verified vote	Vote intention	Intended Trump vote	Intended other vote
Log(Twitter users)	-0.129***	-0.140**	-0.133**	-0.231***	-0.064*
	(0.048)	(0.056)	(0.052)	(0.082)	(0.034)
Marginal effect	[-0.047]	[-0.051]	[-0.048]	[-0.005]	[-0.013]
Observations	94,523	28,413	46,418	14,723	24,354
Mean of DV	0.491	0.495	0.455	0.991	0.137

Notes: This table presents results estimated using IV probit models, as in equation (4). The dependent variable is a dummy for individuals in the CCES who voted for Trump in 2016. *Log(Twitter users)* is instrumented using the number of SXSW followers that joined Twitter in March 2007. All regressions control for the (log) number of SXSW followers that joined Twitter at some point in 2006, family income, gender, education levels, marital status, news interest, and age, as well as county-level population deciles and Census region fixed effects. Regressions are weighted by survey weights. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

A.4. Appendix 4: Further Results

Table A.16: Additional Outcomes

	Switching prob.	*∆Campaign don., 2000-16*		*Trump approval, 2017*	
	Obama to Trump	Democrats	Republicans	Democrats	Republicans
	(1)	(2)	(3)	(4)	(5)
Log(Twitter users)	-0.138***	0.866***	0.168	-0.011**	-0.037***
	(0.048)	(0.185)	(0.235)	(0.005)	(0.009)
Observations	3,065	2,250	2,446	2,727	2,920
Mean of DV	0.105	1.943	1.096	0.066	0.850

Notes: This table presents results from county-level regressions of equation (3). Column 1 shows results from an IV probit regression where the dependent variable is a dummy equal to 1 for the 217 counties for which both Obama and Trump gained the majority of votes in 2008 and 2016, respectively. In columns 2 and 3, the dependent variable is the difference in the natural logarithm of campaign distribution to the Democratic and Republican party, respectively, between 2000 and 2016. In columns 4 and 5, the dependent variable is the share of respondents in the Gallup Daily Poll approving of Trump in 2017. *Log(Twitter users)* is instrumented using the number of users who started following SXSW in March 2007. All regressions control for population deciles and Census region fixed effects and geographical controls. Regressions are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.17: Twitter and Changes in Voter Turnout, 2004-2020

	Δ *Votes cast/voting age pop.*				
	2000-04	2000-08	2000-12	2000-16	2000-20
	(1)	(2)	(3)	(4)	(5)
Panel A: Reduced form					
Log(SXSW followers, March 2007)	-0.000	-0.000	-0.001	0.001	0.007**
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)
Log(SXSW followers, Pre)	-0.000	0.000	-0.002	-0.001	-0.005
	(0.006)	(0.004)	(0.005)	(0.005)	(0.005)
Panel B: 2SLS					
Log(Twitter users)	-0.000	-0.000	-0.001	0.002	0.014**
	(0.006)	(0.006)	(0.008)	(0.008)	(0.006)
Log(SXSW followers, Pre)	-0.000	0.000	-0.002	-0.001	-0.006
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	3,063	3,063	3,063	3,063	3,063
Mean of DV	0.088	0.079	0.053	0.057	0.126
Robust F-stat.	121.23	121.23	121.23	121.23	121.23

Notes: This table presents county-level regressions where the dependent variable is the change in the voter turnout (as a share of voting age population) between 2000 and the indicated year. *Log(SXSW followers, March 2007)* is the number of Twitter users (in logs, with 1 added inside) who joined in March 2007 and follow South by Southwest (SXSW). *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006, defined similarly. *Twitter users* are the number of users in 2014-2015. All regressions control for population deciles, Census region fixed effects, and the full set of controls (as in columns 5 and 10 of Table 2). The first-stage regressions for 2SLS results (Panel B) are presented in Table 1, with the F-stat for the excluded instrument in the bottom row. Observations are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.18: Twitter and Congressional Elections – 2SLS Estimates

Panel A: House elections

	Δ*Republican vote share in House election between...*									
	2000-02 (1)	2000-04 (2)	2000-06 (3)	2000-08 (4)	2000-10 (5)	2000-12 (6)	2000-14 (7)	2000-16 (8)	2000-18 (9)	2000-20 (10)
Log(Twitter users)	0.014	-0.003	0.027	0.032	0.019	0.023	0.039	0.006	0.028	0.023
	(0.018)	(0.019)	(0.020)	(0.022)	(0.021)	(0.023)	(0.024)	(0.024)	(0.023)	(0.023)
Observations	2,982	2,955	2,971	2,957	2,969	2,983	2,978	2,980	2,983	2,982
Mean of DV	0.02	0.01	-0.04	-0.06	0.03	-0.01	0.02	0.00	-0.04	-0.01
Robust F-stat.	109.63	110.42	109.20	109.49	109.83	109.68	110.07	109.87	109.68	109.53

Panel B: Senate elections

	Δ*Republican vote share in Senate election between...*									
	1996-02 (1)	1998-04 (2)	2000-06 (3)	1996-08 (4)	1998-10 (5)	2000-12 (6)	1996-14 (7)	1998-16 (8)	2000-18 (9)	2000-20 (10)
Log(Twitter users)	0.019	0.015	0.007	0.008	-0.011	0.021	-0.035	-0.013	-0.008	-0.019
	(0.023)	(0.024)	(0.021)	(0.021)	(0.018)	(0.031)	(0.026)	(0.026)	(0.022)	(0.018)
Observations	2,183	1,985	1,832	2,183	1,985	1,832	2,183	1,985	1,832	2,183
Mean of DV	0.01	-0.03	-0.06	-0.05	0.01	-0.06	0.03	-0.07	-0.10	-0.00
Robust F-stat.	79.24	85.91	72.85	79.24	85.91	72.85	79.24	85.91	72.85	79.24

Notes: This table presents results estimated using 2SLS, as in equation (3). For House elections in Panel A, the dependent variable is the change in the Republican vote share since 2000. For Senate elections in Panel B, the dependent variable is the change in the Republican vote share from six, twelve, or eighteen years ago (to accommodate senators' 6-year terms). *Log(Twitter users)* is instrumented using the number of users who started following SXSW in March 2007 (in logs with 1 added inside). All regressions control for the (log) number of SXSW followers that joined Twitter at some point in 2006, population deciles and Census region fixed effects and the full set of controls (as in columns 5 and 10 of Table 2). Regressions are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

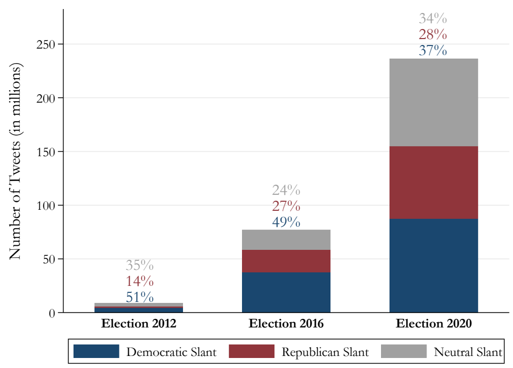
Table A.19: Twitter and the Republican Vote Share in Swing and Safe Counties

	Swing counties (1)	Republican counties (2)	Democratic counties (3)	Safe counties (4)
Panel A: ΔRepublican vote share 2000-2016				
Log(Twitter users)	-0.073***	-0.006	-0.008	-0.005
	(0.024)	(0.008)	(0.008)	(0.006)
Log(SXSW followers, Pre)	0.013	-0.001	0.000	-0.002
	(0.015)	(0.014)	(0.008)	(0.005)
Observations	716	1,990	358	2,348
Mean of DV	-0.033	0.021	-0.040	-0.012
Robust F-stat.	14.70	11.97	105.57	99.87
Panel B: ΔRepublican vote share 2000-2020				
Log(Twitter users)	-0.066***	-0.017**	-0.013	-0.008
	(0.019)	(0.007)	(0.009)	(0.006)
Log(SXSW followers, Pre)	0.006	-0.005	-0.001	-0.003
	(0.012)	(0.013)	(0.009)	(0.006)
Observations	716	1,990	358	2,348
Mean of DV	-0.027	0.026	-0.026	-0.002
Robust F-stat.	14.70	11.97	105.57	99.87

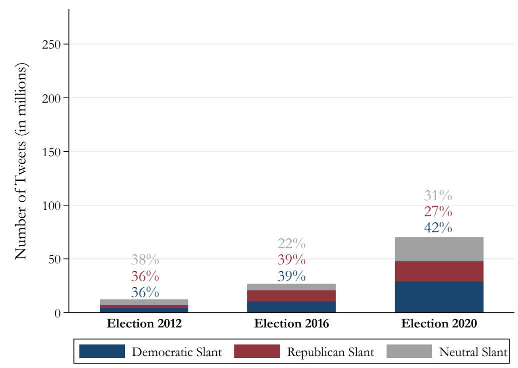
Notes: This table presents results estimated using 2SLS, as in equation (3). The dependent variable is the change in the vote share of the Republican party between the 2000 and 2016/2020 presidential elections in panels A and B, respectively. *Swing counties* are those that were not consistently won by either Republicans or Democrats between 2000 and 2012; *Republican* and *Democratic* counties are those who voted consistently. *Log(Twitter users)* is instrumented using the number of users who started following SXSW in March 2007. *SXSW followers, Pre* is the number of SXSW followers who registered at some point in 2006. All regressions control for population deciles and Census region fixed effects and the full set of controls (as in columns 5 and 10 of Table 2). Regressions are weighted by turnout in the 2000 presidential election. Standard errors in parentheses are clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure A.8: Twitter's Partisan Slant (Tweet Measure)

(a) Tweets about Republican Presidential Candidates



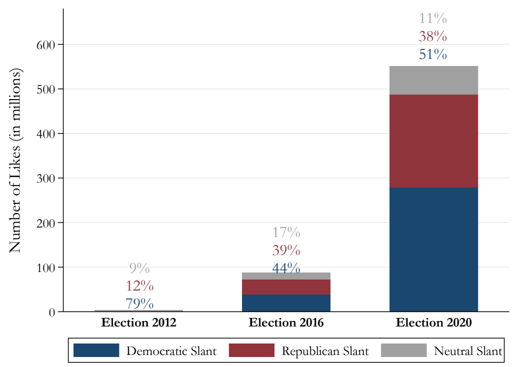
(b) Tweets about Democratic Presidential Candidates



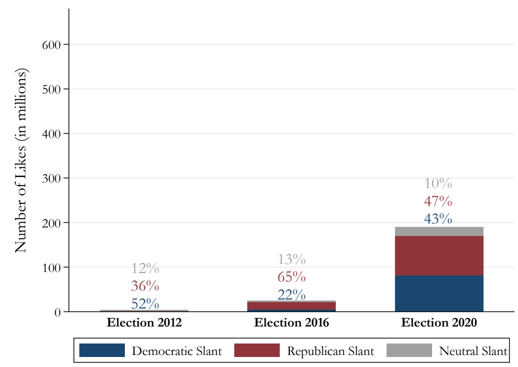
Notes: These figures present the number of tweets (as opposed to the number of "likes" as in Figure 9 received by tweets that contain the last name of the candidates in the 2012, 2016 and 2020 presidential elections, depending on whether the tweet was classified as having a Republican (instead of Democratic) slant. We classify the slant of a tweet based on the Twitter network of the user who sent the tweet. If the user follows more Democratic than Republican Congress members, they will be classified as a Democrat, and vice versa. Users who follow an equal number of Democrats and Republican or no Congress members are classified as neutral.

Figure A.9: Twitter's Partisan Slant (Text-Based Classifier)

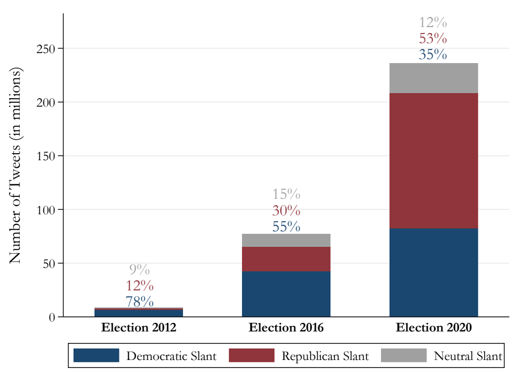
(a) Likes for Tweets about Republican Presidential Candidates



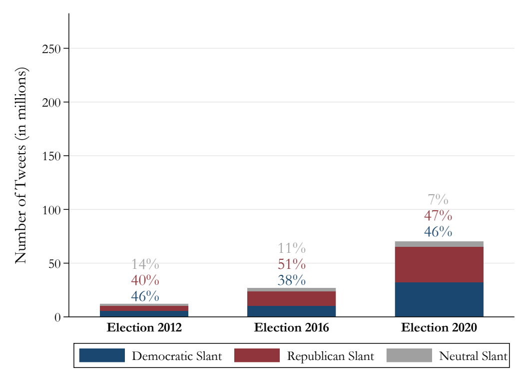
(b) Likes for Tweets about Democratic Presidential Candidates



(c) Tweets about Republican Presidential Candidates



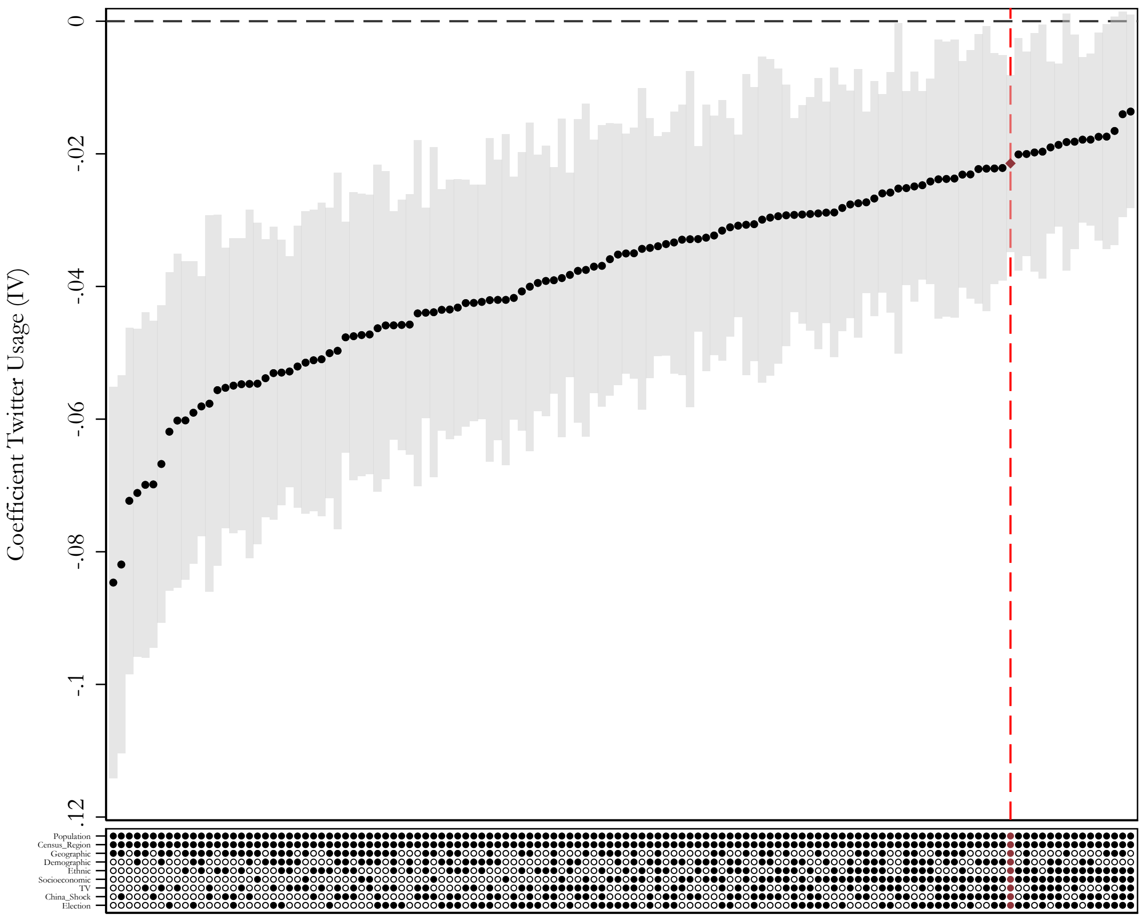
(d) Tweets about Democratic Presidential Candidates



Notes: These figures present the number of "likes" received by tweets, or the number of tweets, that contain the last name of the candidates in the 2012, 2016 and 2020 presidential elections, depending on whether the tweet was classified as having a Republican (instead of Democratic) slant. We classify the slant of a tweet based on similarity in the language to that of a congressional Republican or Democrat, using a L2 regularized logistic regression classifier using the tweets sent by Congress members. Optimal normalization strength is chosen using 10-fold cross-validation. Tweets with a predicted class probability below 60% are coded as neutral. See Appendix A.1.1 for details.

Figure A.10: Specification Curve

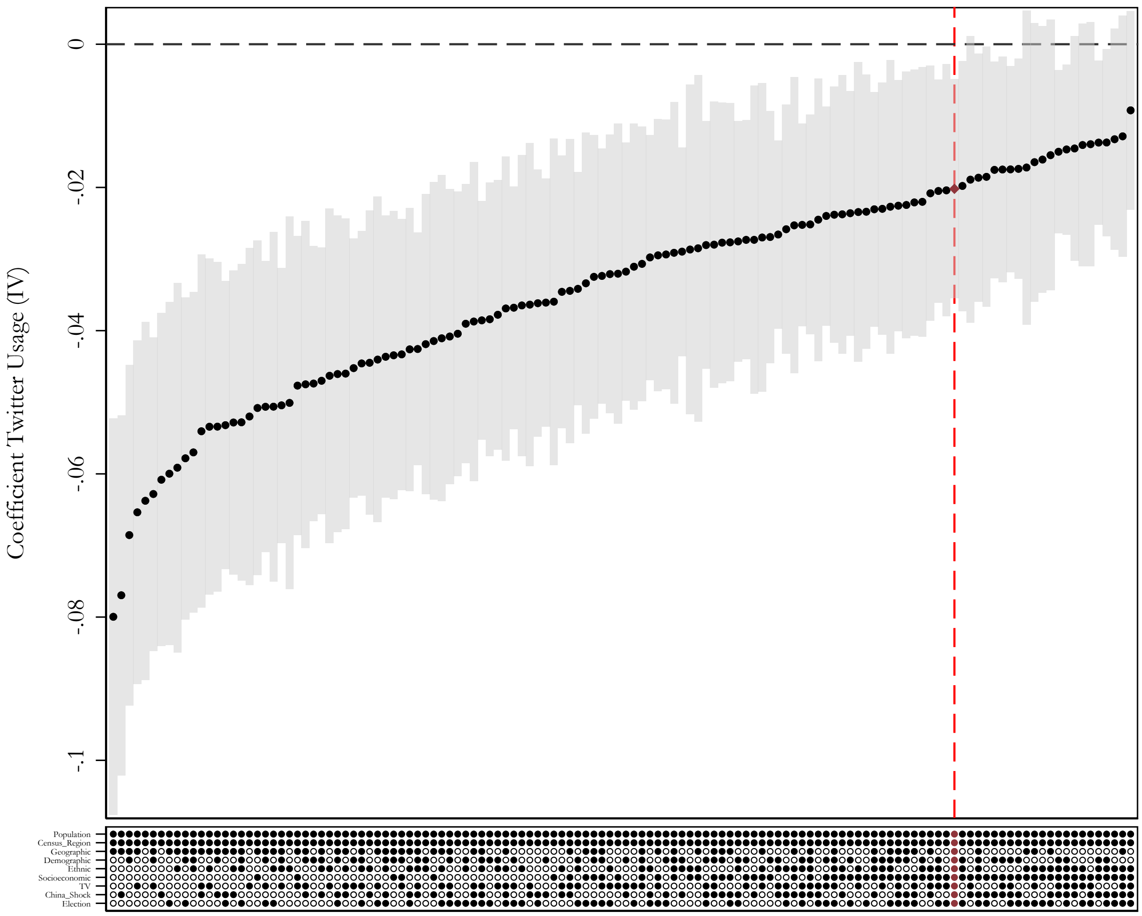
(a) 2016 Presidential Election Results



Notes: These figures plot the 2SLS estimates and 95% confidence intervals from a regression of the Republican vote share in 2016 on $Log(Twitter\ users)$, instrumented with $SXSW^{March\ 2007}$. All regressions include population deciles, census region fixed effects, and $SXSW^{Pre}$. The combination of the other included control variables is shown at the bottom; filled circles mean a set of controls was included. The baseline specification with all controls is marked by the vertical line.

Figure A.10: Specification Curve

(b) 2020 Presidential Election Results



Notes: These figures plot the 2SLS estimates and 95% confidence intervals from a regression of the Republican vote share in 2020 on $Log(Twitter\ users)$, instrumented with $SXSW^{March\ 2007}$. All regressions include population deciles, census region fixed effects, and $SXSW^{Pre}$. The combination of the other included control variables is shown at the bottom; filled circles mean a set of controls was included. The baseline specification with all controls is marked by the vertical line.

A.5. Appendix 5: Additional Details on the Extrapolation for the Average Treatment Effect

Andrews and Oster (2019) show how selection into participating in an experiment can be used to make extrapolations regarding the external validity of an experiment. They illustrate their approach using the experiment from Bloom et al. (2015) within a Chinese call centre in which workers were asked to volunteer for a work-from-home program. 50% of workers volunteered and were then randomly assigned to either treatment and control group. Given this, the measured treatment effect from the experimental sample might be different from the average treatment effect for the population as a whole, since the volunteers likely receive a higher utility from the work-from-home program.

When a set of covariates **X** is observed for both the "experimental sample" and "population," Andrews and Oster (2019) provide a procedure that uses effect heterogeneity based on **X** estimated within the experimental sample to extrapolate to the average treatment effect for the "population."

We build on their procedure and argue that we can similarly use heterogeneity in the treatment effect within the counties that "identify" our results to extrapolate the treatment effect to all other counties in the US. Column (4) of Table A.10 show that we obtain similar estimates to our baseline when we only compare counties with SXSW followers that joined Twitter in March 2007 to counties with followers that joined in the pre-period, while excluding those counties in neither group. We can use this subsample of counties as the "experimental sample", and extrapolate effects to the "population" of all other counties.

Since Andrews and Oster (2019) approach is designed for a binary treatment, we adjust our regression framework by defining a treatment indicator variable equal to 1 for counties with SXSW followers who joined in March 2007 and 0 for the counties with followers that joined in the pre-period. We estimate the treatment effect for the subsample of counties that do not have zero SXSW followers in both periods using the regression specification $y_c = \alpha + \beta \cdot \mathbb{1}[SXSW_c^{March2007} > 0] + \epsilon_c$. The resulting treatment effect estimate is -0.075, which is similar Table 2 Panel B column (1).[50] We then perform a linear prediction of this treatment effect based all observable variables in Table A.5 within this subsample. The resulting predicted treatment effect is -0.085.

[50]Note that our regression specification does not include controls, as in the Andrews and Oster (2019) approach. Moreover, partialling out the controls and applying the Frisch-Waugh theorem was not feasible since the residualized treatment would no longer be binary.

Last, we extrapolate the treatment effect for the rest of US counties. Based on the variation in observable characteristics we would predict an ATE of -0.218 for the US overall.

Note that this extrapolation is based on adjusting our reduced-form estimates to use a binary indicator variable for treatment thus the coefficients are not directly comparable to our baseline estimates. The approach further assumes quasi-random treatment assignment with in the counties with SXSW variation. Taken this into account, the extrapolation should therefore be viewed as suggestive, but confirming the notion that the effect for all US counties would be larger since the more urban counties for which we have variation in our instrument tend to be Democratic strongholds, and thus likely have fewer independents and moderate Republicans, for which we find the largest persuasion effects (in survey data).