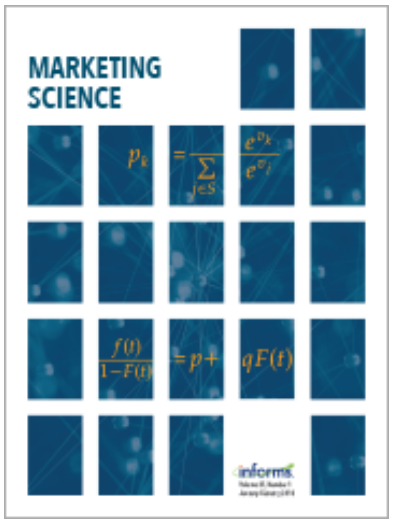

Marketing Science

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

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To cite this article:
Yanwen Wang, Michael Lewis, David A. Schweidel (2018) A Border Strategy Analysis of Ad Source and Message Tone in Senatorial Campaigns. Marketing Science 37(3):333-355. https://doi.org/10.1287/mksc.2017.1079

http://pubsonline.informs.org/journal/mksc/

MARKETING SCIENCE
Vol. 37, No. 3, May–June 2018, pp. 333–355
ISSN 0732-2399 (print), ISSN 1526-548X (online)

A Border Strategy Analysis of Ad Source and Message Tone in Senatorial Campaigns

Yanwen Wang,[a] Michael Lewis,[b] David A. Schweidel[c]

[a] University of British Columbia, Vancouver, British Columbia V6T 1Z2, Canada; [b] Emory University, Atlanta, Georgia 30322; [c] Georgetown University, Washington, DC 20057

Contact: yanwen.wang@sauder.ubc.ca, http://orcid.org/0000-0002-6219-992X (YW); mike.lewis@emory.edu (ML); david.schweidel@georgetown.edu (DAS)

Received: March 9, 2016
Revised: March 3, 2017; July 23, 2017; September 10, 2017
Accepted: September 10, 2017
Published Online in Articles in Advance: May 9, 2018

https://doi.org/10.1287/mksc.2017.1079

Abstract. Political advertising is controversial, as there is widespread concern about money from political action committees (PACs and super PACs) distorting the democratic process. Studying advertising effectiveness is, however, a challenging topic for several reasons, including the endogenous nature of fundraising and ad spending rates. However, the extensive use of targeting based on designated marketing areas (DMAs) creates a setting in which neighboring counties with comparable demographics receive different levels of advertising exposure. In this paper, we leverage these advertising discontinuities along DMA borders to study the relative effectiveness of political advertising on vote shares and turnout rates in 2010 and 2012 senatorial elections. We find that negative advertising sponsored by PACs is significantly less effective than that sponsored by candidates in affecting two-party vote shares and voter turnout. A 1% increase in negative advertising by the candidate produces a significant 0.015% lift in the candidate's unconditional vote shares. By contrast, negative advertising from PACs is ineffective in increasing its supported candidate's unconditional vote share. Further analysis reveals that the competitiveness of races moderates the effectiveness of political advertising, providing implications for those managing candidates' campaigns, PACs, and super PACs.

History: K. Sudhir served as the editor-in-chief and Catherine Tucker served as associate editor for this article.
Supplemental Material: Data and the online appendix are available at https://doi.org/10.1287/mksc.2017.1079.

Keywords: political advertising • super PAC • negative advertising • senatorial elections

1. Introduction

Political advertising is a controversial topic, as there are widespread concerns about money distorting the democratic process and negative advertising reducing voter interest. Concerns about special interest groups using money to distort the democratic process have become increasingly prominent over the last decade as a result of increased spending by political action committees (PACs) and super PACs. Super PACs are particularly controversial because they do not have limits on individual contributions and because they operate independently of candidates. The independence of super PACs from candidates is a potentially important factor in advertising's effectiveness, as it may influence the perceived credibility of messages. The effect of negative advertising on voters is a long-standing question. In addition to questions about whether negative advertising is more powerful in terms of influencing preferences, there are also concerns about negative advertising reducing voter interest. Some studies have found that negative advertising can adversely affect voter turnout (e.g., Ansolabehere et al. 1994, Ansolabehere and Iyengar 1995), while others have found that it may stimulate voter turnout (e.g., Goldstein and Freedman 2002). In this paper, we study two important political advertising issues. We investigate how the source and tone of advertising influence voter response.

Studying political advertising effectiveness is a challenging topic for several reasons. For example, a candidate's fund-raising and spending levels are likely to be endogenously determined (Gordon et al. 2012) because of factors that are not observable to researchers, such as attractiveness and personality traits (Hoegg and Lewis 2011). The use of targeted advertising further increases concerns about endogeneity since money may be allocated based on the perceived competitiveness of races (O'Connor 2014). It is also possible that candidates in noncompetitive races spend advertising dollars to accrue incremental political power or build brand equity, rather than to influence vote shares.

However, the practice of allocating advertising spend based on designated marketing areas (DMAs) may potentially facilitate analysis of political advertising effectiveness. When advertising is targeted based on

DMAs, it creates a setting in which neighboring counties may receive different levels of advertising exposure. Under the assumption that neighboring counties tend to be similar markets, these discontinuities create a natural experiment. In this research, we leverage the advertising discontinuities along DMA borders within states to study the impact of political advertising based on ad source and message tone. The analysis uses a data set from the 2010 and 2012 senatorial elections. The data include all advertisements aired in 210 DMAs, gross rating points for every ad, DMA-county geographic mapping, demographic information, and county-level votes. We apply a modified difference-in-difference approach to estimate the effect of advertising using the border counties that conducted elections in 2010 and 2012. Our econometric specification includes fixed effects to control for possible persistent differences across counties.

By leveraging the variation in advertising created by DMA borders, we investigate political advertising effectiveness without having to make strong assumptions to control for endogenous spending or fundraising. We conduct the analysis sequentially and begin with a baseline specification that investigates the effectiveness of overall, undifferentiated political advertising spending. When the analysis is conducted without differentiating between ad tone or ad source, we find that advertising exposure (measured in gross rating points, or GRPs) is ineffective in affecting either two-party vote shares or mobilizing voters. We then extend the analysis to differentiate between positive and negative advertising effects. We find that negative political advertising has a significant positive effect on two-party vote shares. By contrast, positive political advertising is ineffective.

Our focal research question is concerned with potential interactions between ad source and message tone. There has been some speculation in the academic literature that advertising by super PACs may be more effective because these entities have neutral names and may be viewed as more credible sources relative to candidates who have clear self-interests (Weber et al. 2012). Alternatively, we conjecture that special interest groups such as super PACs may be less credible sources of information because these entities tend to be unknown and therefore lack brand equity.

Our key finding is that negative advertising sponsored by PACs is significantly less effective than that sponsored by candidates in terms of two-party vote shares and turnouts. This is a novel result that, to our knowledge, has not been documented previously in the literature on political advertising. In terms of two-party vote shares, we find that negative advertising GRPs from candidates are approximately twice as effective as advertising GRPs sponsored by PACs.[1] A 1% increase in negative advertising GRPs by PACs yields an approximately 0.004% increase in a candidate's two-party vote share, while a 1% increase in negative advertising by a candidate yields about a 0.008% increase. In terms of mobilizing voters, we find that negative advertising GRPs from candidates have a significant effect on voter turnout. A 1% increase in negative advertising GRPs by a candidate produces a 0.007% increase in turnout, while negative advertising sponsored by PACs are ineffective.

During the 2010 and 2012 senatorial elections, there was a significant correlation between turnout and Democratic candidate vote share. Therefore, we combine the effects on turnout and conditional two-party vote shares to quantify the impact on unconditional vote shares. Interestingly, the difference in the impact on unconditional vote shares between negative advertising by the candidate and that by PACs is even larger. A 1% increase in negative advertising by the candidate produces a significant 0.015% lift in the candidate's unconditional vote shares. By contrast, negative advertising from PACs is ineffective in increasing its supported candidate's unconditional vote shares. Given the rise in third-party spending over the last decade (Goldstein et al. 2011), this is a salient set of findings. Our conjecture is that this pattern of results is due to differences in source credibility across the various ad sponsors and that advertising by PACs may lack credibility.

We further explore whether this pattern holds when races are competitive. We find that the effectiveness of negative political advertising by PACs is moderated by race competitiveness. When a race is less competitive, negative advertising by PACs produces a significant positive lift in two-party vote shares. However, when the race is competitive, negative advertising by PACs is ineffective in shifting two-party vote share. The results imply that the influence of advertising by PACs may be limited in competitive senatorial races.

In terms of methodology, we add to a growing body of literature that uses "border strategy" approaches that rely on discontinuities in advertising rates across historically determined TV markets to infer the effectiveness of advertising. Border-based strategies have become increasingly common in marketing (Shapiro 2018, Tuchman 2017), as they alleviate some concerns about the endogenous nature of advertising expenditures. Our political advertising context is especially useful for demonstrating the border discontinuity approach because the analysis yields fresh insights to an established literature. The political context also helps highlight several of the limitations inherent in the approach such as issues related to generalizability. As the number of applications of the technique grows, it is important to acknowledge the limitations of the method. We conclude the paper with a discussion focused on limitations of what a border strategy allows us to identify and determine.

2. Background

Political advertising is a topic of great interest to multiple academic disciplines and the general public. Political campaigns have largely come to resemble marketing campaigns, and the levels of spending observed in the marketplace suggest that advertising has a significant effect on electoral outcomes. Given the perceived importance of money in influencing campaign outcomes, there is significant interest in understanding and regulating political advertising. For example, one area of concern is the increasing amount of third-party advertising. Super PACs or "independent-expenditure only committees" are a relatively recent type of organization that is prohibited from coordinating directly with campaigns. Super PACs are also allowed to raise funds without any limit on contribution size. This lack of spending limits has raised new concerns about the role of money in political campaigns (Marcus 2012). In this section, we consider literature related to the study of political advertising effects, negative advertising, and source credibility. The purpose of the section is to develop a set of research questions related to the effects of advertising tone and source on vote shares and turnout rates.

2.1. Political Advertising

There is an extensive literature focused on political advertising effectiveness (e.g., Lau et al. 1999, 2007; Franz and Ridout 2007). In terms of the most fundamental question of whether political advertising matters, the literature has yielded mixed results (e.g., Jacobson 1978, Gelman and King 1993). This literature is concentrated in political science journals, but there is a growing interest in the marketing literature (Klein and Ahluwalia 2005, Lovett and Shachar 2011, Gordon and Hartmann 2013, Chung and Zhang 2016).

The mixed results found in the literature are likely due to the challenges inherent to studying advertising effectiveness in the context of politics. On one hand, elections offer an attractive context for studying advertising effectiveness because contests are short-term and finite in nature. However, there are also significant concerns about advertising levels being endogenous. Gordon et al. (2012) provide an extensive discussion of issues related to endogeneity issues in political advertising. The key point is that there are many unobservable factors that enter the decision processes of candidates, parties, and PACs. Prior research has used cost shifters such as the prior year's advertising price (Gordon and Hartmann 2013, Chung and Zhang 2016) as political advertising instruments.

An alternative approach to controlling for the possibility of endogenous advertising levels can be found in the border strategy approach that has been used to study advertising effectiveness for e-cigarettes (Tuchman 2017) and antidepressants (Shapiro 2018). The use of geographically targeted advertising in political campaigns provides a natural experiment setting to study the effectiveness of political advertising. A discontinuity-based natural experiment reduces concerns about endogeneity, while the closed-ended nature of political campaigns reduces concerns about making assumptions about decay rates. One purpose of our study is to exploit the DMA-based advertising discontinuity and thus add insights to the literature on political advertising.

2.2. Negative Advertising

In addition to the question of overall spending effects, there is still considerable debate about the effectiveness of negative advertising (Ansolabehere and Iyengar 1995, Sorescu and Gelb 2000, Lau et al. 2007). Negative advertising has flourished since the 1960s, and its popularity is often attributed to the increased role of television in political campaigns (Lau et al. 1999). A common motivation for studying negative advertising is that, while surveys suggest that voters dislike negative advertising, candidates tend to use negative advertising extensively (Lau et al. 2007).

An additional complication in analyzing the relative efficacy of positive and negative advertising is related to the decision of when campaigns should engage in negative advertising. Goldstein and Freedman (2002) report that a higher proportion of advertisements are negative in close races. Lovett and Shachar (2011) use data on elections for the U.S. House of Representatives from 2000 to 2004 to study advertising tone. They find that negative advertising can increase both the voters' knowledge and the advertising budget of campaigns.

Lau et al. (2007) note that the conventional wisdom among political consultants and candidates is that negative advertising is more effective than positive advertising in its ability to influence voter preferences. The notion that negative advertising will have greater efficacy is often based on some form of negativity bias (Rozin and Royzman 2001). Negativity bias refers to the idea that negative information and events have a greater impact than neutral or positive information. While negative advertising has been theorized to be a more effective tool for changing attitudes, the meta-analyses on the effects of negative advertising (Lau et al. 1999, 2007) have failed to support the premise that negative advertising is an effective means of increasing vote shares.

However, there may also be consequences to "going negative." For instance, there may be a concern that the act of going negative might create unfavorable associations with the sponsoring candidate's brand. For example, Merritt (1984) finds that negative advertising harms the perceptions of both the sponsoring and targeted candidate. Given the increased prominence of third-party advertising (i.e., by PACs and super PACs) in recent years, it is an open question as to

whether candidates themselves should engage in negative advertising or if they can leave it to third-party groups to "do their dirty work."

2.3. Source Credibility and Branding

The political science field has begun to pay significant attention to third-party advertising from PACs and super PACs (e.g., Pfau et al. 2001, Fowler and Ridout 2014, Painter 2014, Franz et al. 2016). Much of this literature is guided by theories of source credibility. One prominent theory is that candidate advertising is discounted because of the obvious self-interest of the candidate. By contrast, third-party ads from PACs may be given more credence because they have neutral-sounding names. Weber et al. (2012) test advertisement effectiveness in a lab setting by varying whether an advertisement is sponsored by a candidate, known interest group, or unknown interest group. They find that ads sponsored by unknown groups are more effective than advertisements from known groups and candidates. They also find that persuasion is moderated by the perceived credibility of the source.

However, the assumptions about the relative source credibility of candidates and third-party advertisers may be incomplete in that they fail to consider important marketing issues. Source credibility might also be considered through the lens of signaling theory or brand equity. The fields of information economics (Stigler 1961) and signaling theory (Stightz 1987) are concerned with how firms can send signals to inform consumers credibly. For example, investment in a brand name can represent a commitment to high quality (Milgrom and Roberts 1986; Erdem and Swait 1998, 2004). The basic notion is that investments in advertising and other marketing communications are at risk if the firm delivers a low-quality product.

In the realm of political advertising, the "sources" of ads differ in terms of the brand equity at risk. While super PACs may have unbiased-sounding names, these names are likely unknown to the vast majority of voters. There is also some evidence that third-party advertising includes a significant number of deceptive claims. For example, Winneg et al. (2014) report that more than a fifth of ads from super PACs include misleading or false claims. This finding indicates a potential issue in terms of super PAC effectiveness if voters form broad opinions about the credibility of super PACs.

In contrast to super PACs that enable donors to remain unknown, often until the election has concluded, individual politicians and parties likely have goals related to building credibility to achieve long-term goals. In the case of individual candidates, this may relate to reelection or aspirations for higher office. In other words, politicians are brands (e.g., Thomson 2006, Hoegg and Lewis 2011) whose brand equity develops over a series of elections. Given the desire of most politicians to have careers that extend across multiple terms, this creates a potential risk to engaging in noncredible negative advertising, as negative perceptions of the candidate may persist from one election to the next. By contrast, super PACs often operate in a single cycle.

The preceding arguments suggest that candidates and parties are "brands" with equity and credibility, while third-party advertisers are less credible. If this conjecture is true, then advertising supported by candidates and parties will be more effective than that of PACs and super PACs. Alternatively, the neutral-sounding names of the super PACs coupled with the self-interest of the candidates might suggest the opposite effect.

2.4. Negativity Biases and Source Credibility

Given the preceding discussion, a natural extension to prior research is to question whether the source of advertising will influence the reaction to advertising tone. Some work in psychology suggests a possible interaction between source credibility and ad tone. Tormala et al. (2006) study the interaction of message tone and source credibility and identify a situation where high credibility may result in lower persuasion. Tormala et al. (2006) find that persuasion is greater "when people generate primarily positive thoughts" (p. 684) and then learn that the source is highly credible. It is also possible that high credibility interacts with a negative tone by buffering backlash from the negativity, thereby making it more effective. It should be noted that this body of research has typically considered situations involving high elaboration.

2.5. Summary

Our review of the literature suggests that there are open questions related to how advertising source and tone affect vote shares and turnout rates. To our knowledge, our research is among the first to jointly consider the effects of ad tone and source in a political setting. Our most important research question relates to the interplay between advertising source and advertising tone. This is a salient question given the lack of restrictions on super PAC donations and the prevalence of negative advertising in the political realm. If different "sources" have different credibility levels, then we might expect that negative advertising might differ in effectiveness across sponsors. If this is true, then candidates may wish to alter their decisions regarding tone and donors may wish to fund different types of entities.

We address these issues in stages with a set of nested research questions. Our *first* research question is the broad question of whether an advantage in advertising spending alters voting patterns. Our *second* research question examines whether negative advertising is more effective than positive advertising.

Our *third and ultimate* research question is about the potential interactive effect of ad sponsorship and tone on voter behavior. Specifically, we examine whether there is an asymmetric advertising effect depending on whether the sponsor is the candidate or a third-party and whether the efficacy of negative advertising is moderated by the source of the message.

3. Empirical Border Strategy

3.1. Setup of Natural Experiment-Based Border Strategy

Our empirical strategy involves using advertising discontinuities along the borders of DMAs to assess advertising effectiveness. Fundamentally, we are interested in comparing vote shares and turnouts of counties that are very near to each other geographically but exposed to different levels of political advertising as a result of the way the television market borders are constructed. These artificial breaks in advertising levels create a natural experiment from which we draw causal inferences about the effects of political advertising on vote shares and turnouts.

The exploitation of variation across borders has been used previously to study advertising effectiveness. Huber and Arceneaux (2007) exploit an "accidental" treatment along state borders, where presidential ads spill over into non-battleground states that are adjacent to a battleground state. Krasno and Green (2008) also leverage a border strategy to study turnout in the 2000 presidential election. In neither of these studies did the authors consider the influence of ad source on the effectiveness of political advertising.

Designated media markets are particularly relevant to political advertising campaigns, as the sale of local advertising to senatorial candidates, parties, and PACs is at the DMA level. The key factor that facilitates our analysis is that DMA borders are exogenous to political elections and voter characteristics. A DMA is a collection of counties based around a large city. It is designed by Nielsen to put together counties that pick up the same local station over the air. As an example of a DMA border, the border of the Atlanta and Macon DMAs, is illustrated in Figure 1. Counties including Upson, Lamar, Butts, Jasper, Putnam, and Greene are in the pink-colored Atlanta DMA. These counties share borders with counties such as Crawford, Monroe, Jones, Baldwin, and Hancock in the orange-colored Macon DMA. In the 2010 senatorial election, there were a total of 6,052 GRPs in the Atlanta DMA versus a total of 6,606 GRPs in the Macon DMA.

Figures 2 and 3 provide a visual image of the geographic structure of the DMA border counties. Figure 2 shows the 2,819 counties relevant to the 47 senatorial elections in 2010 and 2012 located in 210 DMAs.[2] Figure 3 shows the 1,325 counties located along the 325 within-state DMA borders relevant for our analysis of the 2010 and 2012 senatorial elections. As a point of comparison, there are a total 3,144 counties in the United States.

On average, border counties account for about 6% of DMA populations. An important assumption in our work is that DMA-targeted advertising is based on aggregate market-level conditions across the entire DMA rather than on specific factors present in border counties. This assumption is salient, as differences in advertising exposures across DMA borders should not be correlated with observed or unobserved voter characteristics along the borders of DMAs.

Each DMA border is treated as a natural experiment based on the variation in political advertising intensity on the two sides of the border. Counties that lie on the border serve as controls for each other to condition out local border effects. As there can be different numbers of counties on the two sides of DMA borders, each treatment may have a different number of "county" subjects. Given the two rounds of senatorial elections in 2010 and 2012, we conduct the analysis at the DMA-border-county-year level.

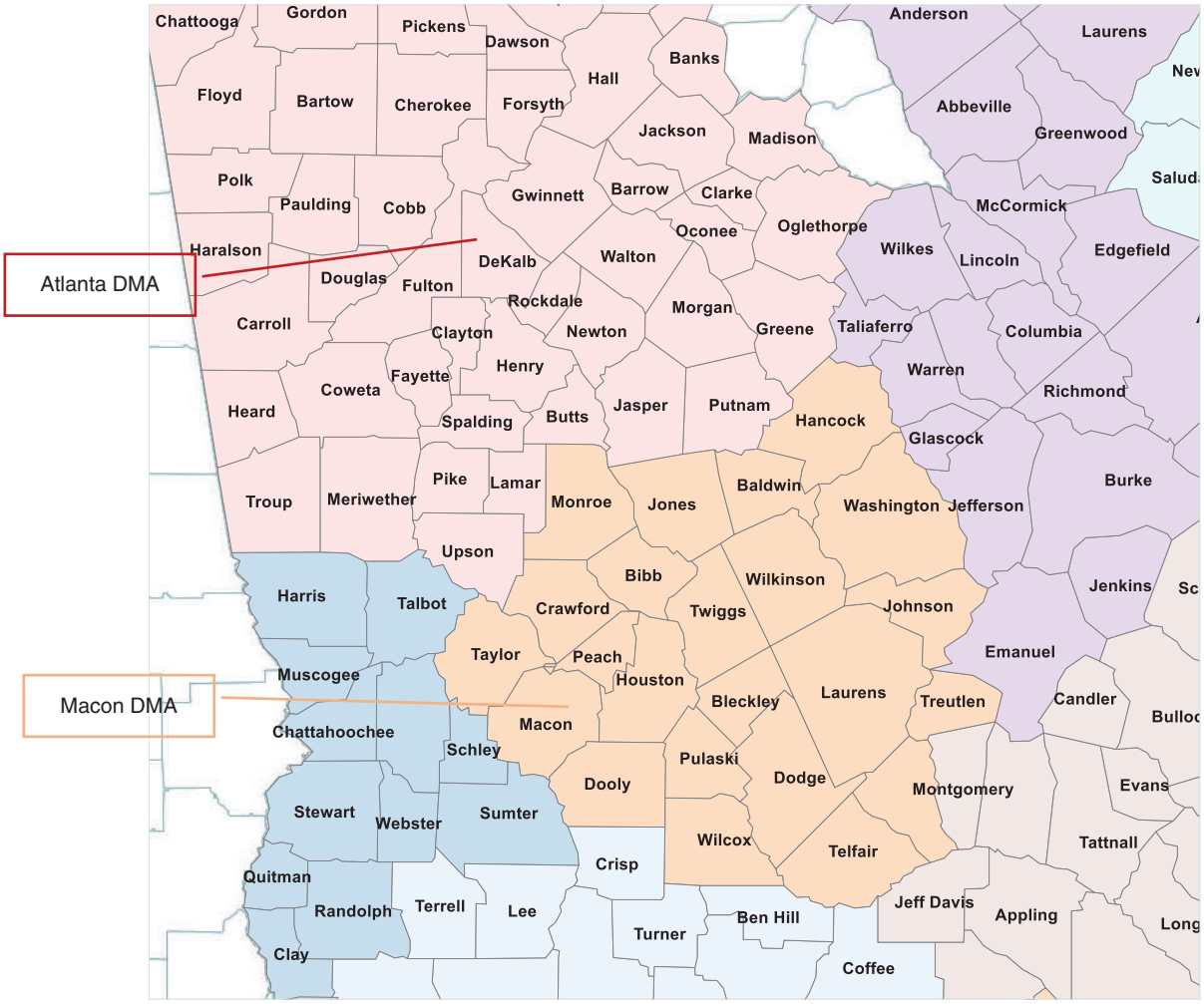
3.2. Difference-in-Difference Approach

We apply a modified difference-in-difference approach to estimate the effects of political advertising tone and source on two-party vote shares and turnout rates. In our empirical analysis, we focus on the states in which two senatorial elections occurred (in 2010 and 2012). In terms of notation, we use b to denote border, m to denote DMA, c to denote county, and t to denote year. The difference-in-difference specification is then given by

$$\begin{aligned}\log\frac{VS_{R,bmct}}{VS_{D,bmct}} &= \alpha_1 \log\frac{1+CanN_{Rmt}}{1+CanN_{Dmt}} + \alpha_2 \log\frac{1+PacN_{Rmt}}{1+PacN_{Dmt}} \\ &\quad + \alpha_3 \log\frac{1+CanP_{Rmt}}{1+CanP_{Dmt}} + \alpha_4 \log\frac{1+PacP_{Rmt}}{1+PacP_{Dmt}} \\ &\quad + \varepsilon_{bmct}, \qquad (1)\\ \log\frac{TO_{bmct}}{1-TO_{bmct}} &= \beta_1 \log(1+CanN_{Tmt}) + \beta_2 \log(1+PacN_{Tmt}) \\ &\quad + \beta_3 \log(1+CanP_{Tmt}) + \beta_4 \log(1+PacP_{Tmt}) \\ &\quad + \omega_{bmct}, \qquad (2)\end{aligned}$$

where the terms $VS_{R,bmct}$ and $VS_{D,bmct}$ are two-party vote shares for Republican and Democratic candidates conditional on turnout in county c in year t, respectively. The term TO_{bmct} is the turnout rate in county c in year t. The terms $CanN_{Rmt}$, $PacN_{Rmt}$, $CanP_{Rmt}$, and $PacP_{Rmt}$ indicate the negative (or positive) advertising GRP ratings by Republican candidates (or PACs). The terms $CanN_{Dmt}$, $PacN_{Dmt}$, $CanP_{Dmt}$, and $PacP_{Dmt}$ indicate

Figure 1. Illustration of Atlanta–Macon DMA Border in Georgia



the negative (or positive) advertising GRP ratings by Democratic candidates (or PACs). The terms $CanN_{Tmt}$, $PacN_{Tmt}$, $CanP_{Tmt}$, and $PacP_{Tmt}$ indicate the total negative advertising GRP ratings by the two candidates (or PACs).

The endogenous nature of advertising leads to a concern that the advertising terms are correlated with unobservable factors that enter candidates' and PACs' decision processes. Thus, we break the error terms into $\varepsilon_{bmct} = \epsilon_c + \epsilon_b + \epsilon_t + \epsilon_{bt} + \epsilon_{cb} + \epsilon_{ct} + \epsilon_{cbt}$. Note that we exclude market unobservables because these are subsumed in the other unobservables. For example, the county fixed effects will capture the market fixed effects, and market-border effects are captured in the border effects. To deal with the unobservables, we include fixed effects and rewrite Equations (1) and (2) as follows:

$$\log \frac{VS_{R,bmct}}{VS_{D,bmct}} = \alpha_c + \alpha_b + \alpha_t + \alpha_{bt} + \alpha_1 \log \frac{1+CanN_{R,mt}}{1+CanN_{D,mt}} + \alpha_2 \log \frac{1+PacN_{R,mt}}{1+PacN_{D,mt}} + \alpha_3 \log \frac{1+CanP_{R,mt}}{1+CanP_{D,mt}} + \alpha_4 \log \frac{1+PacP_{R,mt}}{1+PacP_{D,mt}} + \varepsilon_{bc} + \varepsilon_{ct} + \varepsilon_{bct}, \quad (3)$$

$$\log \frac{TO_{bmct}}{1-TO_{bmct}} = \beta_c + \beta_b + \beta_t + \beta_{bt} + \beta_1 \log(1+CanN_{T,mt}) + \beta_2 \log(1+PacN_{T,mt}) + \beta_3 \log(1+CanP_{T,mt}) + \beta_4 \log(1+PacP_{T,mt}) + \omega_{bc} + \omega_{ct} + \omega_{bct.} \quad (4)$$

Here, α_c and β_c are county fixed effects to control for time-invariant systematic differences across treatments. As long as county unique fixed effects are included, systematic differences in county vote shares, turnout, and advertising GRPs are absorbed. For example, the fact that Pike County in Pennsylvania has a higher vote share for Republicans in both 2010 and 2012 and that King County in Washington has a lower vote share for Republicans in both 2010 and 2012 is not

Figure 2. Map of 2,819 Counties in 47 States in 2010 and 2012 Senatorial Elections Covered by 210 DMAs

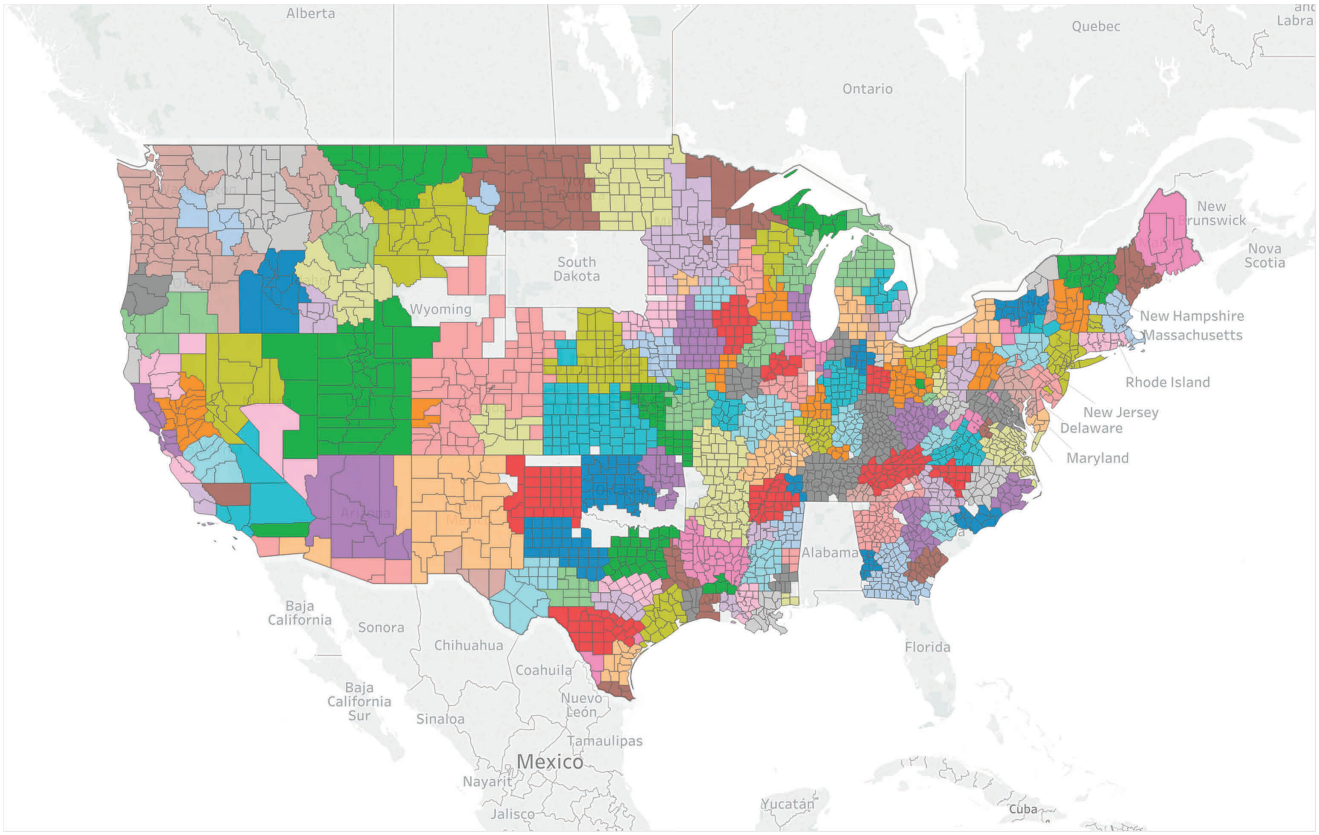
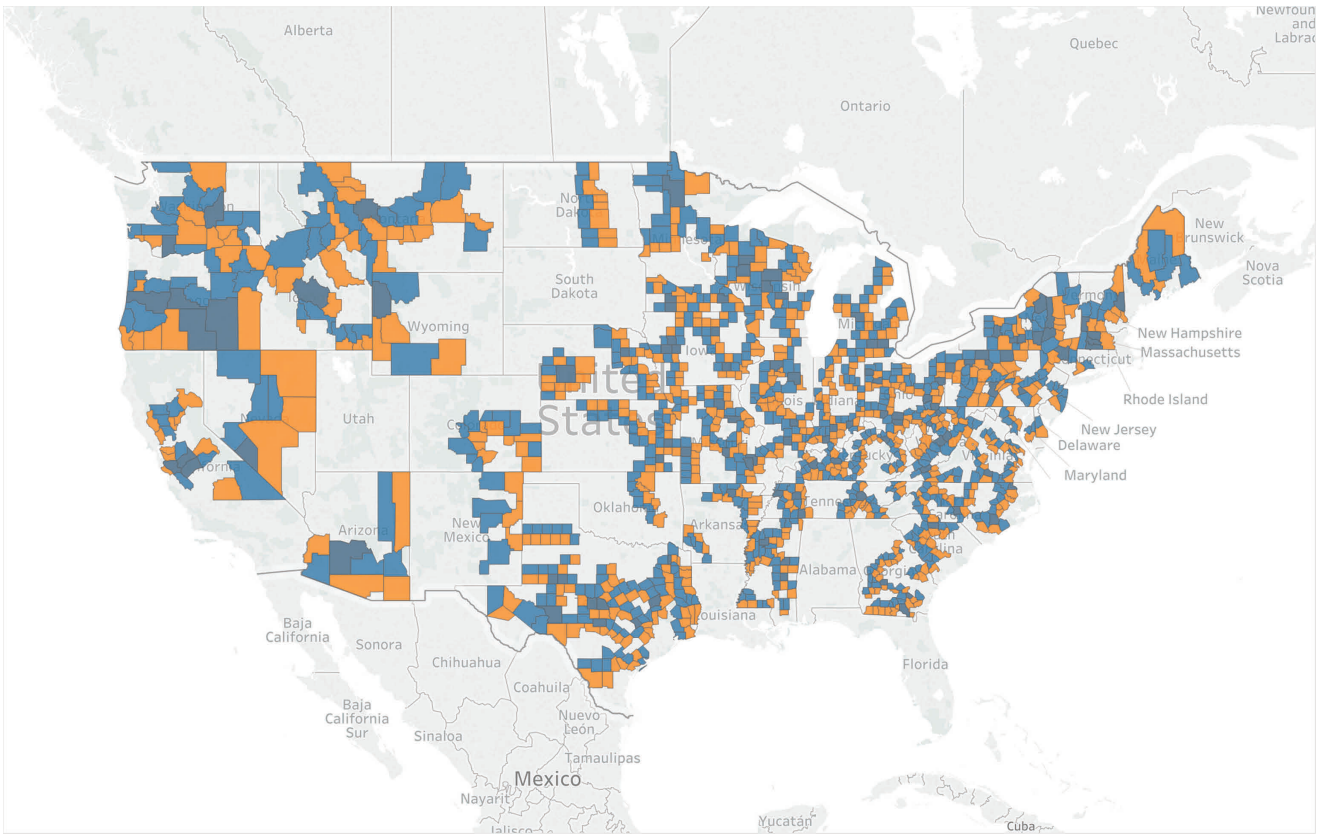


Figure 3. Map of 1,325 Counties in the 325 DMA Borders in 43 States in 2010 and 2012 Senatorial Elections



a concern. Along the same lines, terms α_b and β_b are border fixed effects.

However, temporal variation in unobservable variables is not captured in county or border fixed effects. Thus, we include border-year fixed effects α_{bt} and β_{bt} to control for temporal trends that are common to all counties along a border. Put another way, these are temporal trends that are common to a pair of markets on the two sides of market borders. It is likely that part of the temporal trends in two-party vote shares, for example, could be due to temporal variations in advertising GRPs. Yet it is also possible that the temporal trends in vote shares come from changes in local demographics, economic conditions, or simply candidates' attractiveness, which could be correlated with advertising GRPs. The common temporal trends α_{bt} and β_{bt} pick up temporal changes in local demographics, economic conditions, or simply candidates' attractiveness, which could be correlated with advertising GRPs.

The sets of county fixed effects and year-border fixed effects set the basis for the identification strategy in our border-experiment setting. We now turn to the remaining unobservables, ε_{bc}, ε_{ct}, ε_{bct}, ω_{bc}, ω_{ct}, and ω_{bct} in Equations (3) and (4). The term ε_{bc} includes the unobservable factors associated with county c on a media market border b. As mentioned before, DMA borders are exogenous to political elections and voter characteristics. The media border was designed by Nielsen to place together counties that pick up the same local station over the air. Thus, they are uncorrelated with advertising ratings.

The term ε_{ct} represents county c's deviation from the common temporal trends α_{bt} shared by all the counties along a border. As we focus on the neighboring counties on the two sides of DMA borders, the unobserved local changes including demographics, economic conditions, and weather conditions that may affect advertising GRPs and voting outcomes should not be significantly different between one part of a DMA border and the other. For example, weather patterns are continuous and similar along DMA borders. As long as the time-varying unobservables do not discontinuously change at the border, our assumption that counties along the same border share a common temporal trend is reasonable.

The last term, ε_{bct}, represents random shocks. We denote a new error term, $\varepsilon'_{bct} = \varepsilon_{bc} + \varepsilon_{ct} + \varepsilon_{bct}$, to capture the three unobservables. The same idea applies in Equation (4) for the unobservables ω_{cb}, ω_{ct}, and ω_{cbt}. Therefore, the equations for empirical estimation are written in (5) and (6) as

$$\begin{aligned}\log\frac{VS_{R,bmct}}{VS_{D,bmct}} &= \alpha_c + \alpha_b + \alpha_t + \alpha_{bt} + \alpha_1 \log\frac{1+CanN_{R,mt}}{1+CanN_{D,mt}} \\ &\quad + \alpha_2 \log\frac{1+PacN_{R,mt}}{1+PacN_{D,mt}} + \alpha_3 \log\frac{1+CanP_{R,mt}}{1+CanP_{D,mt}} \\ &\quad + \alpha_4 \log\frac{1+PacP_{R,mt}}{1+PacP_{D,mt}} + \varepsilon'_{bct}, \qquad (5)\end{aligned}$$

$$\begin{aligned}\log\frac{TO_{bmct}}{1-TO_{bmct}} &= \beta_c + \beta_b + \beta_t + \beta_{bt} + \beta_1 \log(1+CanN_{T,mt}) \\ &\quad + \beta_2 \log(1+PacN_{T,mt}) + \beta_3 \log(1+CanP_{T,mt}) \\ &\quad + \beta_4 \log(1+PacP_{T,mt}) + \omega'_{bct}. \qquad (6)\end{aligned}$$

We allow the two error terms, ε'_{bct} and ω'_{bct}, to be correlated, as common factors may drive the decision processes related to two-party voting preferences and the decision to vote. Normally, with multiple endogenous variables, we would need more instruments. However, this is not the case in the difference-in-difference approach because of the assumptions that the unobservables are removed using the differencing by county and border-year unique fixed effects.

4. Data

Data on 2010 and 2012 senatorial advertising were obtained from Kantar Media's Campaign Media Advertising Group (CMAG), a commercial firm that tracks political advertising (see Goldstein and Freedman 2002). For the 2010 and 2012 electoral cycles, the 210 largest media markets were tracked by Kantar. The data were collected at the level of individual ad airings and include sponsor, day and time, media market, and estimated cost.

In addition to tracking aired ads, CMAG staff also code each ad. The staff first research the entity responsible for airing each spot, distinguishing between those paid for by candidates, parties, and PACs. Next, CMAG codes the content of each ad on an extensive list of questions using a web-based content analysis platform called AcademiClip. Examples of the questions include, "Is the primary purpose of the ad to promote a specific candidate, attack a candidate, or contrast the candidates?," "If the ad is a contrast ad, what proportion of the ad promotes (as opposed to attacks) a candidate?," and "If the ad is a contrast ad, does it finish by promoting a candidate or attacking a candidate?" Thus, CMAG creates a storyboard for every ad copy and systematically codes ads as either supporting or attacking a candidate.

To measure advertising intensity, there are three alternative approaches including advertising frequency, advertising spending, and gross rating points. Advertising frequency only accounts for the total number of ads but does not take into account the different reach achieved based on factors such as time of a day. Advertising spending has some positive properties but is problematic for our purposes, given that advertising

costs may differ considerably across media markets. We use gross rating points as our measure of advertising exposure.

To capture the total gross rating points of political advertising, we obtained GRPs of each airing of an advertisement from the Kantar Media Strategy database. We average the GRPs over half-hour intervals on weekdays and weekends in each DMA, and we match the 30-minute ratings to the corresponding political advertisements in that interval in the CMAG data set. Put another way, the rating is matched at the half-hour-week position-market level. Figure 4(a) shows two peaks in GRP ratings within a day. It also shows that GRP ratings are higher on weekdays.

Given the focus of our research, we aggregated the GRPs of all the political advertisements aired between September 1 and the day of the election by ad tone and source. There are four levels of GRPs, including negative GRPs by candidates and parties, negative GRPs by PACs, positive GRPs by candidates and parties, and positive GRPs by PACs.[3] In Figures 4(b) and 4(c), we show that ads with different tones and sources are distributed in a similar pattern across day-parts.

We also obtained county-level votes for each senatorial candidate in 2010 and 2012 from NYtimes.com and demographic information including socioeconomic variables and voting age population of citizens aged 18 and older from the 2010 U.S. census data.

Table 1 presents summary statistics of advertising ratings in DMAs in the 2010 and 2012 senatorial elections. Over the two election cycles, political advertising intensified. In 2010, an average voter watched 78 ads during the approximately two-month period preceding the election, while in 2012, the average voter watched 94 ads in the two-month period. The negative to positive advertising ratio stayed constant at a rate of approximately 3:1. An interesting development is that the amount of political advertising sponsored by PACs has increased over time. The political advertising GRPs sponsored by PACs increased from 14% in 2010 to 23% in 2012.

Table 2 reports descriptive statistics for the election outcomes and demographics. Two-party vote shares

Figure 4. Distribution of Gross Rating Points

Table 1. Descriptive Summary of DMA Advertising Exposures in 2010 and 2012 Senatorial Elections

	N	Mean	SD	Min	Max
2010 senatorial elections					
Negative GRPs by Republican candidates and party (100)	208	26.37	38.32	0	173.62
Negative GRPs by Democratic candidates and party (100)	208	22.20	35.73	0	206.29
Positive GRPs by Republican candidates and party (100)	208	9.63	19.19	0	130.16
Positive GRPs by Democratic candidates and party (100)	208	8.41	15.57	0	77.21
Negative GRPs by Republican PACs (100)	208	8.88	19.88	0	108.05
Negative GRPs by Democratic PACs (100)	208	1.80	7.82	0	70.52
Positive GRPs by Republican PACs (100)	208	0.76	2.80	0	18.96
Positive GRPs by Democratic PACs (100)	208	0.21	0.97	0	8.14
Candidate and party GRPs (100)	208	66.60	79.71	0	372.50
PAC GRPs (100)	208	11.65	26.47	0	160.36
Negative GRPs (100)	208	59.25	92.75	0	525.08
Positive GRPs (100)	208	19.01	24.88	0	145.31
Total ads GRPs (100)	208	78.25	100.16	0	532.85
2012 senatorial elections					
Negative GRPs by Republican candidates and party (100)	199	24.62	43.84	0	185.73
Negative GRPs by Democratic candidates and party (100)	199	27.06	45.40	0	204.80
Positive GRPs by Republican candidates and party (100)	199	6.93	15.89	0	135.64
Positive GRPs by Democratic candidates and party (100)	199	14.18	19.93	0	86.48
Negative GRPs by Republican PACs (100)	199	12.45	25.83	0	121.23
Negative GRPs by Democratic PACs (100)	199	8.09	17.49	0	89.98
Positive GRPs by Republican PACs (100)	199	0.46	2.01	0	19.45
Positive GRPs by Democratic PACs (100)	199	0.34	1.89	0	17.52
Candidate and party GRPs (100)	199	72.80	104.66	0	437.31
PAC GRPs (100)	199	21.34	42.20	0	211.21
Negative GRPs (100)	199	72.23	121.83	0	51.467
Positive GRPs (100)	199	21.90	31.38	0	222.12
Total ads GRPs (100)	199	94.13	139.98	0	561.24

Notes. Because there are DMAs that straddle state borders with elections running in both states, observations in the above table are at the state-DMA-year level. We have advertising information in 210 DMAs, which cover 2,827 counties in 47 senatorial elections in 2010 and 2012.

are calculated as the number of votes for a candidate divided by the total number of votes received for the two candidates. Turnout rates are calculated as the total number of votes in a county divided by the voting age population minus ineligible felons. We include three different sets of counties including all counties, border counties, and border counties with two senatorial elections in 2010 and 2012. The average turnout and two-party vote shares for Republicans and Democrats in the senatorial elections are comparable between the

Table 2. Descriptive Summary of Election Outcomes and Demographics Between All vs. Border Counties

	All the counties				Border counties				Border counties with two continuous senatorial elections			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Rep. vote shares %	59.57	16.11	8.91	96.35	59.59	14.82	11.04	94.95	54.81	11.63	11.04	83.62
Dem. vote shares %	40.43	16.11	3.65	91.09	40.41	14.82	5.05	88.96	45.19	11.63	16.38	88.96
Turnouts %	49.82	11.59	7.23	94.61	49.69	10.80	11.98	86.48	47.78	7.99	27.46	73.56
Partisan voting index	8.08	9.78	−35	29	7.97	8.83	−35	29	5.40	6.88	−35	17
Median HH income	44,475	11,699	19,351	115,574	42,372	10,088	20,081	103,273	44,638	10,096	22,154	103,273
Poverty rate %	21.66	10.41	2.00	49.90	22.97	10.28	2.10	49.90	21.65	9.16	3.50	46.90
Per-capita income	22,555	5,407	10,043	64,381	21,600	4,571	10,925	48,489	22,365	4,645	12,294	48,295
Unemployment rate %	7.48	3.12	0.30	27.50	7.77	3.14	0.30	23.00	7.69	2.40	1.10	21.40
Bachelor's attainment %	19.12	8.79	3.70	71.00	17.35	7.60	4.30	58.30	17.72	7.94	6.30	58.30
Black %	8.72	14.29	0.10	85.70	8.05	14.27	0.10	85.70	2.72	4.78	0.10	64.50
Hispanic %	8.50	13.63	0.10	95.70	7.66	12.69	0.20	95.70	5.63	9.77	0.40	60.60
Population	92,947	315,041	82	9,818,605	60,531	169,687	93	3,817,117	99,368	266,539	452	3,817,117
No. of observations	2,819				1,325				567			

Notes. Two-party vote shares are provided in the table. The unconditional vote shares can be obtained by multiplying the two-party vote shares and turnouts.

Table 3. Descriptive Summary of Election Outcomes and Demographics Between Border vs. Nonborder Counties

	Counties not on the border				Counties on the border					
	Mean	SD	Min	Max	Mean	SD	Min	Max	*t*-statistics	*p*-value
Median HH income	46,340	12,675	19,351	115,574	42,372	10,088	20,081	103,273	9.24	<0.01
Poverty rate %	20.49	10.38	2.00	49.70	22.97	10.28	2.10	49.90	−6.07	<0.01
Per-capita income	23,402	5,927	10,043	64,381	21,600	4,571	10,925	48,489	9.09	<0.01
Unemployment rate %	7.21	3.08	0.30	27.50	7.77	3.14	0.30	23.00	−4.74	< 0.01
Bachelor's attainment %	20.69	9.45	3.70	71.00	17.35	7.60	4.30	58.30	10.38	<0.01
Black %	9.32	14.29	0.100	84.400	8.05	14.27	0.10	85.70	2.33	0.020
Hispanic %	9.24	14.38	0.100	95.700	7.66	12.69	0.20	95.70	3.10	<0.01
Population (1,000s)	121.695	400.049	0.082	9,818.605	60,531	169,687	93	3,817,117	5.39	<0.01
Partisan voting index	8.18	10.55	−35	29.000	7.97	8.83	−35	29	0.56	0.574
No. of counties (observations)	1,494				1,325					

border counties and the complete set of counties. There is greater variation in the electoral outcomes across the complete set of counties. A noticeable difference is that an average border county has a smaller population compared with an average county (60,591 versus 92,947).

Table 3 further compares independent samples of counties on the border versus those not on the border. Border counties tend to have lower median incomes and fewer blacks and Hispanics. Table 4 compares the border county and the center county that reside in the same DMA. We find similar patterns in demographic differences between border and center counties. This is an important issue in a border strategy analysis, as border counties may not be representative of counties in general. To potentially alleviate concerns about differences between border counties and those closer to the center of the DMA, we conduct a robustness check that includes the distance from the DMA center as a potential moderator.

Another assumption of the border strategy approach is that counties along the DMA borders are comparable in observed and unobserved characteristics. Table 5 provides evidence that there are no significant differences between counties that lie on the two sides of DMA borders in observed socioeconomic characteristics including voting age population, median household (HH) income, unemployment rate, college graduation, partisan voting index, and so on.

The border strategy approach specified in Equations (5) and (6) largely relies on the exploration of temporal variation *differences* in two-party vote shares and turnouts of the neighboring counties based on variation *differences* in advertising GRPs on the two sides of DMA borders over time. For example, if the Macon DMA always had a high level of advertising GRPs compared with the Atlanta DMA, the border strategy would not be able to identify the treatment effects of advertising GRPs on outcomes of interest.

In Figure 5(a) we show the degree of advertising variation over time on one side of DMA border versus the other. There is sufficient variation in GRP exposure over time even after subtracting county fixed effects. For example, the political advertising GRPs in Columbus, Ohio, increased sharply from 101 ads in 2010 to 375 ads in 2012, while in Seattle, Washington, GRPs dropped from 324 ads in 2010 to 18 ads in 2012.

The chart in Figure 5(b) illustrates that the advertising variation over time differs considerately on the one side of the DMA border versus the other. Specifically, the dots do not exactly lie on a 45° line where the

Table 4. Comparisons of Border Counties and Center Counties Within the Same State DMAs

	Border county	Center county	Pair difference	*t*-statistics	*p*-value
Median HH income	43,325	47,725	−4,400	−9.86	<0.01
Poverty rate %	23.42	21.01	2.371	4.93	<0.01
Per-capita income	22,137	25,062	−2,925	−13.35	<0.01
Unemployment rate %	7.87	7.63	0.240	2.13	0.035
Bachelor's attainment %	18.14	25.60	−7.457	−15.91	<0.01
Black %	7.50	11.11	−3.70	−6.77	<0.01
Hispanic %	8.23	9.98	−1.75	5.58	<0.01
Population	74,354	397,245	−322,892	−6.34	<0.01
Population density per square mile	106.23	676.23	−570	−3.85	<0.01
Partisan voting index	6.67	5.02	1.62	4.41	<0.01

Notes. We focus on the border versus center counties within the same state's DMAs. We construct 255 pairs of border versus center comparisons at the state-DMA-market level.

Table 5. Comparisons of Observed Characteristics of Counties on the Two Sides of DMA Borders

	Mean1	Mean2	Difference	*t*-statistics	*p*-value
Median HH income	42,832	42,928	−97	−0.23	0.815
Poverty rate %	23.24	23.46	−0.22	−0.47	0.640
Per-capita income	21,765	21,867	−102	−0.54	0.590
Unemployment rate %	7.76	7.73	0.032	0.26	0.796
Bachelor's attainment %	17.49	17.49	0.002	0.01	0.994
Black %	6.40	6.20	0.206	0.40	0.692
Hispanic %	6.94	6.77	0.167	0.34	0.735
Population	72,525	70,871	1,663	0.18	0.858
Partisan voting index	6.983	7.322	−0.339	−0.96	0.336

two sides increased or decreased the same amount of advertising over time. The differences in the temporal variation in advertising GRPs on the two sides of DMA borders along with exogenous border lines and comparable neighboring counties sets up the identification basis of our border strategy.

In Figure 6, we follow Gordon and Hartmann (2016) and plot advertising ratings by state against the state margin of victory. The horizontal axis is the state-level Republican vote shares minus the Democratic vote shares. The vertical axis is the advertising ratings. Ads by Republicans and Democrats are indicated by color,

Figure 5(a). Temporal Variations in GRPs on the Sides of DMA Borders

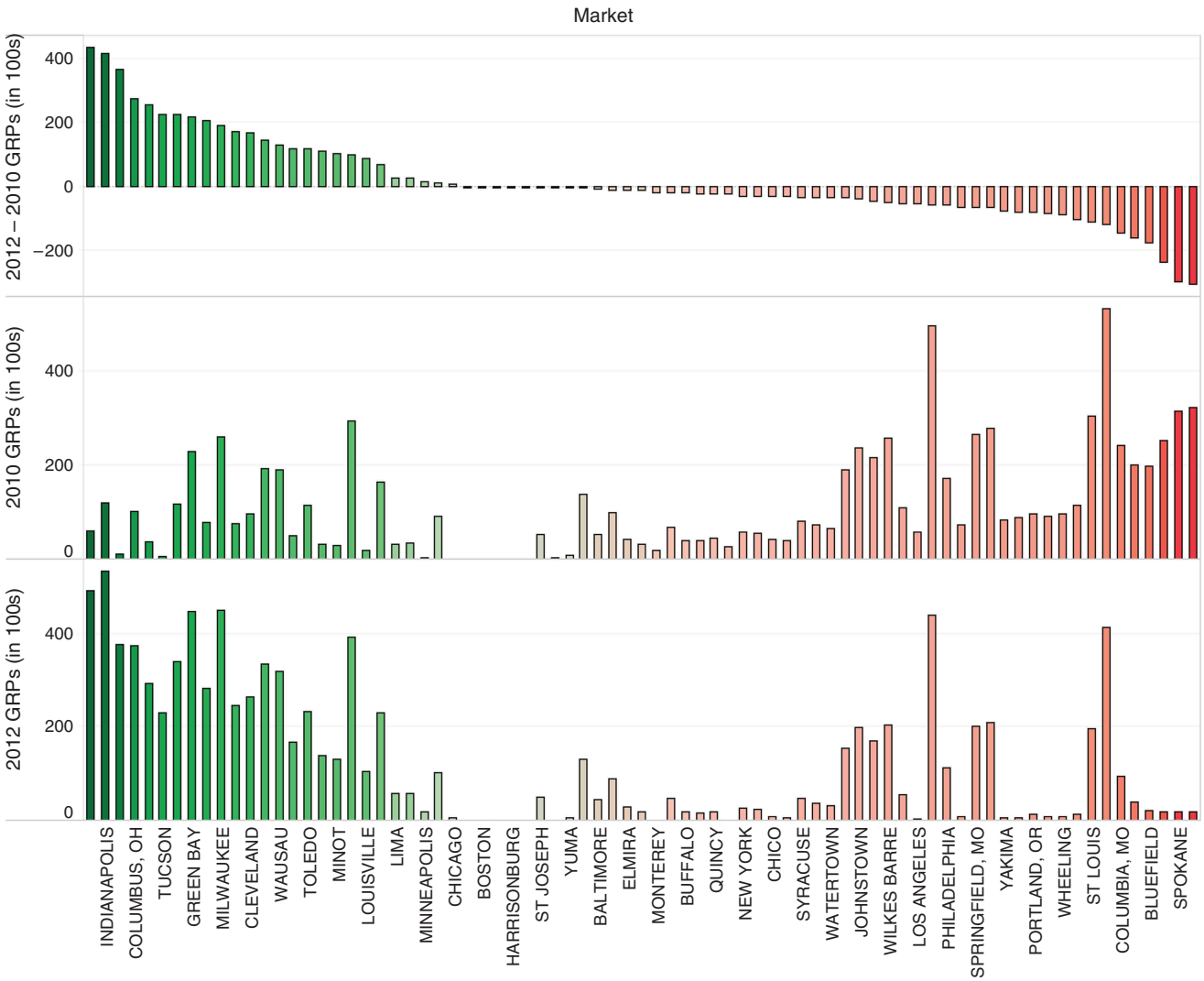


Figure 5(b). Temporal Variations in GRPs on the Two Sides of DMA Borders

while bubbles are proportional to the state's voting age population. The states with a larger margin of victory are exposed to a lower level of advertising. However, we have a large fraction of states with less than a 10% margin of victory in the 2010 and 2012 senatorial races.

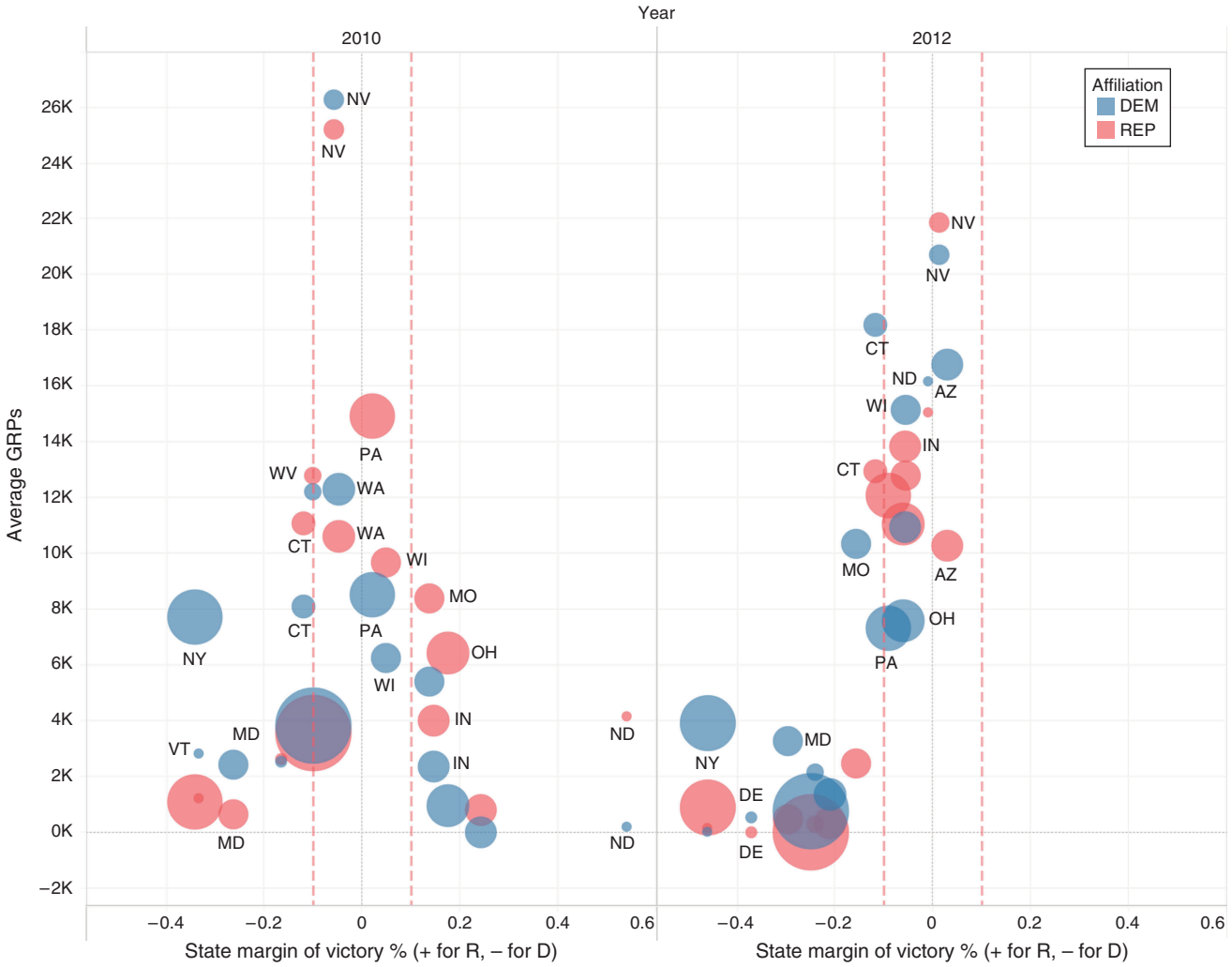
5. Preliminary Evidence

We next provide evidence to illustrate how political advertising tone and source influence electoral outcomes. We estimate the models with the county fixed effects and year-border fixed effects in Equations (5) and (6) but exclude the advertising variables. We also regress each of the advertising terms in Equations (5) and (6) on the same set of county fixed effects and year-border fixed effects. This allows us to control for the unobservable variation across border counties and the common temporal trends between the neighboring border counties in two-party vote shares, turnouts, and different types of advertising ratings. Next, we plot the residuals from two-party vote share and turnout regressions against that from the four types of advertising based on the tone and source. Each dot is a border county. The variation left from the fixed effects is what helps identify the advertising coefficients in Equations (5) and (6).

In the top left panel of Figure 7, we observe a positive relationship between negative GRPs sponsored by candidates and parties (or PACs) and two-party vote shares. The positive relationship is stronger for the GRPs by candidates and parties than that from PACs. The bottom left panel shows that there is also a positive relationship between the negative GRPs by candidates and turnout. However, there is no relationship between the negative GRPs by PACs and turnout.

In the top right panel of Figure 7, we observe a negative relationship between positive GRPs by candidates and parties and two-party vote shares, while we do not observe a relationship between positive GRPs by PACs and vote shares. In the bottom right panel of Figure 7, there seems to be no relationship between either type of positive GRP and turnout.

Figure 6. Race Competitiveness and Gross Rating Points



Overall, Figure 7 shows the variation in two-party vote shares, turnouts, and advertising after controlling for the fixed effects. It suggests that ad tone and source influence the effectiveness of political advertising investments.

6. Results

We estimate Equations (5) and (6) together as seemingly unrelated equations. Given that border counties in the same DMA are exposed to the same advertising levels, we cluster the standard errors at the DMA market level. In the appendix, we provide estimation steps for clustered standard errors. In Table 6, we estimate four versions of the model by including different sets of dummy variables. Column (1) includes only county unique fixed effects. Column (2) includes both county unique fixed effects and local demographics interacted with year dummies. This specification attempts to account for temporal variation across counties with demographic variables. Column (3) partially controls for unobserved local temporal variation by including state unique year dummies. Column (4) fully controls for the unobserved local variation over time by including border unique year dummies. The additional border unique year dummies significantly reduce the advertising coefficient in both two-party vote share and turnout equations.

6.1. Political Advertising Effectiveness by Tone and Source

We start with the question of whether undifferentiated political advertising affects two-party vote share and turnout. We begin by not differentiating between ads based on tone or source, thereby estimating a model that is nested by the full specification presented in Equations (5) and (6). The results in column (4) of Table 6 show that political advertising has no significant impact on two-party vote share and is ineffective in mobilizing voter turnout. Given the level of spending in political campaign years, such a finding

Figure 7. Relationship Between Two-Party Vote Shares, Ads Tones, and Sources

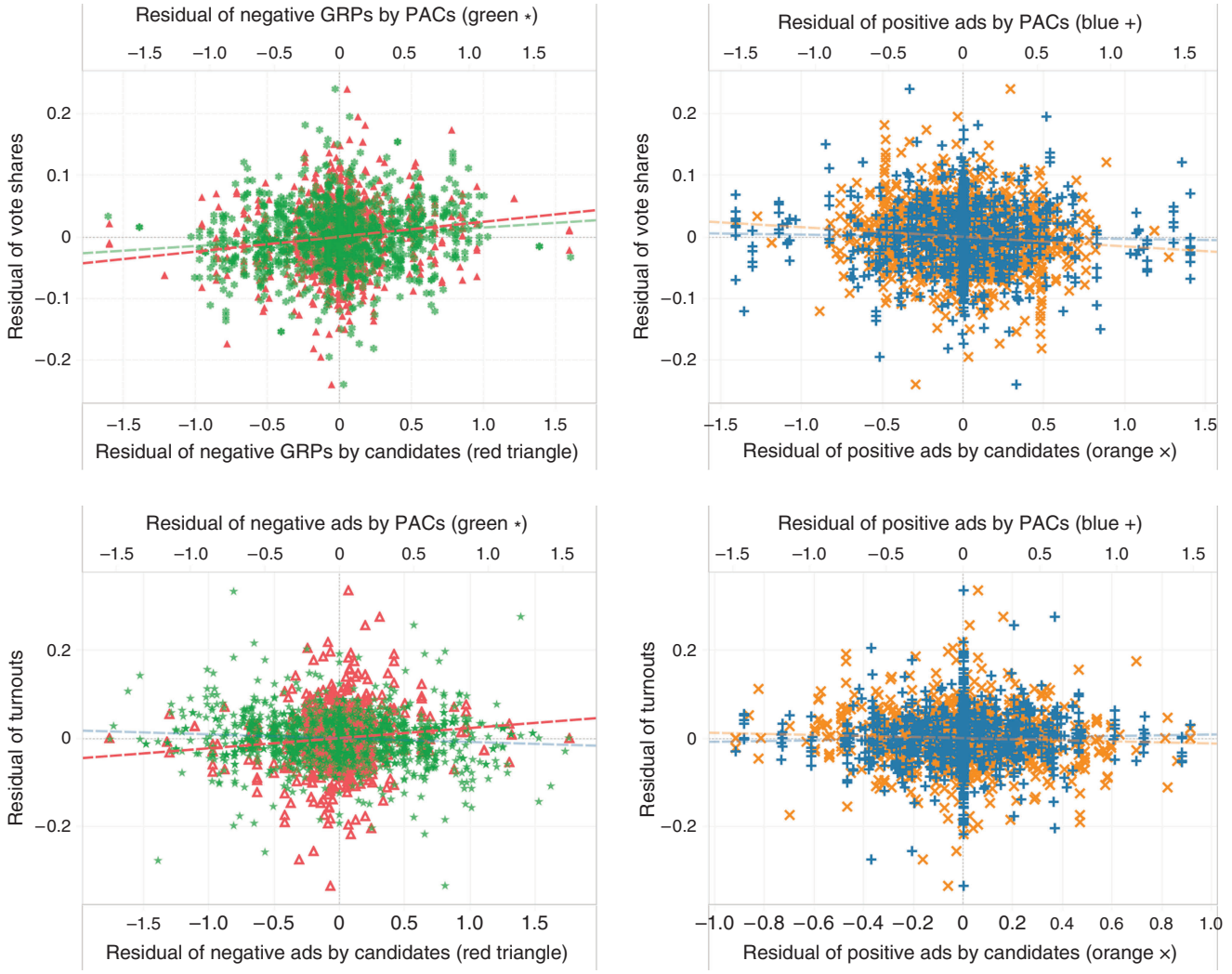


Table 6. Seemingly Unrelated Regression Results of Political Ads with Senatorial Elections

	(1)		(2)		(3)		(4)	
	Two-party vote share	Turnout	Two-party vote share	Turnout	Two-party vote share	Turnout	Two-party vote share	Turnout
log(*GRPs ratio*)	0.111*** (0.023)	/	0.110*** (0.023)	/	0.027* (0.016)	/	0.015 (0.011)	/
log(*GRPs total*)	/	0.069*** (0.014)	/	0.071*** (0.015)	/	0.011 (0.016)	/	−0.000 (0.016)
County fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics × Year dummy	No	No	Yes	Yes	No	No	No	No
State × Year dummy	No	No	No	No	Yes	Yes	No	No
Border × Year dummy	No	No	No	No	No	No	Yes	Yes
Adjusted R^2	0.8970	0.8911	0.8983	0.8912	0.9608	0.9423	0.9780	0.9462
Correlation	−0.018		−0.007		−0.179***		−0.186***	

Notes. There are 1,134 observations, including 567 counties along 122 within-state DMA borders in 2010 and 2012 congressional elections. The standard errors are clustered at the DMA market level. Unemployment rate, median household income, and bachelor's attainment percentage are included as demographics to interact with the year dummy.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table 7. Seemingly Unrelated Regression Results of Ads' Tones with Senatorial Elections

	Two-party vote share equation	Turnout equation
	Estimate (SE)	Estimate (SE)
log(*Ratio of negative GRPs*)	0.028 (0.010)***	/
log(*Ratio of positive GRPs*)	−0.008 (0.009)	/
log(*Total of negative GRPs*)	/	0.012 (0.015)
log(*Total of positive GRPs*)	/	−0.020 (0.020)
County fixed effect	Yes	Yes
Border × Year dummy	Yes	Yes
Correlation of equations	−0.169***	
Adjusted R^2	0.9786	0.9463

Notes. There are 1,134 observations, including 567 counties along 122 within-state DMA borders in 2010 and 2012 congressional elections. The standard errors are clustered at the DMA-market level.
**$p < 0.05$; ***$p < 0.01$.

warrants the attention of both campaign managers and regulators.

In Table 7, we present a model that distinguishes between positive and negative tones. Note that we include border unique year dummies in all the remaining analyses. The results show that negative political advertising has a significant positive effect on two-party vote shares, while positive political advertising does not affect two-party vote shares. These results are consistent with a negativity bias (Skowronski and Carlston 1989, Baumeister et al. 2001, Rozin and Royzman 2001) and explain the prevalence of negative political advertising. When it comes to turnout, neither negative nor positive political advertising is effective in mobilizing turnout.

We further assess the differences in ad effectiveness by interacting the two types of sources (candidates and parties versus PACs) with the two types of tones (positive versus negative). This is the full model specification presented in Equations (5) and (6). The results, presented in Table 8, show that the negative advertising sponsored by candidates and that sponsored by PACs are both effective in increasing two-party vote shares. The difference is that the negative advertising sponsored by PACs is significantly less effective than that sponsored by the candidate or party in affecting two-party vote shares (0.013 versus 0.025). The same directional pattern holds for voter turnout: negative advertising by the candidate or party is significantly effective in mobilizing turnouts, while negative advertising by PACs is ineffective in terms of turnout.

Our empirical findings are consistent with the preliminary evidence provided in Figure 7. Why is the negative advertising by PACs less effective than that by candidates and parties? It is possible that voters respond differently to advertisements from candidates and third-party groups as a result of concerns with the credibility of the ads. One potential explanation for our findings is that advertisers have different degrees of brand equity at risk. While PACs may go to market with unbiased-sounding names, these names are likely new to the vast majority of voters.

The source credibility theory also applies to the positive advertising domain. We find that positive advertising by candidate or party has a negative impact on two-party vote shares, while positive advertising by PACs has no effects on two-party vote shares. The results suggest that positive advertising by candidates and parties leads to backlash because of the obvious self-interest, while positive advertising by PACs has no

Table 8. Seemingly Unrelated Regression Results of Ads' Tones and Sources with Senatorial Elections

	Two-party vote share equation	Turnout equation
	Estimate (SE)	Estimate (SE)
log(*Ratio of negative GRPs by candidate and party*)	0.025 (0.011)**	/
log(*Ratio of negative GRPs by PAC*)	0.013 (0.007)*	/
log(*Ratio of positive GRPs by candidate and party*)	−0.016 (0.009)*	
log(*Ratio of positive GRPs by PAC*)	−0.003 (0.007)	
log(*Total of negative GRPs by candidate and party*)	/	0.029 (0.014)**
log(*Total of negative GRPs by PAC*)	/	−0.012 (0.008)
log(*Total of negative GRPs by candidate and party*)		−0.019 (0.018)
log(*Total of negative GRPs by PAC*)		0.005 (0.009)
County fixed effect	Yes	Yes
Border × Year dummy	Yes	Yes
Correlation of equations	−0.181***	
Adjusted R^2	0.9787	0.9472
Test on Estimate of Ratio of Negative GRPs by Candidate and Party = Estimate of Log Ratio of Negative GRPs by PAC: $\chi^2(1) = 4.514$**		

Notes. There are 1,134 observations, including 567 counties along 122 within-state DMA borders in 2010 and 2012 congressional elections. The standard errors are clustered at the DMA market level.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table 9. Elasticity Estimates Based on Ads, Tones and Sources in Table 8

	Republican (R) two-party vote shares (conditional on turnout)	Democratic (D) two-party vote shares (conditional on turnout)	Republican vote shares	Democrats vote shares	Turnout
A 1% increase in R's negative GRPs by candidates and party	**0.0066** [0.0018, 0.0108]	**−0.0086** [−0.0141, −0.0023]	**0.0133** [0.0057, 0.0190]	−0.0019 [−0.0082, 0.0044]	**0.0068** [0.0020, 0.0111]
A 1% increase in D's negative GRPs by candidates and party	**−0.0069** [−0.0106, −0.0020]	**0.0086** [0.0025, 0.0133]	−0.0006 [−0.0063, 0.0066]	**0.0150** [0.0090, 0.0215]	**0.0063** [0.0013, 0.0102]
A 1% increase in R's negative GRPs by PACs	**0.0035** [0.0002, 0.0067]	**−0.0046** [−0.0088, −0.0002]	0.0003 [−0.0045, 0.0051]	**−0.0078** [−0.0142, −0.0024]	−0.0032 [−0.0066, 0.0005]
A 1% increase in D's negative GRPs by PACs	**−0.0031** [−0.0063, −0.0003]	**0.0040** [0.0003, 0.0082]	−0.0043 [−0.0081, 0.0003]	0.0028 [−0.0006, 0.0065]	−0.0012 [−0.0036, 0.0011]
A 1% increase in R's positive GRPs by candidates and party	**−0.0041** [−0.0071, −0.0004]	**0.0053** [0.0005, 0.0093]	**−0.0082** [−0.0145, −0.0014]	0.0012 [−0.0037, 0.0073]	−0.0041 [−0.0081, 0.0009]
A 1% increase in D's positive GRPs by candidates and party	**0.0042** [0.0009, 0.0074]	**−0.0046** [−0.0082, −0.0009]	−0.0012 [−0.0126, 0.0084]	**−0.0099** [−0.0194, −0.0009]	−0.0053 [−0.0157, 0.0036]

Notes. To interpret the results, for example, a 1% increase in a Democrat's candidate and party-sponsored negative advertising exposure (GRPs) increases his vote shares by 0.0150%. The 90% confidence intervals are in brackets.

effect on vote shares because of the lack of credibility. Neither source of positive advertising has an effect on turnout rates.

6.2. Political Advertising Elasticity by Tone and Source

The estimated correlation between the equations for two-party vote share and turnout is significantly negative (−0.18), suggesting that a higher turnout increased Democratic candidates' two-party vote shares in the 2010 and 2012 elections. In Table 9, we take into account the correlation between the two-party vote shares and turnouts, and we calculate advertising elasticity of two-party vote shares, unconditional vote shares, and turnouts through simulation.

We find that a 1% increase in a Republican candidate's negative advertising GRPs will increase the Republican's two-party vote share by 0.007% and reduce the Democrat's two-party vote share by 0.009%. A 1% increase in a Republican candidate's negative advertising GRPs also leads to a 0.007% increase in turnout. When combining the changes in turnout and conditional vote shares, we find that a 1% increase in a Republican candidate's negative advertising GRPs will increase the Republican's unconditional vote share by 0.013%. Interestingly, it does not hurt the unconditional vote shares of Democrats. This is due to the positive correlation between turnout and Democrats' vote share.

Similarly, a 1% increase in a Democratic candidate's negative advertising GRPs yields a 0.009% increase in the Democrat's two-party vote share and reduces the Republican's two-party vote share by 0.007%. Taking into account the 0.006% increase in turnouts, the expected increase in the Democratic candidate's unconditional vote share is 0.015%.

We next consider the elasticity of negative advertising by PACs and super PACs. We find that a 1% increase in the negative advertising GRPs by Republican PACs increases a Republican's two-party vote shares by 0.004% and reduces the Democrat's two-party vote shares by 0.005%. However, the two-party vote share changes do not translate into a significant change in the unconditional vote shares. This is due to the positive correlation between turnout and voting preference for the Democrats. We find similar patterns for the elasticity of negative advertising GRPs from Democratic PACs.

The empirical results suggest that negative advertising from candidates and parties is approximately twice as effective as negative advertising from super PACs when we consider two-party vote shares as the performance metric. The difference is larger when it comes to unconditional vote shares. Negative advertising by PACs is ineffective in affecting its supported candidate's unconditional vote shares, while negative advertising by candidate or party has a significant elasticity of approximately 0.015 on a candidate's unconditional vote share.

In terms of positive advertising, our analysis shows that a 1% increase in positive advertising GRPs by candidate or party produces an approximately 0.005% reduction in the two-party vote share of the candidate and about a 0.009% reduction in unconditional vote share.

We further report the estimated effect of political advertising using persuasion rates (DellaVigna and Kaplan 2007, DellaVigna and Gentzkow 2010). The persuasion rate was originally developed in a setting with a binary behavioral outcome (e.g., vote for a candidate), a treatment group that receives a message, and a control group that does not. It measures the percentage of

receivers who are not already persuaded but change behavior after receiving a message. We find that the persuasion rates of one additional gross rating point on the partisan vote share difference in the senatorial races under study range from 0.01% to 0.74%.[4]

6.3. Moderators of Race Competitiveness when Tone and Source Matters

We have shown that candidates' and parties' negative advertising is more effective than PACs' negative advertising. We next explore whether this pattern holds when races are competitive. Whether negative advertising by PACs has a larger effect in competitive races provides a deeper understanding of the impact of PACs' advertising and could provide PACs with insight into managing their investments in different races.

To conduct this analysis we use a partisan voting index to indicate race competitiveness. The Cook Partisan Voting Index (PVI) measures how strongly a congressional district leans Democratic or Republican, compared to the nation as a whole. It is calculated by comparing the district's average Democratic or Republican Party's share of the two-party presidential vote in the past two presidential elections to the nation's average share of the same. The national average for 2004 and 2008 was 51.2% Democratic to 48.8% Republican. Thus, a PVI being zero means that it is an almost even and extremely competitive race, while a large absolute value of the PVI implies that a region leans heavily toward one party.

We collected the partisan voting index from the Cook Political Report and matched each county to a congressional district. We split the absolute value of county PVI scores by its median and categorize counties with scores below the median as competitive. Table 10 reports estimation results with heterogeneous effects for ad tone and source by race competitiveness. We find that the effectiveness of negative political advertising by PACs is moderated by race competitiveness. When the race is less competitive, negative advertising by PACs produces a significant positive lift in two-party vote shares. However, when the race is competitive, negative advertising by PACs is ineffective in shifting two-party vote shares. In contrast to advertising by PACs, we do not find that the competitiveness of the race moderates the effectiveness of advertising by candidates, providing additional support for the notion that consumers process advertisements differently based on their source. Our results suggest that negative advertising from PACs and super PACs plays a limited role in competitive senatorial races. This finding deserves attention from major donors, PACs, super PACs, campaign managers, and regulators.

A possible explanation for the findings related to competitive races may be found in dual process theories such as the elaboration likelihood mode (ELM) (Petty

Table 10. Seemingly Unrelated Regression Results of Ads' Tones and Sources by Race Competitiveness with Senatorial Elections

	Two-party vote share equation	Turnout equation
	Estimate (SE)	Estimate (SE)
log(*Ratio negative GRPs by candidate and party*)	0.028 (0.015)*	/
log(*Ratio negative GRPs by candidate and party* × *Race competitiveness*)	−0.004 (0.014)	/
log(*Ratio negative GRPs by PACs*)	0.025 (0.009)***	/
log(*Ratio negative GRPs by PACs* × *Race competitiveness*)	−0.020 (0.011)*	/
log(*Ratio positive GRPs by candidate and party*)	−0.018 (0.011)	/
log(*Ratio positive GRPs by candidate and party* × *Race competitiveness*)	0.004 (0.011)	/
log(*Ratio positive GRPs by PACs*)	0.003 (0.010)	/
log(*Ratio positive GRPs by PACs* × *Race competitiveness*)	−0.011 (0.013)	/
log(*Total negative GRPs by candidate and party*)	/	0.034 (0.019)*
log(*Total negative GRPs by candidate and party* × *Race competitiveness*)	/	−0.008 (0.017)
log(*Total negative GRPs by PACs*)	/	−0.007 (0.010)
log(*Total negative GRPs by PACs* × *Race competitiveness*)	/	−0.003 (0.014)
log(*Total positive GRPs by candidate and party*)	/	−0.029 (0.024)
log(*Total positive GRPs by candidate and party* × *Race competitiveness*)	/	0.015 (0.024)
log(*Total positive GRPs by PACs*)	/	−0.005 (0.010)
log(*Total positive GRPs by PACs* × *Race competitiveness*)	/	0.011 (0.018)
County fixed effect	Yes	Yes
Border × Year dummy	Yes	Yes
Correlation of equations	−0.183***	
Adjusted R^2	0.9788	0.9470

Notes. There are 1,134 observations, including 567 counties along 122 within-state DMA borders in 2010 and 2012 congressional elections. The standard errors are clustered at the DMA market level. We split the partisan voting index by its median and indicate those below it as more competitiveness races. We do not include the main effect of partisan voting index, as all the county attributes (e.g., PVI) are absorbed in the county fixed effects.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

et al. 1983). The ELM may be relevant to the preceding result if we assume that race competitiveness somehow equates to greater involvement. Perhaps heightened media attention results in a more informed and engaged electorate and therefore a greater likelihood that voters utilize more detailed, central route processing. Research in marketing has found that negative and comparative advertising results in greater counterarguing and "boomerang" effects (Belch 1981, James and Hensel 1991). However, it should be noted that this is theoretical conjecture that rests on the notion that greater race competitiveness results in more involved voters.

We also conducted additional analyses focused on possible asymmetries in advertising effects based on demographics factors. Specifically, we tested possible interactions between socioeconomic factors and ad characteristics. These tests were motivated largely by themes expressed in the popular media. For example, Graham (2016) suggests that negative advertising has been used as a tool for suppressing minority voting. This suggests a need to test an interaction between minority populations and negative advertising rates. We also tested an interaction between educational levels and advertising source based on the logic that higher educational levels might result in a more engaged or elaborative voting population. Neither line of testing yielded significant results. In other words, we do not find evidence that ad source or ad tone operate differently based on demographics. These null findings provide further support for the use of the border strategy. While border counties tend to be demographically different from DMA centers, these preliminary tests suggest that our key findings are not driven by demographic differences.

These null findings regarding interactions between advertising characteristics and socioeconomics provide a robustness check, as it does not appear that these demographic differences produce asymmetric advertising effects. As shown in Tables 3 and 4, border counties tend to have a lower median income, smaller black and Hispanic populations, and lower populations. The lack of systematic differences in response based on demographics provides support for the generalizability of our findings.

6.4. Additional Robustness Checks

We also conducted a robustness check related to population level. Given that border counties are less populous, they are less likely to affect campaign advertising decisions. This may mitigate some concerns about endogeneity. However, the smaller populations may raise a concern that the counties under examination are more "rural" than average. To investigate whether more rural areas respond differently to advertising, we operationalize "ruralness" based on the driving distance between the county and the center of DMA market. We then investigated whether advertising effectiveness varies by the distance between the border county and the center of DMA market. We labeled counties as rural using a median split (60 miles). Online Appendix 1 reports estimation results based on ad tone, source, and distance between border county and DMA center. We find no significant interactions between driving distance and ad tone or source.[5] We obtained similar results when using aerial distance instead of driving distance. The results suggest that advertising effectiveness does not vary between rural and metro areas in senatorial elections.

We also compared a multinomial logit specification to our joint specification of two-party vote shares and turnout rates. In Equations (5) and (6), we allow the error terms of the two-party vote share and turnout equations to be correlated. Alternatively, a multinomial logit specification with each voter choosing among three options of Republican, Democratic, and not voting could be formulated. In Online Appendix 2, we report advertising coefficients by tone and source in a multinomial logit specification. Note that we include exactly the same set of county and border-year unique fixed effects as those in Table 8. We also cluster the standard errors at the DMA market level. The results show that only the negative ads by candidate or party produce a significant effect on vote shares.

In Online Appendix 3, we calculate the elasticity of two-party vote shares, unconditional vote shares, and turnouts through simulation using the logit specification. For example, a 1% increase in a Republican candidate's negative advertising GRPs will increase a Republican's two-party vote shares by 0.008% and reduce a Democrat's two-party vote shares by 0.011%. The 1% increase in a Republican candidate's negative advertising GRPs also leads to a 0.006% increase in turnout. Combining the changes in two-party vote shares and turnouts, we find that a 1% increase in a Republican candidate's negative advertising GRPs increases a Republican's unconditional vote shares by 0.014%, and it reduces the unconditional vote shares of Democrats by 0.005%.

Three things are worth noting when comparing the elasticities reported in Table 9 and Online Appendix 3. First, advertising elasticities from the two specifications are similar in magnitude. The elasticity of negative advertising by candidate or party on unconditional vote shares is approximately 0.015. Second, the cross elasticity on opponent's unconditional vote share is insignificant in our joint specification but significant in the multinomial logit specification. This is because our joint model of two-party vote shares and turnouts is better at accommodating the potential correlation between turnout and voting preference. When the Republican candidate increases negative GRPs by 1%, there is a 0.006% increase in

voter turnout. Correspondingly, the increase in voter turnout increases the competitiveness of the Democratic candidate. This link is not available in the multinomial logit specification. Third, our joint specification allows political advertising to affect two-party vote shares and turnouts differently. For example, the joint specification shows that negative GRPs by PACs have a significant effect on two-party vote shares but are ineffective in mobilizing voters. By contrast, the multinomial logit specification suggests a conclusion that negative GRPs by PACs have no significant effect in either vote share or turnout.

We also performed a robustness check using data from a different political context. Specifically, we performed a similar difference-in-difference border-strategy analysis using data from presidential elections. In Online Appendix 4, we present summary statistics for advertising in the 2008 and 2012 presidential elections. Two patterns are worth noting. First, the 2012 presidential election featured significantly more negativity. The negative to positive advertising GRP ratio increased from approximately 2:1 to 9:1. Second, the proportion of advertising sponsored by PACs increased from 4% to 15% for the Republican presidential candidates, while the proportion of advertising sponsored by PACs remained at a low level for the Democratic presidential candidate (about 3%–6%).

An important issue in the presidential context is that the Electoral College system leads to a high concentration of advertising in more competitive or "swing" states. Online Appendices 5 and 6 show the relationship between ad source, ad tone, and popular vote margins. In states such as Washington, New York, and California, there is minimal advertising spending. Therefore, in a border strategy analysis, we are left with limited data points mostly from "swing" states such as Colorado, Florida, Iowa, Michigan, Minnesota, Ohio, Nevada, New Hampshire, North Carolina, Pennsylvania, Virginia, and Wisconsin.

Online Appendix 7 presents results from a model that includes advertising source and tone for presidential elections. The presidential results are consistent but less significant relative to the senatorial results. We again find a significant effect for negative advertising GRPs sponsored by candidates and parties. However, negative advertising GRPs sponsored by PACs are ineffective. This is consistent with our key takeaway that negative advertising sponsored by candidates and parties is more effective than that sponsored by PACs. However, the "marginally significant" results related to the positive spending by candidates are no longer significant.

The differences in the results between senatorial and presidential elections may be due to systematic differences between the two contexts. As noted, the Electoral College system may introduce additional complications. For example, the focus on swing states may result in a set of nonrepresentative counties. This might occur because swing state residents are subject to more intensely contested elections that feature significant amounts of advertising. Over time, this might fundamentally alter how these counties and states respond to advertising.

One potential technique to increase the sample size in presidential elections is to use DMA borders that straddle a swing and a non-swing state. However, an implicit assumption of the border strategy approach is that counties on the two sides are similar. DMA borders between swing and non-swing states violate this assumption and thus should not be included to increase sample size. A second potential issue is related to the greater media coverage focused on presidents and presidential campaigns. A recent study (Blake 2017) has suggested that the tone of coverage received by Donald Trump in his first 100 days in office was 80% negative, compared with 41% negative for Barack Obama. The relevant issue is that significant differences in the tone of news coverage might interact with advertising tone decisions made by candidates and PACs. This may lead to systematic differences in how advertising works in senatorial and presidential elections.

7. Discussion

In our research, we exploit advertising discontinuities arising from DMA borders to produce findings related to asymmetries in advertising effectiveness in political campaigns. Given the level of spending observed in political campaigns, our findings on the differential effects of political advertising based on source and tone should be of great interest to candidates, campaign managers, donors, and the public.

Our most notable results are related to the advertising effectiveness of outside organizations such as PACs and super PACs. While the existing political science literature has conjectured that the seeming neutrality of PACs' names will result in greater source credibility and therefore greater advertising effectiveness (Weber et al. 2012), our empirical results reveal the opposite. Negative advertising by candidates and parties is about twice as effective as PACs' advertising when it comes to two-party vote shares. The difference is larger when we consider unconditional vote shares. This finding is consistent with existing marketing theories related to brand equity (Stigler 1961; Erdem and Swait 1998, 2004). While the notion that political candidates are reliable sources is debatable, the key difference between candidates and PACs may be their relative credibility. In addition, we find that super PAC and PAC advertising is even less effective

in competitive races. We leave the issue of systematically assessing credibility across candidates, parties, and PACs to future research.

In terms of limitations, there are issues related to the available data and our approach that should be acknowledged. While our DMA border approach is consistent with previous research on the effectiveness of political advertising (e.g., Huber and Arceneaux 2007, Krasno and Green 2008) and other marketing contexts (e.g., Shapiro 2018, Tuchman 2017), it is important to note limiting issues. A key issue is that any research relying on a border strategy must be mindful of differences between those counties that lie on the border (and are included in the analysis) and those counties that do not. While a comparison of the demographics of border and nonborder counties suggest demographic differences exist, we do not find evidence to suggest that the effects of ad tone and source vary based on the distance from the center of the DMA. Although this provides some assurance as to the robustness of our findings, future research may seek to generalize the border strategy to incorporate data from all counties available, regardless of whether or not they lie on a border.

In general terms, the existence of advertising discontinuities across adjacent counties provides opportunities to investigate advertising effectiveness. The insight is that the arbitrary nature of the border break points creates an experimental treatment. However, by definition, these analyses focus on the border counties of DMAs rather than the central counties. While the approach allows for a relatively clean analysis of advertising effectiveness in these border counties, it is possible that these border counties are not representative of the general U.S. population. This issue is similar in spirit to the trade-off that occurs between internal and external validity in experimental analyses (e.g., Calder et al. 1982). While the border strategy based results speak directly to the behavior in counties that exist along DMA borders, the extendibility of findings from a sample of this "type" of county to the more urban counties at the center of DMAs is an open question for future research.

Border strategy-based analyses should also acknowledge that issues related to advertising design may potentially influence the interpretation of results. For instance, if advertisers place little emphasis on border counties because these regions are lightly populated or because these residents are not representative of the advertiser's core customer segments, then we might conjecture that these residents are irrelevant and are not explicitly targeted. If this is the case, null findings related to advertising, such as our finding regarding overall expenditures, would be explainable based on an argument that border county residents are not receiving appropriately tailored messages. However, we should note that this is speculation and that we do not have any evidence that voters in border regions are systematically different in terms of response to marketing or that these voters are viewed as irrelevant.

Another possible criticism of using the border strategy in political advertising contexts is that the long-term consequences of prolonged differences in advertising are difficult to consider.[6] Because political campaigns are repeated events, it is possible that advertising decisions made in previous cycles have dynamic consequences in terms of shaping the future responsiveness of border districts. Greater absolute advertising levels or different levels of negative advertising might result in long-term effects that change how potential voters respond to advertising. For example, one could imagine a scenario where negative advertising creates disillusioned voters. If this is true, then over time, districts with more negative advertising might become less responsive to political advertising. This type of dynamic scenario suggests opportunities for additional research. If data on advertising tone and source were available for an extended period of time, it might be useful to model the dynamics of decisions related to spending and tone. For instance, if one were to assume that campaigns make advertising expenditures and tone decisions proactively to change voter preferences across cycles, then a researcher could model these decisions using a dynamic game-theoretic model of campaign decisions. We leave this topic to future research.

Another direction to pursue would be to look into the content of the ads produced by candidates and PACs. For example, we do not consider the possibility that the advertising created by candidates and PACs is fundamentally different. Our classification of advertising as being negative and positive in tone is consistent with tradition and with the available data. It is possible, however, that candidates and PACs utilize different advertising approaches. Candidates may tend to be more or less aggressive in their attacks than PACs. PACs might also tend to attack based on different issues. Candidates might be reluctant to attack based on personal issues for fear about damaging themselves, while a third-party organization might be less concerned. These types of issues could be addressed in future research via content analysis.

Acknowledgments

The authors are grateful to the editor-in-chief, associate editor, and two anonymous reviewers for their helpful comments.

Appendix. Seemingly Unrelated Estimation with Clustered Errors

***Step* 1.** Let us denote Equations (5) and (6) as

$$Y_1 = X_1\beta_1 + \varepsilon_1,$$
$$Y_2 = X_2\beta_2 + \varepsilon_2.$$

Each equation has T observations with K_1 and K_2 parameters. We can rewrite Equations (5) and (6) as $Y = X\beta + \varepsilon$, where $Y_{2T\times 1} = \binom{Y_1}{Y_2}$, $\varepsilon_{2T\times 1} = \binom{\varepsilon'}{\omega'}$, $\beta_{K\times 1} = \binom{\beta_1}{\beta_2}$, and $X_{2T\times K} = \begin{pmatrix} X_1 & 0 \\ 0 & X_2 \end{pmatrix}$ with $K = K_1 + K_2$.

The errors ε have $E(\varepsilon) = 0$, and $V(\varepsilon) = \Sigma \otimes I_T = \begin{pmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{pmatrix} \otimes I_T$.

The generalized least squares (GLS) estimator of β, assuming Σ is known, is $\hat{\beta}_{\text{GLS}} = (X'(\Sigma^{-1} \otimes I_T)X)^{-1}X'(\Sigma^{-1} \otimes I_T)Y$.

When Σ is unknown, Σ can be estimated and replaced by matrix $\hat{\Sigma}$.

Thus the feasible GLS estimator of β is

$$\hat{\beta}_{\text{FGLS}} = (X'(\hat{\Sigma}^{-1} \otimes I_T)X)^{-1}X'(\hat{\Sigma}^{-1} \otimes I_T)Y,$$

where $\hat{\Sigma} \equiv [\hat{\sigma}_{ij}]$.

***Step* 2.** We first try to estimate some estimator of σ_{ij} as s_{ij}.

Let Q be the total number of distinct explanatory variables out of the K_1 and K_2 variables in the model. Let Z be a $T \times Q$ observation matrix of these variables.

We can obtain $s_{ij} = (1/T)\hat{\varepsilon}_i'\hat{\varepsilon}_j = (1/T)y_i'\bar{H}_z y_j$, where $\bar{H}_z = I_T - Z(Z'Z)^{-1}Z'$.

We can also show that $E((T/(T-Q))s_{ij}) = \sigma_{ij}$. Thus an unbiased estimator of σ_{ij} is given by $(T/(T-Q))s_{ij}$.

***Step* 3.** We use a cluster-robust variance matrix estimator.

Since the counties belong to the same DMA market get exposed to the same level of advertising, we apply a cluster-robust estimator for the variance matrix.

We show that

$$\hat{V}_{\text{clu}}(\hat{\beta}_{\text{FGLS}}) = (X'(\hat{\Sigma}^{-1} \otimes I_T)X)^{-1}\hat{B}_{\text{clu}}(X'(\hat{\Sigma}^{-1} \otimes I_T)X)^{-1},$$

where $\hat{B}_{\text{clu}} = \sum_{g=1}^{G} X_g'(\hat{\Sigma}^{-1} \otimes I_T)\sqrt{c}\hat{u}_g\sqrt{c}\hat{u}_g'(\hat{\Sigma}^{-1} \otimes I_T)X_g$ with G clusters.

Here, $\hat{u}_g = Y_g - X_g\hat{\beta}_{\text{FGLS}}$ is the vector of residuals for the gth cluster. To reduce the downward bias in $\hat{V}_{\text{clu}}(\hat{\beta}_{\text{FGLS}})$ due to the finite G, we include an adjustor, $c = (G/(G-1))\cdot(2T-1)/(2T-K)$.

Endnotes

[1] The data on spending aggregate PACs and super PACs. For ease of exposition when discussing empirical findings, we use the term "PAC" to refer to category that includes both PACs and super PACs.

[2] Note that we exclude the 2010 senatorial elections in Alaska and Florida from our analysis, as there were three candidates in the race.

[3] We group together GRPs by candidates and parties, as the CMAG data sometimes list the sponsors of an ad as "candidates and party."

[4] The estimated persuasion rates are close in magnitude to that reported by Spenkuch and Toniatti (2018), ranging from 0.01% to 1%.

[5] We also tested a split based on 30 miles. We do not find significant interactions between driving distance and ad tone or source.

[6] We thank an anonymous reviewer for raising this point.

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