Mobile Internet and Political Polarization*

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Abstract

How has mobile internet affected political polarization in the United States? Using Gallup Daily Poll data covering 1,765,114 individuals in 31,499 ZIP codes between 2008 and 2017, I show that, after gaining access to 3G internet, Democratic voters became more liberal in their political views and increased their support for Democratic congressional candidates and policy priorities, while Republican voters shifted in the opposite direction. This increase in polarization largely did not take place among social media users. Instead, following the arrival of 3G, active internet and social media users from both parties became more pro-Democratic, whereas less-active users became more pro-Republican. This divergence is partly driven by differences in news consumption between the two groups: after the arrival of 3G, active internet users decreased their consumption of Fox News, increased their consumption of CNN, and increased their political knowledge. Polarization also increased due to a political realignment of voters: wealthy, well-educated people became more liberal; poor, uneducated people—more conservative.

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During the past decade, the United States has experienced a significant increase in political polarization. According to Gallup, 2019 witnessed a record-setting 82-percentage-point gap in the presidential job approval rating between Republicans (89% approved of President Trump) and Democrats (7%), surpassing the previous records set by President Trump in 2018 and President Obama in 2016 (Jones, 2020). This increase in partisanship was not limited to presidential approval; a recent study found that 60% of both political parties consider the opposing party "a serious threat to the United States," and more than 40% think of the other side as "downright evil" (Kalmoe and Mason, 2019). In addition to having a detrimental effect on interpersonal interactions, such political tribalism can create stalemate and undermine lawmaking (Binder, 2014).

Many observers have blamed the internet and social media for this recent rise in political polarization. In an interview with *Vox*, prominent social psychologist Jonathan Haidt describes social media in the following way: "I really believe it's one of our biggest problems. So long as we are all immersed in a constant stream of unbelievable outrages perpetrated by the other side, I don't see how we can ever trust each other and work together again" (Illing, 2018).

This sentiment has been echoed in a number of recent studies that suggest social media users are, indeed, largely exposed to like-minded content (e.g., see Pariser, 2011; Flaxman, Goel and Rao, 2016; Halberstam and Knight, 2016; Lelkes, Sood and Iyengar, 2017; Sunstein, 2017; Levy, 2021; Peterson, Goel and Iyergar, 2021). However, other studies have presented contradictory evidence, showing that there is little segregation of online news consumption (Gentzkow and Shapiro, 2011; Prior, 2013; Eady et al., 2019; Guess, 2021); that the increase in polarization can partly be explained by factors unrelated to the internet (Autor et al., 2020; Boxell, 2020); that the ideological gap increased primarily among individuals who are less likely to be active internet users (Boxell, Gentzkow and Shapiro, 2017); that exposure to opposing views may not lead to moderation of one's political attitudes (Bail et al., 2018); and that social media use might actually decrease political polarization (Barberá, 2015; Beam, Hutchens and Hmielowski, 2018).

This paper addresses the debate about the effects of the internet and social media on political polarization in the United States. It is the first to analyze how the expansion of third-generation (3G) mobile networks—the first generation of mobile networks that allowed users to actively browse the internet from their smartphones, which became a major driver of social media usage (Rainie and Wellman, 2012)—affected the ideological views and policy preferences of the U.S. population. Using data from the Gallup Daily Poll covering 1,765,114 individuals living in 31,499 ZIP codes between 2008 and 2017, I show that, after the arrival of 3G internet in the ZIP code, Democratic-leaning voters became more liberal in their political views, while Republican-leaning

voters became more conservative. Similarly, Democratic voters increased their support both for Democratic candidates in elections to the House of Representatives and for Democratic policy positions on abortion, gay marriage, the Affordable Care Act (ACA), and immigration. Meanwhile, Republican voters shifted in the opposite direction.

This paper also presents novel evidence on the mechanisms behind the effects of mobile internet and social media on political polarization. The existing literature on this topic has focused overwhelmingly on polarization *within* social media (e.g., Facebook), primarily on the question of whether social media algorithms create so-called "echo chambers," where social media users are disproportionately exposed to like-minded news content (e.g., Bakshy, Messing and Adamic, 2015; Barberá, 2015; Halberstam and Knight, 2016; Bail et al., 2018; Beam, Hutchens and Hmielowski, 2018; Eady et al., 2019; Guess, 2021; Levy, 2021). However, this approach overlooks the fact that not all internet users are present on social media, and, while social media algorithms may partly contribute to increasing partisan divides (e.g., see Levy, 2021), this paper shows that the 3G-driven increase in political polarization largely did not take place among social media users. Instead, after the arrival of 3G, residents of ZIP codes with a large pre-3G share of social media users (and active internet users more generally) became more liberal in their political views and increased their support for Democratic congressional candidates and their policy priorities; the views of residents of ZIP codes with a small pre-3G share of social media users shifted in the opposite direction. This divergence took place both in Democratic and Republican areas, suggesting that the results are not driven by Democratic voters having a more substantial online presence.

These findings demonstrate that the internet-driven increase in political polarization largely did not take place among social media users, suggesting that researchers and policymakers should adjust their focus away from algorithms used by social media companies and, instead, explore other mechanisms behind the internet's effects on political polarization.

I present evidence in support of two such mechanisms. First, I show that after the arrival of 3G networks, active and less-active internet users diverged in their news consumption, with residents of ZIP codes with many active users becoming relatively less likely to watch Fox News and more likely to watch CNN. Active internet users also increased their political knowledge, becoming more likely to know the identities of their congressional representative and two senators, possibly due to the shift in news consumption.

Second, I focus on the insights from recent work by Bonomi, Gennaioli and Tabellini (2021), which suggests that when cultural conflict in society becomes more prominent, as it has in the United States, conflict over redistributive policies becomes muted. Thus, by increasing the salience

of cultural disagreements, the expansion of mobile internet may have resulted in a political realignment of U.S. voters, leading voters who are poor, uneducated, and out of the labor force—who benefit most from redistribution policies supported by Democrats—to become more conservative, and voters who are wealthy, employed, and well-educated to become more liberal. Given that wealthy, well-educated people are also more likely to be active on the internet and social media, the divergence between the views of active and less-active internet users may be partly driven by this political realignment of U.S. voters.

The results in this paper rely on two empirical strategies: a difference-in-differences (DiD) analysis and an instrumental-variable (IV) design. The DiD analysis uses the variation in the timing of the expansion of 3G networks across ZIP codes, controlling for geographic and time fixed effects, as well as many individual- and county-level socioeconomic characteristics. I document the absence of pretrends: the change in political views takes place only after the arrival of mobile internet, and the future availability of 3G networks is not related to political views in the ZIP code. The results are also robust to including state-year and county-year fixed effects, demonstrating that the estimates are driven by local variation in 3G availability. In addition, I present the results of a test developed by Oster (2017), showing that the effects of mobile internet on individuals' political views are highly unlikely to be driven by omitted-variable bias.

The IV identification strategy follows the design previously used by Manacorda and Tesei (2020) and Guriev, Melnikov and Zhuravskaya (2021). It relies on the fact that in areas with frequent lightning strikes, mobile infrastructure was rolled out more slowly—damage caused by lightning increases the costs of maintaining the infrastructure and providing telecommunication services. The IV estimates confirm the findings of the DiD analysis.

I also present two placebo exercises which demonstrate that the effects of 3G on political attitudes are driven by access to online content and not by other features on mobile infrastructure. First, I show that the previous generation of mobile networks (2G)—which allowed users to make calls and send text messages but not to actively browse the internet—did not affect individuals' political views. Second, I document that, in the short run, the expansion of 3G infrastructure had no impact on local socioeconomic conditions or migration patterns.

This paper contributes to several strands of the existing literature. First and foremost, it contributes to the extensive literature studying political polarization in the United States (Gentzkow and Shapiro, 2011; Pariser, 2011; Prior, 2013; Barberá, 2015; Flaxman, Goel and Rao, 2016; Halberstam and Knight, 2016; Boxell, Gentzkow and Shapiro, 2017; Lelkes, Sood and Iyengar, 2017; Spohr, 2017; Sunstein, 2017; Bail et al., 2018; Beam, Hutchens and Hmielowski, 2018; Eady et al.,

2019; Allcott et al., 2020; Autor et al., 2020; Boxell, 2020; Guess, 2021; Levy, 2021; Peterson, Goel and Iyergar, 2021). In particular, one paper that is especially relevant to mine is Allcott et al. (2020), which shows that polarization decreased among Facebook users who were paid to deactivate their accounts. I complement this work by providing novel evidence on how mobile broadband internet affected the political views, policy preferences, and voting behavior of a much broader slice of the U.S. population, including individuals who are not active on social media. I also show that the increase in political polarization largely did not occur due to algorithms used by social media companies, as has been widely hypothesized in the literature. Instead, I present evidence for two previously ignored mechanisms that may be responsible for this divide.

This paper also contributes to the broader literature on the political effects of information technology, especially the internet and social media. The study most closely related to mine is Guriev, Melnikov and Zhuravskaya (2021), which shows that the expansion of 3G mobile internet around the globe resulted in a decrease in government approval. In addition to focusing on different political outcomes, my paper differs from this study in two important ways. First, I demonstrate that, in a polarized environment, where individuals on opposite sides of the political spectrum are exposed to different information, the direction of the mobile internet's effects on political views depends on individuals' initial position on the political spectrum. Second, I analyze the mechanisms behind these divergent effects of 3G network availability.

Another important paper studying the effects of information technology on political outcomes is Manacorda and Tesei (2020), which shows that the expansion of 2G infrastructure between 1998 and 2012 facilitated political protests during economic downturns across the African continent. However, unlike 3G infrastructure, 2G technology does not allow users to actively browse the internet. As noted above, this paper uses 2G network coverage as a placebo treatment, showing that the non-internet-related aspects of mobile network coverage have not affected political opinions in the United States.

This paper is also related to a growing literature studying the effects of the internet on electoral outcomes. Recent studies have found that in Germany (Falck, Gold and Heblich, 2014), Italy (Campante, Durante and Sobbrio, 2018), the United Kingdom (Gavazza, Nardotto and Valletti, 2019), and in Europe more generally (Guriev, Melnikov and Zhuravskaya, 2021), the availability of broadband internet has reduced voter participation in elections, possibly by crowding out news consumption with entertainment content. A number of papers have also found that the expansion of internet access has negatively affected the electoral performance of incumbent political parties (Miner, 2015; Donati, 2019; Guriev, Melnikov and Zhuravskaya, 2021) and, in Europe, contributed

to the rise of populists (Campante, Durante and Sobbrio, 2018; Schaub and Morisi, 2019; Guriev, Melnikov and Zhuravskaya, 2021). In the United States, greater exposure to Twitter has been shown to decrease the probability of supporting Donald Trump in the 2016 and 2020 presidential elections (Fujiwara, Müller and Schwarz, 2021). Other recent papers have also studied the effectiveness of campaign advertising on social media (Bright et al., 2020; Liberini et al., 2020) as well as the effects of social media on protest participation (Fergusson and Molina, 2019; Qin, Strömberg and Wu, 2019; Enikolopov, Makarin and Petrova, 2020), exposing corruption (Enikolopov, Petrova and Sonin, 2018; Enríquez et al., 2021), xenophobia (Bursztyn et al., 2019; Müller and Schwarz, 2020), and political contributions (Petrova, Sen and Yildirim, 2020).[1]

My paper contributes to this literature by analyzing how the internet's effects on political outcomes differ depending on individuals' initial position on the political spectrum and by studying the mechanisms behind these differences. In particular, I show that after the arrival of 3G, residents of ZIP codes with many and few social media and internet users diverged both in their political views and in their news consumption. I also show that the internet-driven increase in the salience of cultural issues resulted in a realignment of U.S. voters, with well-educated, wealthy individuals becoming more liberal, and uneducated, poor individuals becoming more conservative.

Finally, this paper contributes to the rapidly expanding literature studying the spread of fake news and misinformation on social media (e.g., see Del Vicario et al., 2016; Allcott and Gentzkow, 2017; Faris et al., 2017; Spohr, 2017; Guess, Nyhan and Reifler, 2018; Allcott, Gentzkow and Yu, 2019; Bovet and Makse, 2019; Grinberg et al., 2019; Cantarella, Fraccaroli and Volpe, 2020). Specifically, it shows that, after the arrival of 3G, residents of ZIP codes with many social media and internet users became better informed about politics. This result is fully consistent with the findings of Allcott et al. (2020), which suggest that Facebook users who were paid to deactivate their accounts experienced a decrease in their news knowledge. Therefore, while certain groups of voters may be susceptible to the effects of online disinformation, social media and the internet can also increase political knowledge by providing access to accurate information.

The rest of the paper is structured as follows. Section I describes the data and the identification strategy. Section II presents the effects of 3G internet on political views, policy preferences, and voting outcomes and discusses the identification assumptions underlying the estimation. Section III provides an analysis of the mechanisms behind the effects of mobile internet on political polarization. Section IV concludes.

[1]For a recent review of the literature on the political effects of the internet and social media, see Zhuravskaya, Petrova and Enikolopov (2020).

I Data and Identification Strategy

I.A Data

This subsection briefly describes the main data sources used in the analysis. Further details about these data sources, as well as a description of the secondary variables, are available in Appendix Section A.I.

Mobile network coverage.—The data on 3G and 2G network coverage come from annual maps provided by Collins Bartholomew's Mobile Coverage Explorer and cover the period from 2007 to 2019. The data consist of 1×1-kilometer binary grid cells. Figure 1 illustrates the expansion of 3G network coverage between 2008 and 2018 (i.e., the years focused on in this paper) for the contiguous United States, showing that very few locations had 3G coverage in 2008, while by 2018, 3G mobile internet had become available in most parts of the country.[2]

To combine data on mobile network coverage with the other variables used in the analysis that have ZIP-code or county-level geolocalization, I calculate the share of the ZIP codes' and counties' territory covered by mobile networks.

Gallup Daily Poll.—The data on individuals' political preferences come from the Gallup Daily Poll and cover the period from 2008 to 2017. The data consist of repeated cross-sectional daily polls of 1,000 respondents with geolocalization at the ZIP-code level. The main question of interest is the following: "*How would you describe your political views: very liberal, liberal, moderate, conservative, or very conservative*?" Other questions also ask the respondents about their political affiliation, gender, race, age, education level, marital status, and income group. After merging the Gallup Daily Poll and mobile network coverage data, the sample consists of approximately 1,765,000 observations from 31,499 ZIP codes in all 50 states and the District of Columbia.

Cooperative Congressional Election Study (CCES).—The data on individuals' policy preferences come from the CCES and cover the period from 2007 to 2019. The data consist of repeated cross-sectional annual polls of 10,000–18,000 respondents in nonelection years and 25,000–60,000 respondents in election years with geolocalization at the ZIP-code level. In the survey, the respondents are asked to state their opinions about whether abortion should always be legal (2007–2019), whether they support gay marriage (2008–2016), whether the Affordable Care Act should be repealed (2012–2019), and whether security along the U.S.–Mexico border should be increased (2007, 2010–2019). The dataset also includes a question about political views, similar to the one included

[2]By definition, all grid cells that have 4G network coverage also have 3G coverage. Thus, the maps should be interpreted as showing which areas have *at least* 3G network coverage.

in the Gallup Daily Poll, and a variable for whom the individual voted for in the previous presidential election.

House election data.—The data for the 2008–2016 presidential elections and the 2008–2018 elections to the U.S. House of Representatives come from Dave Leip's Atlas of U.S. Elections. The unit of observation is a county.[3] The data include the vote shares of the Republican and Democratic candidates, the total number of ballots cast, and the number of Republican and Democratic candidates who participated in the election. To calculate turnout, I divide the number of ballots cast by the population of the county from the 2010 population census.

SimplyAnalytics.—The data on internet and social media use come from SimplyAnalytics, a mapping application that aggregates demographic, business, and marketing data from multiple sources. The main variables of interest represent the percentage of households that in the past 30 days have *(i)* used the internet to obtain the latest news/current events, *(ii)* visited a TV network or TV show's website, *(iii)* visited YouTube.com, *(iv)* visited Facebook.com, *(v)* visited CNN.com, and *(vi)* visited FoxNews.com. Other variables also represent the percentage of households that use the internet (in general), that used the internet yesterday, and that spent more than 30 minutes on the internet yesterday. The data for all these variables come from annual MRI Consumer Surveys, which cover the period from 2011 onward.[4] These data are available at both the ZIP-code and the county levels.

Lightning strike frequency.—The data on the frequency of lightning strikes come from NASA's LIS/OTD Gridded Lightning Climatology Data Collection, which presents a map of the average annual lightning-flash rate in each 0.5×0.5-decimal-degree grid cell.[5] I use these data to calculate the average population-weighted frequency of lightning strikes in every U.S. county. Thus, the resulting variable represents the average number of people per square kilometer potentially affected by the lightning strikes.

I.B Identification strategy

To estimate the effects of mobile broadband internet on individuals' political views, I perform the following identification strategy. First, I calculate the share of the ZIP codes' territory (or counties' territory, depending on the geolocalization of the outcome variable) covered by 3G

[3] In Alaska, election results are not available at the county level. For this reason, Alaska is excluded from the regressions analyzing the effects of 3G internet on voting outcomes. In the non-county-level regressions, all locations in Alaska are characterized as Republican-leaning based on how the state voted in the 2008 presidential election.

[4] The one exception is the variable for the percentage of households that in the last 30 days have visited FoxNews.com. This variable is available only from 2017 onward.

[5] The data can be found and are described here: https://ghrc.nsstc.nasa.gov/lightning/data/data_lis_otd-climatology.html (accessed on June 26, 2021).

networks in that year.[6] I then estimate the following DiD model:

$$Pol.\ views_{i,t} = \alpha_1\ 3G_{z,t} \times Pol.\ affiliation_i + \alpha_2\ Pol.\ affiliation_i + \mathbf{X}'_{i,c,t}\lambda + \varphi_c + \tau_t + \varepsilon_{i,t} \quad (1)$$

where i, z, c and t index individuals, ZIP codes, counties, and years, respectively. *Pol. views* represents the respondents' political views (e.g., a dummy variable for whether the respondent characterizes their views as liberal or very liberal). *3G* is the share of territory covered by 3G networks, the main explanatory variable. *Pol. affiliation* is a variable for the respondents' party affiliation. φ_c and τ_t are county and year fixed effects.[7] $\mathbf{X}$ is a vector of baseline individual-level and county-level controls, which include dummies for the respondents' gender, race, year of birth, education level, marital status, and income group, as well as the county's unemployment rate, log of median household income, median age, and the share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Standard errors are corrected for clusters at the level of the states and the District of Columbia.[8]

For the regression estimates to be valid, *Pol. affiliation* needs to be an exogenous measure of individuals' party membership (e.g., party membership before the arrival of 3G). In reality, party membership is observed only at the time when the survey was conducted, making it valid only under the assumption that individuals never switch their party membership. This assumption is unlikely to be satisfied. For this reason, the regression specification that will be more commonly used throughout the paper is the following:

$$Pol.\ views_{i,t} = \alpha_1\ 3G_{z,t} \times Pol.\ affiliation_c + \mathbf{X}'_{i,c,t}\lambda + \varphi_c + \tau_t + \varepsilon_{i,t} \quad (2)$$

where *Pol. affiliation* is represented by the political affiliation of the individual's county of residence in the 2008 presidential election. This definition of party membership is defined at the beginning

[6] Given that the ZIP codes represent very small geographic areas, in the vast majority of cases, the share of the ZIP codes' territory covered by 3G is equal to either zero or one.

[7] The results are robust to including ZIP code fixed effects instead of county fixed effects. However, most ZIP codes have only a small number of observations per year (e.g., the average ZIP code has 5 observations per year), making the specification with ZIP code fixed effects very restrictive. At the same time, measuring 3G network coverage at the more local ZIP code level allows to precisely measure individuals' treatment status (measuring 3G network coverage at the county level is equivalent to introducing measurement error to the treatment variable).

[8] The standard errors are clustered at this level because, in the United States, most policies and regulations are defined at the state level. The potential alternative is to correct the standard errors for spatial and over-time correlation, as suggested in Conley (1999), Hsiang (2010), and Collela et al. (2018). However, in the main regression specifications, the sample consists of approximately 1,765,000 observations, making this calculation extremely computationally demanding and practically impossible to implement. In the regression specifications where the sample is smaller (e.g., voting behavior at the county level), I have verified that even very conservative Conley standard errors that allow for spatial correlation within a 1,000-kilometer radius and autocorrelation of 10-year temporal lags are generally smaller than the standard errors corrected for clusters at the state level.

of the sample period and is robust to individuals switching their party membership.

As Guriev, Melnikov and Zhuravskaya (2021) first pointed out, the availability of 3G network coverage affects internet usage in multiple ways, all of which are important for interpreting the overall effect of mobile infrastructure on political views. First, 3G network coverage increases internet use on the extensive margin by providing a connection to people who previously did not have it. Second, mobile broadband affects internet use on the intensive margin by making it easier to spend more time online. Finally, 3G availability affects *what* individuals do on the internet, most notably by facilitating engagement with social media (Rainie and Wellman, 2012). To document the importance of all these factors, I estimate the following relationship between 3G network coverage and various aspects of internet usage, the data for which are available at the ZIP-code level from annual MRI Consumer Surveys:

$$\textit{Internet usage}_{z,t} = \gamma\, 3G_{z,t} + \varphi_z + \tau_t + \varepsilon_{z,t}. \tag{3}$$

The main identification challenge for interpreting the DiD estimates as causal is that the expansion of 3G mobile networks could have taken place in locations that were already experiencing a change in political views before the arrival of 3G internet. To address this concern, Subsection II.C presents a number of robustness and placebo exercises, as well as the results of the test proposed in Oster (2017), all of which show that the estimates of Specification (2) represent the causal effect of 3G internet on individuals' political views. For instance, I show that individuals' views are not affected by the future availability of mobile internet but start to change as soon as the ZIP code becomes covered by 3G networks. The results of the Oster test also show that the estimates are highly unlikely to be driven by omitted-variable bias. In addition, Subsection II.C shows that the expansion of 3G infrastructure was not correlated with changes in major local socioeconomic characteristics such as income, unemployment, poverty, or education.

To alleviate remaining concerns that the identification assumptions behind the DiD estimates might be violated, I use variation in the frequency of lightning strikes per square kilometer across U.S. counties to predict the speed of the expansion of 3G network coverage, an identification strategy used in several recent studies (e.g., see Manacorda and Tesei, 2020; Guriev, Melnikov and Zhuravskaya, 2021). The frequency of lightning strikes affects the spread of digital technologies by increasing the expected costs of building and maintaining this type of infrastructure (Andersen et al., 2012). Mobile internet towers are especially sensitive to lightning strikes, which can both cause immediate damage and result in quicker depreciation of equipment (Zeddam and Day,

2014; Martin, 2016). The problem can partially be addressed with surge-protection equipment, but a large swath of U.S. infrastructure is not protected. For instance, in 2017, the United States experienced 3,526 power outages affecting 36.7 million people (EATON, 2017), and its energy infrastructure received a D+ grade from the American Society of Civil Engineers (ASCE, 2017).[9] Overall, the expanion of 3G networks is likely to be slower in areas with a high frequency of lightning strikes. Therefore, I use the following first-stage equation to predict 3G network coverage in year t:

$$3G_{z,t} = \beta \, \textit{Lightning strikes per km}^2_c \times t + \mathbf{Z}'_{z,c,t}\lambda + \varphi_c + \tau_t + \varepsilon_{z,t} \tag{4}$$

where *Lightning strikes per km* is the population-weighted frequency of lightning strikes per square kilometer, t is a linear time trend, and $\mathbf{Z}$ represents all the control variables, including all the baseline controls listed above, as well as separate year fixed effects for all quartiles of county population size, the log of maximum elevation in the county interacted with a time trend, and the share of the county's territory that is uninhabited interacted with a time trend. Additional controls are added to account for other factors that potentially influenced the speed of the expansion of 3G networks.

Finally, I study the mechanisms behind the internet-driven increase in political polarization. The existing literature on this topic has overwhelmingly focused on polarization *within* social media, often emphasizing the role of algorithms in creating so-called echo chambers within social media: the phenomenon that individuals become disproportionately exposed to like-minded news content, which, in turn, reaffirms their initial beliefs. While social media algorithms may contribute to increasing partisan attitudes (e.g., see Levy, 2021), I show that the 3G-driven growth in political polarization largely did not take place among social media users. Instead, after the arrival of mobile internet, social media users (and active internet users more generally) became more liberal in their political views and increased their support for Democratic congressional candidates and their policy priorities, while social media nonusers changed their views in the opposite direction.

To demonstrate this fact, I interact 3G network coverage with pre-3G measures of social media and internet usage in the respondent's ZIP code of residence (e.g., the share of households

[9] Guriev, Melnikov and Zhuravskaya (2021) find that lightning strikes affect the expansion of mobile infrastructure primarily in countries with below-median per capita income, presumably because surge-protection equipment is widely used in most rich countries. However, though the United States has above-median per capita income, the poor state of its infrastructure makes it vulnerable to damage from lightning strikes.

in the ZIP code that were using Facebook) and estimate the following model:[10]

$$\textit{Pol. views}_{i,t} = \psi_1\, 3G_{z,t} + \psi_2\, 3G_{z,t} \times \textit{Internet usage}_z + \psi_3\, \textit{Internet usage}_z + \mathbf{X}'_{i,c,t}\lambda + \varphi_c + \tau_t + \varepsilon_{i,t} \quad (5)$$

To show that the estimates of Specification (5) are not driven by members of a particular party being more active on the internet and social media, I also interact *3G*, *Internet usage*, and *3G* $\times$ *Internet usage* with a variable representing the political affiliation of the respondent's county of residence. As demonstrated in Subsection III.A, the results hold for members of both parties.

The decision to be active on social media is an individual choice and, therefore, not an exogenous characteristic. For this reason, the estimates of Specification (5) do not necessarily represent the causal effect of active internet and social media usage on political views. Instead, they serve a descriptive function, showing that the 3G-driven increase in political polarization largely did not take place among social media users. Thus, while social media algorithms that disproportionately expose users to like-minded content may also contribute to the growth in partisan attitudes, future research should additionally explore other mechanisms behind the effects of the internet on political polarization.

This paper provides suggestive evidence on two such mechanisms. First, I use MRI data on media consumption at the ZIP-code level to estimate Specification (5) for these outcome variables, showing that after the arrival of 3G networks, active and less-active internet users diverged in their news consumption, with active users becoming relatively less likely to watch Fox News and more likely to watch CNN.[11] I also analyze whether this divergence in the choice of news sources translated into differences in political knowledge. Specifically, I estimate Specification (5) for the outcome variables of whether the respondent knows the identities of their congressional representative and two senators.

Second, I test the insights from recent work by Bonomi, Gennaioli and Tabellini (2021), which suggests that increased cultural conflict in society should lead to less conflict over redistribution policies, resulting in a political realignment of voters. As demonstrated in Table 2, the arrival of 3G

[10]The data for social media and internet usage first became available in 2011, three years after the emergence of 3G. Therefore, to estimate the level of social media and internet usage in the ZIP codes prior to the arrival of 3G (i.e., $\textit{Internet usage}_z$), I perform the following calculation. First, I estimate Specification (3) to find the effects of mobile internet on social media and internet usage (i.e., γ). Then, I calculate $\textit{Residual internet usage}_{z,t} := \textit{Internet usage}_{z,t} - \gamma\, 3G_{z,t}$, which provides a measure of social media and internet usage in the absence of 3G infrastructure. $\textit{Internet usage}_z$ is then calculated as the average of $\textit{Residual internet usage}_{z,t}$ in the first four years for which the data are available (i.e., the first half of the sample period) and represents the estimated level of internet usage prior to the arrival of 3G. I focus on the first half of the sample period to ensure that $\textit{Internet usage}_z$ is not affected by technologies that became available in later years. The results are very similar if one, instead, uses the data for a different time period (e.g., the first two years for which the data are available).

[11]Given that the data for media consumption are available only at the ZIP-code level, the exact regression specification I use in this part of the analysis is the following: $\textit{Media}_{z,t} = \psi_1\, 3G_{z,t} + \psi_2\, 3G_{z,t} \times \textit{Internet usage}_z + \varphi_z + \tau_t + \varepsilon_{z,t}$.

internet has indeed widened the cultural divide between Democrats and Republicans. Therefore, according to Bonomi, Gennaioli and Tabellini (2021), the expansion of mobile infrastructure should have also resulted in people who are poor, uneducated, and out of the labor force—the main beneficiaries of the redistribution policies supported by Democrats—becoming more conservative, and wealthy, employed, and well-educated people becoming more liberal. To test this mechanism, I present the heterogeneity of the effects of mobile internet on political views by education, income, and employment status. Specifically, I estimate Specification (2), replacing the variable for political affiliation with dummy variables for all the values of the socioeconomic characteristic of interest, controlling for all the baseline covariates, including dummies for the direct effects of all the values of the socioeconomic characteristic.

II 3G Internet and Political Polarization

II.A Main Results

Table 1 presents the results of estimating the effect of 3G network coverage on individuals' political views using Specifications (1) and (2). The sample consists of approximately 1,765,000 observations from 31,499 ZIP codes in all 50 states and the District of Columbia. In Columns 1 and 2, the outcome variable is a dummy for an individual having liberal or very liberal views. Column 1 presents how the availability of 3G internet affects the probability of holding such views, depending on individuals' political affiliation. Democratic voters became 5.1 percentage points more likely to hold liberal or very liberal views, while Republican voters became 3.5 percentage points less likely to do so. Figure 2 illustrates these results.

Under the assumption that individuals do not switch their political affiliation, the estimates in Column 1 of Table 1 represent the causal effect of 3G internet on holding liberal or very liberal political views. However, it is quite likely that, along with a shift in political views, individuals also change their party affiliation. For this reason, Column 2 of Table 1 presents the results of estimating Specification (2), where the respondents' political affiliation is replaced with the political affiliation of the counties where they live. The political affiliation of the counties is based on voting outcomes in the 2008 presidential election. Counties that Obama won by a margin of at least 30 percentage points are characterized as reliably Democratic, counties that Obama won by a margin of 10 to 30 percentage points as Democratic-leaning, counties that Obama lost by a margin of at least 30 percentage points as reliably Republican, and counties that Obama lost by a margin of 10 to 30 percentage points as Republican-leaning; the remaining counties are characterized as swing

counties.

The results in Column 2 of Table 1 present the same pattern as those in Column 1: after the arrival of 3G internet, residents of counties with mainly Democratic voters became more likely to hold liberal or very liberal political views, while for counties with mainly Republican voters the effect is the opposite. Unsurprisingly, the estimates in Column 2 are smaller in magnitude than those reported in Column 1—this happens because all counties consist of a mix of Democratic, Republican, and Independent voters, whose views change in divergent directions. On the other hand, the results in Column 2 are robust to individuals potentially changing their party affiliation as long as they do not selectively migrate in or out of partisan counties, an assumption that I check and verify in Subsection II.C.

Columns 3 and 4 present similar results for the outcome variable of having conservative or very conservative political views.[12] After getting access to 3G internet, Democratic voters and residents of Democratic-voting counties became less likely to hold conservative political views, while Republican voters and residents of reliably Republican counties became more likely to describe themselves as conservative. The effects are stronger in Democratic counties than in Republican counties, which is explained by the fact that, similarly to Democratic voters, Independent voters became less conservative after the arrival of 3G network coverage. Thus, the share of Republican voters needs to be very high for the effect of mobile internet on Republican voters to dominate the effect on Democratic and Independent voters.[13]

Overall, the results in Table 1 confirm the notion that the expansion of 3G network coverage has increased political polarization.

II.B 3G Coverage and Internet Usage

When interpreting the impact of mobile internet on political outcomes, it is important to note that the availability of 3G infrastructure affects several dimensions of internet usage, all of which can contribute to the overall effects of 3G. To document the importance of these factors, I estimate Specification (3) for various aspects of internet usage. Table A1 presents the results. The estimates in Columns 1 and 2 demonstrate that the availability of 3G network coverage increased internet

[12] Notably, the outcome variable for having conservative or very conservative political views is not perfectly collinear with the variable for holding liberal or very liberal views, because the respondents could also describe themselves as moderate.

[13] In addition, as discussed in detail in Subsection III.C, residents of Republican counties primarily became more conservative in their views during the years when President Obama was in office, especially the years when, in addition to controlling the White House, Democrats controlled both chambers of Congress. In contrast, during the first years of the Trump presidency, residents of Republican counties became less conservative in their political views.

usage on the extensive margin by affecting the share of people using the internet.[14] The results in Column 3 show that mobile internet coverage also affected internet usage on the intensive margin by increasing the amount of time people spend online. Finally, Columns 4–8 illustrate that the expansion of 3G impacted how people use the internet. In particular, 3G led to an increase in social media usage and in the share of people using the internet to access the news. All of these dimensions are potentially important for interpreting the effects of mobile internet on political views.

II.C Identification Assumptions and Robustness Checks

In this subsection, I analyze a number of assumptions that need to be satisfied for the effects of mobile internet on individuals' political views to be interpreted as causal. In particular, I demonstrate that the change in political views started to take place only after the arrival of 3G networks. I also present a number of other tests and robustness checks, including the results of the IV analysis, in which the frequency of lightning strikes per square kilometer is used as an exogenous source of variation affecting the speed of the expansion of 3G networks.

State-year, county-year, and political-affiliation-year fixed effects.—A potential concern is that the change in individuals' political views may be driven not by the local availability of 3G networks but by certain state-level, county-level, or party-level factors unrelated to mobile internet. To address this concern, I estimate Specifications (1) and (2), controlling for state-year, county-year, and political-affiliation-year fixed effects (in separate regressions), which absorb all the variation from the respective sources. Table A2 in the Appendix presents the results, which are similar to those presented in Table 1. The estimates remain highly significant even if one controls for county-year fixed effects, which is a very demanding specification, given that counties represent small geographic areas, many parts of which experienced an increase in 3G network coverage in the same year. Nevertheless, the results in Table A2 demonstrate that it is local variation in mobile internet availability that is driving the effects on political views.

Leads of 3G network coverage.—Another potential concern is that, instead of causing individuals to change their opinions, 3G networks expanded to areas that were already experiencing a change in political views before the arrival of mobile internet. To address this concern, I estimate Specification (2), additionally controlling for the leads of 3G network coverage interacted with the

[14] To highlight the magnitudes of the effects, the outcome variables are normalized by the average of the within-ZIP-code standard deviations of the respective variables (i.e., the outcome variables are measured in standard deviations). Within-ZIP-code standard deviations are used (instead of overall standard deviations) because they reflect within-ZIP-code changes in internet use and not the heterogeneity in internet use across ZIP codes.

counties' political affiliation.[15] Appendix Table A3 presents the results. If the expansion of mobile internet took place in areas that were already becoming more partisan before the arrival of 3G, then individuals' views would be correlated with the future availability of 3G network coverage. However, the results in Table A3 show that the respondents' views started to change only after mobile internet became available (i.e., the leads of 3G coverage are not correlated with individuals' political views, while the effects of contemporaneous 3G availability remain significant).

Event study.—To further demonstrate that the change in political views started to take place only after the arrival of mobile internet, I conduct an event-study analysis, in which a ZIP code is assumed to be treated when it first becomes fully covered by 3G networks.[16] Figure 3 presents the event-study estimates for the subsample of Democratic-voting and swing counties (Appendix Table A4 presents the regression estimates).[17] In the years before the arrival of 3G network coverage, the residents of those counties did not change their political views. However, after getting access to mobile internet, their views started to shift, becoming less conservative and more liberal, with the magnitudes of the effects growing over time.[18]

[15]More generally, because the assumption that individuals do not change their political affiliation after experiencing a shift in their views is unlikely to be satisfied, the rest of the paper focuses primarily on the political affiliation of the counties where the respondents live.

[16]Because the ZIP codes represent very small geographic areas, in the vast majority of cases, they have either no or full 3G coverage. Thus, in the first treatment year, most ZIP codes experienced a sigificant increase in the share of territory covered by 3G. The event-study results are very similar if, instead, the definition of treatment status is based on the ZIP code experiencing an increase in the share of territory covered by 3G of x percentage points, where x is any number above 50. However, observationally, the residents of ZIP codes with incomplete 3G coverage are largely unaffected by the partial availability of mobile internet. A potential explanation for this fact is that, because ZIP codes represent very small geographic areas, incomplete coverage might imply that the internet signal is not stable in the entire ZIP code. When 3G network coverage is calculated for larger areas (e.g., a county or a state), this problem disappears, because the larger areas consist of many smaller units that have either full (and stable) coverage or no coverage at all.

[17]Thus, the sample consists of all the counties that Obama either won or narrowly lost (by a margin of no more than 10 percentage points) in 2008. All these counties are combined in one group to increase the precision of the estimates and because, as shown in Table 1 and Appendix Tables A2 and A3, the residents of these counties changed their views in the same direction after the arrival of 3G.

[18]It is important to note that an equivalent event-study design for Republican-voting counties (not reported) does not present the opposite relationship (i.e., individuals becoming less liberal and more conservative after the arrival of 3G). Instead, although the effects are significantly closer to zero, it presents a pattern that is qualitatively similar to the one presented in Figure 3. This fact can be explained as follows. First, it appears that the effect of 3G internet on Democratic voters' political views is much stronger than on Republican voters' political views. Therefore, given that the estimated effect on the views of the counties' residents is a weighted average of the individual effects on Democrats, Republicans, and Independents, a large effect on Democratic voters can overwhelm the smaller effect on Republicans, even in Republican-voting counties. This finding is generally consistent with the results for Republican-voting counties in Table 1 and Appendix Tables A2 and A3, where the effects on the political views of people living in Republican-voting counties have also been weaker and less robust. However, as shown in Subsection II.D, the arrival of 3G internet did affect the policy preferences and voting patterns in Republican counties. Thus, while 3G network coverage has had a limited effect on Republicans' self-described political views, it has affected their attitudes and preferences. The second factor that explains why, while the effects are significantly closer to zero, the event-study graph for Republican counties is qualitatively similar to the one presented in Figure 3 is the following. As discussed in detail in Subsection III.C, the effect of mobile internet on the views of residents of Republican counties changed over time, depending on the party in control of the federal government. In the first years of the Obama administration, when Democrats also controlled both chambers of Congress, residents of Republican counties became more conservative in their political views. In the later years of the Obama presidency, when Republicans took control over at least one chamber of Congress, this effect stopped being statistically significant. Finally, during the first years of the Trump administration, when Republicans controlled

The underlying assumption behind the estimates presented in Figure 3 is the absence of heterogeneous treatment effects across the ZIP codes in the sample. If this assumption is not satisfied, the event-study estimates might place negative weights on the average treatment effects for certain groups and periods (e.g., see De Chaisemartin and D'Haultfœuille, 2020; Borusyak, Jaravel and Spiess, 2021; Goodman-Bacon, 2021; Sun and Abraham, 2021). To demonstrate that the results are robust to heterogeneity in the treatment effects, I also use an alternative estimator suggested in De Chaisemartin and D'Haultfœuille (2020), which calculates the average of the individual treatment effects. Appendix Figure A1 presents the estimates (and Appendix Table A4 reports the underlying coefficients), confirming the notion that individuals started to change their political views after getting access to 3G internet, while before the arrival of 3G, their views remained stable.

Sensitivity to omitted-variable bias.—To evaluate whether the effects of 3G network coverage on individuals' political views can be driven by omitted-variable bias, I follow Oster (2017) and calculate Oster's δ statistic, which shows how much more important unobservable characteristics need to be compared to observable controls to fully explain the regression results by omitted-variable bias. Appendix Table A5 reestimates the effects of 3G internet on self-identified Democratic, Republican, and Independent voters, as well as on the residents of Democratic-voting, Republican-voting, and swing counties.[19] It also reports Oster's δs for the effects of 3G on Democratic- and Republican-leaning voters and counties, which are calculated based on the standard methodology suggested in Oster (2017).[20] The results suggest that the regression estimates are highly unlikely to be driven by omitted-variable bias. For instance, in the regression specifications with political affiliation measured at the county level, the δs for the statistically significant coefficients vary between 2.34 and 9.87, suggesting that unobserved characteristics need to be at least 2.34 times more important than observed controls to make the effects on political views equal to zero. Given that

both chambers of Congress, residents of Republican counties became *less* conservative in their political views.

[19] Hereafter, counties previously characterized as "reliably Democratic/Republican" and "Democratic/Republican-leaning" are combined into one category of "Democratic/Republican-leaning" counties. The reason for the change is that the two groups generally change their views in similar ways, and a smaller number of groups increases the statistical power of the estimation. More generally, there is a tradeoff between the size of the effect on a particular group (e.g., reliably Democratic counties are likely to be more affected by 3G internet than Democratic-leaning counties, because they have more Democratic voters and fewer Republican voters) and statistical power, which depends on the number of observations in that group. Therefore, when statistical power is sufficient to highlight the differences between Democratic-voting, Republican-voting, and swing counties, which is the case for most estimates in this paper, I report the results for each of those groups. However, in some cases, in order to increase statistical power, I present the results for just two groups: counties that Obama won in 2008 and counties that Obama lost in 2008.

[20] In particular, to calculate the δs, as suggested in Oster (2017), I set R^2_{max}—the R-squared from a hypothetical regression of the outcome variable on all observed and unobserved controls—to be equal to $1.3\tilde{R}^2$, where $\tilde{R}^2$ is the R-squared reported in the table. In the context of the empirical exercise in this paper, this level of R^2_{max} is likely to be appropriate because the R^2 of a regression that includes ZIP-code-year fixed effects—which presents an unrealistically high upper bound of the share of variation that can be explained by observed and unobserved controls, because it assumes that a researcher can perfectly predict political views at the ZIP-code level (including the composition of the sample respondents in each ZIP-code-year)—has an R^2 that is only slightly larger than R^2_{max}.

observed controls include individuals' race, education, age, gender, income, and many other important individual- and county-level characteristics, all of which are well-known determinants of political views in the United States, it is very unlikely that such unobserved characteristics exist.

ZIP-code fixed effects.—To demonstrate that the effects of 3G network coverage on political views are not driven by time-invariant characteristics of the ZIP codes, I show that the results are robust to the inclusion of ZIP-code fixed effects. This regression specification is very restrictive, because the median number of observations in each ZIP-code-year is equal to four, and 23% of ZIP-code-years have only one observation. Nevertheless, the results in Appendix Table A6 confirm the notion that the availability of 3G internet increases political polarization, even after the inclusion of ZIP-code fixed effects.

3G availability and local economic conditions.—Two potential concerns are that *(i)* the expansion of 3G networks took place primarily in areas with higher economic growth and that *(ii)* the arrival of 3G could have further improved local socioeconomic conditions, potentially leading to a shift in political views. I address these concerns in the following ways. First, I analyze whether the changes in counties' socioeconomic characteristics—namely, median household income, the unemployment rate, the share of the population receiving food assistance, the share of the population with a college degree, and the share of the population with no schooling—can predict the current or future availability of 3G networks. Specifically, I estimate the effects of these characteristics on county-level 3G network coverage in years t and $t + 1$, controlling for county and year fixed effects, as well as for the other baseline county-level controls. Columns 1 and 2 of Appendix Table A7 present the regression estimates. The results suggest that none of these characteristics affected the expansion of mobile infrastructure.

Next, I analyze whether the arrival of 3G had an impact on future local socioeconomic conditions. In particular, Columns 3–5 of Table A7 present the relationship between county-level 3G network coverage in year $t - 1$ and the counties' median household income, unemployment rate, and share of the population receiving food assistance in year t, respectively. None of these outcome variables were affected by previous expansions of 3G, at least in the short run.[21] Thus, it is unlikely that the immediate effect of 3G availability on individuals' political views can be explained by 3G affecting local socioeconomic conditions.

Lightning strikes and the expansion of 3G networks.—To allay remaining concerns about the validity of the effects of 3G coverage on political views, I perform the IV identification strategy pre-

[21] I also verified that there are no effects on the share of the population with a college degree and the share of the population with no schooling. These results are not reported, because education outcomes are unlikely to change within one year, so the nonresults for these variables are not surprising.

viously employed by Manacorda and Tesei (2020) and Guriev, Melnikov and Zhuravskaya (2021), which uses the frequency of lightning strikes to predict the speed of the expansion of 3G networks. Lightning strikes damage mobile infrastructure, often causing service interuptions and necessitating repairs. Because of the higher costs of providing and maintaining 3G infrastructure in areas with a high frequency of lightning strikes, the expansion of mobile networks is likely to be slower in those areas.

As described in Subsection I.B, I use Specification (4) to predict the speed of the expansion of 3G coverage. The first-stage relationships between 3G network coverage and the excluded instrument in counties that Obama lost and won in 2008 are reported in Columns 1 and 4 of Table A8, respectively. Appendix Figure A2 illustrates the results. In both cases, the estimates are highly significant. Columns 2 and 5 report the reduced-form relationships between the instrument and individuals' political views, and Columns 3 and 6 present the 2SLS estimates along with the first-stage F-stats for the excluded instrument. The results confirm the notion that the spread of 3G internet has contributed to increasing political polarization, with Democratic voters becoming more liberal and Republican voters more conservative.

2G coverage as placebo treatment.—To demonstrate that 3G coverage affects individuals' political views through providing access to online content and not through other features of mobile networks, I use the expansion of 2G networks as a placebo treatment. 2G (or GSM) technology allows for phone calls and text messages, but it does not allow for actively browsing the internet or watching online videos. Thus, if 3G affects individuals' political views not by providing access to internet content but through other aspects of mobile networks, one would expect the effects of 2G availability to be similar to the effects of 3G. Table A9 presents the results of the placebo exercise, showing that 2G has had no effect on the political views of the respondents. This result confirms the notion that 3G availability affects people by providing access to online content.

No effect on migration.—Another potential concern is that the arrival of mobile infrastructure might have an effect on migration to or from the affected areas, which can change the composition of the survey respondents living in a location. To alleviate this concern, I estimate the effect that the expansion of 3G internet has had on migration between the counties in the sample (i.e., the unit of analysis used to measure the political affiliation of the area), controlling for county and year fixed effects, as well as for the other baseline county-level controls. The results, reported in Appendix Table A10, show that 3G network coverage has no impact on any of the outcome variables (i.e., the in-migration, out-migration, and net-migration rates). Moreover, given that the outcome variables

are measured in percentage points, the regression coefficients are very small.[22]

Vote type in last presidential election.—As a further robustness check, I consider an alternative measure of individuals' political affiliation: whether they voted for the Democratic or Republican presidential nominee in the last election. The advantage of this approach is that the survey respondents cannot change their vote in past presidential elections. The drawback of this approach is that, in the United States, not all adults participate in elections (in the 2008–2016 presidential elections, turnout varied between 58% and 61.6%), with turnout being higher among older, wealthier, and more-educated people and lower among minority groups.[23]

The Gallup Daily Poll does not include data on votes cast in the last presidential election, so instead, I estimate Specification (1) using CCES data.[24] Table A11 presents the regression estimates, which confirm the results presented earlier in the paper.

II.D Policy Preferences and Voting Outcomes

The evidence presented in the previous subsections demonstrates that the expansion of mobile internet has had a significant effect on individuals' political views, shifting Democratic and Republican voters toward opposite ends of the political spectrum. In this subsection, I address the question of whether 3G infrastructure similarly affected policy preferences and voting outcomes.

Policy preferences.—The data on individuals' policy preferences come from the CCES dataset, which includes questions on many polarizing topics (namely, abortion, gay rights, the Affordable Care Act, and immigration). For all the policy questions, it is well known that Democrats generally stand on one side of the policy debate (e.g., abortion should be legal), while Republicans support the opposite point of view (e.g., abortion should not be legal). Therefore, under the hypothesis that 3G internet increases political polarization, individuals' policy preferences are expected to converge with the position of the party that they support.

To test this hypothesis, I estimate Specification (2), using dummies for various policy preferences as the outcome variables. Table 2 reports the results. For all the policy variables, residents of Democratic- and Republican-leaning counties shift their views in opposite directions. Thus, the expansion of 3G internet affected not only individuals' overall political views but also their

[22]Thus, in addition to not being statistically significant, the effects are not economically meaningful. For instance, the arrival of 3G internet, on average, increases the out-migration rate by a mere 0.08%.

[23]The personalities of the presidential nominees can also affect the composition of voters who participate in a given election.

[24]The CCES dataset includes 293,587 observations that can be used in the analysis, which is six times fewer than in the Gallup Daily Poll. The substantial difference in sample size is the main reason why the Gallup Daily Poll is the main dataset used in this paper.

attitudes toward specific policy proposals.[25]

The availability of mobile internet also affected the salience of some of the problems facing the country in the eyes of voters. The data on this question come from the Gallup Poll Social Series, where the respondents were asked to name the most important problem facing the country. Appendix Table A13 presents the results of estimating the effects of 3G internet on individuals' perceptions of whether immigration, inequality, race relations, or gun violence is the most important problem facing the country today.[26] As expected, after the arrival of 3G networks, Democratic and Republican voters diverged in their views about the salience of these problems.

Voting outcomes.—To estimate the effects of mobile internet on voting outcomes, I use 2008–2018 county-level data on elections to the U.S. House of Representatives. The outcome variables of interest are the vote shares of Republican and Democratic candidates, as well as the vote margins of the Republican candidates (i.e., the vote share of the Republican candidate minus the vote share of the Democratic candidate). Columns 1–6 of Table 3 report the results of estimating Specification (2) for these outcome variables. The odd columns present the estimates for the full sample; the even columns, for the subsample of county-years with at least one Republican candidate and at least one Democratic candidate running for office. The results confirm the notion that the expansion of 3G internet has increased political polarization. After the arrival of 3G, voters in Republican-leaning counties increased their support for Republican congressional candidates while proportionally decreasing the vote share of Democratic candidates; in Democratic-leaning counties, the relationship is reversed. Figure 4 illustatrates the results for the Republican and Democratic vote shares (Columns 2 and 4 of Table 3).[27]

The magnitudes of the effects are quite large, especially in Republican-leaning counties. For instance, the results in Column 2 suggest that, after the county becomes fully covered by 3G networks, the vote share of Republican candidates increases by 4.5 percentage points in Republican-leaning counties and decreases by 2.6 percentage points in Democratic-leaning counties.[28] The results in Columns 7 and 8 also suggest that the expansion of 3G internet resulted in an approxi-

[25] Appendix Table A12 demonstrates that, similarly to the change in political views, individuals' attitudes toward these policies started to change only after the arrival of 3G, while the future availability of 3G is not correlated with current policy views.

[26] Individuals on different sides of the political spectrum have disparate views about the salience of these problems, with Republican voters being more concerned about immigration and Democratic voters being more concerned about race relations, inequality, and gun safety.

[27] Appendix Table A14 demonstrates that, similarly to the change in political views and policy preferences, voting outcomes are affected by current levels of 3G coverage, not the future availability of 3G (i.e., the future availability of 3G is not correlated with current voting outcomes).

[28] The fact that, for voting outcomes, the magnitudes of the effects are larger than those for political views and policy preferences is likely explained by the composition of people who vote in elections. Most notably, election turnout is consistently higher among older Americans, who generally favor Republican candidates. Also, as shown in Appendix Table A19, 3G internet primarily increased polarization among older voters.

mately 1-percentage-point decrease in turnout in both Democratic- and Republican-leaning counties, which is consistent with the previously documented effects of the internet on turnout in Europe (Falck, Gold and Heblich, 2014; Campante, Durante and Sobbrio, 2018; Gavazza, Nardotto and Valletti, 2019; Guriev, Melnikov and Zhuravskaya, 2021).[29] Thus, part of the effects on the vote shares of Democratic and Republican candidates might be explained by the decreases in turnout, although the impact on turnout is not sufficiently large (approximately 1 percentage point) to be fully driving the results. Overall, the results demonstrate that, in addition to causing individuals to change their political views and policy preferences, the expansion of 3G networks also induced people to change their voting behavior.

II.E Magnitudes of the Effects

Share of increase in political polarization explained by 3G.—To analyze the extent to which mobile internet is responsible for the increase in political polarization, I perform the following exercise. First, for each outcome variable, I consider the share of population in Democratic- and Republican-leaning counties that is aligned with the position of the dominant party in the county (e.g., the share of population that votes for the party) and calculate the change in that share between 2008 and 2018.[30] This change represents the overall increase in political polarization that took place during this period. I then calculate the effect that mobile internet had on increasing the share of population that is aligned with the position of their county's dominant party. For each outcome variable, I consider the regression coefficients for the effects of 3G on the probability of holding the same views as the main party in the county, separately for Democratic- and Republican-leaning counties. Then, I multiply these estimates by the average increases in 3G network coverage that Democratic- and Republican-leaning counties experienced during the period, and I take the average of the effects on Democratic- and Republican-leaning counties, weighted by their relative sample size. The resulting variable represents the effect of mobile internet on political polarization. Finally, I calculate the share of the increase in political polarization that can be explained by mobile internet. Full details of the calculations are presented in Appendix Section A.II.

Appendix Table A15 presents the results of estimating the share of the increase in political polarization that can be explained by mobile internet. 3G network coverage can account for 11.3%

[29] The decrease in turnout might be driven by voters' disillusionment with the partisan nature of U.S. politics. It is also possible that the internet might decrease participation among certain groups of voters by crowding out political information with entertainment content (e.g., see Campante, Durante and Sobbrio, 2018). More generally, previous studies have shown that political participation can both increase and decrease with access to the internet (for a review of the literature, see Zhuravskaya, Petrova and Enikolopov, 2020).

[30] For the outcome variables that did not cover the entire period from 2008 to 2018, I consider the change between the first and last years for which the data are available.

of the increase in polarization in political views, 37.7% of the increase in polarization in voting behavior, and, on average, 34.8% of the increase in polarization in policy preferences.

Persuasion rates.—Following DellaVigna and Kaplan (2007) and Enikolopov, Petrova and Zhuravskaya (2011), I also calculate the persuasion rates for the effects of mobile internet on political views and voting behavior (i.e., the share of population exposed to mobile internet that is persuaded by its message). As demonstrated in Table A1, 3G coverage affects individuals' political preferences through multiple dimensions, and mobile internet should not be thought of as a "first stage" for any one variable. For this reason, it is hard to find the appropriate estimate of individuals' "exposure" to the treatment, which is one of the parameters needed to calculate the persuasion rates. To accurately measure the share of population affected by mobile broadband, while ensuring that all dimensions of internet usage are taken into account, I consider the average share of the ZIP codes' population that had a subscription to a cellular internet data plan, separately for Democratic- and Republican-leaning areas. Using this and other assumptions, the full details of which are presented in Appendix Section A.III, I calculate the persuasion rates for the effects of 3G internet of individuals' political views, voting behavior, and policy preferences.

Appendix Table A16 presents the results. For residents of Democratic-leaning counties, the average persuasion rate is equal to $10.98/N$; for residents of Republican-leaning counties—$13.42/N$, where N represents the number of people affected by the internet per cellular-data-plan subscription (i.e., if $N = 1$, there are no spillover effects, and only one person is affected per connection; $N > 1$ indicates the presence of spillover effects).[31] These magnitudes are fully consistent with the persuasion effects of the media documented in previous literature (e.g., see an overview by DellaVigna and Gentzkow, 2010).

III Mechanisms

In this section, I examine the determinants of the internet-driven increase in political polarization. The previous literature on this topic has overwhelmingly focused on polarization *within* social media, often emphasizing the role of "echo chambers" created by algorithms used by social media. While social media algorithms may increase political polarization (e.g., see Levy, 2021), by definition, they can only affect the views of people using these platforms. In reality, not all internet users are active on social media, nor do all of them use the internet to search for news. In this section, I analyze the differential impact of mobile internet on the political views and voting

[31] These averages include the results reported in Appendix Table A16, in which the estimates are statistically significant. Full details of the calculations of the persuasion rates are presented in Appendix Section A.III.

behavior of active and less-active internet users, showing that the differences in the effects on these two groups are largely responsible for the 3G-driven increase in political polarization.

III.A Internet Usage and Political Polarization

To analyze how the expansion of mobile internet differentially affected individuals' political views depending on how they use the internet, I estimate Specification (5), in which 3G network coverage is interacted with various measures of internet and social media usage prior to the arrival of 3G infrastructure (*Internet usage*$_z$).[32] Table 4 presents the results. In Columns 1–4 and 7–10, 3G network coverage is interacted with four different measures of internet usage: the share of households in the ZIP code that use the internet to (1) obtain news, (2) visit TV networks' websites, (3) use YouTube, and (4) use Facebook. All the measures are normalized to have a mean of zero and a standard deviation of one (at the ZIP-code level). The results show that, after the arrival of 3G internet, residents of ZIP codes with many active internet and social media users became less likely to hold conservative political views and more likely to hold liberal views. For instance, the estimates in Column 4 suggest that a one-standard-deviation difference in the share of households using Facebook, on average, is associated with a 3.5-percentage-point change in the probability of holding conservative political views after the arrival of mobile internet.

Given the similarity of the findings in Columns 1–4 and 7–10, Columns 5 and 11 present the estimates for the average of the four aforementioned variables, which will henceforth be the main measure of internet usage in this paper. Finally, the results in Columns 6 and 12 of Table 4 demonstrate that the increase in political polarization can also be partly explained by individuals' choices of online news consumption. After the arrival of 3G, ZIP codes where many residents used the internet to access CNN.com became less conservative and more liberal in their views, while ZIP codes with many individuals visiting FoxNews.com experienced the opposite effect.

In general, the results in Table 4 show that the expansion of 3G network coverage differentially affected individuals' political views depending on how they use the internet: active internet and social media users became more liberal, while less-active users became more conservative. Importantly, these results are not driven by Democratic voters having higher levels of online engagement. To demonstrate this point, I reestimate Specification (5), interacting 3G network coverage,

[32] I calculate *Internet usage*$_z$ as follows. First, I regress *Internet usage*$_{z,t}$ on 3G coverage and ZIP-code and year fixed effects, as described in Specification (3). Then, I calculate *Internet usage*$_z$ as the residual of *Internet usage*$_{z,t}$, after subtracting the effect of 3G, in the first four years of the sample period. Thus, *Internet usage*$_z$ represents internet usage in the ZIP codes prior to the arrival of 3G infrastructure. All the regression results are robust to performing this procedure separately for Democratic-leaning, Republican-leaning, and swing counties (i.e., there is little heterogeneity in the effects of 3G coverage on internet usage).

internet usage, and their interaction term with the political affiliation of the respondent's county of residence. Appendix Table A17 presents the results, showing that the divergence between the effects of 3G coverage on the views of active and less-active internet users took place within party affiliation. For instance, the estimates in Column 3 suggest that in both Democratic and Republican counties, a one-standard-deviation difference in the share of households using Facebook, on average, is associated with a 3.7-percentage-point change in the probability of holding conservative political views after the arrival of mobile internet.[33]

After the arrival of 3G coverage, active and less-active internet users also diverged in their voting behavior and policy preferences. Tables 5 and 6 report the results of estimating Specification (5) for individuals' voting behavior and policy preferences, respectively. The results suggest that after the arrival of 3G, active internet and social media users increased their support for Democratic congressional candidates and their policy priorities, while less-active internet users shifted their views in the opposite direction. Similarly to the estimates reported in Appendix Table A17, this divergence took place within party affiliation and, therefore, cannot be explained by Democratic voters having a more substantial online presence.

Notably, after the arrival of 3G, ZIP codes with many active internet users also experienced an increase in turnout (e.g., see Columns 15 and 16 of Table 5). This result stands in contrast with the estimates reported in Columns 7 and 8 of Table 3, which suggest that, on average, the availability of mobile internet decreased turnout. Thus, while the average internet user became less likely to vote after getting access to 3G, active internet users became more engaged in politics.

Figure 5 illustrates the results reported in Columns 5 and 10 of Table A17 and Columns 10 and 12 of Table 5. The left-hand side of the figure presents the average effects of 3G network coverage on residents of Democratic counties who live in ZIP codes that are in the highest and lowest quartiles of internet usage, along with 90% confidence intervals.[34,35] The right-hand side of the figure presents the same results for residents of Republican counties. In both cases, there is a clear divergence between the views and voting behavior of individuals living in ZIP codes in the highest and lowest quartiles of internet usage.

Overall, the results presented in this subsection suggest that the divergence between the

[33] In Democratic counties, the 3.7-percentage-point decrease in the probability of holding conservative political views is accompanied by a 3.2-percentage-point increase in the probability of holding liberal views, while in Republican counties, the effect on liberal views is smaller and not statistically significant. This fact demonstrates that in Democratic counties, active internet and social media users became more liberal after the arrival of 3G, while in Republican counties, active users became more "moderate" (the intermediate category between "conservative" and "liberal").

[34] Appendix Figure A3 presents a similar illustration for the results in Columns 2, 4, 6, and 8 of Table 6.

[35] In Figure 5, the Republican and Democratic vote shares are measured in shares (rather than in percentage points) to be consistent with the outcome variables for holding liberal and conservative political views.

views of active and less-active internet users is largely responsible for the 3G-driven increase in political polarization. This divergence took place both in Democratic and Republican counties, showing that it is unlikely to be caused by supporters of one political party being more engaged online than supporters of the other party. Together, these two facts demonstrate that the 3G-driven increase in political polarization largely did not occur among social media users, as has been widely hypothesized in the literature, but instead was determined by differential effects of mobile internet on social media users and nonusers. This result does not necessarily imply that active internet and social media usage causes a one-sided shift in individuals' political views, but it does suggest that future research should devote more attention to studying the mechanisms behind this divergence. Subsection III.B presents suggestive evidence for two such mechanisms.

III.B Mechanisms Behind the Increase in Political Polarization

News consumption and political knowledge.—One mechanism that may be partly responsible for the divergence between the views of active and less-active internet users is related to the differences in news consumption between the two groups. To test this hypothesis, I estimate Specification (5) using MRI data on the share of the ZIP codes' households that watch Fox News and CNN as the outcome variables.[36] Columns 1 and 2 of Table 7 present the results, showing that, after the arrival of 3G networks, residents of ZIP codes with many active internet users became less likely to watch Fox News and more likely to watch CNN. Thus, the divergence between the views of the two groups can be partly explained by their choices of information sources.

Next, I analyze a related question regarding the quality of the information received by the two groups. Namely, I consider whether, after the arrival of 3G, active internet users became better informed about politics than less-active users. To address this question, I use CCES data, in which the survey respondents were asked whether they know the identities of the politicians representing them in Congress, and estimate Specification (5) for the outcome variables of whether the individual knows their congressional representative and two senators. Columns 3–5 of Table 7 report the results, showing that, after the arrival of 3G, active internet users increased their political knowledge, becoming more likely to know who represents them in Congress, possibly as a result of their choices of news consumption. Notably, these results are fully consistent with the findings in Chen and Yang (2019), Allcott et al. (2020), and Guriev, Melnikov and Zhuravskaya (2021), all of which suggest that access to uncensored internet can make people better informed about politics.[37]

[36] The outcome variables are normalized by the average of the within-ZIP-code standard deviations of the respective variables (i.e., the outcome variables are measured in standard deviations).

[37] Gerber, Karlan and Bergan (2009) also suggest that, in the United States, exposure to the media may increase

While the expansion of 3G infrastructure, on average, increases the political knowledge of active internet users, less-active users may be susceptible to propaganda and disinformation, which might, in turn, affect their political views and voting behavior. This hypothesis is indirectly confirmed by the findings that exposure to social media has been shown to increase xenophobic attitudes (Bursztyn et al., 2019) and hate crimes (Müller and Schwarz, 2020). Thus, although 3G network coverage enables active internet users to become better informed about politics, certain changes to the online ecosystem may be necessary to limit the potential for individuals' exposure to online propaganda and disinformation.

Political realignment of voters.—Another potential mechanism that might explain the differential effects of 3G availability on active and less-active internet users is related to the differences in the socioeconomic characteristics between the two groups. Recent work by Bonomi, Gennaioli and Tabellini (2021) suggests that when cultural issues become more prominent, as they have in the United States since 2008, the salience of redistributive policies goes down, and conflict along this dimension is muted. As a result, the expansion of mobile internet, which has increased the cultural divide among Democrats and Republicans (see Table 2), may have resulted in a political realignment in the United States, with voters who are poor, uneducated, and out of the labor force—who benefit the most from redistribution policies supported by Democrats—becoming more conservative, and wealthy, employed, and well-educated voters becoming more liberal. At the same time, wealthy, educated individuals are also more likely to be active on the internet and social media than poor, uneducated individuals. Thus, the divergence between the views of active and less active internet users may be partly driven by the realignment of U.S. voters.

To test this hypothesis, I present the heterogeneity of the effects of 3G internet on political views by socioeconomic characteristics such as education, income, and employment status. In the analysis, the outcome variables are regressed on 3G network coverage interacted with all the values of the socioeconomic characteristic of interest, controlling for all the baseline controls, including the direct effect of the socioeconomic characteristic. The estimates are presented in Table 8 and suggest that, after the arrival of 3G, educated, wealthy, and employed individuals became less likely to hold conservative political views and more likely to hold liberal views. In contrast, the opinions of those who are uneducated, poor, and out of the labor force shifted in the opposite direction. These results confirm the notion that part of the increase in political polarization might be driven by the political realignment of voters in the United States.

Importantly, if the growth in political partisanship is largely determined by existing societal

support for Democratic candidates.

inequalities, a potential long-term solution to the problem of increasing political polarization could lie in reducing educational, income, and other inequalities in the United States. While further research is needed to confirm this policy implication, it stands in stark contrast to most of the existing literature, which has predominantly focused on search and recommendation algorithms used by social media companies.

Can differences in socioeconomic status fully account for the disparate effects of 3G coverage on the views of active and less active internet users? To address this question, I estimate Specification (5) controlling for 3G network coverage interacted with dummies for individuals' education, income, and age, as well as the level of poverty in the ZIP code.[38] Appendix Table A18 reports the results, showing that the coefficients for the interaction terms between 3G coverage and internet usage remain statistically significant, although slightly smaller in magnitude. Thus, while the socioeconomic differences between active and less-active internet users are likely to be partly responsible for the increase in political polarization, they do not appear to be the sole determinants of the divergence between the effects of 3G on the views of the two groups.

III.C Other Heterogeneity

Age.—In previous work, Boxell, Gentzkow and Shapiro (2017) have suggested that political polarization predominantly increased among older individuals, who tend to be less active online, concluding that the internet is unlikely to be a major determinant of the recent growth in polarization. To address this debate, I present the heterogeneity of the effects of 3G network coverage by age. Specifically, I estimate Specification (2), replacing $3G \times Pol.\ affiliation$ with its interaction terms with dummies for the respondent being younger and older than 40.[39]

Appendix Table A19 presents the results, showing that, indeed, the expansion of mobile internet increased political polarization primarily among middle-aged and older individuals (collectively, over age 40). For those respondents, the direction of the effect of 3G on political views strongly depends on whether they lived in a Republican-leaning or Democratic-leaning county. In contrast, after the arrival of 3G, younger individuals became less likely to hold conservative political views and more likely to hold liberal political views, regardless of where they lived. This result is likely explained by the fact that the vast majority of young people actively use the internet,

[38]The full set of additional controls includes 3G network coverage interacted with dummies for individuals not having a high school degree, having at least a bachelor's degree, 20-year age bins, five survey-defined income groups, and the share of people living in poverty in the ZIP code in 2010–2014. All the regressions also control for the direct effects of all the characteristics that are interacted with 3G coverage.

[39]Additional controls also include non-collinear lower-level interaction terms between 3G coverage, the political affiliation of the counties, and dummies for the two age groups.

whereas there is substantially more hetrogeneity in internet usage among older people. Overall, the findings in Appendix Table A19 confirm those of Boxell, Gentzkow and Shapiro (2017), showing that political polarization primarily increased among older individuals. However, despite this fact, the expansion of mobile internet played an important role in widening the gap between the political views of Republican and Democratic voters.

Heterogeneity by time.—Appendix Table A20 presents the heterogeneity of the effects of 3G internet on political views by time. The results suggest that residents of Republican counties became more conservative in their political views in 2008–2009, when President Obama assumed office and Democrats controlled both chambers of Congress. In turn, in 2016–2017, when President Trump came to power and Republicans controlled both chambers of Congress, residents of both Democratic- and Republican-leaning counties became less conservative in their views.[40] The findings suggest that the internet amplifies voters' reaction to events in national politics, plausibly by providing access to (partisan) information about these events. The results are fully consistent with those of Guriev, Melnikov and Zhuravskaya (2021), who show that corruption scandals led to higher corruption perception in places covered by 3G networks.

Spillover effects.—Appendix Table A21 presents how the effects of 3G on individuals of a particular political affiliation depend on the political affiliation of the other residents of the area where they live (i.e., spillover effects). These results should be interpreted with caution because, as previously discussed, individuals can change their political affiliation along with their political views. Keeping in mind this caveat, the results suggest that the effect of mobile internet on Republican voters is stronger in counties with a large number of Democratic voters. One potential explanation for this result could be that the presence of Democratic voters antagonizes Republicans, producing a larger effect on their political views. However, it is also possible that in Democratic-leaning counties, after the arrival of 3G, Republicans with more moderate political views might choose not to identify with the party. The effect of 3G internet on Democratic voters also depends on the political affiliations of the other residents of their county. In particular, Democratic voters become more likely to hold liberal political views if they live in a Democratic-leaning county. However, they are also less likely to stop holding conservative views if they live in a Democratic-leaning county. Thus, Democratic peer pressure induces individuals not to identify as a moderate but, instead, to hold either liberal or conservative political views.

[40] The results for Republican-leaning counties are not necessarily driven by Republican voters changing their political views. Instead, it could be the case that the views of Republican voters did not change, while Democratic residents of those counties became less conservative.

IV Conclusion

This paper demonstrates that the expansion of mobile internet has increased political polarization. After the arrival of 3G networks, residents of Democratic-leaning counties started holding more liberal political views and increased their support for Democratic congressional candidates and their policy priorities; residents of Republican-leaning counties shifted in the opposite direction. The increase in political polarization largely did not take place among social media users. Instead, after the arrival of 3G network coverage, regardless of political affiliation, ZIP codes with many active internet users became more likely to hold liberal views and increased their support for Democratic candidates and policy priorities, while ZIP codes with few active internet users became more conservative and pro-Republican.

In this paper, I present evidence for two mechanisms that may be partly responsible for this divergence in political views. First, I show that, after the arrival of 3G, active internet users changed their news consumption and became better informed about politics. Second, I highlight how the expansion of mobile internet resulted in a political realignment of voters in the United States, with well-educated, wealthy, and employed people becoming more liberal, and those who are uneducated, poor, and out of the labor force becoming more conservative. The latter mechanism suggests that one long-term solution to the problem of increasing political polarization could lie in reducing existing educational and income inequalities.

References

Allcott, Hunt, and Matthew Gentzkow. 2017. "Social Media and Fake News in the 2016 Election." *Journal of Economic Perspectives*, 31(2): 211–236.

Allcott, Hunt, Luca Braghieri, Sarah Eichmeyer, and Matthew Gentzkow. 2020. "The Welfare Effects of Social Media." *American Economic Review*, 110(3): 629–676.

Allcott, Hunt, Matthew Gentzkow, and Chuan Yu. 2019. "Trends in the diffusion of misinformation on social media." *Research & Politics*, 6(2): 1–8.

American Society of Civil Engineers. 2017. "2017 Infrastructure Report Card: Energy." https://2017.infrastructurereportcard.org/cat-item/energy/ (accessed on June 28, 2021).

Andersen, Thomas Barnebeck, Jeanet Bentzen, Carl-Johan Dalgaard, and Pablo Selaya. 2012. "Lightning, IT diffusion, and economic growth across U.S. states." *Review of Economics and Statistics*, 94(4): 903–924.

Autor, David, David Dorn, Gordon Hanson, and Kaveh Majlesi. 2020. "Importing Political Polarization? The Electoral Consequences of Rising Trade Exposure." *American Economic Review*, 110(10): 3139–3183.

Bail, Christopher A., Lisa P. Argyle, Taylor W. Brown, John P. Bumpus, Haohan Chen, M. B. Fallin Hunzaker, Jaemin Lee, Marcus Mann, Friedolin Merhout, and Alexander Volfovsky. 2018. "Exposure to opposing views on social media can increase political polarization." *PNAS*, 115(37): 9216–9221.

Bakshy, Eytan, Solomon Messing, and Lada A. Adamic. 2015. "Exposure to ideologically diverse news and opinion on Facebook." *Science*, 348(6239): 1130–1132.

Barberá, Pablo. 2015. "How Social Media Reduces Mass Political Polarization. Evidence from Germany, Spain, and the U.S." Mimeo.

Beam, Michael A., Myiah J. Hutchens, and Jay D. Hmielowski. 2018. "Facebook news and (de)polarization: reinforcing spirals in the 2016 US election." *Information, Communication & Society*, 21(7): 940–958.

Binder, Sarah. 2014. "How political polarization creates stalemate and undermines lawmaking." The Washington Post.

Bonomi, Giampaolo, Nicola Gennaioli, and Guido Tabellini. 2021. "Identity, Beliefs, and Political Conflict." *Quarterly Journal of Economics*, 136(4): 2371–2411.

Borusyak, Kirill, Xavier Jaravel, and Jann Spiess. 2021. "Revisiting Event Study Designs: Robust and Efficient Estimation." Mimeo.

Bovet, Alexandre, and Hernán A. Makse. 2019. "Influence of fake news in Twitter during the 2016 US presidential election." *Nature Communications*, 10(7): 1–14.

Boxell, Levi. 2020. "Demographic change and political polarization in the United States." *Economics Letters*, 192: 1–4.

Boxell, Levi, Matthew Gentzkow, and Jesse M. Shapiro. 2017. "Greater Internet use is not associated with faster growth in political polarization among US demographic groups." *PNAS*, 114(40): 10612–10617.

Bright, Jonathan, Scott Hale, Bharath Ganesh, Andrew Bulovsky, Helen Margetts, and Phil Howard. 2020. "Does Campaigning on Social Media Make a Difference? Evidence From Candidate Use of Twitter During the 2015 and 2017 U.K. Elections." *Communication Research*, 47(7): 988–1009.

Bursztyn, Leonardo, Georgy Egorov, Ruben Enikolopov, and Maria Petrova. 2019. "Social Media and Xenophobia: Evidence from Russia." *NBER Working Paper № 26567*.

Campante, Filipe, Ruben Durante, and Francesco Sobbrio. 2018. "Politics 2.0: The Multifaceted Effect of Broadband Internet on Political Participation." *Journal of the European Economic Association*, 16(4): 1094–1136.

Cantarella, Michele, Nicolò Fraccaroli, and Roberto Volpe. 2020. "Does Fake News Affect Voting Behaviour?" *CEIS Working Paper № 493*.

Chen, Yuyu, and David Yang. 2019. "The Impact of Media Censorship: 1984 or Brave New World?" *American Economic Review*, 109(6): 2294–2332.

Collela, Fabrizio, Rafael Lalive, Seyhun Orcan Sakalli, and Mathias Thoenig. 2018. "Inference with arbitrary clustering." University of Lausanne, Mimeo.

Conley, T.G. 1999. "GMM estimation with cross sectional dependence." *Journal of Econometrics*, 92(1): 1–45.

De Chaisemartin, Clément, and Xavier D'Haultfœuille. 2020. "Two-way fixed effects estimators with heterogeneous treatment effects." *American Economic Review*, 110(9): 2964–2996.

DellaVigna, Stefano, and Ethan Kaplan. 2007. "The Fox News Effect: Media Bias and Voting." *Quarterly Journal of Economics*, 122(3): 1187–1234.

DellaVigna, Stefano, and Matthew Gentzkow. 2010. "Persuasion: Empirical Evidence." *Annual Review of Economics*, 2: 643–669.

Del Vicario, Michela, Alessandro Bessi, Fabiana Zollo, Fabio Petroni, Antonio Scala, Guido Caldarelli, H. Eugene Stanley, and Walter Quattrociocchi. 2016. "The spreading of misinformation online." *PNAS*, 113(3): 554–559.

Donati, Dante. 2019. "Mobile Internet access and political outcomes: Evidence from South Africa." Universitat Pompeu Fabra, Mimeo.

Eady, Gregory, Jonathan Nagler, Andy Guess, Jan Zilinsky, and Joshua A. Tucker. 2019. "How Many People Live in Political Bubbles on Social Media? Evidence From Linked Survey and Twitter Data." *SAGE Open*, 9(1): 1–21.

EATON. 2017. "Blackout Tracker. United States Annual Report 2017." https://switchon.eaton.com/plug/blackout-tracker (accessed on June 28, 2021).

Enikolopov, Ruben, Alexey Makarin, and Maria Petrova. 2020. "Social media and protest participation: evidence from Russia." *Econometrica*, 88(4): 1479–1514.

Enikolopov, Ruben, Maria Petrova, and Ekaterina Zhuravskaya. 2011. "Media and Political Persuasion: Evidence from Russia." *American Economic Review*, 101: 3253–3285.

Enikolopov, Ruben, Maria Petrova, and Konstantin Sonin. 2018. "Social Media and Corruption." *American Economic Journal: Applied Economics*, 10(1): 150–174.

Enríquez, José Ramón, Horacio Larreguy, John Marshall, and Alberto Simpser. 2021. "Online Political Information, Electoral Saturation, and Electoral Accountability in Mexico." Mimeo.

Falck, Oliver, Robert Gold, and Stephan Heblich. 2014. "E-lections: Voting Behavior and the Internet." *American Economic Review*, 104(7): 2238–2265.

Faris, Robert, Hal Roberts, Bruce Etling, Nikki Bourassa, Ethan Zuckerman, and Yochai Benkler. 2017. "Partisanship, Propaganda, and Disinformation: Online Media and the 2016 U.S. Presidential Election." Berkman Klein Center for Internet & Society at Harvard University Research Publication № 2017-6.

Fergusson, Leopoldo, and Carlos Molina. 2019. "Facebook Causes Protests." Universidad de los Andes. mimeo.

Flaxman, Seth, Sharad Goel, and Justin M. Rao. 2016. "Filter Bubbles, Echo Chambers, and Online News Consumption." *Public Opinion Quarterly*, 80: 298–320.

Fujiwara, Thomas, Karsten Müller, and Carlo Schwarz. 2021. "The Effect of Social Media on Elections: Evidence from the United States." Mimeo.

Gavazza, Alessandro, Mattia Nardotto, and Tommaso Valletti. 2019. "Internet and Politics: Evidence from U.K. Local Elections and Local Government Policies." *Review of Economic Studies*, 86(5): 2092–2135.

Gentzkow, Matthew, and Jesse M. Shapiro. 2011. "Ideological Segregation Online and Offline." *Quarterly Journal of Economics*, 126: 1799–1839.

Gerber, Alan S., Dean Karlan, and Daniel Bergan. 2009. "Does the Media Matter? A Field Experiment Measuring the Effect of Newspapers on Voting Behavior and Political Opinions." *American Economic Journal: Applied Economics*, 1(2): 35–52.

Goodman-Bacon, Andrew. 2021. "Differences-in-Differences with Variation in Treatment Timing." *Journal of Econometrics*, forthcoming.

Grinberg, Nir, Kenneth Joseph, Lisa Friedland, Briony Swire-Thompson, and David Lazer. 2019. "Fake news on Twitter during the 2016 U.S. presidential election." *Science*, 363(6425): 374–378.

Guess, Andrew. 2021. "(Almost) Everything in Moderation: New Evidence on Americans' Online Media Diets." *American Journal of Political Science*, forthcoming.

Guess, Andrew, Brendan Nyhan, and Jason Reifler. 2018. "Selective Exposure to Misinformation: Evidence from the consumption of fake news during the 2016 U.S. presidential campaign." European Research Council.

Guriev, Sergei, Nikita Melnikov, and Ekaterina Zhuravskaya. 2021. "3G Internet and Confidence in Government." *Quarterly Journal of Economics*, 136(4): 2533–2613.

Halberstam, Yosh, and Brian Knight. 2016. "Homophily, group size, and the diffusion of political information in social networks: Evidence from Twitter." *Journal of Public Economics*, 143: 73–88.

Hsiang, Solomon. 2010. "Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America." *Proceedings of the National Academy of Sciences*, 107(35): 15367–15372.

Illing, Sean. 2018. "Why social media is terrible for multiethnic democracies." Vox.

Jones, Jeffrey M. 2020. "Trump Third Year Sets New Standard for Party Polarization." Gallup.

Kalmoe, Nathan P., and Lilliana Mason. 2019. "Lethal Mass Partisanship: Prevalence, Correlates, & Electoral Contingencies." *National Capital Area Political Science Association American Politics Meeting*.

Lelkes, Yphtach, Gaurav Sood, and Shanto Iyengar. 2017. "The Hostile Audience: The Effect of Access to Broadband Internet on Partisan Affect." *American Journal of Political Science*, 61(1): 5–20.

Levy, Ro'ee. 2021. "Social Media, News Consumption, and Polarization: Evidence from a Field Experiment." *American Economic Review*, 111(3): 831–870.

Liberini, Federica, Michela Redoano, Antonio Russo, Ángel Cuevas, and Ruben Cuevas. 2020. "Politics in the Facebook Era - Evidence from the 2016 US Presidential Elections." *CESifo Working Paper № 8235*.

Manacorda, Marco, and Andrea Tesei. 2020. "Liberation Technology: Mobile Phones and Political Mobilization in Africa." *Econometrica*, 88(2): 533–567.

Martin, Al. 2016. "Effects of Lightning on ICT Circuits: Induction and GCR." *In Compliance Magazine*. https://incompliancemag.com/article/effects-of-lightning-on-ict-circuits-induction-and-gcr/ (accessed on June 28, 2021).

Miner, Luke. 2015. "The unintended consequences of Internet diffusion: Evidence from Malaysia." *Journal of Public Economics*, 132(C): 66–78.

Müller, Karsten, and Carlo Schwarz. 2020. "From Hashtag to Hate Crime: Twitter and Anti-Minority Sentiment." Mimeo.

Oster, Emily. 2017. "Unobservable Selection and Coefficient Stability: Theory and Evidence." *Journal of Business & Economic Statistics*, 37(2): 187–204.

Pariser, Eli. 2011. *The Filter Bubble: What the Internet Is Hiding from You.* Penguin Books.

Peterson, Erik, Sharad Goel, and Shanto Iyergar. 2021. "Partisan selective exposure in online news consumption: evidence from the 2016 presidential campaign." *Political Science Research and Methods*, 9: 242–258.

Petrova, Maria, Ananya Sen, and Pinar Yildirim. 2020. "Social Media and Political Contributions: The Impact of New Technology on Political Competition." *Management Science*, 67(5): 2997–3021.

Prior, Markus. 2013. "Media and Political Polarization." *Annual Review of Political Science*, 16: 101–127.

Qin, Bei, David Strömberg, and Yanhui Wu. 2019. "Social Media, Information Networks, and Protests in China." Mimeo.

Rainie, Lee, and Barry Wellman. 2012. *Networked – The New Social Operating System.* MIT Press.

Schaub, Max, and Davide Morisi. 2019. "Voter mobilization in the echo chamber: Broadband internet and the rise of populism in Europe." Collegio Carlo Alberto. mimeo.

Spohr, Dominic. 2017. "Fake news and ideological polarization: Filter bubbles and selective exposure on social media." *Business Information Review*, 34(3): 150–160.

Sun, Liyang, and Sarah Abraham. 2021. "Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects." *Journal of Econometrics*, forthcoming.

Sunstein, Cass R. 2017. *#Republic: Divided Democracy in the Age of Social Media.* Princeton University Press.

Zeddam, Ahmed, and Phil Day. 2014. "Improving the protection of ICT equipment against lightning strikes." *ITU News*. https://news.itu.int/improving-protection-ict-equipment-lightning-strikes/ (accessed on June 28, 2021).

Zhuravskaya, Ekaterina, Maria Petrova, and Ruben Enikolopov. 2020. "Political effects of the internet and social media." *Annual Review of Economics*, 12(1): 415–438.

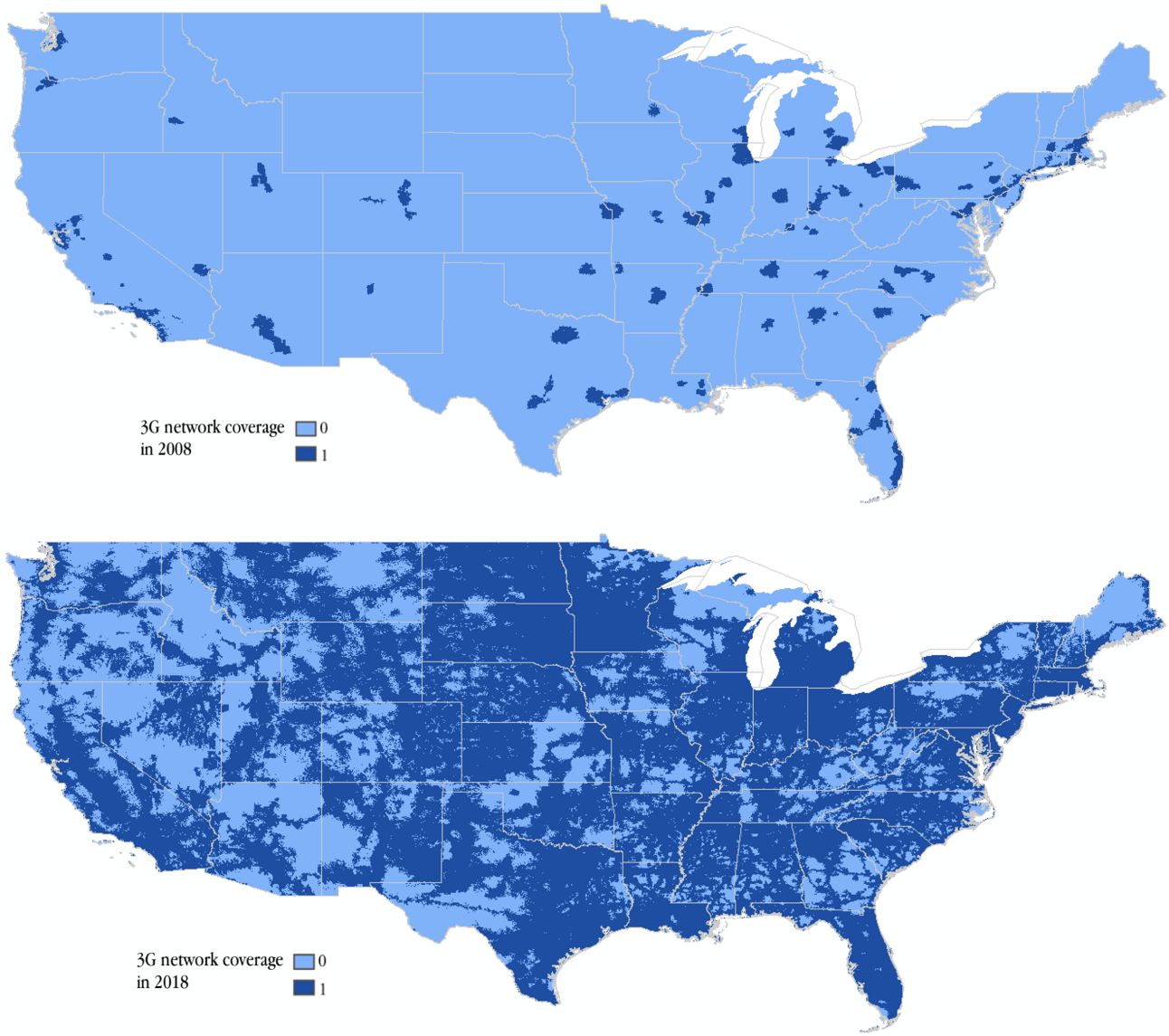

Figure 1: Expansion of 3G Network Coverage Between 2008 and 2018

Note: The two maps depict 3G network coverage for the contiguous United States in 2008 and 2018. The data consist of 1×1-kilometer binary grid cells.

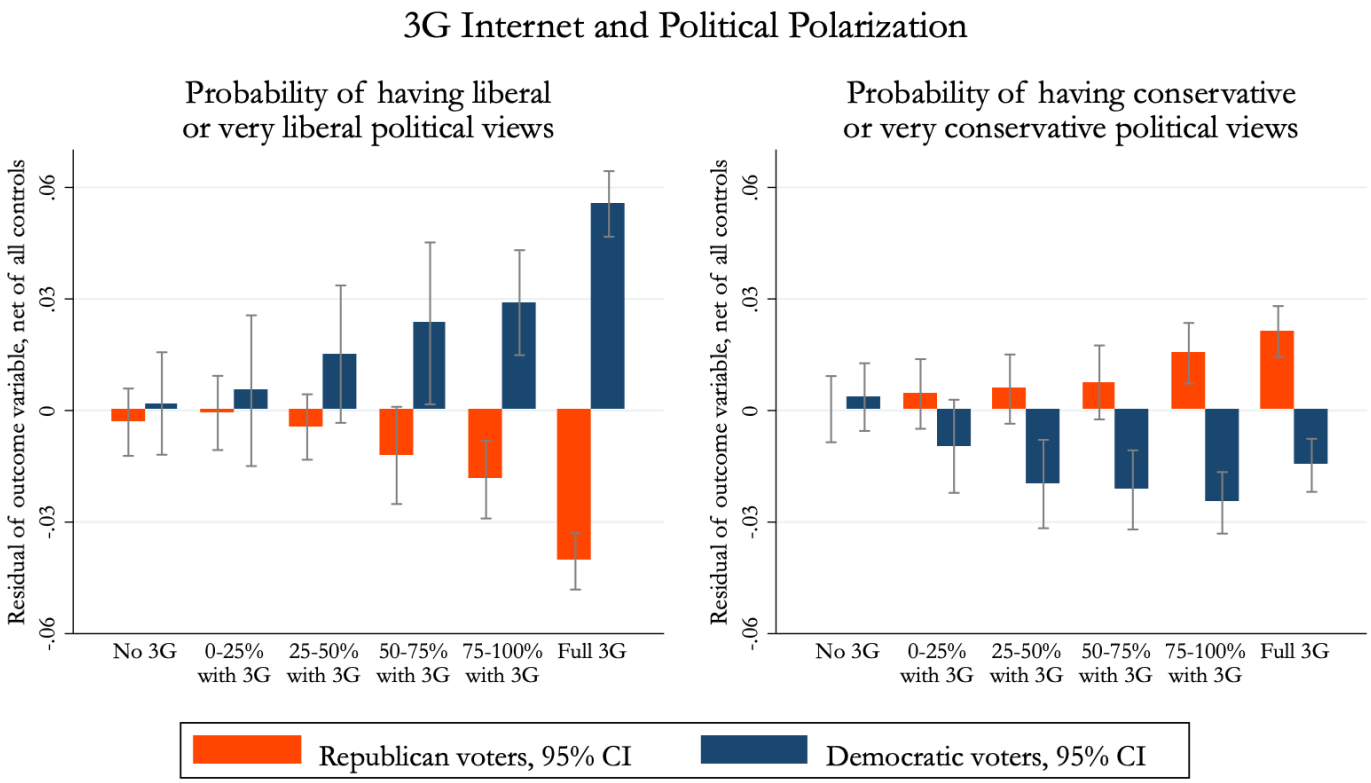

Figure 2: 3G Internet and the Change in Political Views

Note: The figure presents the relationship between the respondents' political views and the availability of 3G internet in their ZIP code of residence. The regression estimates are presented in Columns 1 and 3 of Table 1. In the left part of the figure, the outcome variable is a dummy for whether the respondent describes their political views as liberal or very liberal; in the right part—a similar dummy for having conservative or very conservative political views. The bars show the means of the outcome variable, net of all controls, along with 95% confidence intervals. Standard errors are corrected for clusters at the level of the states and the District of Columbia.

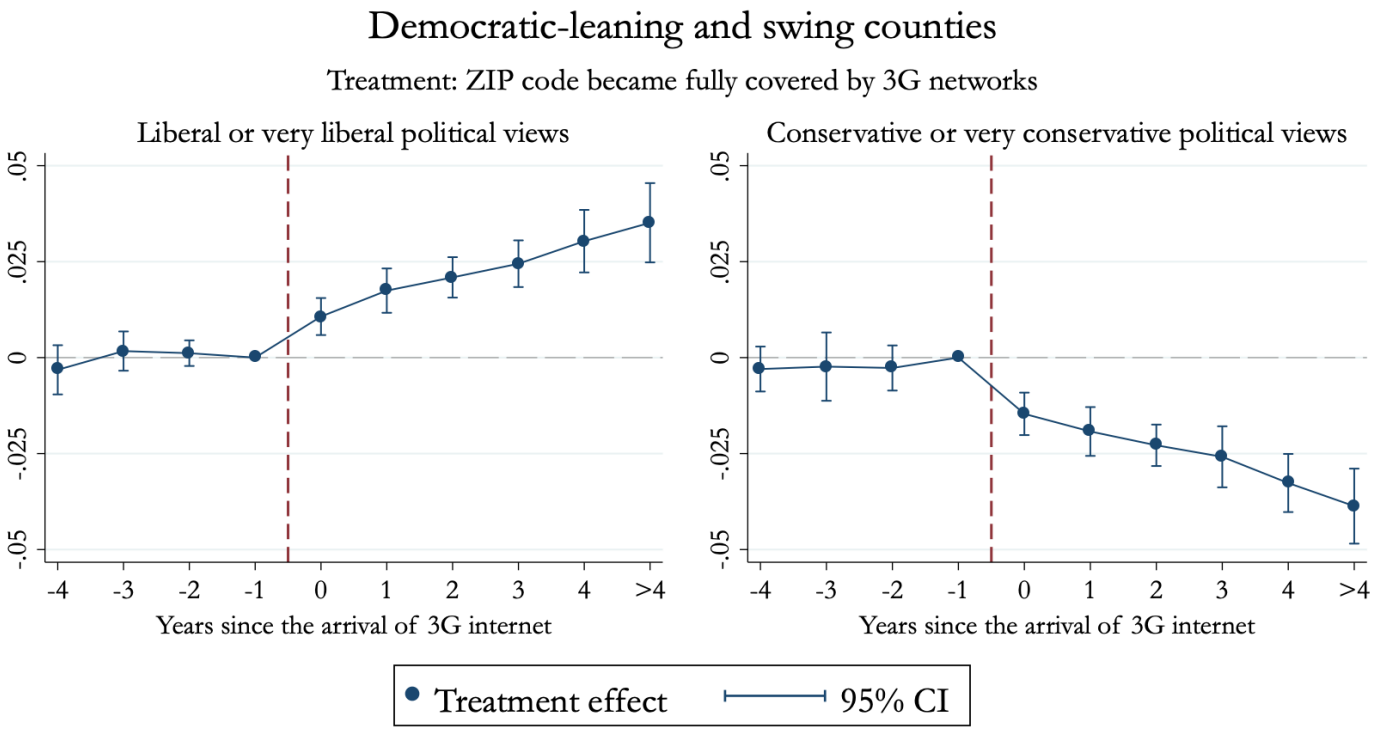

Figure 3: Event Study Analysis

Note: The figure presents an event study showing how the respondents' political views changed after the arrival of 3G internet to their ZIP code of residence. Columns 1 and 3 of Table A4 present the regression estimates. A ZIP code is defined to be treated when it becomes fully covered by 3G networks for the first time. The sample consists of individuals living in Democratic-leaning and swing counties. In the left part of the figure, the outcome variable is a dummy for whether the respondent describes their political views as liberal or very liberal; in the right part—a similar dummy for self-described views being conservative or very conservative.

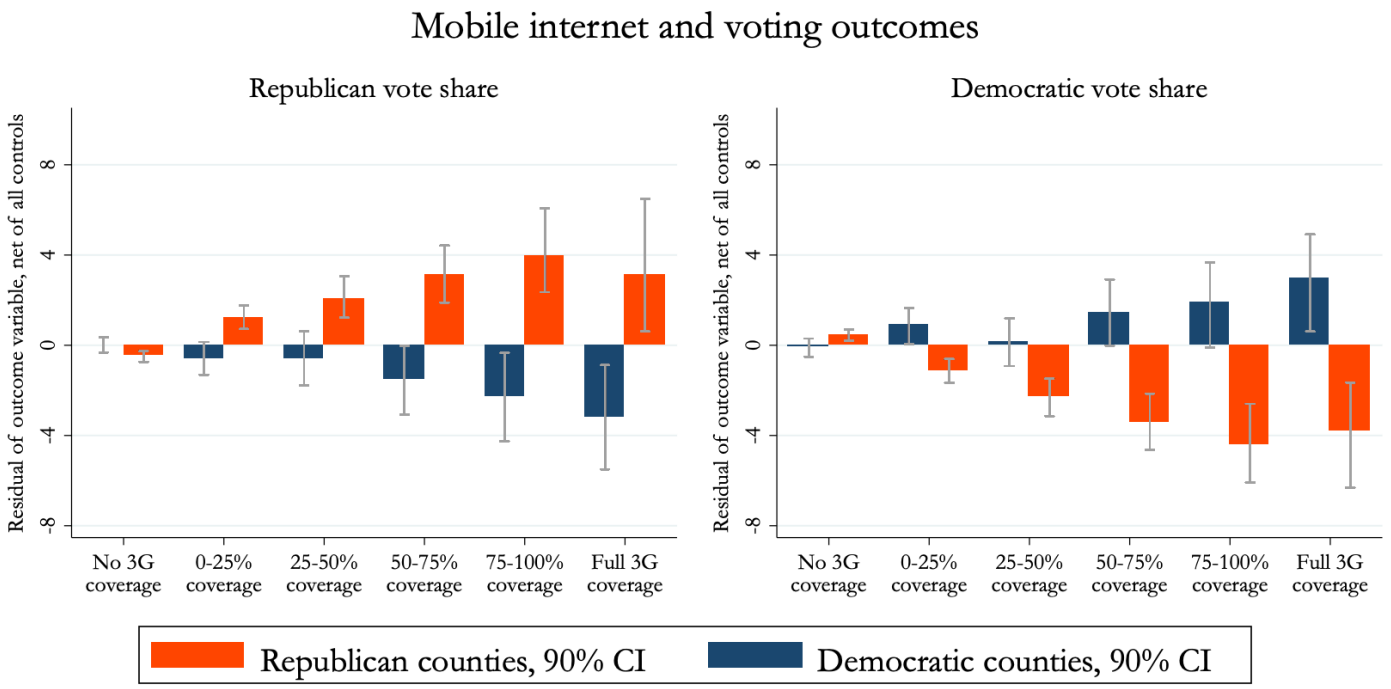

Figure 4: 3G Internet the Change in Voting Behavior

Note: The figure presents the relationship between the availability of 3G internet in a county and voting outcomes in the county. The outcome variables are the Republican and Democratic vote shares in the 2008–2018 House elections. Columns 2 and 4 of Table 3 present the regression estimates. The sample focuses on county-years when at least one Republican candidate and at least one Democratic candidate ran for office. A county is assumed to be Democratic if Obama won the county in 2008 by a margin of at least 10 percentage points; a county is assumed to be Republican if Obama lost the county in 2008 by a margin of at least 10 percentage points. The bars show the means of the outcome variable (net of all controls) along with 90% confidence intervals, which are corrected for clusters at the level of the states and the District of Columbia using 1,000 bootstrap replications, which take into account the uncertainty regarding the effects of the control variables.

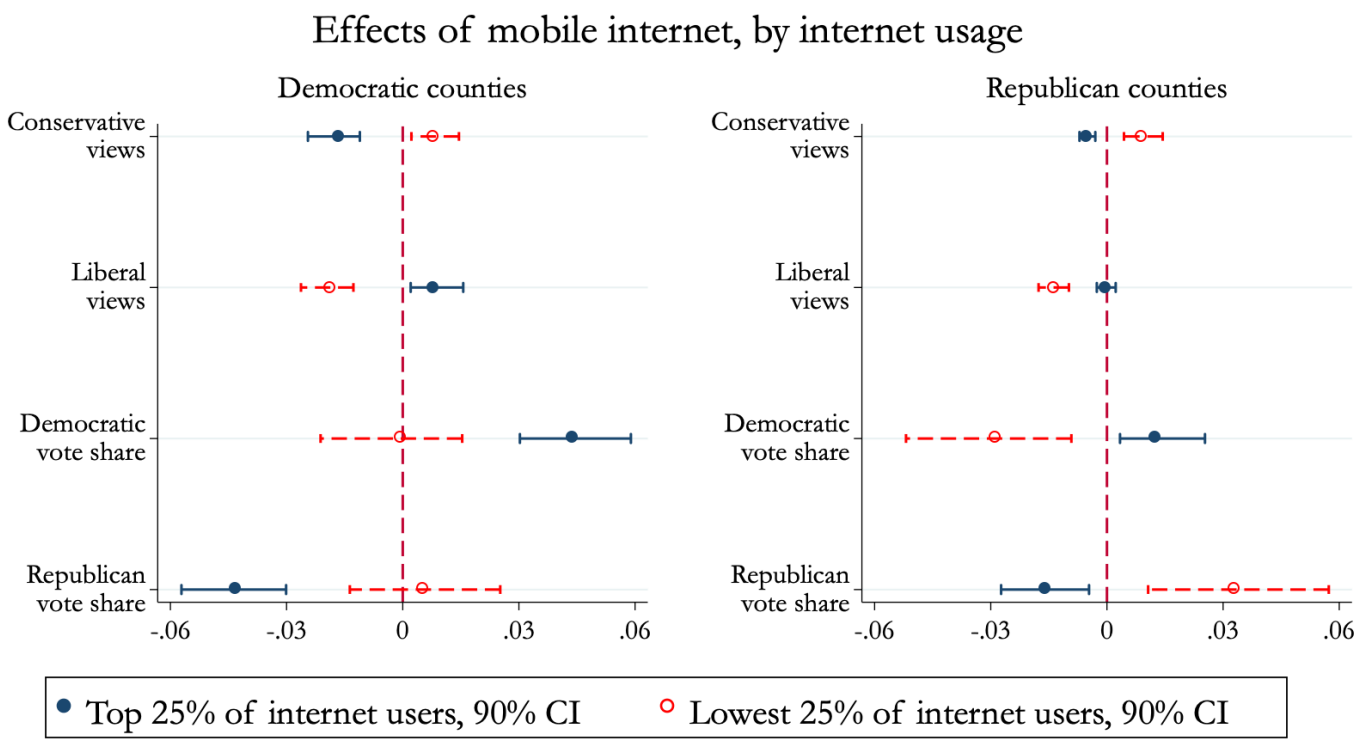

Figure 5: Internet Usage and Political Polarization

Note: The figure illustrates the relationship between internet usage, political views, and voting outcomes presented in Columns 5 and 10 of Table A17 and Columns 10 and 12 of Table 5. The vertical axis represents the outcome variables for which the results are reported. The left part of the figure shows the effects on residents of Democratic-leaning counties; the right part of the figure—on residents of Republican counties. The reported effects represent the effects of mobile internet on individuals living in ZIP codes that are in the top 25% of internet users and in the lowest 25% of internet users. The 90% confidence intervals are corrected for clusters at the level of the states and the District of Columbia using bootstrap replications, which take into account the uncertainty regarding the effects of the control variables.

Table 1: 3G Internet and Political Polarization

	(1)	(2)	(3)	(4)
Dep. Var.:	Political views are:			
	Liberal or very liberal		Conservative or very conservative	
3G network coverage ×				
× Democratic voter	0.051***		-0.017***	
	(0.006)		(0.005)	
× Independent voter	-0.015***		-0.019***	
	(0.003)		(0.003)	
× Republican voter	-0.035***		0.020***	
	(0.002)		(0.003)	
× Resident of reliably Democratic county		0.013**		-0.016***
		(0.006)		(0.004)
× Resident of Democratic-leaning county		0.008***		-0.019***
		(0.003)		(0.003)
× Resident of swing county		0.000		-0.007***
		(0.002)		(0.002)
× Resident of Republican-leaning county		-0.007***		-0.001
		(0.002)		(0.004)
× Resident of reliably Republican county		-0.004		0.005*
		(0.002)		(0.003)
Observations	1,765,114	1,765,113	1,765,114	1,765,113
R-squared	0.205	0.073	0.260	0.091
Mean dep. var	0.234	0.234	0.420	0.420
Number of clusters	51	51	51	51
Number of ZIP codes	31,499	31,499	31,499	31,499
County & year FEs	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓

Note: This table presents the results of estimating Specifications (1) and (2) for respondents' self-described political views. The unit of observation is an individual. In Columns 1 and 2, the outcome variable is a dummy for whether the respondent describes their political views as liberal or very liberal; Columns 3 and 4 use a similar dummy for self-described views being conservative or very conservative. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. In Columns 1 and 3, controls also include dummies for individuals' party affiliation. A county is assumed to be reliably Democratic if Obama won the county in 2008 by a margin of at least 30 percentage points; Democratic-leaning if Obama won the county in 2008 by a margin of 10–30 percentage points; Republican-leaning if Obama lost the county in 2008 by a margin of 10–30 percentage points; or reliably Republican if Obama lost the county in 2008 by a margin of at least 30 percentage points. Other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2: 3G Internet and Policy Preferences

	(1)	(2)	(3)	(4)
Dep. Var.:	Always allow abortion	Support gay marriage	Repeal the ACA	Increase border security
3G network coverage ×				
× Resident of Democratic-leaning county	0.013**	0.037***	-0.053***	-0.029***
	(0.006)	(0.011)	(0.019)	(0.010)
× Resident of swing county	0.004	0.017	0.007	-0.019**
	(0.007)	(0.012)	(0.019)	(0.009)
× Resident of Republican-leaning county	-0.012**	-0.033***	0.027	0.017**
	(0.006)	(0.009)	(0.016)	(0.007)
Observations	394,518	316,521	278,657	356,933
R-squared	0.110	0.107	0.109	0.107
Mean dep. var	0.536	0.578	0.486	0.523
Number of clusters	51	51	51	51
Number of ZIP codes	23,216	22,450	21,375	22,614
County & year FEs	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓

Note: This table presents the results of estimating Specification (2) for the respondents' policy preferences. The unit of observation is an individual. The outcome variables are dummies for the respondents' policy preferences. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 and separate year fixed effects for the ZIP codes that were. A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points, and Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points; other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3: 3G Internet and Voting Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.:	Republican vote share (R)		Democratic vote share (D)		Republican vote margin (R-D)		Turnout	
3G network coverage ×								
× Resident of Democratic-leaning county	-5.063**	-2.577*	4.423*	2.396*	-9.486**	-4.973*	-1.516***	-1.068**
	(2.340)	(1.390)	(2.223)	(1.355)	(4.474)	(2.716)	(0.475)	(0.415)
× Resident of swing county	1.692	3.106*	-1.645	-2.913*	3.338	6.019*	-1.242**	-1.083**
	(2.058)	(1.666)	(2.012)	(1.569)	(4.021)	(3.191)	(0.481)	(0.512)
× Resident of Republican-leaning county	4.573***	4.540***	-4.530***	-4.789***	9.103***	9.329***	-0.943*	-0.753*
	(1.325)	(1.249)	(1.401)	(1.190)	(2.686)	(2.408)	(0.477)	(0.440)
Observations	18,573	16,864	18,573	16,864	18,573	16,864	18,573	16,864
R-squared	0.793	0.858	0.779	0.857	0.794	0.862	0.893	0.915
Mean dep. var	60.74	59.53	36.08	38.11	24.66	21.42	37.33	37.93
Number of counties	3,110	3,110	3,110	3,110	3,110	3,110	3,110	3,110
County & year FEs	✓	✓	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓	✓	✓
Excluding unopposed races		✓		✓		✓		✓

Note: This table presents the results of estimating Specification (2) for voting outcomes. The unit of observation is a county. The outcomes are measured in percentage points. In the odd columns, the results are reported for the full sample; in the even columns, for county-years with at least one Democrat and at least one Republican running for office. Alaska is excluded from the sample because, in Alaska, election results are not available at the county level. Baseline controls include county and year fixed effects, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the county was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the counties that were. A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points, and Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points; other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Internet Usage and Political Views

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep. Var.:	Conservative or very conservative political views						Liberal or very liberal political views					
3G network coverage ×												
× Share of households using the internet to obtain news	-0.011*** (0.002)						0.004*** (0.001)					
× Share of households visiting TV networks' websites		-0.013*** (0.002)						0.005** (0.002)				
× Share of households using YouTube			-0.033*** (0.005)						0.018** (0.008)			
× Share of households using Facebook				-0.035*** (0.006)						0.018* (0.009)		
× Average of internet usage measures					-0.020*** (0.003)						0.008** (0.004)	
× Share of households visiting CNN.com						-0.139*** (0.013)						0.136*** (0.023)
× Share of households visiting FoxNews.com						0.036*** (0.005)						-0.043*** (0.007)
Observations	1,765,004	1,765,004	1,765,004	1,765,004	1,765,004	1,764,815	1,765,004	1,765,004	1,765,004	1,765,004	1,765,004	1,764,815
R-squared	0.091	0.091	0.091	0.091	0.091	0.093	0.074	0.073	0.073	0.073	0.073	0.076
Mean dep. var	0.420	0.420	0.420	0.420	0.420	0.420	0.234	0.234	0.234	0.234	0.234	0.234
Number of ZIP codes	31,473	31,473	31,473	31,473	31,473	31,434	31,473	31,473	31,473	31,473	31,473	31,434
County & year FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table demonstrates how individuals' political views are affected depending on how they use the internet. The internet usage variables represent the average values of the respective variables in the first four years for which the data are available (i.e., the first half of the sample period) after subtracting the effect of 3G internet on these variables. The unit of observation is an individual. In Columns 1–6, the outcome variable is a dummy for whether the respondent describes their political views as conservative or very conservative; Columns 7–12 use a similar dummy for self-described views being liberal or very liberal. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. All the regressions also control for the direct effects of the internet usage measures. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Internet Usage and Voting Outcomes

Panel A: Full sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.:	Republican vote share (R)		Democratic vote share (D)		Republican vote margin (R-D)		Turnout	
3G network coverage ×	-8.944***		9.285***		-18.229***		3.783***	
× Average of internet usage measures	(2.221)		(2.087)		(4.239)		(0.552)	
Resident of Democratic-leaning county ×								
× 3G network coverage ×		-5.287		8.179***		-13.466*		5.284***
× Average of internet usage measures		(4.252)		(2.893)		(7.006)		(1.041)
Resident of Republican-leaning county ×								
× 3G network coverage ×		-8.689***		8.291***		-16.981***		3.546***
× Average of internet usage measures		(2.355)		(2.471)		(4.765)		(0.573)
Observations	18,573	18,573	18,573	18,573	18,573	18,573	18,573	18,573
Mean dep. var	60.74	60.74	36.08	36.08	24.66	24.66	37.33	37.33
Number of counties	3,110	3,110	3,110	3,110	3,110	3,110	3,110	3,110
Panel B: Excluding unopposed races	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Dep. Var.:	Republican vote share (R)		Democratic vote share (D)		Republican vote margin (R-D)		Turnout	
3G network coverage ×	-8.256***		8.348***		-16.604***		3.663***	
× Average of internet usage measures	(1.533)		(1.553)		(3.064)		(0.527)	
Resident of Democratic-leaning county ×								
× 3G network coverage ×		-6.886***		7.980***		-14.866***		4.256***
× Average of internet usage measures		(2.206)		(2.097)		(4.285)		(0.853)
Resident of Republican-leaning county ×								
× 3G network coverage ×		-7.405***		7.137***		-14.542***		3.667***
× Average of internet usage measures		(1.946)		(2.029)		(3.929)		(0.636)
Observations	16,864	16,864	16,864	16,864	16,864	16,864	16,864	16,864
Mean dep. var	59.53	59.53	38.11	38.11	21.42	21.42	37.93	37.93
Number of counties	3,110	3,110	3,110	3,110	3,110	3,110	3,110	3,110
County & year FEs	✓	✓	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table demonstrates how voting outcomes are affected by 3G network coverage, depending on how individuals use the internet. The unit of observation is a county. The outcomes are measured in percentage points. In Columns 1-8, the results are reported for the full sample; in Columns 9-16—for county-years with at least one Democrat and at least one Republican running for office. Alaska is excluded from the sample because, in Alaska, election results are not available at the county level. Baseline controls include county and year fixed effects, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points; a county is assumed to be Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points; other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Internet Usage and Policy Preferences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.:	Always allow abortion		Support gay marriage		Repeal the ACA		Increase border security	
3G network coverage ×	0.027***		0.042***		-0.085***		-0.044***	
× Average of internet usage measures	(0.009)		(0.008)		(0.031)		(0.014)	
Resident of Democratic-leaning county ×								
× 3G network coverage ×		0.025		0.037**		-0.146**		-0.093***
× Average of internet usage measures		(0.016)		(0.015)		(0.057)		(0.029)
Resident of Republican-leaning county ×								
× 3G network coverage ×		0.051***		0.035***		-0.107**		-0.040**
× Average of internet usage measures		(0.014)		(0.011)		(0.044)		(0.016)
Observations	394,319	394,184	316,343	316,223	278,535	278,458	356,786	356,683
Mean dep. var	0.536	0.536	0.578	0.578	0.486	0.486	0.523	0.523
Number of ZIP codes	23,129	23,078	22,369	22,320	21,313	21,280	22,545	22,502
County & year FEs	✓	✓	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table demonstrates how the respondents' policy preferences are affected by 3G network coverage, depending on how they use the internet. The unit of observation is an individual. The outcome variables are dummies for the respondents' policy preferences. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. All the regressions also control for the direct effect of the internet usage measure. In even columns, an additional control also includes 3G coverage interacted with the level of poverty in the ZIP code. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Internet Usage, the Choice of Media Outlets, and Political Knowledge

	(1)	(2)	(3)	(4)	(5)
Dep. Var.:	Share of households that:		Respondent knows their:		
	Watch Fox News	Watch CNN	Congressional representative	First senator	Second senator
3G network coverage ×					
× Average of internet usage measures	-1.500***	0.576***	0.007**	0.007**	0.008**
	(0.174)	(0.128)	(0.003)	(0.003)	(0.003)
Observations	285,508	285,508	396,317	398,902	398,729
Number of clusters	51	51	51	50	50
Number of ZIP codes	32,513	32,513	23,224	23,233	23,233
County & year FEs			✓	✓	✓
ZIP code & year FEs	✓	✓			

Note: This table demonstrates the divergence between active and less-active internet users in their choices of news consumption and in political knowledge. In Columns 1 and 2, the unit of observation is a ZIP code; in Columns 3-5—an individual. In Columns 1 and 2, the outcome variables represent the shares of the ZIP codes' households that watch Fox News and CNN, respectively, normalized by the average within-ZIP-code standard deviations of the outcome variables. In Columns 3-5, the outcome variables are dummies for the respondents knowing their congressional representatives and senators. In Columns 1 and 2, controls include ZIP-code and year fixed effects. In Columns 3-5, controls include county and year fixed effects, dummies for the respondents' gender, race, year of birth, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Heterogeneity by Education, Income, and Employment Status

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	Political views are:					
	Conservative or very conservative			Liberal or very liberal		
3G network coverage ×						
× Less than high school degree	0.070***			-0.036***		
	(0.006)			(0.005)		
× High school degree	0.009**			-0.008***		
	(0.004)			(0.003)		
× Technical/Vocational school	-0.004			-0.005*		
	(0.004)			(0.003)		
× Some college education	-0.008**			0.000		
	(0.003)			(0.002)		
× College degree	-0.033***			0.013***		
	(0.003)			(0.003)		
× Post-graduate degree	-0.019***			0.011**		
	(0.004)			(0.004)		
× Income < $24,000		0.026***			-0.015***	
		(0.003)			(0.003)	
× $24,000 ≤ Income < $48,000		-0.001			0.004	
		(0.003)			(0.003)	
× $48,000 ≤ Income < $90,000		-0.018***			0.010***	
		(0.003)			(0.002)	
× Income ≥ $90,000		-0.031***			0.008***	
		(0.004)			(0.003)	
× Employed			-0.025***			0.009**
			(0.004)			(0.004)
× Unemployed			-0.003			-0.004
			(0.005)			(0.004)
× Out of labor force			0.018***			-0.009**
			(0.004)			(0.004)
Observations	1,765,114	1,765,114	1,244,135	1,765,114	1,765,114	1,244,135
Mean dep. var	0.420	0.420	0.421	0.234	0.234	0.235
Number of ZIP codes	31,499	31,499	30,934	31,499	31,499	30,934
County & year FEs	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓

Note: This table illustrates the heterogeneity of the effects of 3G coverage by education, income, and employment status. The unit of observation is an individual. In Columns 1–3, the outcome variable is a dummy for whether the respondent describes their political views as conservative or very conservative; Columns 4–6 use a similar dummy for self-described views being liberal or very liberal. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. In Columns 3 and 6, controls also include dummies for individuals' employment status. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX

A.I Data

This section presents information about the secondary data sources used in the analysis as well as additional information about the primary data sources.

Mobile network coverage.—The data on 3G and 2G network coverage come from maps provided by Collins Bartholomew's Mobile Coverage Explorer and cover the period from 2007 to 2019 with the exception of 2011.[41] Collins Bartholomew does not provide the data for 2011 due to a change in the company administering collection of mobile network coverage data, which prevented the data from being collected that year. Therefore, throughout the analysis, the data for 2011 are imputed as the average of the values for 2010 and 2012. The results are robust to excluding 2011 altogether.

In certain other countries, mobile network operators occasionally do not submit data to Collins Bartholomew, leading to measurement error in mobile coverage. For the United States, this issue is not relevant: the maps of mobile coverage were updated every year.

Cooperative Congressional Election Study (CCES).—The data on individual's policy preferences come the CCES and cover the period from 2007 to 2019.[42] The exact wording of the questions is the following: *(i) Do you support or oppose each of the following proposals? Always allow a woman to obtain an abortion as a matter of choice. (ii) Do you favor or oppose allowing gays and lesbians to marry legally? (iii) Congress considered many important bills over the past two years. For each of the following tell us whether you support or oppose the legislation in principle. Repeal Affordable Care Act. Would repeal the Affordable Care Act. (iv) What do you think Congress and the President should do about immigration? Increase the number of border patrol on the U.S.-Mexico border.*

Gallup Poll Social Series.—The data on individuals' opinions about the most important problem facing the country come from the Gallup Poll Social Series and cover the period from 2008 to 2018.[43] The data consist of repeated cross-sectional monthly polls of approximately 1,000 respondents with geolocalization at the ZIP-code level. The question of interest is the following: *What do you think is the most important problem facing this country today?*

PolicyMap.—The data for several county-level variables come from PolicyMap, a mapping application that aggregates data with detailed geolocalization from multiple sources. The vari-

[41] These data are described here: https://www.collinsbartholomew.com/map-data-products/ vector-map-data/mobile-coverage-explorer/ (accessed on June 25, 2021).

[42] These data are described here: https://doi.org/10.7910/DVN/II2DB6 (accessed on June 26, 2021).

[43] The data are described here: https://www.gallup.com/175307/gallup-poll-social-series-methodology.aspx (accessed on June 26, 2021).

ables obtained via PolicyMap are the following:

— *Median family income*. The data cover the period from 2008 to 2019 and were originally provided by the U.S. Department of Housing and Urban Development.

— *Unemployment rate*. The data cover the period from 2008 to 2019 and were originally provided by the Bureau of Labor Statistics Local Area Unemployment Statistics Program.

— *Share of population receiving food assistance*. The data cover the period from 2008 to 2019 and were originally provided by the U.S. Census Small Area Income and Poverty Estimates.

— *Migration data*. The data cover the period from 2008 to 2017 and were originally provided by the IRS Statistics of Income Division, County-to-County Migration Data Files.

SimplyAnalytics.—The data for several county-level control variables come from SimplyAnalytics, a mapping application that aggregates data with detailed geolocalization from multiple sources. The control variables obtained via SimplyAnalytics are the following:

— *Median age of the population*. The data cover the period from 2010 to 2018 and originally come from the American Community Survey. In order not to reduce the sample to 2010-2018, the data for 2008-2009 are imputed to have the same values as in 2010.

— *Share of population that is single*. The data cover the period from 2010 to 2018 and originally come from the American Community Survey. In order not to reduce the sample to 2010–2018, the data for 2008–2009 are imputed to have the same values as in 2010.

— *Share of population that is married*. The data cover the period from 2010 to 2018 and originally come from the American Community Survey. In order not to reduce the sample to 2010–2018, the data for 2008–2009 are imputed to have the same values as in 2010.

— *Share of population that is White, Black, and Asian*. The data cover the period from 2010 to 2018 and originally come from the American Community Survey. In order not to reduce the sample to 2010–2018, the data for 2008–2009 are imputed to have the same values as in 2010.

— *Share of population that have no schooling*. The data cover the period from 2010 to 2018 and originally come from the American Community Survey. In order not to reduce the sample to 2010-2018, the data for 2008-2009 are imputed to have the same values as in 2010.

— *Share of population that have at least a bachelor's degree*. The data cover the period from 2010 to 2018 and originally come from the American Community Survey. In order not to reduce the sample to 2010–2018, the data for 2008–2009 are imputed to have the same values as in 2010.

— *Share of population with a cellular data plan.* The ZIP-code-level data are available for 2018 and originally come from the American Community Survey. These data are not used as a control variable in any of the regression specifications. Instead, these data are used in the calculation of the persuasion rates, a detailed discussion of which is presented in Appendix Section A.III.

A.II Share of the Increase in Political Polarization Explained by 3G

To calculate the share of the change in political polarization that is driven by mobile internet, I use the following formula:

$$m = 100 \times \frac{\beta_R \, \Delta 3G_R \, w_R + \beta_D \, \Delta 3G_D \, w_D}{w_R + w_D} \times \frac{1}{\Delta P} = 100 \times \frac{\Delta P_I}{\Delta P} \tag{6}$$

ΔP denotes the overall change in polarization (i.e., the change in the share of Democratic and Republican counties' population that holds views aligned with the views of the county's dominant party); Δ3G is the average change in 3G network coverage; β denotes the regression coefficients for 3G increasing the share of population in Democratic- and Republican-leaning counties that hold views aligned with the views of the dominant party in the county; w represents the relative sample size of Democratic- and Republican-leaning counties; and D and R index Democratic- and Republican-leaning counties, respectively. All changes represent the changes between the beginning and end of the sample period.

The first part of the formula (i.e., ΔP_I) represents the effect of mobile internet on political polarization; the second part of the formula (i.e., ΔP)—the overall change in political polarization. The formula can only be applied when both parts have the same sign. If, instead, $\Delta P_I \times \Delta P < 0$, m can be calculated as the absolute value of $100\Delta P_I/(\Delta P - \Delta P_I)$.

Appendix Table A15 presents the results of applying Formula (6) to the outcome variables for individuals' views and voting behavior. Mobile internet can account for 11.3% of the increase in polarization in political views, 37.7% of the increase in polarization in voting behavior, and, on average, 34.8% of the increase in polarization in policy preferences.

A.III Persuasion Rates

The calculations of the persuasion rates are generally based on the following baseline formula developed by DellaVigna and Kaplan (2007):

$$f = 100 \times \frac{y_T - y_C}{e_T - e_C} \times \frac{1}{1 - y_0} \tag{7}$$

where e denotes exposure to the message, y is the outcome variable, y_0 is the outcome variable in the absence of the message, and T and C index the treatment and control groups, respectively. Formula (7) was later extended by Enikolopov, Petrova and Zhuravskaya (2011) to allow for continuous variation in exposure to the message, which is the case in the setting of this paper, and take into account the effect of turnout:

$$f = 100 \times \frac{1}{1 - y_0 t_0} \left(t \frac{dy}{de} + y \frac{dt}{de} \right) \tag{8}$$

where t represents turnout, and the other notation is described above. Formula (8) can also be rewritten as

$$f = 100 \times \frac{1}{1 - y_0 t_0} \left(t \frac{dy}{dn} + y \frac{dt}{dn} \right) \frac{1}{de/dn} \tag{9}$$

where n represents 3G network coverage. The main difficulty of applying Formula (9) to the effects of 3G availability on Democratic and Republican voters is that it is not immediately clear how to measure exposure to 3G internet. On the one hand, the assumption that all residents of the ZIP code are affected by the arrival of 3G would lead to the underestimation of the persuasion rates because, in reality, it is unlikely that all invidiuals are affected. On the other hand, as shown in Subsection II.E, 3G networks have an impact on multiple dimensions of internet usage and should not be thought of as a "first-stage" for any one variable (e.g., access to the internet). The variable that represents the best measure of exposure to 3G internet is the share of the ZIP codes' population that has a subscription to a cellular data plan, the data for which are available for 2018 from SimplyAnalytics. By definition, 3G network coverage is necessary for an individual to use a cellular data plan. Therefore, the share of population that has a mobile internet subscription represents the share of people that are directly affected by 3G availability.[44] Nevertheless, it is possible that more than one individual is affected by each subscription. For instance, if one family member has access to mobile internet, they might share information they get online with other members of the household. Thus, one can only measure exposure to 3G internet up to a factor of N, where N represents the extent of spillover effects (i.e., if $N = 1$, there are no spillover effects, and only one person is affected per connection; $N > 1$ represents the presence of spillover effects). In the context of the United States, where most individuals can afford to get a mobile internet data plan, spillover effects are unlikely to be large, but they can still play a role in determining the magnitudes of the persuasion rates.

[44] It is potentially possible that a small number of individuals have cellular data plans even though they live in ZIP codes without 3G network coverage (e.g., if they work in a ZIP code with a 3G connection and need to use mobile internet for work). However, the share of such individuals is likely to be quite small.

y_0 is measured as the average of the outcome variables after subtracting the effects of 3G internet, separately for Democratic- and Republican-voting counties. A similar strategy is used for t_0 in the election regressions.[45] The measures of dy/dn and dt/dn come from the regression estimates; y and t are represented by the average values of the respective variables. Overall, the assumptions used in the calculation of the persuasion rates are exactly the same as those used by Guriev, Melnikov and Zhuravskaya (2021).

Table A16 presents the persuation rates of the effects of 3G internet on the preferences of Republican- and Democratic-leaning voters. For residents of Democratic-leaning counties, the average persuasion rate is equal to $10.98/N$; for residents of Republican-leaning counties, it is equal to $13.42/N$. Assuming that N is fixed throughout the regression specifications, the persuasion rates are somewhat larger for election outcomes. However, it is plausible that the spillover effects (i.e., N) are larger for election outcomes because of the high salience of elections.

[45] In the survey-based regressions, turnout is assumed to be universal.

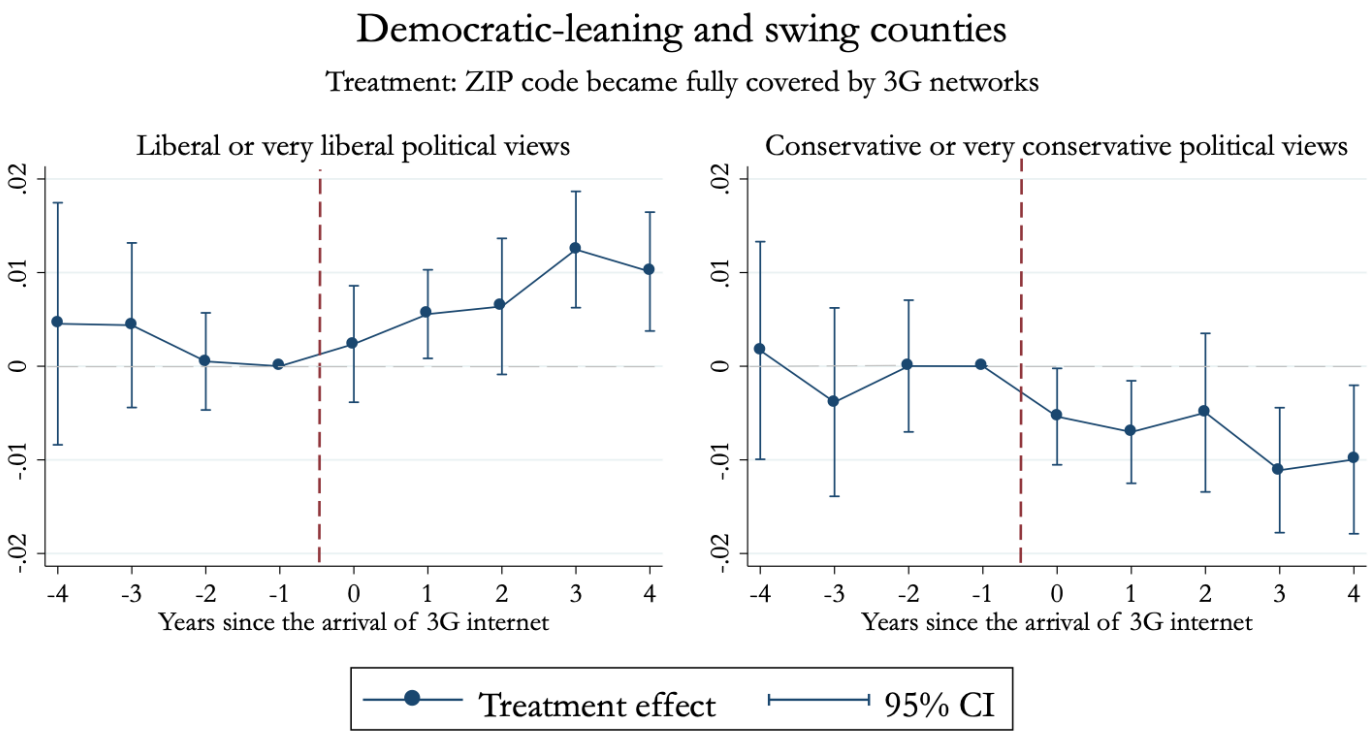

Figure A1: De Chaisemartin-D'haultfœuille Event-Study Estimator

Note: The figure presents the De Chaisemartin-D'haultfœuille event-study estimator, showing how the respondents' political views changed after the arrival of 3G internet to their ZIP code of residence. The regression estimates are presented in Columns 2 and 4 of Table A4. A ZIP code is defined to be treated when it becomes fully covered by 3G networks for the first time. The sample consists of individuals living in Democratic-leaning and swing counties. In the first part of the figure, the outcome variable is the share of respondents in a ZIP code that describe their political views as conservative or very conservative; in the second part—a similar share of respondents with self-described views being liberal or very liberal.

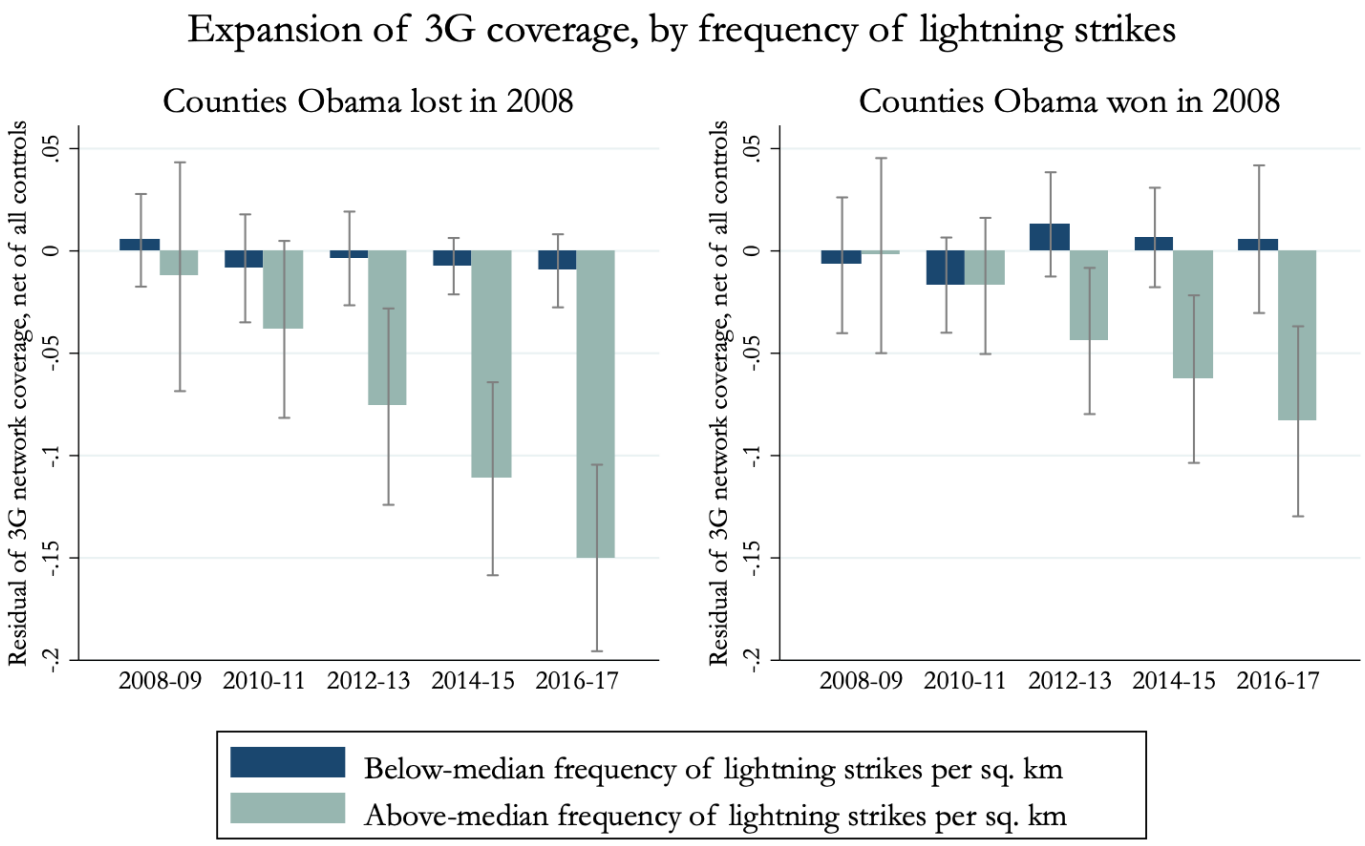

Figure A2: First stage of the IV analysis

Note: The figure illustrates the first stage of the IV analysis, described in Specification (4), showing that areas with a high frequency of lightning strikes experienced significantly slower growth in 3G network coverage. The left part of the figure illustrates the relationship in Column 1 of Table A8; the right part of the figure, the relationship in Column 4 of Table A8. The bars represent the mean residual of 3G network coverage (net of all controls) along with 95% confidence intervals. Standard errors are corrected for clusters at the level of the states and the District of Columbia.

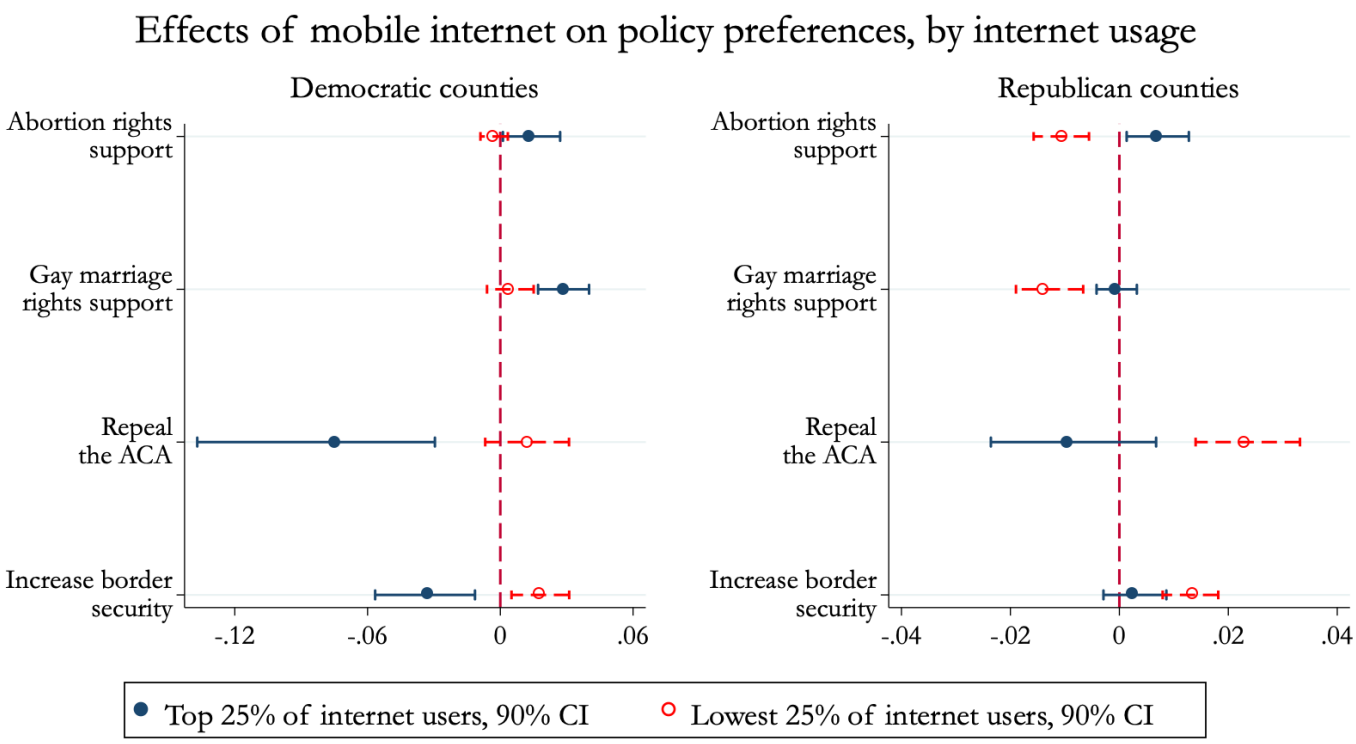

Figure A3: Internet Usage and Policy Preferences

Note: The figure illustrates the relationship between internet usage and political preferences presented in Columns 2, 4, 6, and 8 of Table 6. The vertical axis represents the outcome variables for which the results are reported. The left part of the figure shows the effects on residents of Democratic-leaning counties; the right part of the figure, on residents of Republican counties. The reported effects represent the effects of mobile internet on individuals living in ZIP codes that are in the top 25% of internet users and in the lowest 25% of internet users. The 90% confidence intervals are corrected for clusters at the level of the states and the District of Columbia using bootstrap replications, which take into account the uncertainty regarding the effects of the control variables.

Table A1: 3G Network Coverage and Internet Use

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.:	Share of households that:						
	Use the internet	Used the internet yesterday	Spent >30 minutes on the internet yesterday	Use the internet to obtain news	Use the internet to visit a TV network's website	Use YouTube	Use Facebook
3G network coverage	0.800***	0.569***	0.369***	0.268**	0.480***	0.177***	0.420***
	(0.138)	(0.108)	(0.094)	(0.120)	(0.135)	(0.053)	(0.056)
Observations	254,451	254,451	254,451	254,451	254,451	254,451	254,451
R-squared	0.975	0.988	0.993	0.966	0.957	0.995	0.996
Number of clusters	51	51	51	51	51	51	51
Number of ZIP codes	32,507	32,507	32,507	32,507	32,507	32,507	32,507
ZIP code & year FEs	✓	✓	✓	✓	✓	✓	✓

Note: This table presents the estimates of Specification (3), showing that the availability of 3G networks affected multiple dimensions of internet usage in the ZIP codes where it became available. The unit of observation is a ZIP code. The outcome variables are normalized by the average of their within-ZIP-code standard deviations. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A2: State-Year, County-Year, and Political-Affiliation-Year Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep. Var.:	Liberal or very liberal political views						Conservative or very conservative political views					
3G network coverage ×												
× Democratic voter	0.052***	0.059***	0.061***				-0.018***	-0.025***	-0.011*			
	(0.006)	(0.008)	(0.007)				(0.005)	(0.006)	(0.006)			
× Independent voter	-0.014***	-0.008**	-0.013***				-0.019***	-0.027***	-0.032***			
	(0.003)	(0.003)	(0.003)				(0.003)	(0.004)	(0.003)			
× Republican voter	-0.034***	-0.028***	-0.043***				0.020***	0.012***	0.028***			
	(0.002)	(0.004)	(0.003)				(0.003)	(0.003)	(0.004)			
× Resident of reliably Democratic county				0.013**	0.055***	0.018**				-0.016***	-0.030***	-0.017***
				(0.006)	(0.011)	(0.008)				(0.004)	(0.010)	(0.005)
× Resident of Democratic-leaning county				0.009***	0.037***	0.012***				-0.021***	-0.049***	-0.023***
				(0.003)	(0.010)	(0.003)				(0.003)	(0.008)	(0.003)
× Resident of swing county				0.002	0.011	0.005				-0.009***	-0.023***	-0.008***
				(0.002)	(0.007)	(0.003)				(0.002)	(0.005)	(0.003)
× Resident of Republican-leaning county				-0.006***	-0.009	-0.008***				-0.000	-0.013	0.000
				(0.002)	(0.006)	(0.002)				(0.004)	(0.009)	(0.005)
× Resident of reliably Republican county				-0.003	-0.013**	-0.006*				0.011***	0.006	0.006
				(0.003)	(0.006)	(0.003)				(0.004)	(0.010)	(0.006)
Observations	1,765,114	1,764,198	1,765,114	1,765,113	1,764,197	1,765,113	1,765,114	1,764,198	1,765,114	1,765,113	1,764,197	1,765,113
R-squared	0.205	0.215	0.205	0.074	0.085	0.073	0.261	0.273	0.261	0.091	0.106	0.091
Mean dep. var	0.234	0.234	0.234	0.234	0.234	0.234	0.420	0.420	0.420	0.420	0.420	0.420
Number of clusters	51	51	51	51	51	51	51	51	51	51	51	51
Number of ZIP codes	31,499	31,458	31,499	31,499	31,458	31,499	31,499	31,458	31,499	31,499	31,458	31,499
County & year FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State-year FEs	✓			✓			✓			✓		
County-year FEs		✓			✓			✓			✓	
Political-affiliation-year FEs			✓			✓			✓			✓

Note: This table presents the results of estimating Specifications (1) and (2) for respondents' self-described political views, controlling for state-year, county-year, and political-affiliation-year fixed effects. The unit of observation is an individual. In Columns 1–6, the outcome variable is a dummy for whether the respondent describes their political views as liberal or very liberal; Columns 7–12 use a similar dummy for self-described views being conservative or very conservative. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is male, single, married, White, Black, Asian, of multiple race, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Baseline controls also include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. In Columns 1–3 and 7–9, controls also include dummies for individuals' party affiliation. A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points, and Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points; other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A3: Leads of 3G Network Coverage

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	Political views are:					
	Liberal or very liberal			Conservative or very conservative		
3G network coverage in year t ×						
× Resident of reliably Democratic county	0.015**	0.016**	0.015**	-0.015***	-0.016***	-0.015***
	(0.007)	(0.007)	(0.007)	(0.004)	(0.005)	(0.004)
× Resident of Democratic-leaning county	0.008***	0.010***	0.008***	-0.015***	-0.017***	-0.015***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
× Resident of swing county	0.005*	0.003*	0.005*	-0.007**	-0.007**	-0.007**
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
× Resident of Republican-leaning county	-0.005*	-0.006***	-0.005	0.001	0.001	0.001
	(0.003)	(0.002)	(0.003)	(0.005)	(0.004)	(0.006)
× Resident of reliably Republican county	-0.001	-0.001	-0.002	-0.002	0.002	-0.002
	(0.004)	(0.003)	(0.004)	(0.005)	(0.004)	(0.005)
3G network coverage in year t + 1 ×						
× Resident of reliably Democratic county	0.006		0.005	-0.006		-0.006
	(0.007)		(0.012)	(0.005)		(0.011)
× Resident of Democratic-leaning county	0.007		0.004	-0.009		-0.005
	(0.004)		(0.004)	(0.006)		(0.006)
× Resident of swing county	-0.004		-0.003	0.001		-0.001
	(0.004)		(0.004)	(0.004)		(0.006)
× Resident of Republican-leaning county	0.000		-0.002	-0.002		-0.000
	(0.004)		(0.005)	(0.005)		(0.007)
× Resident of reliably Republican county	-0.002		0.002	0.012		0.008
	(0.005)		(0.006)	(0.007)		(0.009)
3G network coverage in year t + 2 ×						
× Resident of reliably Democratic county		0.006	0.001		-0.005	-0.000
		(0.015)	(0.023)		(0.014)	(0.022)
× Resident of Democratic-leaning county		0.009	0.006		-0.011	-0.007
		(0.006)	(0.006)		(0.008)	(0.008)
× Resident of swing county		-0.004	-0.002		0.003	0.004
		(0.004)	(0.005)		(0.005)	(0.008)
× Resident of Republican-leaning county		0.002	0.003		-0.003	-0.003
		(0.004)	(0.005)		(0.005)	(0.005)
× Resident of reliably Republican county		-0.004	-0.005		0.009	0.004
		(0.005)	(0.006)		(0.007)	(0.008)
Observations	1,765,113	1,765,113	1,765,113	1,765,113	1,765,113	1,765,113
Mean dep. var	0.234	0.234	0.234	0.420	0.420	0.420
Number of clusters	51	51	51	51	51	51
Number of ZIP codes	31,499	31,499	31,499	31,499	31,499	31,499
County & year FEs	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓

Note: Political views are affected by the current availability of 3G network coverage but not by the future availability of 3G. The unit of observation is an individual. In Columns 1–3, the outcome variable is a dummy for whether the respondent describes their political views as liberal or very liberal; Columns 4–6 use a similar dummy for self-described views being conservative or very conservative. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. A county is assumed to be reliably Democratic if Obama won the county in 2008 by a margin of at least 30 percentage points; Democratic-leaning if Obama won the county in 2008 by a margin of 10–30 percentage points; Republican-leaning if Obama lost the county in 2008 by a margin of 10–30 percentage points; and reliably Republican if Obama lost the county in 2008 by a margin of at least 30 percentage points. Other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A4: Event-Study Estimates, Democratic-Leaning and Swing Counties

	(1)	(2)	(3)	(4)
Dep. Var.:	Political views are:			
	Conservative or very conservative		Liberal or very liberal	
Fully covered by 3G networks in:				
Year t + 4	-0.003	0.002	-0.003	0.005
	(0.003)	(0.006)	(0.003)	(0.007)
Year t + 3	-0.003	-0.004	0.002	0.004
	(0.004)	(0.005)	(0.003)	(0.004)
Year t + 2	-0.003	0.000	0.001	0.001
	(0.003)	(0.004)	(0.002)	(0.003)
Year t	-0.015***	-0.005**	0.011***	0.002
	(0.003)	(0.003)	(0.002)	(0.003)
Year t − 1	-0.019***	-0.007**	0.017***	0.006**
	(0.003)	(0.003)	(0.003)	(0.002)
Year t − 2	-0.023***	-0.005	0.021***	0.006*
	(0.003)	(0.004)	(0.003)	(0.004)
Year t − 3	-0.026***	-0.011***	0.024***	0.012***
	(0.004)	(0.003)	(0.003)	(0.003)
Year t − 4	-0.033***	-0.010**	0.030***	0.010***
	(0.004)	(0.004)	(0.004)	(0.003)
Year t − 5 or earlier	-0.039***		0.035***	
	(0.005)		(0.005)	
Observations	1,170,457	1,170,457	1,170,457	1,170,457
Number of clusters	51	51	51	51
Number of ZIP codes	18,116	18,116	18,116	18,116
Standard event study estimates	✓		✓	
De Chaisemartin-D'Haultfœuille estimator		✓		✓

Note: This table presents the event study estimates for the effects of the arrival of 3G internet on political views in Democratic-leaning and swing counties. A ZIP code is defined to be treated when it becomes fully covered by 3G networks for the first time. Columns 1 and 3 present standard event study estimates; Columns 2 and 4 present the De Chaisemartin-D'haultfœuille event-study estimator. In Columns 1 and 3, the unit of observation is an individual; in Columns 2 and 4, it is a ZIP code. In Columns 1 and 2, the outcome variable is a dummy for whether the respondent describes their political views as conservative or very conservative; Columns 3 and 4 use a similar dummy for self-described views being liberal or very liberal. In Columns 1 and 3, unreported controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. In Columns 2 and 4, observations are weighted by the number of observations in each ZIP code. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A5: Oster δs for the Effects of 3G Coverage on Political Views

	(1)	(2)	(3)	(4)
Dep. Var.:	Political views are:			
	Liberal or very liberal		Conservative or very conservative	
3G network coverage ×				
× Democratic voter	0.051***		-0.017***	
	(0.006)		(0.005)	
× Independent voter	-0.015***		-0.019***	
	(0.003)		(0.003)	
× Republican voter	-0.035***		0.020***	
	(0.002)		(0.003)	
× Resident of Democratic-leaning county		0.010***		-0.018***
		(0.003)		(0.002)
× Resident of swing county		0.000		-0.007***
		(0.002)		(0.002)
× Resident of Republican-leaning county		-0.006***		0.001
		(0.002)		(0.003)
Observations	1,765,114	1,765,113	1,765,114	1,765,113
R-squared	0.205	0.073	0.260	0.091
Oster δ for 3G × Democratic political affiliation	11.391	2.335	0.989	3.269
Oster δ for 3G × Republican political affiliation	-8.787	9.871	4.664	1.756

Note: This table presents the Oster δs for the effects of 3G network coverage on individuals' political views, showing that selection on unobservable variables needs to be very high to reduce the effects of 3G coverage to zero. Following Oster (2017), I set the value of R^2_{max}—the R-squared from a hypothetical regression of the outcome variable on all observed and unobserved controls—to be equal to $1.3\tilde{R}^2$, where $\tilde{R}^2$ is the R-squared reported in the table. The unit of observation is an individual. In Columns 1 and 2, the outcome variable is a dummy for whether the respondent describes their political views as liberal or very liberal; Columns 3 and 4 use a similar dummy for self-described views being conservative or very conservative. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. In Columns 1 and 3, controls also include dummies for individuals' party affiliation. A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points, and Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points; other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A6: 3G Internet and Political Polarization, ZIP-Code Fixed Effects

	(1)	(2)	(3)	(4)
Dep. Var.:	Political views are:			
	Liberal or very liberal		Conservative or very conservative	
3G network coverage ×				
× Democratic voter	0.045***		-0.011**	
	(0.006)		(0.005)	
× Independent voter	-0.018***		-0.013***	
	(0.003)		(0.003)	
× Republican voter	-0.036***		0.025***	
	(0.002)		(0.003)	
× Resident of Democratic-leaning county		-0.002		-0.005**
		(0.003)		(0.003)
× Resident of swing county		-0.006***		0.003
		(0.002)		(0.003)
× Resident of Republican-leaning county		-0.010***		0.011***
		(0.002)		(0.004)
Observations	1,763,756	1,763,755	1,763,756	1,763,755
R-squared	0.222	0.099	0.275	0.113
Mean dep. var	0.234	0.234	0.420	0.420
Number of clusters	51	51	51	51
Number of ZIP codes	30,140	30,140	30,140	30,140
ZIP code & year FEs	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓

Note: This table presents the results of estimating Specifications (1) and (2) for respondents' self-described political views. The unit of observation is an individual. The number of ZIP codes is smaller than in Table 1 because ZIP codes with only one observation are automatically dropped from the sample. In Columns 1 and 2, the outcome variable is a dummy for whether the respondent describes their political views as liberal or very liberal; Columns 3 and 4 use a similar dummy for self-described views being conservative or very conservative. Controls include ZIP code and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. In Columns 1 and 3, controls also include dummies for individuals' party affiliation). A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points, and Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points; other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A7: 3G Network Coverage and County Socioeconomic Characteristics

	(1)	(2)	(3)	(4)	(5)
Dep. Var.:	3G coverage in year t	3G coverage in year t + 1	Median income in county	Unemployment rate in county	Share of population on food stamps
3G coverage in year t − 1			-0.327	0.103	0.114
			(0.419)	(0.171)	(0.193)
Median income in county	-0.001	-0.000			
	(0.001)	(0.001)			
Unemployment rate in county	0.003	0.000			
	(0.006)	(0.007)			
Share of population on food stamps	-0.001	-0.002			
	(0.003)	(0.003)			
Share of population with no schooling	-0.002	-0.002			
	(0.006)	(0.005)			
Share of population with college degree	-0.000	-0.003			
	(0.001)	(0.002)			
Observations	34,496	34,496	34,496	34,496	34,496
Mean dep. var	0.477	0.544	56.91	6.701	14.41
Number of counties	3,139	3,139	3,139	3,139	3,139
County & year FEs	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓

Note: This table presents the relationship between 3G network coverage and the socioeconomic characteristics of the county. The unit of observation is a county. Median income is measured in thousands. Baseline controls include county and year fixed effects, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. The three outcome variables in Columns 3–5 are excluded from the list of controls in those regressions. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A8: Lightning Strikes, 3G Network Coverage, and Political Views

	(1)	(2)	(3)	(4)	(5)	(6)
Sample:	Counties Obama lost in 2008			Counties Obama won in 2008		
Dep. Var.:	3G network coverage	Political views: conservative or very conservative		3G network coverage	Political views: liberal or very liberal	
Lightning strikes per km$^2 \times t$	-0.438***	-0.017***		-0.106***	-0.003**	
	(0.114)	(0.005)		(0.024)	(0.001)	
3G network coverage			0.038**			0.025*
			(0.016)			(0.014)
Anderson-Rubin 90% CI			*[0.018, 0.080]*			*[0.007, 0.058]*
Observations	749,786	749,786	749,786	1,013,599	1,013,599	1,013,599
F-stat, excluded instrument			14.68			20.42
Mean dep. var	0.621	0.506	0.506	0.791	0.282	0.282
Number of clusters	47	47	47	51	51	51
Number of ZIP codes	17,707	17,707	17,707	14,173	14,173	14,173
County & year FEs	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓
Additional controls	✓	✓	✓	✓	✓	✓

Note: This table presents the IV results, where 3G network coverage is predicted using the frequency of lightning strikes. The unit of observation is an individual. In Columns 1–3, the sample consists of counties that Obama lost in 2008; in Columns 4-6, the counties that Obama won in 2008. In Columns 1 and 4, the outcome variable is the share of the ZIP code's territory that has 3G network coverage; in the other columns, a dummy for whether an individual holds certain political views. The frequency of lightning strikes is measured in standard deviations. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Additional controls used in the IV analysis include separate year fixed effects for all quartiles of county population size, the log of maximum elevation in the county interacted with a time trend, and the share of the counties' territory that is uninhabited interacted with a time trend. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. In Columns 1–3, the number of clusters is smaller because Obama won all the counties in Connecticut, the District of Columbia, Hawaii, and Vermont. *** p<0.01, ** p<0.05, * p<0.1.

Table A9: 2G Network Coverage and Political Views

	(1)	(2)	(3)	(4)
Dep. Var.:	Political views are:			
	Liberal or very liberal		Conservative or very conservative	
2G network coverage ×				
× Counties Obama won in 2008	-0.003	-0.007	-0.003	0.001
	(0.004)	(0.005)	(0.004)	(0.004)
× Counties Obama lost in 2008	-0.002	0.003	0.002	-0.003
	(0.002)	(0.002)	(0.003)	(0.003)
3G network coverage ×				
× Counties Obama won in 2008		0.011***		-0.015***
		(0.003)		(0.003)
× Counties Obama lost in 2008		-0.004***		0.001
		(0.001)		(0.003)
Observations	1,762,802	1,762,795	1,762,802	1,762,795
Mean dep. var	0.234	0.234	0.420	0.420
Number of clusters	51	51	51	51
Number of ZIP codes	31,066	31,063	31,066	31,063
County & year FEs	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓

Note: This table presents the relationship between 2G network coverage and individuals' political views. The unit of observation is an individual. In Columns 1 and 2, the outcome variable is a dummy for whether the respondent describes their political views as liberal or very liberal; Columns 3 and 4 use a similar dummy for self-described views being conservative or very conservative. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A10: 3G Network Coverage and Migration

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	In-migration rate		Out-migration rate		Net-migration rate	
3G network coverage ×	0.121		0.079		0.042	
	(0.073)		(0.048)		(0.061)	
3G network coverage ×						
× Resident of Democratic-leaning county		0.004		0.111		-0.106
		(0.110)		(0.090)		(0.073)
× Resident of Republican-leaning county		0.129		0.037		0.093
		(0.095)		(0.058)		(0.077)
Observations	30,545	30,545	30,545	30,545	30,545	30,545
Mean dep. var	4.868	4.868	4.807	4.807	0.062	0.062
Number of counties	3,121	3,121	3,121	3,121	3,121	3,121
County & year FEs	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓

Note: This table presents the relationship between 3G network coverage and migration. The unit of observation is a county. The outcome variables are measured in percentage points. Baseline controls include county and year fixed effects, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points, and Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A11: 3G Internet and Political Polarization, by Past Vote Type

	(1)	(2)	(3)	(4)
Dep. Var.:	Political views are:			
	Liberal or very liberal		Conservative or very conservative	
3G network coverage ×				
× Voted for Democratic presidential nominee in last election	0.045***	0.050***	0.008	0.001
	(0.007)	(0.008)	(0.007)	(0.007)
× Voted for Republican presidential nominee in last election	-0.017***	-0.016***	0.013*	0.021***
	(0.005)	(0.005)	(0.007)	(0.007)
Observations	293,588	293,588	293,588	293,588
Mean dep. var	0.286	0.286	0.387	0.387
Number of clusters	51	51	51	51
Number of ZIP codes	21,701	21,701	21,701	21,701
County & year FEs	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓
Political-affiliation-year FEs		✓		✓

Note: This table presents the results of estimating Specification (1) for individuals who voted for the Democratic and Republican presidential nominees in the last election. The unit of observation is an individual. In Columns 1 and 2, the outcome variable is a dummy for whether the respondent describes their political views as liberal or very liberal; Columns 3 and 4 use a similar dummy for self-described views being conservative or very conservative. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. Observations are weighted by survey weights. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A12: Policy Preferences and Leads of 3G Network Coverage

	(1)	(2)	(3)	(4)
Dep. Var.:	Always allow abortion	Support gay marriage	Repeal the ACA	Increase border security
3G network coverage in year t ×				
× Resident of Democratic-leaning county	0.004	0.031**	0.009	-0.031
	(0.008)	(0.015)	(0.046)	(0.024)
× Resident of swing county	-0.002	0.020	0.005	-0.010
	(0.009)	(0.015)	(0.030)	(0.016)
× Resident of Republican-leaning county	-0.015**	-0.030**	0.038*	0.035***
	(0.007)	(0.012)	(0.022)	(0.011)
3G network coverage in year t + 1 ×				
× Resident of Democratic-leaning county	0.017	0.010	-0.050	0.005
	(0.012)	(0.016)	(0.051)	(0.033)
× Resident of swing county	0.011	-0.004	-0.015	-0.015
	(0.012)	(0.012)	(0.036)	(0.022)
× Resident of Republican-leaning county	0.005	-0.003	-0.023	-0.031*
	(0.009)	(0.013)	(0.026)	(0.018)
Observations	394,518	316,521	278,657	356,933
R-squared	0.110	0.108	0.109	0.107
Mean dep. var	0.536	0.578	0.486	0.523
Number of clusters	51	51	51	51
Number of ZIP codes	23,216	22,450	21,375	22,614
County & year FEs	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓

Note: Policy preferences are affected by current 3G network coverage, not future availability of 3G. The unit of observation is an individual. The outcome variables are dummies for the respondents' policy preferences. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. In Columns 1, 2, and 4, additional controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 and separate year fixed effects for the ZIP codes that were, separately for Democratic-leaning, Republican-leaning, and swing counties. In Column 3, additional controls include the same specification with 3G networks in 2012. The reason for the change is that the question about repealing the ACA was first asked in 2012. A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points, and Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points; other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A13: 3G Internet and the Main Problem Facing the Country

	(1)	(2)	(3)	(4)
Dep. Var.:	Main problem facing the country:			
	Immigration	Inequality	Race	Guns
3G network coverage ×				
× Resident of Democratic-leaning county	0.005	0.007***	0.001	0.001
	(0.003)	(0.002)	(0.002)	(0.001)
× Resident of swing county	-0.000	-0.003*	-0.002	-0.001
	(0.003)	(0.001)	(0.002)	(0.001)
× Resident of Republican-leaning county	0.008**	-0.004***	-0.008***	-0.003***
	(0.003)	(0.001)	(0.002)	(0.001)
Observations	105,217	105,217	105,217	105,217
R-squared	0.060	0.032	0.062	0.037
Mean dep. var	0.041	0.012	0.020	0.008
Number of clusters	51	51	51	51
Number of ZIP codes	20,392	20,392	20,392	20,392
County & year FEs	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓

Note: This table presents the results of estimating Specification (2) for the respondents' views on the most important problems facing the country. The unit of observation is an individual. The outcome variables are dummies for whether the respondent considers this problem to be the most important problem facing the country today. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points, and Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points; other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A14: Voting Outcomes and Leads of 3G Network Coverage

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	Republican vote share (R)		Democratic vote share (D)		Republican vote margin (R-D)	
3G network coverage in year t ×						
× Resident of Democratic-leaning county	-4.567**	-1.571	4.393*	1.403	-8.960**	-2.974
	(2.240)	(0.964)	(2.261)	(1.056)	(4.380)	(1.955)
× Resident of swing county	1.287	1.497	0.017	-0.770	1.271	2.267
	(1.635)	(1.281)	(1.733)	(1.207)	(3.185)	(2.305)
× Resident of Republican-leaning county	3.687**	3.900***	-3.823*	-4.703***	7.509**	8.602***
	(1.531)	(1.157)	(2.216)	(1.455)	(3.675)	(2.500)
3G network coverage in year t + 1 ×						
× Resident of Democratic-leaning county	-0.377	-1.049	-0.346	1.151	-0.031	-2.200
	(2.653)	(1.569)	(2.232)	(1.575)	(4.724)	(3.099)
× Resident of swing county	0.768	2.333	-2.457	-2.911	3.225	5.245*
	(1.839)	(1.424)	(1.999)	(1.752)	(3.681)	(3.094)
× Resident of Republican-leaning county	1.352	1.061	-1.201	-0.260	2.553	1.321
	(1.485)	(1.320)	(2.380)	(1.935)	(3.730)	(3.183)
Observations	18,573	16,864	18,573	16,864	18,573	16,864
R-squared	0.793	0.858	0.779	0.857	0.795	0.862
Mean dep. var	60.74	59.53	36.08	38.11	24.66	21.42
Number of counties	3,110	3,110	3,110	3,110	3,110	3,110
County & year FEs	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓
Excluding unopposed races		✓		✓		✓

Note: Voting outcomes are affected by current 3G network coverage, not future availability of 3G. The unit of observation is a county. The outcomes are measured in percentage points. In the odd columns, the results are reported for the full sample; in the even columns, for county-years with at least one Democrat and at least one Republican running for office. Alaska is excluded from the sample because, in Alaska, election results are not available at the county level. Baseline controls include county and year fixed effects, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the county was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the counties that were, separately for Democratic-leaning, Republican-leaning, and swing counties. A county is assumed to be Democratic-leaning if Obama won the county in 2008 by a margin of at least 10 percentage points, and Republican-leaning if Obama lost the county in 2008 by a margin of at least 10 percentage points; other counties are characterized as swing counties. Standard errors in parentheses are corrected for clusters at the level of the states. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A15: Share of Increase in Political Polarization Explained by 3G

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	Political views	Voting	Abortion	Gay marriage	The ACA	Border security
Share of increase in political polarization explained by 3G	11.3%	37.7%	22.1%	97.6%	12.8%	6.8%
Source of results:	Tab. A5, Col. 2 and 4	Tab. 3, Col. 2 and 4	Tab. 2, Col. 1	Tab. 2, Col. 2	Tab. 2, Col. 3	Tab. 2, Col. 4
Regression estimates for Democratic counties (β_D)	0.010*** (0.003)	2.396* (1.355)	0.013** (0.006)	0.037*** (0.011)	0.053*** (0.019)	0.029*** (0.010)
Regression estimates for Republican counties (β_R)	0.001 (0.003)	4.540*** (1.249)	0.012** (0.006)	0.033*** (0.009)	0.027 (0.016)	0.017** (0.007)
Increase in polarization (ΔP)	0.034	7.765	0.038	0.024	0.014	0.075
Increase in 3G coverage, Democratic counties ($\Delta 3G_D$)	0.613	0.687	0.607	0.601	0.020	0.126
Increase in 3G coverage, Republican counties ($\Delta 3G_R$)	0.775	0.733	0.780	0.749	0.109	0.432
Share of Democratic counties (w_D)	0.418	0.180	0.454	0.456	0.457	0.456
Share of Republican counties (w_R)	0.323	0.575	0.287	0.284	0.284	0.284

Note: This table reports the share of the increase in poltical polarization that can be explained by mobile internet, using Formula (6). Further details of the calculations are available in Appendix Section A.II. *** p<0.01, ** p<0.05, * p<0.1.

Table A16: Persuasion Rates

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	Liberal or very liberal political views			Conservative or very conservative political views		
Persuasion rate	6.18/N	7.51/N	17.62/N	9.46/N	0.39/N	15.98/N
Source of results:	Tab. A5, Col. 2	Tab. A5, Col. 2	Tab. A8, Col. 6	Tab. A5, Col. 4	Tab. A5, Col. 4	Tab. A8, Col. 3
Political affiliation:	Democratic	Republican	Democratic	Democratic	Republican	Republican
Regression estimates	0.010***	-0.006***	0.025*	-0.018***	0.001	0.038**
	(0.003)	(0.002)	(0.014)	(0.002)	(0.003)	(0.016)
Cellular coverage (*de/ds*)	0.549*N*	0.488*N*	0.541*N*	0.549*N*	0.488*N*	0.493*N*
Mean of dep. var.	0.303	0.160	0.282	0.332	0.522	0.506
Mean of 3G coverage	0.816	0.608	0.791	0.816	0.608	0.620
	(7)	(8)	(9)	(10)	(11)	(12)
Dep. Var.:	Republican vote share (R)		Democratic vote share (D)		Always allow abortion	
Persuasion rate	16.80/N	9.57/N	2.18/N	35.31/N	3.93/N	5.64/N
Source of results:	Tab. 3, Col. 2	Tab. 3, Col. 2	Tab. 3, Col. 4	Tab. 3, Col. 4	Tab. 2, Col. 1	Tab. 2, Col. 1
Political affiliation:	Democratic	Republican	Democratic	Republican	Democratic	Republican
Regression estimates	-2.577*	4.540***	2.396*	-4.789***	0.013**	-0.012**
	(1.390)	(1.249)	(1.355)	(1.190)	(0.006)	(0.006)
Effect on turnout	-1.068**	-0.753*	-1.068**	-0.753*		
	(0.415)	(0.440)	(0.415)	(0.440)		
Cellular coverage (*de/ds*)	0.549*N*	0.488*N*	0.549*N*	0.488*N*	0.549*N*	0.488*N*
Mean of dep. var.	37.12	68.78	60.56	28.76	0.615	0.427
Mean of 3G coverage	0.536	0.447	0.536	0.447	0.906	0.738
Mean of turnout	38.58	37.12	38.58	37.12		
	(13)	(14)	(15)	(16)	(17)	(18)
Dep. Var.:	Support gay marriage		Repeal the ACA		Increase border security	
Persuasion rate	11.10/N	13.29/N	20.87/N	9.82/N	10.72/N	6.61/N
Source of results:	Tab. 2, Col. 2	Tab. 2, Col. 2	Tab. 2, Col. 3	Tab. 2, Col. 3	Tab. 2, Col. 4	Tab. 2, Col. 4
Political affiliation:	Democratic	Republican	Democratic	Republican	Democratic	Republican
Regression estimates	0.037***	-0.033***	-0.053***	0.027	-0.029***	0.017**
	(0.011)	(0.009)	(0.019)	(0.016)	(0.010)	(0.007)
Cellular coverage (*de/ds*)	0.549*N*	0.488*N*	0.549*N*	0.488*N*	0.549*N*	0.488*N*
Mean of dep. var.	0.640	0.486	0.411	0.587	0.465	0.542
Mean of 3G coverage	0.888	0.692	0.973	0.879	0.950	0.894

Note: This table presents the persuasion rates of the effects of 3G internet on political outcomes. N represents the number of individuals that are affected by the internet's "message" per cellular data plan subscription (i.e., if $N = 1$, there are no spillover effects, and only one person is affected per connection; $N > 1$ indicates the presence of spillover effects). The calculation of the persuasion rates is based on the formulas in Enikolopov, Petrova and Zhuravskaya (2011), which are also reproduced in Appendix Section A.III. Further details of the calculations are available in Appendix Section A.III. *** p<0.01, ** p<0.05, * p<0.1.

Table A17: Internet Usage and Political Views, by Party Affiliation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var.:	Conservative or very conservative political views					Liberal or very liberal political views				
Resident of Democratic-leaning county ×										
× 3G network coverage ×										
× Share of households using the internet to obtain news	-0.014***					0.013***				
	(0.004)					(0.004)				
× Share of households visiting TV networks' websites		-0.015***					0.014***			
		(0.004)					(0.005)			
× Share of households using YouTube			-0.031**					0.024		
			(0.012)					(0.017)		
× Share of households using Facebook				-0.037***					0.032*	
				(0.014)					(0.018)	
× Average of internet usage measures					-0.025***					0.024***
					(0.007)					(0.008)
Resident of Republican-leaning county ×										
× 3G network coverage ×										
× Share of households using the internet to obtain news	-0.011***					0.001				
	(0.004)					(0.003)				
× Share of households visiting TV networks' websites		-0.012***					0.002			
		(0.003)					(0.002)			
× Share of households using YouTube			-0.037***					0.009		
			(0.007)					(0.008)		
× Share of households using Facebook				-0.037***					0.008	
				(0.008)					(0.009)	
× Average of internet usage measures					-0.020***					0.003
					(0.005)					(0.004)
Observations	1,764,533	1,764,533	1,764,533	1,764,533	1,764,533	1,764,533	1,764,533	1,764,533	1,764,533	1,764,533
County & year FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table demonstrates how individuals' political views are affected depending on how they use the internet, separately for Democratic-leaning and Republican-leaning counties. The internet usage variables represent the average values of the respective variables in the first four years for which the data are available (i.e., the first half of the sample period) after subtracting the effect of 3G internet on these variables. The unit of observation is an individual. In Columns 1–5, the outcome variable is a dummy for whether the respondent describes their political views as conservative or very conservative; in Columns 6–10, liberal or very liberal. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Additional controls include 3G network coverage interacted with the ZIP code's level of poverty in 2010–2014 as well as for the direct effects of 3G internet and the internet usage measures, separately for each political affiliation. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A18: Internet Usage and Political Views, Controlling for the Effects of 3G by Age, Education, and Income

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep. Var.:	Conservative or very conservative political views						Liberal or very liberal political views					
3G network coverage ×												
× Share of households using the internet to obtain news	-0.005**						0.003					
	(0.002)						(0.002)					
× Share of households visiting TV networks' websites		-0.008***						0.005**				
		(0.002)						(0.002)				
× Share of households using YouTube			-0.022***						0.015*			
			(0.006)						(0.008)			
× Share of households using Facebook				-0.023***						0.015*		
				(0.007)						(0.009)		
× Average of internet usage measures					-0.012***						0.008**	
					(0.003)						(0.004)	
× Share of households visiting CNN.com						-0.119***						0.134***
						(0.015)						(0.025)
× Share of households visiting FoxNews.com						0.044***						-0.052***
						(0.007)						(0.009)
Observations	1,764,534	1,764,534	1,764,534	1,764,534	1,764,534	1,764,350	1,764,534	1,764,534	1,764,534	1,764,534	1,764,534	1,764,350
R-squared	0.092	0.092	0.092	0.092	0.092	0.093	0.074	0.074	0.074	0.074	0.074	0.077
Mean dep. var	0.420	0.420	0.420	0.420	0.420	0.420	0.234	0.234	0.234	0.234	0.234	0.234
Number of ZIP codes	31,329	31,329	31,329	31,329	31,329	31,292	31,329	31,329	31,329	31,329	31,329	31,292
County & year FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Baseline controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Controls for the effects of 3G by age, education, and income	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table demonstrates how individuals' political views are affected depending on how they use the internet, controlling for the effects of 3G by age, education, and income. The internet usage variables represent the average values of the respective variables in the first four years for which the data are available (i.e, the first half of the sample period) after subtracting the effect of 3G internet on these variables. The unit of observation is an individual. In Columns 1–6, the outcome variable is a dummy for whether the respondent describes their political views as conservative or very conservative; Columns 7–12 use a similar dummy for self-described views being liberal or very liberal. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Additional controls include 3G network coverage interacted with dummies for individuals not having a high school degree, having at least a bachelor's degree, 20-year age bins, five survey-defined income groups, and the share of people living in poverty in the ZIP code. All the regressions also control for the direct effects of 3G internet, the internet usage measures, and all the other additional controls. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A19: Heterogeneity by Age and Political Affiliation

	(1)	(2)
Dep. Var.:	Political views are:	
	Conservative or very conservative	Liberal or very liberal
3G network coverage × Age ≤ 40 ×		
× Resident of Democratic-leaning county	-0.023***	0.015***
	(0.004)	(0.004)
× Resident of swing county	-0.027***	0.005
	(0.004)	(0.004)
× Resident of Republican-leaning county	-0.032***	0.007**
	(0.006)	(0.003)
3G network coverage × Age > 40 ×		
× Resident of Democratic-leaning county	-0.017***	0.008**
	(0.003)	(0.004)
× Resident of swing county	-0.002	0.000
	(0.002)	(0.002)
× Resident of Republican-leaning county	0.010***	-0.008***
	(0.003)	(0.002)
Observations	1,747,806	1,747,806
Mean dep. var	0.419	0.234
Number of ZIP codes	31,492	31,492
County & year FEs	✓	✓
Baseline controls	✓	✓

Note: This table illustrates the heterogeneity of the effects of 3G network coverage by age, showing that polarization primarily increased among older individuals, which is consistent with the findings in Boxell, Gentzkow and Shapiro (2017). The unit of observation is an individual. In Column 1, the outcome variable is a dummy for whether the respondent describes their political views as conservative or very conservative; Column 2 uses a similar dummy for self-described views being liberal or very liberal. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include non-collinear lower-level interactions between 3G network coverage, the political affiliation of the counties, and the dummies for the two age groups as well as a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A20: Heterogeneity by Time

	(1)	(2)
Dep. Var.:	Political views are:	
	Conservative or very conservative	Liberal or very liberal
Resident of Democratic county ×		
× 3G network coverage ×		
× 2008-2009	-0.015***	0.007*
	(0.003)	(0.004)
× 2010-2011	-0.017***	0.007*
	(0.004)	(0.004)
× 2012-2013	-0.025***	0.012***
	(0.004)	(0.004)
× 2014-2015	-0.021***	0.007
	(0.005)	(0.006)
× 2016-2017	-0.050***	0.030***
	(0.006)	(0.006)
Resident of Republican county ×		
× 3G network coverage ×		
× 2008-2009	0.010*	-0.013***
	(0.005)	(0.002)
× 2010-2011	0.007	-0.002
	(0.005)	(0.003)
× 2012-2013	-0.006	-0.003
	(0.005)	(0.003)
× 2014-2015	-0.005	-0.001
	(0.005)	(0.005)
× 2016-2017	-0.026***	0.003
	(0.005)	(0.005)
Observations	1,765,113	1,765,113
Mean dep. var	0.420	0.234
Number of ZIP codes	31,499	31,499
County & year FEs	✓	✓
Baseline controls	✓	✓

Note: This table illustrates the heterogeneity of the effects of 3G network coverage by time. The unit of observation is an individual. In Column 1, the outcome variable is a dummy for whether the respondent describes their political views as conservative or very conservative; Column 2 uses a similar dummy for self-described views being liberal or very liberal. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** p<0.01, ** p<0.05, * p<0.1.

Table A21: Spillover Effects

	(1)	(2)
Dep. Var.:	Political views are:	
	Conservative or very conservative	Liberal or very liberal
3G network coverage × Democratic voter	-0.029***	0.043***
	(0.004)	(0.007)
3G network coverage × Democratic voter × Obama's vote margin in 2008	0.071***	0.049***
	(0.009)	(0.011)
3G network coverage × Independent voter	-0.011***	-0.018***
	(0.003)	(0.002)
3G network coverage × Independent voter × Obama's vote margin in 2008	-0.072***	0.020**
	(0.006)	(0.010)
3G network coverage × Republican voter	0.020***	-0.034***
	(0.003)	(0.004)
3G network coverage × Republican voter × Obama's vote margin in 2008	0.025**	-0.102***
	(0.011)	(0.009)
Observations	1,759,896	1,759,896
Mean dep. var	0.420	0.234
Number of ZIP codes	31,335	31,335
County & year FEs	✓	✓
Baseline controls	✓	✓

Note: This table presents how the effects of 3G network coverage on a respondent of a particular political affiliation differ depending on the political affiliation of the county that respondent lives in. The unit of observation is an individual. In Column 1, the outcome variable is a dummy for whether the respondent describes their political views as conservative or very conservative; Column 2 uses a similar dummy for self-described views being liberal or very liberal. Baseline controls include county and year fixed effects, dummies for the respondents' gender, race, age, education level, marital status, and income group, the counties' unemployment rate, log of median household income, median age, and share of population that is single, married, White, Black, Asian, has no schooling, has at least a bachelor's degree, and is receiving food assistance. Other controls include a dummy variable for whether the ZIP code was fully covered by 3G networks in 2008 (i.e., the first year in the sample) and separate year fixed effects for the ZIP codes that were. Standard errors in parentheses are corrected for clusters at the level of the states and the District of Columbia. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.