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Abstract

Why is negative advertising such a prominent feature of competition in the political market? We propose an explanation that is based on the "fewness" of competitors in a political race. The typical election in the United States is a two-candidate race. In such duopoly contests, there is a simple economic rationale for "going negative" relative to non-duopoly contests: when the number of competitors is greater than two, engaging in negative ads creates positive externalities for opponents that are not the object of the attack. In contrast, positive ads benefit only the advertiser. To empirically investigate the hypothesis that the number of competitors can explain the volume of negative advertising in an election, we focus on US non-presidential primary contests in 2004, where the nature of primaries provides us with a cross section of independent races and large variation in the number of entrants. Our estimation employs novel data from the Wisconsin Advertising Project, which contains information on all political advertisements aired in the top 100 media markets in 2004 races. We find that duopolies are twice as likely to air a negative ad when compared to non-duopolies, and that doubling the number of competitors drives the rate of negative advertising in an election close to zero. These results are robust to the inclusion of a variety of controls and instruments for entrants in the race.

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1 Introduction

Political competition has long been famous for using negative portrayals of one's opponent as a strategic weapon. Indeed negative advertising, or "mudslinging" as it is sometimes called, is usually considered par for the course in any political contest. What is more alarming is the sheer amount spent on negative advertising. For example, John Kerry and George Bush together spent $522 million in the 2004 presidential campaign, with over $365 million (or 69.9 percent) of this amount being spent on negative advertising.[1] In the current election cycle (the November 2010 electoral contests for state and federal offices), a media analysis company has reported that 80 percent of advertisements have been negative (NPR 2010).

The widespread presence of negative advertising in the political market has been a serious concern to policymakers and commentators alike. Critics have long bemoaned negative advertising as harmful to the health of a democracy. This perspective is consistent with the conclusions of a strand of studies (see e.g., Crotty and Jacobson (1980), Cappella and Jamieson (1997), Ansolabehere and Iyengar (1995)) that find negativity alienates the political middle and harms participation. The fear that negative ads turn off voters has prompted policymakers in recent times to regulate its usage. One such well known piece of legislation is the "Stand By Your Ad" provision of the Bipartisan Campaign Reform Act in 2002, which requires each candidate to provide a statement identifying himself and his approval of the communication. By forcing candidates to personally associate themselves with their campaign message, the belief is that candidates will be less inclined to air attack ads.

What is missing from the debate about negative advertising in politics is a clear understanding of *why* negative advertising is such a central feature of political competition. That is, while there has been much interest in both the political science and economics literature as to the consequences of campaigning for election outcomes, virtually no empirical attention has been devoted to the supply side incentives to produce negativity.[2] If negative advertising is the norm in political competition, why is it not the norm in the marketing of non-political consumer goods? What is it about the nature of political competition, especially in the United States, that lends itself towards "going negative"?

In this paper we hypothesize that an important part of the explanation lies in a unique feature of the structure of political markets. In particular, the two-party system effectively gives rise to duopoly competition between political candidates in a general election, whereas pure duopolies are rarely observed in the consumer product market.[3] We conjecture that there is a clear economic rationale for why duopolies are more likely to "go negative": when the number

[1] Calculation based on WiscAds 2004 presidential data (Goldstein and Rivlin 2007b)

[2] Empirical studies of political advertising in general primarily examine the effects of campaigning on voter behavior (see e.g., Shachar and Nalebuff (1999), Coate and Conlin (2004), Stromberg (2008), Levitt (1994) and Prat et al. (2006)).

[3] While a number of industries might feature two dominant firms, even in these cases there will typically be a group of firms with smaller market share that impact the behavior of the dominant firms.

of competitors is greater than two, engaging in negative ads creates positive externalities to those opponents that are not the object of the attack. In contrast, positive ads benefit only the advertiser. Therefore, the presence of a spillover effect makes it less beneficial to use negative advertising when you face more than one opponent. Moreover the benefit of negative advertising is decreasing in the number of opponents you face (since the spillover to another candidate is more likely when there are more substitutes available). This link between the incentives to produce negative advertising and duopolistic market structures does not appear to have been previously recognized or explored in either the industrial organization or political economy literature.

Our economic explanation for negative advertising seems to accord with a familiar armchair observation - for the most obvious cases where a consumer product market also looks like a duopoly, there exist some very well known negative advertising campaigns (Apple versus Microsoft and Verizon versus AT&T). However, there could be other confounding factors that contribute to explain the larger use of negative ads in politics when compared to everyday product markets. For example, political markets are "winner take all markets" where it is winning a plurality of votes rather than the absolute market share that matters, and hence the convexity of the objective function could partly fuel the incentive to go negative. Furthermore, the time horizon is different: whereas firms repeatedly interact without a definite end in sight, competitors in a political campaign face a finite horizon that ends with the election day, and hence it may be harder to cooperate on staying positive. Lastly, whereas the FTC regulates deceptive advertising by businesses, it does not have any jurisdiction over political ads, perhaps giving politicians more legal leeway to air attack ads.

How then can we empirically isolate the effect of the number of competitors in a market on the incentive to go negative? An ideal strategy is to only use data on political races that share the same institutional features, but have different number of competitors. This strategy however gives rise to a natural problem: if political markets in the United States are for the most part characterized by head to head competition between the two major party candidates, how can we determine the effect of the number of competitors on the propensity for "going negative" when there is little to no variation in the number of candidates? Our strategy is to instead exploit the inherent variation in non-presidential primary contests within the Untied States, i.e., the contest among Democrats or Republicans that decide who will become the party nominee in a particular House, Senate, or gubernatorial race. The local nature of these primary contests provides us with a cross section of independent races that exhibit a rich degree of variation in the number of entrants. Using this variation, we seek to measure the effect of the number of competitors on the likelihood that a political ad is negative.

We use a unique dataset from the Wisconsin Advertising Project (WiscAds), which contains information on all political advertisements aired in the top 100 media markets in the United States 2004 elections. As the data contains a comprehensive record of the amount of political

advertising and its content, we are able to measure the probability of going negative at the ad level as a function of market and candidate characteristics. Our main findings are that duopolies have over twice as high a likelihood of airing a negative ad as compared to non-duopolies, and depending on the measure of negativity we use, cutting the number of competitors in half generates a five to ten fold increase in the rate of negative advertising. These magnitudes suggest that even just a handful of competitors can all but eliminate the incentives to "go negative" as compared to the duopoly case. These results remain robust to the inclusion of a variety of controls as well as instruments that we construct for the number of competitors in a race.

To formally illustrate our hypothesis as it pertains to political competition, we construct a simple model of political competition that draws upon ideas from the political literature based on games of voters' mobilization, which were first developed by Snyder (1989) and Shachar and Nalebuff (1999). The model helps to clarify the economic mechanism underlying our hypothesis, which is that the introduction of more competitors creates a spillover effect that diminishes the incentive to negatively advertise. Our empirical findings, which tie together the number of competitors and the tone of the campaign, also shed new light on the consequences that the policies aimed at shaping the "competitiveness" of primary elections (and therefore entry) may have on the tone of the campaign, and in turn on voters' behavior. We discuss such policy implications in the conclusion.

The plan of the paper is the following. In Section 2, we introduce a stylized model that illustrates the effects of adding competitors on the incentive to negatively advertise. In Section 3 we introduce the data, and in Section 4 we carry out the empirical analysis and illustrate the key empirical relationships in the data. We also include a discussion of the robustness of the raw effects in the data to omitted variable bias by both controlling for relevant race covariates and finding instruments that exploit the primary structure of the races. We conclude in Section 5.

2 The Spillover Effect

We now formally illustrate the spillover effect in a model of political competition. We choose to focus the model on political competition both because the data we will use comes from political markets, and also because it allows us to consider a model where the source of the spillover effect is less obvious than the case of advertising among firms. We follow the literature that views voter mobilization as the primary objective of campaigning (see e.g., Snyder (1989) and Shachar and Nalebuff (1999)).[4] In the same spirit as these papers, we black-box the

[4]Another strand of the theoretical literature focuses on the informative role of advertising (see for instance Coate (2004A), (2004B), Galeotti and Mattozzi (2009), Polborn and Yi (2006), and Prat (2002)). In particular, Polborn and Yi (2006) differentiate between positive and negative advertising. In the context of incomplete information, they show that balancing negative and positive advertising provides voters with the most information. They argue that negative advertisements show a different side of the candidate that a voter will not be exposed

underlying mechanism by which voters' choices are affected by campaigning, and posit a model in which candidates engage in positive (negative) advertising to mobilize (demobilize) their own (opponent's) supporters. The model is revealing in that there is no "spillover" directly built into the technology that mobilizes voters - by negatively advertising against your opponent, you only persuade his supporters to stay home rather than to vote for someone else (which differentiates this setting from the more obvious spillover story among firms, where negative advertising against your opponent causes some of its customers to flock to to a different firm). The key effect we show is that when L is greater than two, engaging in negative ads nevertheless creates positive externalities to those opponents that are not the object of the attack. On the contrary, positive ads benefit only the advertiser. Therefore, it is the strategic nature of the interaction that creates a spillover effect and reduces the incentive to use negative advertising when facing more than one opponent. We emphasize that our model is not the only way to capture the spillover effect, but just one revealing way to illustrate it.

We begin by assuming that candidates simultaneously choose how to allocate their budget between two different forms of campaigning to increase their support on election day. Specifically, each candidate i chooses positive advertising (P_i) to increase the number of his own voters that go to the polls, and negative advertising to keep candidate j's supporters home ($\mathbf{N}_i^j = N_i^1, \ldots, N_i^L$) on election day. Let $k = 1, \ldots, L$ denote a candidate and Π_{k_0} her political support in the absence of a campaign. We assume that the number of votes that candidate i receives after the campaign is equal to,

$$\Pi_i\left(P_i, N_1^i, \ldots, N_L^i\right) = \Pi_{i_0} \frac{P_i^\alpha}{\left(\eta + \sum_j N_j^i\right)^\beta} \tag{1}$$

where $\alpha, \beta \in (0,1)$, and η is a small positive constant.[5] Note that $P_i^\alpha/(\eta + \sum_j N_j^i)^\beta$ is increasing and concave in P_i and decreasing and convex in N_j^i. This assumption captures the idea that the number of i's supporters that are mobilized is directly affected by both the amount of i's positive ads and the amount of negative ads that i receives from her opponents, and the marginal mobilization effect of an ad is decreasing. The functional form we use is merely illustrative, and the example can be expanded to allow for more general voter mobilization technologies.

Letting π_k denote candidate k's political market share (vote share) we have that

to without this type of technology.

[5] A small positive value of η guarantees that the expression in (1) is well-defined also when $\sum_j N_j$ is equal to 0. Other than this, η plays no role in the analysis.

$$\pi_i = \frac{\Pi_{i_0} \frac{P_i^{\alpha}}{\left(\eta + \sum\limits_j N_j^i\right)^{\beta}}}{\sum\limits_{k=1}^{L} \Pi_{k_0} \frac{P_k^{\alpha}}{\left(\eta + \sum\limits_j N_j^k\right)^{\beta}}}.$$

Each candidate has the same war chest, which we normalize to be equal to 1. The objective of the candidate is to maximize his vote share $\pi_i(\cdot)$ given his budget constraint $P_i + N_i^1 + \ldots + N_i^L = 1$, which is a plausible assumption in primaries. Note that it will always be the case that $N_i^i = 0$ for all i.

To see how the model generates a spillover effect, let's consider a three person race. After substituting in the budget constraint, the problem for candidate $k = 1$ is

$$\max_{(P_1, N_1^2)} \frac{\Pi_{1_0} \left(\frac{P_1}{\eta + N_2^1 + N_3^1}\right)^{\alpha}}{\Pi_{1_0} \left(\frac{P_1}{\eta + N_2^1 + N_3^1}\right)^{\alpha} + \Pi_{2_0} \left(\frac{P_2}{\eta + N_1^2 + N_3^2}\right)^{\alpha} + \Pi_{3_0} \left(\frac{P_3}{\eta + \left(1 - P_1 - N_1^2\right) + N_2^3}\right)^{\alpha}} \tag{2}$$

and similarly for candidates $k = 2, 3$. Thus we see that in (2), Π_1 decreases in N_2^1 and N_3^1 (the negative advertising of its opponents against candidate one), but it increases in N_2^3 and N_3^2 (the negative advertising of candidate 1's opponents against each other). Since the terms N_2^3 and N_3^2 would not enter candidate 1's objective function in a two person race, they capture the spillover effects caused by adding competitors to a race.

The spillover effect directly translates to the equilibrium solution of the model. We focus on the symmetric case where $\alpha = \beta$ and Π_{i_0} is equal across candidates i. In a $L = 3$ person race, the unique symmetric equilibrium is

$$P_i = \frac{2 + 2\eta}{3} \text{ and } N_i^j = \frac{1 - \eta}{6} \text{ for all } i.$$

However the unique symmetric equilibrium in an $L = 2$ person race is

$$P_i = \frac{1 + \eta}{2} \text{ and } N_i^j = \frac{1 - \eta}{2}.$$

The details of the derivations are in the appendix. This result shows that when η is small, a candidate is almost indifferent between engaging in positive or negative advertising in a two-candidate race, but strictly prefers positive advertising in a three person race. In words, a competitor in a three-candidate race is more likely to engage in positive rather than in negative advertising.

3 Data Description

In order to explore the empirical relevance of the spillover effect, we assembled data from the 2004 primary elections in the United States. First we obtain data on each House, Senate, and gubernatorial primary election in 2004 from the records kept in *America Votes* (Alice, Scammon and Cook 2005). Throughout our analysis, we refer to an election (or electoral contest) as each specific race (e.g., Democratic Primary for Wisconsin Governor). Thus, for each electoral contest, we collected data about the number of candidates in the race, along with the name of each candidate, the vote share (percentage) obtained in the primary election, and her partisan affiliation. We then eliminate the unopposed elections (i.e., elections with only one candidate running) and all elections where no candidates ran. In a strongly Democratic district, for example, it is not uncommon for there to be no Republican candidates running in a primary. Overall there were 966 elections from 2004 Senate, House, and gubernatorial primaries; but of these, 558 elections were unopposed and 68 elections had no candidates, which leaves us with 340 primary elections that had two or more competitors (199 are two-candidate races and 141 elections have three or more candidates).

We then match this data with advertising data from TNSMI/Campaign Media Analysis Group (CMAG) that was made available to us by the University of Wisconsin Advertising Project (WiscAds).[6] A unique aspect of this dataset is that it contains information on each airing of a political advertisement in the top 100 media markets in the United States for all elections in 2004, including all special and run-off elections. The top 100 media markets cover about 85% of the US population (see Figure 1).[7] Throughout the entire 2004 election season, over half a million television spots (558,989 ads) were aired in favor of gubernatorial, U.S. Senate, and U.S. House candidates. Of these ads, 254,368 were aired during the primary campaigns for these elections, which are the focus of this paper due to their large variation in the number of candidates.[8] When we merged the primary election data with the advertising data, we lost 214 House races, 7 gubernatorial races and 13 Senate races. Of these dropped races that arose in the match with the advertising data, approximately 20% were due to the fact that they were outside of the top 100 media markets, and about 80% were due to the fact that there was no advertising for the primary election.[9]

[6] See (Goldstein and Rivlin 2007a) for a detailed description of the WiscAds data.

[7] Candidates make an extensive use of televised advertising. For example, in the 2008 US presidential election, candidates spent over $360 million on broadcast time throughout their campaigns. Broadcast media accounted for the highest share of the overall media expenditure, followed by miscellaneous media ($273 million), internet media ($43 million) and print media ($21 million). See http://www.opensecrets.org/pres08/expenditures.php?cycle=2008.

[8] Whether an advertisement was aired during the primary or general election was determined by the date of the primary in each state. If the ad aired prior to the primary election, then it was counted as a primary ad; if it aired between a primary and a primary run-off, it was considered to be part of that campaign. Any ads that aired after the primary (or after the primary run-off if the state had one) were dropped from the dataset.

[9] We drop one Louisiana governor race, since it had a runoff after the primary. We also drop Ronnie Musgrove's advertising in a 5 candidate Mississippi election, since he (the incumbent) was prematurely attacking the general

In the final dataset, there are 104 primary elections with two or more candidates and active campaign advertising, with 26 for the Senate, 63 for the House, and 15 for gubernatorial elections. As shown in Table 1, 75% of the electoral contests have two to four candidates on the ballot, with similar patterns across gubernatorial, House and Senate races. The most candidates that compete in a primary contest is ten. As reported in Table 2, we observed 242,461 ads in the campaign of these races, of which 42% are from Senate elections, 18% from House elections, and 40% from gubernatorial elections. Given the fact that media markets are almost always larger than House districts, it is not surprising that a small percentage of campaign advertising is for House candidates. Senate and gubernatorial elections, on the other hand, are state-wide, and candidates typically campaign via televised advertising.

The CMAG data provides a rich set of information for each ad aired throughout the election, as the unit of analysis is an individual television broadcast of a single advertisement. The data contains information on when the advertisement aired (date, time of day, and program) and where the ad aired (television station and media market) in addition to the cost of the ad.[10] [11]

The WiscAds coders then examine the content of each advertisement in the CMAG data and record a number of variables related to the content of the ad, including the name of the favored candidate, his/her political party, the race being contested, the tone, and issues addressed. Specifically related to the tone of the advertisement, coders are asked to determine whether the objective of the ad is to promote a candidate, attack a candidate, or a contrast of the two.[12] The WiscAds data also includes measures for whether or not the opposing candidate is pictured in the ad, and if the focus of the ad is on personal or policy matters.[13] It is possible to construct various measures of negativity based on this data. Five possible measures of negativity are the following (each of which is coded as one if the advertisement is designated as "negative" under a specific set of criteria, and zero otherwise):

Negative1 includes ads that either spend the entire time attacking an opponent or spend some time promoting and some attacking (attack plus contrast ads).

Negative2 includes ads that attack for at least half of the airtime.

election candidate, which does not pertain to primary competition.

[10] While there are cost measures in the dataset for each ad, they are estimated by TNS (the parent company of CMAG) based on the media market, time of day, and the show the ad aired on. Part of TNS's expertise is the measurement of these costs. Virtually all advertisements are for 30 second television spots, so the length of an ad is not a relevant issue.

[11] We also observe the sponsor of the ad both by name, i.e. "Paid for by Friends of Jon Jennings Committee" or "Paid for by Emily's List" and by category, i.e. candidate, party, or special interest group. Since, however, candidates sponsored over 94% of all ads, with interest groups sponsoring only 4% of ads, we ignore the latter two.

[12] Attack ads are coded as such if the favored candidate is not mentioned in the ad at all; contrast ads mention both the favored and opposing candidate; promote ads mention only the favored candidate.

[13] Observe that while we see whether the opposing candidate was pictured or not, we do not see the identity of this opposing candidate who is the target of the attck. We do know if the ad is refuting previous negativity directed at a candidate, which occurs about 6 percent of the time in the data.

Negative3 includes only those ads that end with an attack.

Negative4 includes all ads that only attack the opponent.

Negative5 includes ads that attack for at least half of the airtime and are focused on personal issues rather than policy.

For our purposes, the most relevant categories of negative advertising are *Negative1* (which flags an ad as negative if it contains any negativity whatsoever) and *Negative4* (which only flags an ad as negative if all of its message is negative). Thus *Negative1* is a more inclusive measure than *Negative4*.

4 Empirical Analysis

We now seek to empirically examine the effect of the number of competitors in a race on the incentive to air negative ads in the data. Recall that the economic mechanism illustrated in Section 2 showed that increasing the number of competitors beyond two players generates a spillover effect that reduces the benefit of negative advertising. The spillover effect thus suggests two predictions about the data:

1. Duopoly markets should exhibit a greater tendency for negative advertising than non-duopoly markets.

2. The tendency for negative advertising should decrease monotonically with the number of competitors.

Both predictions are non-trivial and products of the spillover story. Our analysis will be concerned with seeing whether these effects are present in the data and quantifying their magnitude. Assessing the magnitudes will provide a sense of the order of importance of the competition as a means of explaining negativity.

We start with the first prediction and plot the proportion of negative ads under the five different measure of negativity for both duopoly and non-duopoly markets. The result is shown in Figure 2. The figure reveals a clear consistency with our hypothesis: across all the negativity measures, duopoly markets exhibit a significantly higher probability of airing a negative ad as opposed to non-duopoly markets. The order of magnitude of this "duopoly effect" is remarkable: across all measures, duopolies exhibit over twice as high a likelihood of airing a negative ad as compared to non-duopolies.

There is a natural concern that our measure of the number of competitors, which is the number of candidates who appear on the primary ballot (we refer to this measure of candidates as "Ballot N") may be overstated, since there could be a number of "fringe" candidates on the ballot who pose no real competitive threat to the "viable" candidates (meaning that the viable

candidates effectively ignore potential spillover to the fringe candidate in making advertising choices). We thus construct an alternative measure of the number of candidates in a race by ignoring candidates who earned less than 5 percent of the popular vote in the election. We shall refer to this alternative measure as "Effective N". Table 3 shows the effect on the distribution of the number of candidates across races, and as can be seen, the "Effective N" measure puts more mass of the distribution on races with 2, 3, or 4 candidates (since elections with 5 or more candidates are getting re-classified into one of these groups). The more compressed distribution accords with common sense that primary races with 5 or more credible candidates vying for votes are quite rare.[14]

Figure 3 reproduces the comparison between duopoly and non-duopoly using "Effective N" as the measure of competition as opposed to the "Ballot N". As can be seen, the duopoly effects grow even larger, with duopolies now exhibiting a likelihood of negative advertising that ranges from approximately 2.5 to 3.5 times higher than non-duopolies.[15] It is interesting to note that the relative increase in the rate of negative advertising for duopoly markets is larger when one considers the *Negative4* measure as opposed to the *Negative1* measure. This accords with our theory since since *Negative4* only counts ads that spend the whole time attacking as negative while *Negative1* counts ads that spend any part of the ad attacking as negative. Thus the reduction in the benefits of using negative advertising for non-duopoly markets should be even larger under *Negative4* advertising as compared to *Negative1* advertising.

Table 4 breaks out the information in Figure 2 further by showing the proportion of ads that are negative under the five different measures conditional on the number of competitors in each election. Here we see that the trend in the tables is consistent with prediction 2 - there is a monotone relation on negativity as we add competitors beyond two. Interestingly, for most of the measures, the bulk of the reduction is realized in just doubling the number of players from 2 to 4 players (two person races having between 4 and 10 times the rate of negative ads as four person races). If we restrict attention to advertising that spends the whole time attacking, i.e., *Negative4*, we also see that with just 5 players, the rate of negative advertising virtually goes to zero (note that while the number of races with five or more players is small, the number of advertisements with five or more races is not, the sample size being close to 8,000). Thus with just a handful of competitors, we see that the monotone effect of negativity in the number of

[14] If we revise this measure to candidates who earned more than 2% of the vote share or increase the threshold to candidates who received more than 10% of the vote share, the number of 2 candidate, 3 candidate, and 4 candidate elections remain similar. The only variability comes from races with 5 or more candidates. All results that follow are robust to altering the threshold to 2 or 10 percent.

[15] An alternative measure of the number of effective candidates could be obtained using polling data collected at an early stage of the campaigns. However, it is hard to find reliable data of polls for all 2004 primary elections. A popular resource on trends in American public opinion is PollingReport, which systematically reports all the electoral polling data that have been collected during a US campaign. According to PollingReport we could recover information about only 31 primary races that actually have primary match-up polls. With this small sample size, we still find that duopolies have more than double the probability of going negative when compared to non-duopolies.

players can drive negativity to almost zero.

Robustness

The evidence presented in the previous section illustrated a revealing empirical relationship between the number of competitors and the incentives for going negative. The steep reduction in the rate of negative advertising that is associated with adding just a few players suggests that our hypothesis is a first order reason for the high rates of negative advertising in political markets overall (since most elections in the United States are head to head duopoly races). In this section we will consider the robustness of these results to the possible presence of omitted variable bias. The possible endogeneity concern is that factors that lead a race to only have a few candidates might also be related to the factors that cause the "tone" of an election to be more negative. While we view entry into a primary race as a highly idiosyncratic event and hence exogenous to the decision to go negative upon entering (which accords with a common wisdom in political science, see e.g., Brady et Al. (2007)),[16] we can nevertheless show that our main results do not rely on requiring entry in primary races to be exogenous. First, we show that introducing control variables that are likely candidates for explaining negativity do not alter the estimated magnitude of the effect of competition on negativity. We then show robustness to the inclusion of instruments for the number of competitors in a race, which we construct by exploiting the primary structure of the electoral campaigns we consider. We will restrict attention to the two most straightforward categories of negativity, i.e., *Negative1* and *Negative4*.[17]

We start with the results pertaining to *Negative1*. Table 5 reproduces the main effect we found in the data within a regression framework. In particular, we employ a linear probability model for the event that an advertisement in the data is negative (where we are careful to cluster the ad level observations at the election level to control for any unobserved shock that correlates observations within an election, and also careful to use robust standard errors to control for heteroskedasticity).[18] [19] Specification (1) shows the regression of negative advertising on the log number of effective candidates, and specification (3) shows the regression of negativity on a duopoly indicator variable. Both of these regressions are run without any controls, and as can be seen, the coefficients capture the unconditional moment found in Figure 3 and Table

[16]This view of entry in primaries was also conveyed to us in a private conversation with Ken Goldstein, the director of the WiscAds project.

[17]We will use the "Effective N" measure of competition, however the robustness results that we present would also hold if we had used the Ballot measure of N.

[18]We opt for a linear probability model for the simplicity of implementing the IVs. Our basic marginal effects do not change in an economically significant way when we use a logit instead of a linear probability model as illustrated in Table 11.

[19]Our use of clustered standard errors throughout the paper is a conservative strategy for the standard errors. Given our data has a "long panel" dimension (many advertisements within each race), imposing more model structure would allow us to improve upon standard errors. It is reassuring that such additional modeling structure is not needed for our main substantive results to hold.

4: doubling the number of candidates (say going from 2 to 4) leads to an absolute decline in the probability of going negative of about 40 percent, and duopolies have a 25 percent absolute higher probability of airing a negative ad than non-duopolies (or more than double).

Specifications (2) and (4) in Table 5 then show that the effects from the unconditional regressions (1) and (3) remain approximately the same when we add control variables that might also be related to the likelihood of an advertisement being negative. The significant controls across specifications are the partisan color of the primary, whether it is a primary for a House race, whether the candidate is the incumbent, the total ad volume[20], and the time to election. The latter variable measures the days until the election (normalized by the length of the campaign). It is continuous on the interval (0,1), and takes a value equal to one at the farthest day away from the election and 0 at the election day. Its estimated coefficient is significant and negative in specification (2), meaning that as we get closer to the election day the probability of going negative increases. Interestingly, the incumbency of the candidate does not seem to play a role.[21] One of the potential omitted variable concerns is that incumbency is likely to be correlated with both the number of candidates in the race (i.e., the presence of the incumbent may deter entry) as well as the likelihood of engaging in negative advertising (it could be more likely to observe attacks directed towards the incumbent). However, our results show that this potential confounding effect due to incumbency does not appear to play a role in the data. In both specifications (2) and (4) we see that Republicans are more likely to attack in primaries than Democrats, and House races, when compared to gubernatorial and Senate races, have a higher propensity to go negative. Also, elections with a higher total quantity of advertising allocate a larger fraction of those ads towards being negative.

Of course, it could be the case that even after including controls, there could still exist unobserved factors that explain the relationship between competition and negativity. To address this concern, we now turn to the discussion of an instrumental variable strategy for the number of entrants in a race. We motivate the IVs by thinking about two possible incentives a candidate may have for entering the primary: to hold political office or achieve other benefits unrelated to winning the general election, such as personal gain from exposure. We first focus on exposure, using the variation in the cost of ads across media markets and hence the the number of viewers of ads. The WiscAds data provides an estimated cost measure for each ad, which is a function of both the program during which the ad aired and the market in which it is aired. Markets with higher ad cost (i.e. Los Angeles, Chicago) tend to be more densely populated, making the cost of an advertisement a proxy for viewership. Thus, the median ad cost over an election allows us to account for the number of "eyeballs" viewing advertising throughout an election. In elections with higher estimated viewership, candidates may be particularly interested in advertising to

[20] In the analysis, we take the natural log of total ad volume.

[21] When we instead control for the presence of an incumbent in a race, we obtain the same insignificant coefficient for incumbency, and it does not alter the sign and magnitude of the estimated coefficient for Effective N.

promote their image. In larger (and more expensive) media markets, the probability of attracting national press is also much higher, and hence there are greater benefits to entry and possibly holding political office in such areas for those politicians seeking fame. Since broadcast stations by law cannot charge politicians differently than their standard rates, they also cannot charge different prices for negative and positive advertising. Hence to summarize, the median ad price is determined outside of the political process and is thus a market level shifter that possibly influences the incentive for entry. We note that the use of market size as an instrument for entry in imperfectly competitive markets was also used in a different context by Berry and Waldfogel (2006).

Another reason to enter a political primary, other than the exposure it provides, is to win the political office. Any factors that would make it less likely to win the general election would be a deterrence to entry. Our first instrument in this regard uses a unique feature of the political primary process - the existence of the opposing party's primary for the same political seat. If the opposing party is fielding an especially strong candidate, then it makes it less likely that anyone from a candidate's own party will succeed in the general election. Intuitively, if a strong candidate runs in the Democratic primary, this can deter entry in the Republican primary, as candidates may anticipate their low probability of winning the general election. To measure this, we construct the opposing party's Herfindahl-Hirschman Index (henceforth, HHI), a measure of concentration of the popular vote share across candidates. As HHI gets large, the popular vote is becoming more concentrated on a small number of candidates. Thus a more concentrated HHI captures the presence of a dominant candidate in the election.

There may be initial concern that the excluded party primary is not a valid "exclusion restriction," since if the Democrats are running a strong candidate, this might weaken the negativity in Republican advertising, as Republicans are internalizing their general election prospects. However, it is a commonly accepted wisdom that primary candidates do not internalize general election effects in their primary campaigning (i.e., they do not hold back on attacking for fear that the attack can be used against the primary opponent in the general election). This wisdom is consistent with Malhotra and Snowberg's (2010) finding that each state's presidential primary contest/campaign in the 2008 election did not change the probability a party would win the general election. Moreover, in the data we do not find evidence that the excluded party's HHI is related to negativity in a primary after controlling for the number of competitors.[22]

We finally consider the effects that one's own party can have on entry. For example, if the Republican party dominates the district, it is more likely to have strong candidates in the form of local party leaders, which will deter the entry of outsiders. To measure the dominance of a party in a district, we use a dummy variable for whether or not the party won the previous general election. This measure is quite different than there being an incumbent in the race:

[22]When we regress negativity on the number of candidates and opposing party HHI, the latter coefficient is insigificant. This relationship is also shown in Table 7.

conditional on the party that won the previous election, the politician that previously served only ran in the following primary 20 percent of the time in our data. Thus the instrument captures party strength in a district, not the existence of a strong incumbent in the race.

To summarize, Median Election Cost, Incumbent Party, and the opposing party's HHI constitute our instrument set. In Tables 6 and 7 we show the behavior of these IV's. In particular, Table 6 shows that the "first stage" results of regressing the number of competitors on the IV's all yield significant coefficients that go in the anticipated direction. Table 7 shows that none of the IV's appear to explain negativity when we control for the number of competitors. Thus the data support the theory that these variables serve as valid exclusion restrictions that are correlated with entry. We will also perform formal over-identifying tests for the validity of these instrumental variables in the analysis that follows.

Table 8 shows the effects of competition on negativity when we instrument for the "Effective N" number of candidates in a race. Both the unconditional effect and the partial effect tell the same basic story as before: doubling the number of competitors (from 2 to 4, say) leads to an absolute reduction in the probability of going negative of about 40-50 percent (that is, we go from a little over 40 percent chance of an ad being negative in a two person race to something closer to a 5 percent probability in 4 or more person races). These numbers tightly match the coefficients found in the previous regressions (i.e., columns (1) and (2) in Table 5). Notice that the results are robust even if we only use the market size instrument (i.e., median election cost). However, median cost on its own is not a particularly strong IV, giving larger standard errors, and thus the two remaining IV's that exploit the primary structure of the election tighten the estimates considerably. We also formally test for the exogeneity of the instrumental variables using a Sargan test for overidentification. In all specifications we fail to reject that the excluded variables are valid IV's, with a p-value of 0.851 in the specification including all three instruments.

A similar robustness result is seen by comparing just duopolies to non-duopolies. In Table 9, when we instrument for the duopoly indicator variable, we see that the coefficients from the relevant regressions from Table 5 (i.e., columns (3) and (4)) change very little. We continue to fail to reject the validity of the excluded variables as IV's, with a p-value of 0.763 for the case where we include all of our instruments.

Finally we note that these robustness results are not particular to the *Negative1* measure. In Table 10, we show the corresponding analysis for the *Negative4* measure, and the same phenomenon holds. The unconditional regressions replicate the effects found in Figure 3 and Table 4, and the controls and instruments do not fundamentally change the order of magnitude of the effect. The overidentifying tests for our IV's also fail to reject their validity as IV's.

5 Concluding Remarks

In this paper we provide a novel explanation for the high volume of negative advertising that is generally found in the U.S. political market. When the number of competitors in a market is greater than two, engaging in negative ads creates positive externalities to those opponents that are not the object of the attack. However political competition in the U.S. is largely characterized by "duopolies" (races with only two viable competitors, i.e. Republican versus Democrat), where this spillover effect is not present, thus creating a greater incentive for negative advertising.

Using primary elections in 2004 and the WiscAds data, we find that duopolies are two to four times more likely to use negativity in an advertisement than non-duopolies. In addition, adding just a handful of competitors drives the rate of negativity found in the data quite close to zero. These results show that the data is not just consistent with our theory in a directional sense, but the magnitude of the results suggest that this economic mechanism appears to have first order implications for why political markets are associated with producing more negativity than product markets (since political contests in the United States are more likely to be characterized by head to head duopoly competition than product markets). Our results have policy implications for the regulation of political contests. Consider for example campaign finance reform. If relaxing spending caps decreases the number of candidates entering races,[23] then an unintended consequence of such a policy would be an increase in the negative tone of the campaign advertising. Understanding the presence of such unintended consequences should help inform the policy debate on campaign finance reform and also the debate on controlling the amount of negativity in politics.

[23] See for example Iaryczover and Mattozzi (2010).

Figures

Figure 1: Top 100 Media Markets

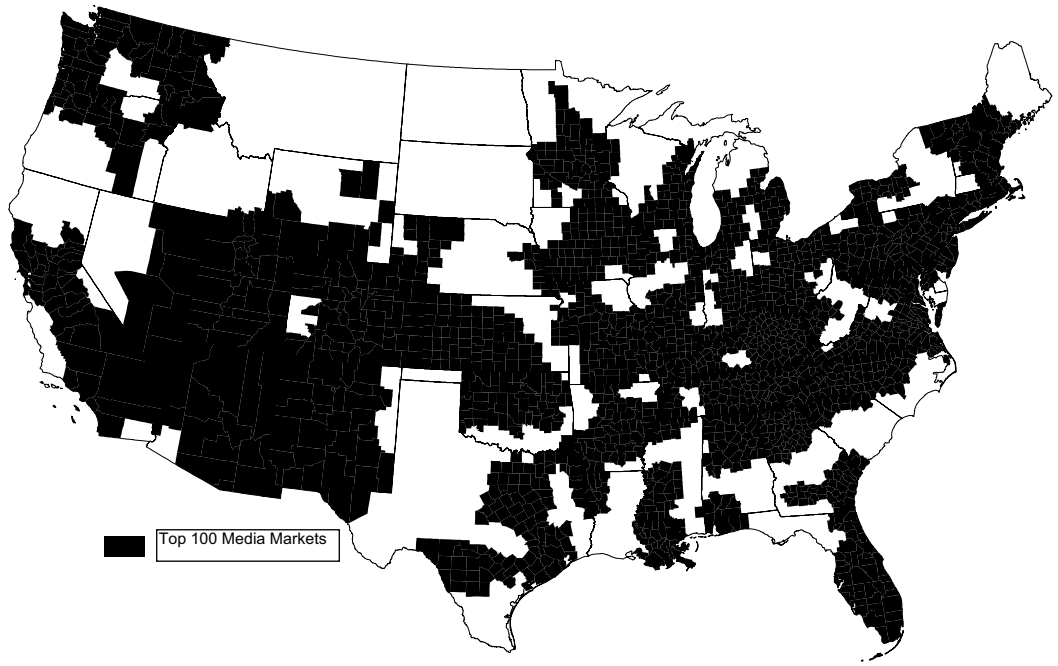


Figure 2: Frequency of Negative Ads with Two Candidates and more than Two Candidates

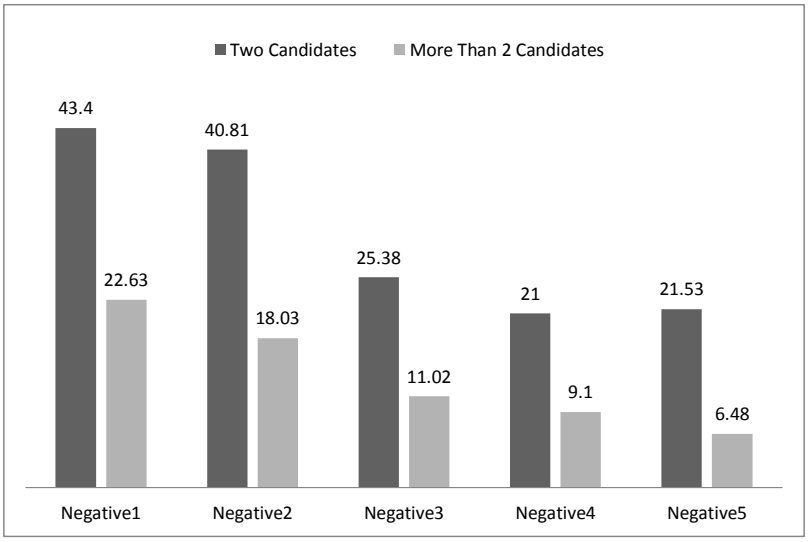
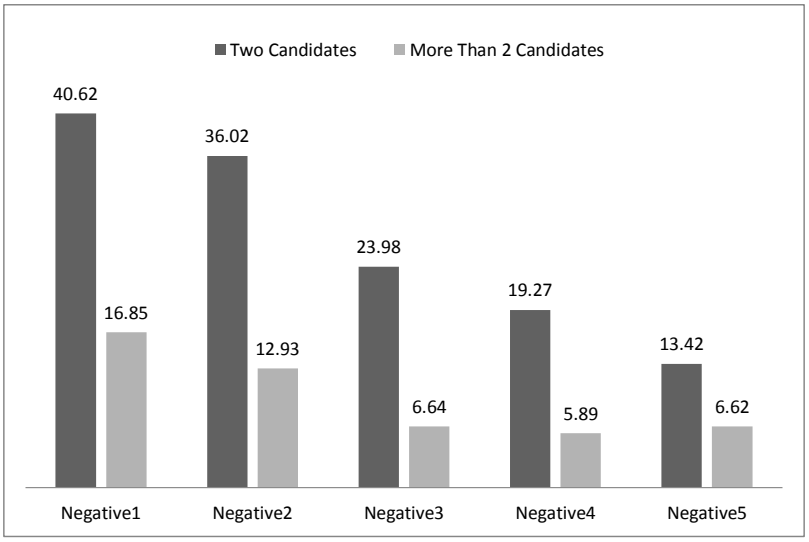


Figure 3: Frequency of Negative Ads with Two Effective Candidates and more than Two Effective Candidates



Tables

Table 1: Summary of Office by Number of Candidates

Candidates	Senate	House	Governor	Races
2	8	25	5	38
	21.0%	65.8%	13.2%	
3	5	17	3	25
	20.0%	68.0%	12.0%	
4	4	9	2	15
	26.7%	60.0%	13.3%	
5	1	3	0	4
	25.0%	75.0%	0.0%	
6	2	4	2	8
	25.0%	50.0%	25.0%	
7	1	2	0	3
	33.3%	66.7%	0%	
8	3	2	1	6
	50.0%	33.3%	16.7%	
9	1	0	1	2
	50.0%	0.0%	50.0%	
10	1	1	1	3
	33.3%	33.3%	33.3%	
Total Races	26	63	15	104

Table 2: Breakdown of Ads by Races

	Number of Ads	Percent of Total Ads
U.S. Senate	102,051	42.09
U.S. House	42,560	17.55
Governor	97,850	40.36
Total	242,461	

Table 3: Ballot N and Effective N

Ballot N	Frequency	Percent	Effective N	Frequency	Percent
1	0	0	1	1	0.96
2	38	36.54	2	49	47.12
3	25	24.04	3	28	26.92
4	15	14.42	4	16	15.38
5	4	3.85	5	6	5.77
6	8	7.69	6	3	2.88
7	3	2.88	7	1	0.96
8	6	5.77	8	0	0
9	2	1.92	9	0	0
10	3	2.88	10	0	0
Total	104	100	**Total**	104	100

Table 4: Percent of Negative Advertisements, using Effective N

Overall

	Negative1	Negative2	Negative3	Negative4	Negative5	Sample Size
	.2673	.2252	.1385	.1145	.0945	242,461

By Number of Candidates

	Negative1	Negative2	Negative3	Negative4	Negative5	Sample Size
2	0.4062	0.3602	0.2398	0.1927	0.1342	100,736
3	0.2779	0.2271	0.1273	0.1135	0.114	59,949
4	0.0865	0.0547	0.0226	0.0208	0.0281	73,957
5 or more	0.1058	0.0852	0.014	0.0014	0.0607	7,806
P-value	0.000	0.000	0.000	0.000	0.000	

Notes: All variables Negative1 through Negative 5 are dummies for whether or not the ad is "Negative" given the following specifications. Negative1 includes all ads that are attack ads or contrast ads. Negative2 encompasses all ads that attack for at least half of the airtime. Negative3 looks at attack ads and all contrast ads that end with an attack. Negative4 includes all ads that are only attack ads. Negative5 accounts for ads that attack for at least half of the airtime and are focused on personal issues rather than policy. P-value is the probability that percent of negative ads is equal across N.

Table 5: Raw Effects using Regression Framework

	(1) Negative1	(2) Negative1	(3) Negative1	(4) Negative1
log(Effective N)	-0.421***	-0.430***		
	(0.0955)	(0.107)		
Duopoly			0.238***	0.231***
			(0.0731)	(0.0842)
Incumbent		0.0441		0.0568
		(0.0467)		(0.0545)
Time until Election		-0.410***		-0.408
		(0.0645)		(0.0649)
Total Ad Volume		0.0886***		0.0831***
		(0.0251)		(0.0282)
Republican		0.105**		0.120*
		(0.0514)		(0.0633)
Governor		-0.0216		0.000220
		(0.0729)		(0.0877)
House		0.178***		0.165***
		(0.0453)		(0.0577)
N	242,448	242,448	242,448	242,448

Standard errors clustered at the election level in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Validity of IVs: First Stage Results

	log(Effective N)			**Duopoly**		
Median Cost	0.00074***	0.00069***	0.00072***	-0.00092***	-0.00084***	-0.0009***
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
HHI Opposing Party		-0.3007***	-0.3076***		0.4132***	0.4248**
		(0.0983)	(0.0835)		(0.1941)	(0.1673)
Incumbent Party			-0.1991***			0.3345***
			(0.0590)			(0.1007)
N	242,448	242,448	242,448	242,448	242,448	242,448

Robust standard errors clustered at the election level in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Validity of IVs

	(1)	(2)	(3)
	Negative1	Negative1	Negative1
log(Effective N)	-0.397***	-0.367***	-0.358***
	(0.0110)	(0.0806)	(0.0841)
Median Election Cost	-0.00012	-0.00012	-0.00013
	(0.00012)	(0.00012)	(0.00011)
HHI Opposing Party		0.0970	0.100
		(0.119)	(0.120)
Incumbent Party			0.0157
			(0.0581)
N	242,448	242,448	242,448

Robust standard errors clustered at the election level in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: IV Second Stage Results

	(1)	(2)	(3)	(4)	(5)	(6)
	Negative1	Negative1	Negative1	Negative1	Negative1	Negative1
log(Effective N)	-0.555***	-0.601***	-0.555***	-0.509**	-0.618**	-0.437***
	(0.126)	(0.167)	(0.150)	(0.237)	(0.247)	(0.165)
Incumbent				0.0155	-0.0245	0.0417
				(0.0937)	(0.0934)	(0.0625)
Time Until Election				-0.413***	-0.417***	-0.410***
				(0.0655)	(0.0655)	(0.0647)
Total Ad Volume				0.0915***	0.0957***	0.0888***
				(0.0253)	(0.0257)	(0.0259)
Republican				0.101*	0.0959*	0.105**
				(0.0541)	(0.0506)	(0.0509)
Governor				-0.0412	-0.0687	-0.0232
				(0.0934)	(0.0983)	(0.0863)
House				0.180***	0.184***	0.178***
				(0.0448)	(0.0480)	(0.0440)
N	242,448	242,448	242,448	242,448	242,448	242,448
Instruments used						
Median Election Cost	X	X	X	X	X	X
HHI Opposing Party	-	X	X	-	X	X
Incumbent Party	-	-	X	-	-	X
Hansen J Statistic	-	0.086	0.322	-	0.139	1.323
P-value	-	0.770	0.851	-	0.710	0.516

Robust standard errors clustered at the election level in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Duopoly Regression

	(1) Negative1	(2) Negative1	(3) Negative1	(4) Negative1	(5) Negative1	(6) Negative1
Duopoly	0.448***	0.468***	0.386***	0.604	0.503**	0.295**
	(0.160)	(0.154)	(0.112)	(0.406)	(0.250)	(0.125)
Incumbent				-0.177	-0.114	0.0162
				(0.269)	(0.160)	(0.0789)
Time Until Election				-0.434***	-0.427***	-0.413***
				(0.0707)	(0.0674)	(0.0649)
Total Ad Volume				0.101***	0.0959***	0.0862***
				(0.0349)	(0.0308)	(0.0276)
Republican				0.112	0.114	0.119*
				(0.0865)	(0.0752)	(0.0642)
Governor				-0.140	-0.102	-0.0241
				(0.180)	(0.137)	(0.0984)
House				0.170**	0.169**	0.166***
				(0.0832)	(0.0736)	(0.0591)
N	242,448	242,448	242,448	242,448	242,448	242,448
Instruments used						
Median Election Cost	X	X	X	X	X	X
HHI Opposing Party	-	X	X	-	X	X
Incumbent Party	-	-	X	-	-	X
Hansen J Statistic	-	0.021	0.540	-	0.055	2.323
P-value	-	0.885	0.763	-	0.815	0.313

Robust standard errors clustered at the election level in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Least Squares and IV Results using Negative4

	(1) Negative4 OLS	(2) Negative4 OLS	(3) Negative4 IV	(4) Negative4 IV
log(Effective N)	-0.210***			-0.253***
	(0.0656)			(0.0971)
Duopoly		0.108**	0.167**	
		(0.0486)	(0.0733)	
Incumbent	0.0595**	0.0687**	0.0316	0.0439
	(0.0286)	(0.0316)	(0.0419)	(0.0304)
Days Until Election	-0.150***	-0.149***	-0.153***	-0.152***
	(0.0368)	(0.0374)	(0.0361)	(0.0360)
Total Ad Volume	0.0608***	0.0579***	0.0607***	0.0624***
	(0.0154)	(0.0170)	(0.0162)	(0.0152)
Republican	0.0495	0.0571	0.0558	0.0475
	(0.0316)	(0.0374)	(0.0377)	(0.0306)
Governor	0.0118	0.0242	0.00209	0.00115
	(0.0462)	(0.0511)	(0.0569)	(0.0523)
House	0.117***	0.111***	0.112***	0.118***
	(0.0295)	(0.0363)	(0.0392)	(0.0296)
Constant	-0.189*	-0.436***	-0.468***	-0.151
	(0.104)	(0.148)	(0.145)	(0.118)
N	242,448	242,448	242,448	242,448
Instruments used				
Median Election Cost	-	-	X	X
HHI Opposing Party	-	-	X	X
Incumbent Party	-	-	X	X
Hansen J Statistic	-	-	3.095	1.500
P-value	-	-	0.213	0.472

Robust standard errors clustered at the election level in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Comparison of Linear Probability and Logit

	OLS	Logit	OLS	Logit	OLS	Logit	OLS	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Negative1	Negative1	Negative1	Negative1	Negative1	Negative1	Negative1	Negative1
log(Effective N)	-0.421***	-0.438***	-0.397***	-0.448***				
	(0.0955)	(0.103)	(0.112)	(0.109)				
Duopoly					0.238***	0.238***	0.231**	0.219***
					(0.0731)	(0.0731)	(0.0842)	(0.0839)
Incumbent			0.0735	0.0260			0.0844	0.0563
			(0.0499)	(0.0564)			(0.0587)	(0.0617)
Time Until Election			-0.000416	-0.000522*			-0.000470*	-0.000537*
			(0.000253)	(0.000295)			(0.000258)	(0.000297)
Total Ad Volume			0.108***	0.134***			0.105***	0.128***
			(0.0299)	(0.0397)			(0.0328)	(0.0449)
Republican			0.106**	0.124**			0.120*	0.137**
			(0.0514)	(0.0541)			(0.0624)	(0.0667)
Governor			0.0664	0.0680			0.0975	0.114
			(0.0917)	(0.0990)			(0.105)	(0.116)
House			0.216***	0.312***			0.209***	0.307***
			(0.0497)	(0.0777)			(0.0597)	(0.0971)
N	242,448	242,448	242,448	242,448	242,461	242,461	242,461	242,461

Marginal effects reported; Standard errors clustered at the election level in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Appendix

We first show that if $\alpha = \beta$ and $L = 2$ then P_i and N_i^j approach $\frac{1}{2}$ when η is arbitrarily small. The problem for candidate $k = 1$ is

$$\max_{(P1,N_1^2)} \frac{\Pi_{1_0}\left(\frac{P_1}{\eta+N_2^1}\right)^\alpha}{\Pi_{1_0}\left(\frac{P_1}{\eta+N_2^1}\right)^\alpha + \Pi_{2_0}\left(\frac{P_2}{\eta+N_1^2}\right)^\alpha} \text{ s.t. } P_1 + N_1^2 = 1, \tag{3}$$

and similarly for candidate $k = 2$. By substituting in the budget constraints we get

$$\max_{P_1} \frac{1}{1+\frac{\Pi_{2_0}}{\Pi_{1_0}}\left(\frac{P_2(\eta+1-P_2)}{P_1(\eta+1-P_1)}\right)^\alpha}$$
$$\max_{P_2} \frac{1}{1+\frac{\Pi_{1_0}}{\Pi_{2_0}}\left(\frac{P_1(\eta+1-P_1)}{P_2(\eta+1-P_2)}\right)^\alpha}.$$

Note that the objectives are globally concave in P_1 and P_2, respectively. Furthermore they attain a unique maximum at

$$P_i = \frac{1+\eta}{2} \text{ and } N_i^j = \frac{1-\eta}{2}.$$

This result shows that when η is small a candidate is almost indifferent between engaging in positive or negative advertising in a two-candidate race. We next show that this is not the case in a three-candidate race. Namely, $P_i > N_i^j$ when $L = 3$, even if $\alpha = \beta$. After substituting in the budget constraint, the problem for candidate $k = 1$ is

$$\max_{(P_1,N_1^2)} \frac{\Pi_{1_0}\left(\frac{P_1}{\eta+N_2^1+N_3^1}\right)^\alpha}{\Pi_{1_0}\left(\frac{P_1}{\eta+N_2^1+N_3^1}\right)^\alpha + \Pi_{2_0}\left(\frac{P_2}{\eta+N_1^2+N_3^2}\right)^\alpha + \Pi_{3_0}\left(\frac{P_3}{\eta+\left(1-P_1-N_1^2\right)+N_2^3}\right)^\alpha} \tag{4}$$

and similarly for candidates $k = 2, 3$.

The comparison between the vote share of candidate 1 (Π_1) in (3) and (4) highlights the spillover effect that rises when $N = 3$. For example, it is immediate to see that in (3) Π_1 is decreasing in N_2^1 . On the contrary, in (4) Π_1 still decreases in N_2^1 and N_3^1, but it increases in N_2^3 and N_3^2, which are the spillover effects of negative ads made by candidate 2 against candidate 3, and vice-versa.

By letting $\Pi_{1_0} = \Pi_{2_0} = \Pi_{3_0}$, and $\left(\frac{P_1}{\eta+N_2^1+N_3^1}\right)^\alpha + \left(\frac{P_2}{\eta+N_1^2+N_3^2}\right)^\alpha + \left(\frac{P_3}{\eta+\left(1-P_1-N_1^2\right)+N_2^3}\right)^\alpha = D$, we can rewrite (4) as[24]

[24]Assuming symmetry in the ex-ante market share and budget simplifies the exposition, but it is not needed for our results.

$$\max_{(P_1,N_1^2)} \frac{\left(\frac{P_1}{\eta+N_2^1+N_3^1}\right)^\alpha}{D\left(\cdot\right)}.$$

Taking the first order condition with respect to P_1 we obtain,

$$\frac{\alpha\left(\frac{P_1}{\eta+N_2^1+N_3^1}\right)^\alpha \frac{1}{P_1} D - \alpha\left(\left(\frac{P_1}{\eta+N_2^1+N_3^1}\right)^\alpha \frac{1}{P_1} + \left(\frac{P_3}{\eta+\left(1-P_1-N_1^2\right)+N_2^3}\right)^\alpha \frac{1}{\eta+\left(1-P_1-N_1^2\right)+N_2^3}\right)\left(\frac{P_1}{\eta+N_2^1+N_3^1}\right)^\alpha}{D^2} = 0,$$

which can be rewritten as,

$$\frac{\alpha\left(\frac{P_1}{\eta+N_2^1+N_3^1}\right)^\alpha \left(\frac{1}{P_1} D - \left(\frac{P_1}{\eta+N_2^1+N_3^1}\right)^\alpha \frac{1}{P_1} - \left(\frac{P_3}{\eta+\left(1-P_1-N_1^2\right)+N_2^3}\right)^\alpha \frac{1}{\eta+\left(1-P_1-N_1^2\right)+N_2^3}\right)}{D^2} = 0.$$

Since $P = 0$ cannot be optimal in equilibrium, $\alpha\left(P_1/(\eta + N_2^1 + N_3^1)\right)^\alpha > 0$ and can be neglected. Furthermore, in the symmetric equilibrium, $D = 3\left(P/(\eta + 2N)\right)^\alpha$. Hence,

$$\left(\frac{P}{\eta+2N}\right)^\alpha \left(\frac{2}{P} - \frac{1}{\eta+1-P}\right) = 0.$$

Therefore, $P_i = \frac{2+2\eta}{3}$ and $N_i^j = \frac{1-\eta}{6}$ for all i. It is easy to also show that the second first order condition with respect to N_1^2 is satisfied.