Targeted media bias and voting

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Abstract

This paper investigates the effect of a tailored news report and its targeted release by a politically biased firm on the equilibrium level of media bias with heterogeneous voters. Targeted media strategies include selective information disclosure and audience targeting, with audience targeting being a novel method of distorting information to voters. When the media firm cannot commit to either strategy, targeted media provides less media bias than traditional media. With full commitment in both strategies, however, targeted media does not necessarily generate more media bias because selective audience targeting may be more effective in channeling the bias.

Keywords: media bias, targeted media, disclosure, audience targeting, voting, commitment

JEL classification: D72, D83, L82

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1 Introduction

In many elections, especially nation-wide presidential elections with large electorates, voters usually lack comprehensive information about candidate's quality and suitability for office. The media, which is more efficient at searching for, uncovering, and disseminating information, is generally regarded as a provider of such information. While acquiring such information is vital for informed voting, the bias of media outlets is widely recognized to persist despite society's awareness of its existence. In recent years, the role of social media in the persistence of biased news is being inspected under microscope.

Social media use has been expanding rapidly over the world. The number of Facebook monthly active users rose to around 2.45 billion as of September 2019(Facebook, 2019), and Twitter active users rose to around 0.330 billion as of March 2019(Twitter, 2019). Given this pervasiveness, the channel of news feeds has shifted its weight from traditional media such as newspapers, radio and television to online platforms, especially social media platforms. The growing traffic raises concerns about biased news reports on social media. Allcott and Gentzkow (2017) uses a post-election online survey to study the level of exposure to fake news among US citizens before the election. Compared with mainstream news sites, fake news sites rely heavily on social media. The authors find that 15% of survey respondents recalled seeing fake stories and among them more than half claimed they believed the stories to be true.

There are several features of social media that distinguish it from traditional media in the context of media bias: (1) the entry cost into social media is relatively low (Allcott and Gentzkow, 2017; Madrigal, 2017), (2) the media outlet can provide politically targeted information to a select group of voters (Dutton et al., 2017; Lazer et al., 2018), and (3) the friend networks on these platforms are ideologically segregated such that there is little information sharing among people having different political preferences which makes the targeted news release effective (Bakshy et al., 2015; Dubois and Blank, 2018).

To understand the effect of social media on media bias, I develop a model to study how the interaction of media bias and targeted news release affect voter behavior and welfare under. I compare it with traditional media that cannot easily tailor news reports to selective ideological groups. The novel feature of my model compared to existing papers on media bias is the added dimension of audience targeting in the action space for targeted media versus traditional media firms. A targeted media firm maximizes its media bias – in terms of swinging voters toward a certain candidate – under full commitment because the firm can better refine disclosure roles for each voter type and exploit the null signal to its advantage.

Under no commitment, the targeted media firm would continue targeting the same ideological group of voters, but would truthfully report new stories in equilibrium because the added dimension of audience targeting makes voters more skeptical about media bias strategies. In contrast, the traditional media firm is generally biased (i.e. tailors news reports) depending on the distribution of voter ideology under full commitment. Under no commitment, the traditional media will have some amount of bias in their disclosure rule in equilibrium.

In the framework of this paper, voters try to get more information about the state to make an informed vote. What matters to each voter is the state that would make her change the vote. With voters of heterogeneous ideologies, they would seek information on different states. Hence a biased media firm would have aligned interests with some voters and conflicting ones with others. A targeted media firm would target voters with aligned interests under full commitment and they can design the disclosure rule for each type to maximize the persuasion probability while keeping the null signal persuasive. Since traditional news firm cannot tailor the news report for each type, the disclosure strategies depending on relative proportion of the two groups. When the firm cannot commit to its strategies, voters would be more skeptical of targeted media due to audience targeting and hence targeted media cannot use null signal to persuade and would truthfully report to the aligned interest voters instead. Traditional media, however, would find it not beneficial to truthfully report because voters with conflicting interests would also learn about the state.

There is an concern that targeted media would bring more biased news reports because they can target and tailor them. I show that this is no necessarily true especially when the firm cannot commit to its strategies. With the popularity of social media, some small news sites started to receive an audience. Unlike larger news outlets, small media firms do not have a long standing reputation about their political biases or an established target audience. I frame this as media firms having different commitment power over their strategies. A general wisdom is that commitment would benefit the sender. I show that this does not necessarily translate to more biased news even when the sender is biased. When considering the effect of both commitment and audience targeting altogether, commitment would change how we compare the media bias between targeted and traditional media. I also show that commitment in disclosure rule is more crucial in shaping firm strategies.

The remainder of the paper proceeds as follows. Section 2 discusses about the related literature. Section 3 sets up the model. Section 4 gives the equilibrium strategies of both targeted and traditional media under no commitment. Section 5 discusses the role of commitment. Section 6 considers possible extensions. Section 7 concludes. All proofs are in

Appendix A.

2 Related Literature

The persistence of media bias and the effect of competition on these biases have been widely investigated (Gentzkow et al., 2016). Papers on this topic have considered several cases, like homogeneous versus heterogeneous viewers, viewer preferences for truth over their own ideology, media firms' profit and political motives, the effect of competition and entry and the impact of mergers. Mullainathan and Shleifer (2005) considers equilibrium media bias with homogeneous and heterogeneous readers in terms of their prior beliefs using a location model. They show that competition results in lower price but more biased news catering to the ideologies of different reader groups. Voter welfare, however, increases if they can access information from both media firms to obtain an unbiased picture of events. Anand et al. (2007) also considers the effect of competition on media bias using a location model with costly entry. They find that while competition cannot reduce media bias, increase in verifiability can. In contrast to these papers, voters in my model also feature a similar preference with one dimension being their own ideologies but they do not enjoy the content or bias of the news itself. Instead of consuming the content directly, voters use the news report or lack thereof to make an inference about the state of the world. I only consider one news outlet as a sender in this paper and ignore the effect of competition for now.

The idea that utility of sincere voters decreases with the distance between voting decision and the true state or between voting decision and one's own ideology is standard in the literature on media bias and voting. Bernhardt et al. (2008) discusses the effect of media bias on voters when media firms commit to their selective information disclosure policy for negative news on either candidate. Since reading the news has a time cost, voters choose news stories that are more enjoyable to read – that is, news reports closer to their own ideological position. Purely profit-driven media firms would provide biased news reports to increase readership leading to more polarized electoral outcomes. Anderson and McLaren (2012) considers homogeneous viewers with the same preferences and prior beliefs with utility determined by an unknown state on which firms have private information. The authors show that competition would increase consumer welfare by decreasing news report price but a ban on media mergers may also increase consumer welfare by maintaining diversified reports from media firms with different political preferences. Chan and Suen (2008) finds that more consumption of informative news lead to less partisan candidate policies but also created more biased media

outlets to attract voters with extreme views. Voter welfare is also higher under competition. In contrast, I focus on the strategy of a monopoly firm that provides news free of charge.

Several papers specifically consider the effect of media bias on voting behavior and associated polarization. Gal-Or et al. (2012) investigates the role of hosting advertisements on media firms' incentive to increase readership and choice of political slant. The authors show that, since media firms rely on ad revenues alongside viewer subscription fees, advertisers may drive media firms to provide more partisan news and generate greater polarization when viewers are more heterogeneous. Levy and Razin (2015) builds a model where voters underestimate the correlation between their information sources and shows that this correlation neglect can be beneficial for information aggregation and that the whole electorate may reach better and more informed outcomes despite individual sub-optimality. In contrast, my model assumes voters process information fully rationally and the focus is on the level of media instead of polarization. As voters process information fully rationally and in the same way, the results driven by profit motive are straightforward and I will focus on the political motive.

Other literature more specifically apply Bayesian persuasion to study news report on voting. Alonso and Câmara (2016b) consider a monopoly politician strategically designing a policy experiment (a public signal) to be observed by a small number of voters with heterogeneous preferences. The politician can influence the voting by forming different coalitions among voters. The authors characterize the voter preferences over different electoral rules. On the one hand, voters do not want excessive rejection of the proposal; on the other hand, they want the the politician to provide more information. Alonso and Câmara (2016a) extends Bayesian persuasion to the case where the sender and receiver have different priors. Instead of a discrete number of voters and strategic voting, I consider a continuum of voters and sincere voting, which is more plausible in the motivation of national elections. I also analyze firm's strategies under both no commitment and full commitment settings.

In the literature on media bias, none of them considers how audience targeting and tailored news reports could affect firm's disclosure strategies and the level of media bias. The targeting feature is mainly discussed in the literature on online privacy and advertising in two-sided markets. Bergemann and Bonatti (2011) models target ability as accuracy of the match between the firm and its viewers and finds a non-monotonic relationship between of the advertising price and targeting ability, and characterizes the impact of targeting under competitive equilibrium. Since they model targeting as a way to create a desirable match, social welfare increases in their framework. Hoffmann et al. (2017) considers equilibrium persuasion through selective disclosure based on information the sender collects about the

receiver's preferences. They consider competition effect and whether receivers are naive or sophisticated. The receiver in their model is interested in the value of two attributes, but the informed sender can only disclose one of them. The selective disclosure of these two attributes can benefit from targeting when receivers have different values for both attributes. In this paper, I will combine audience targeting and selective disclosure and study the effect of targeting on media bias. The targeting in advertising literature is quite different from my model in terms of the goal of the firm and how targeting is implemented.

3 Model

A mass one of voters are faced with two political candidates L and R in an election. The candidates' relative quality is captured by the state $\omega \in \Omega = \{-1, 1\}$, where candidate L is better suited for office in state $\omega = -1$ and conversely candidate R is better is state $\omega = 1$. Voters cast their votes sincerely, as no one voter can affect the election outcome alone. Voters care about both the relative capability of the two candidates and their own ideological preferences. Each voter knows his/her own ideology but is uncertain about the candidates' qualifications. A media firm privately observes an informative signal about the state and can strategically releases news reports to a selectively targeted group of voters.

3.1 Voter utility

Voters are heterogeneous in their ideological position θ, which is distributed according to $F(\theta)$ on the interval $\Theta = [-1, 1]$, where there is no gap or atom in $F(\theta)$. Larger θ represents greater preference for candidate R. Each voter makes the voting decision, $a \in \mathbb{A} = \{-1, 0, 1\}$, where $a = -1$ represents voting for L, $a = 1$ for R, and $a = 0$ for staying home or abstention. The *ex-post* utility of voter θ depends on both her action a and state ω:

$$u_\theta(a, \omega) = -(a - \theta)^2 - \beta(a - \omega)^2,$$

where $\beta \in (0, \frac{1}{2})$ is the relative weight voters place on voting for the more capable candidate compared to voting for their ideological preference. Given a certain state, voters with extreme ideologies will vote for their favorite candidate while voters with more neutral preferences will stay home. The restriction $\beta < \frac{1}{2}$ simply ensures that voters with extreme ideological preferences will vote for their favorite candidate regardless of the candidates' relative qualifications. The quadratic loss functional form provides tractability for our analysis and also

reflects the fact that voting is costly compared with abstention. Voters stay home when they do not have a strong preference towards either candidate or when they do not have a good knowledge of relative candidate quality.

Voters know their own ideological type θ but do not know the true state ω. Assume that all voters have a common prior about the state $\mu \equiv \Pr(\omega = 1)$. Arguably voters could also have heterogeneous beliefs about candidates' qualifications. Section 6 shows that incorporating heterogeneous beliefs about voter ideology does not materially alter the results of the analysis. Voters update their beliefs about the state after the media's news reports. Voter θ has belief $p_\theta = \Pr_\theta(\omega = 1|E)$ about the state being $\omega = 1$, where E is some event that may affect the voter's belief. The *ex-ante* expected utility of choosing action a is

$$U_\theta(a, p_\theta) = -(1+\beta)a^2 + 2[\theta + \beta(2p_\theta - 1)]a - \theta^2 - \beta.$$

Let $h(p_\theta) = \beta(1-2p_\theta)$ denote the distribution of votes among voters who have the same belief $p_\theta$with cutoffs $\underline{h}(p_\theta) = h(p_\theta) - \frac{1+\beta}{2}$ and $\bar{h}(p_\theta) = h(p_\theta) + \frac{1+\beta}{2}$.

Lemma 1. *The optimal action and the maximized expected utility for a voter of type θ and belief p_θ is*

$$a^*_\theta(p_\theta) = \begin{cases} 1 & \text{if } \theta \geq \bar{h}(p_\theta) \\ 0 & \text{if } \underline{h}(p_\theta) < \theta < \bar{h}(p_\theta) \\ -1 & \text{if } \theta \leq \underline{h}(p_\theta), \end{cases}$$

$$u^*_\theta(p_\theta) = \begin{cases} -(1-\theta)^2 - 4\beta(1-p_\theta) & \text{if } \theta \geq \bar{h}(p_\theta) \\ -\theta^2 - \beta & \text{if } \underline{h}(p_\theta) < \theta < \bar{h}(p_\theta) \\ -(1+\theta)^2 - 4\beta p_\theta & \text{if } \theta \leq \underline{h}(p_\theta). \end{cases}$$

This lemma characterizes voter strategy given belief p_θ. Given the cutoffs of the distribution of votes among voters with the same belief, we can see that middle types will stay home while those with more extreme ideologies will vote according to their preferences. The positions of these cutoffs are also affected by their belief about the state.

3.2 Media firm

The media firm searches for information about the state and may privately observe an informative signal. Media bias emerges when the firm does not fully and truthfully report the

signal. In this paper, I consider media bias as a strategic disclosure of information. An informative signal arrives with some probability and the firm cannot manipulate it but can hide it. This form of bias is particularly related to audience targeting because voters that receive no news need to infer about whether or not they are in the targeted audience group. This is because, when a voter receives no news, there are three possibilities: it could be that there was no informative signal received by the media firm, the firm is hiding it, or that the voter is not in the target group.

The media firm holds the same common prior μ about the state. It also receives a signal $s \in \mathbb{S} = \{-1, 0, 1\}$ about the state, where $s = 0$ means that the news is uninformative of the state (null signal) and the firm receives such signal with probability $1 - \pi$ regardless of the state, i.e. $\Pr(s = 0) = \Pr(s = 0|\omega = 1) = \Pr(s = 0|\omega = -1) = 1 - \pi$. With probability π, the firm receives an informative signal with exogenous precision $\rho > \frac{1}{2}$ such that $\Pr(s = \omega|\omega, s \neq 0) = \rho$. Based on the observed signal, the firm can write a report $r \in \mathbb{S}$ and release the report to a selected group of voters. The firm can only choose whether to disclose an informative signal, i.e. $r|s \in \mathbb{S}_s = \{s\} \cup \{0\}$, where $r = 0$ means that the firm does not release any news. This applies when the news is easily verifiable such that any lie can be detected. The firm observes the ideological type of each voter and chooses a target audience group $T \subseteq \Theta$ and a selective disclosure policy for each type $D_T : T \times \mathbb{S} \to \triangle\mathbb{S}$, i.e. $D_T = \{D_\theta : \mathbb{S} \to \triangle\mathbb{S} | \theta \in T\}$. Specifically, we can express the disclosure rule in terms of media bias. For each type $\theta \in T$, the firm chooses $(b_L^\theta, b_R^\theta) = (\Pr(r = 0|s = 1, \theta), \Pr(r = 0|s = -1, \theta))$, where b_L^θ is left media bias and represents the probability that the firm hides a signal favorable to candidate R and vice versa for b_R^θ. In contrast, the strategy profile of traditional media only consists of the disclosure rule $D : \mathbb{S} \to \triangle\mathbb{S}$ independent of type θ such that all voter types receive the same report. Specifically, the firm chooses $(b_L, b_R) = (\Pr(r = 0|s = 1), \Pr(r = 0|s = -1))$. In defining strategies of the media firm, the choice of target group T does not depend on the realization of the signal s. This corresponds to the case where a media firm always reports news for a fixed group of viewers. In the extension, I will also discuss the case where the choice of target group could be contingent on the observed signal s. Additionally, assume also that the firm has a limited budget and can only release news reports to a sufficiently small measure M of the voter population. Let targeted media choose its target group of measure $M \ll 1$ and let traditional media reach a measure M randomly.

A strategy of voter θ is $v_\theta : \mathbb{S} \to \triangle\mathbb{A}$ such that, for each report $r \in \mathbb{S}$ she reads, she makes a voting decision. In the following analysis, "shift right" refers to voters switching from voting L to abstention and from abstention to voting R, and "shift left" refers to voters

switching from voting R to abstention and from abstention to vote L.

A media firm could have two objectives: maximize the readership (profit motive) and maximize the share of votes to its preferred candidate (political motive). In this paper, I mainly consider equilibrium firm strategy (or equilibrium bias) under the political motive. In terms of political preference, let us consider without loss of generality that the firm favors candidate R, and it will maximize the probability of voters shifting right in the population. For the profit motive, the firm maximizes the probability that voters read its news report and hence target the types most likely to read the news upon receipt when faced with a fixed budget. The choice of target group and disclosure rule is straightforward under my setting with fully rational voters.

3.3 Equilibrium

The main question I would like to answer is whether targeted media induces higher levels of media bias than traditional media. One crucial condition affecting the media firm's equilibrium behavior is whether it can commit to its strategies *ex ante*. I compare the equilibrium strategies of targeted media and traditional media under both the case of no commitment and that of full commitment. Considering that targeted media can employ both selective disclosure and audience targeting, I also discuss the partial commitment case where the firm can only commit to one of the two dimensions. The timing of the game for targeted media with full commitment to both target group and disclosure rule is as follows. For the no commitment case, there is no first stage. For partial commitment, the firm only commits to the specific dimension in the first stage.

1. The firm commits to target group T and disclosure policy D_T.
2. The firm observes signal realization s and releases news report r to the target group following the disclosure rule.
3. All voters update their beliefs and make their voting decision.
4. The state is realized and both parties receive their payoffs determined by the realized state ω and voters' actions a.

I further impose the following two assumptions on tie-breaking rules to simplify the analysis. These two assumptions only concern marginal cases and are not essential to the underlying mechanism of the results. However, they are useful for removing some uninteresting equilibria. The first assumption means the media firm will not add a slant to its news report if there

is no benefit from doing so, such that any equilibrium bias is meaningful to the firm. The second assumption ensures we can properly define the equilibrium concerning the marginal case that the tie breaks in favor of the firm.

Assumption 1. *Whenever the firm is indifferent between reporting biased news and unbiased news, it always reports truthfully.*

Assumption 2. *Whenever the voter is indifferent between voting R and abstention, they will vote R; whenever the voter is indifferent between abstention and voting L, they will stay home.*

I use the Perfect Bayesian Equilibrium (PBE) solution concept when there is no full commitment or partial commitment. A firm strategy $\sigma = (T, D_T)$ associates with a target group $T \subseteq \Theta$ and for each type $\theta \in T$ a disclosure rule $D_\theta : \mathbb{S} \to \triangle\mathbb{S}$ such that $D_T = \{D_\theta | \theta \in T\}$. A strategy of voter θ is $\tau_\theta : \mathbb{S} \to \triangle\mathbb{A}$ such that for each report $r \in \mathbb{S}$ she reads, she makes voting decision. The full set of voter strategies is $\tau = \{\tau_\theta | \theta \in \Theta\}$. A belief updating rule of voter θ is $\nu_\theta : \mathbb{S} \to \triangle\Omega$ such that the voter updates her beliefs after each report she reads. A full belief system is $\nu = \{\nu_\theta | \theta \in \Theta\}$ with $\nu_\theta(r) = \Pr(\omega = 1|r)$. An equilibrium is a triple (σ, τ, ν) such that

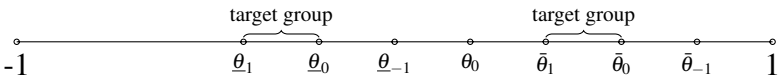
1. σ maximizes the firm's objective function given voter strategies τ.
2. τ maximizes the utility of each voter type given firm strategy σ and beliefs ν.
3. ν is obtained from μ given firm strategy σ using Bayes' rule whenever possible.

4 No Commitment

4.1 Choice of the target group

First I discuss the choice of target group by the media firm. For now suppose the firm can only truthfully report the signal, i.e. $r|s = \{s\}$, and the firm commits to target group choice in the first stage. Define $\underline{\theta}_0 = \underline{h}(\mu)$ and $\bar{\theta}_0 = \bar{h}(\mu)$ as the cutoff types where voters switch between voting L and abstention and between abstention and voting R. Define $x \equiv \Pr(s = 1|s \neq 0) = \mu\rho + (1-\mu)(1-\rho)$ as the probability of the firm receiving signal $s = 1$ conditional on the

Figure 1: Targeting under truthful reporting



received signal being informative. The posterior beliefs of both the firm and voters are

$$\begin{aligned} \nu(1) &= \frac{\mu\rho}{x}, \\ \nu(-1) &= \frac{\mu(1-\rho)}{1-x}, \\ \nu(0) &= \mu, \end{aligned}$$

and the probability of receiving each type of news is

$$\begin{aligned} \Pr(s=1) &= \pi x, \\ \Pr(s=-1) &= \pi(1-x), \\ \Pr(s=1) &= 1-\pi. \end{aligned}$$

Define $\underline{\theta}_{-1} = \underline{h}(\nu(1))$ and $\bar{\theta}_{-1} = \bar{h}(\nu(1))$ as the cutoff types under truthful reporting signal $s=-1$. Define $\underline{\theta}_1 = \underline{h}(\nu(-1))$ and $\bar{\theta}_1 = \bar{h}(\nu(-1))$ as the cutoff types under truthful reporting signal $s=1$. When the firm can only truthfully report the signal, every voter in the target group has the same posterior belief. In addition, if a voter receives no news, her posterior belief will remain her prior regardless of whether she is in the target group or not. If she is targeted, no news would indicate the firm received an uninformative signal; if she is not targeted, she will never receive news regardless. The firm can only affect voters through releasing an informative signal. Voters within $[\underline{\theta}_1, \underline{\theta}_0)$ and $[\bar{\theta}_1, \bar{\theta}_0)$ will shift right upon seeing pro-R news and will not change their actions from pro-L news. Voters within $[\underline{\theta}_0, \underline{\theta}_{-1})$ and $[\bar{\theta}_0, \bar{\theta}_{-1})$ will shift left upon seeing pro-L news and will not change their actions from pro-R news. Hence, when the firm chooses the target group in the first stage, it will target voters $[\underline{\theta}_1, \underline{\theta}_0)$ and $[\bar{\theta}_1, \bar{\theta}_0)$ who can be persuaded to shift right. We therefore have the following lemma also illustrated in Figure 1.

Lemma 2. *When the firm can only report truthfully and the target group is chosen in the first stage, the firm will target any left-leaning voters within* $[\underline{\theta}_1, \underline{\theta}_0)$ *or right-leaning voters within* $[\bar{\theta}_1, \bar{\theta}_0)$.

Voters within $[\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ will shift right when they receive pro-R news and not

change their actions otherwise. The firm is indifferent targeting any voter in these ranges given the measure M of targeted voters allowed by the budget.

4.2 Perfect Bayesian equilibrium

Now consider the full game where the media firm cannot commit. For now assume that the firm can only choose the same target group for all possible signals it may receive, i.e. $T(s) = T, \forall s \in \mathbb{S}$. I show in the first extension that this assumption is without loss of generality for the targeted media. We will reach the same conclusion for all cases with or without commitment if we assume that the firm can choose different target group for different signals it may receive, i.e. $T(s)$ may be different for different $s \in \mathbb{S}$. As the firm cannot fabricate informative news, any posterior belief upon receiving an informative signal will be the same as under truthful reporting. The focus is how voters both inside and outside the target group would infer no news as now no news could be due to not being in the target group, the firm getting a null signal or the firm hiding it and how the firm would react by choosing who to target and how to disclose. For voter of type θ, the posterior belief given the disclosure rule is

$$\begin{aligned}
\nu_\theta(1|b_L^\theta, b_R^\theta) &= \frac{\mu\rho}{x}, \\
\nu_\theta(-1|b_L^\theta, b_R^\theta) &= \frac{\mu(1-\rho)}{1-x}, \\
\nu_\theta(0|b_L^\theta, b_R^\theta) &= \mu\frac{(1-\pi)+\pi[\rho b_L^\theta + (1-\rho)b_R^\theta]}{1-\pi+\pi[xb_L^\theta + (1-x)b_R^\theta]}.
\end{aligned}$$

The probability of type θ receiving each signal is

$$\begin{aligned}
\Pr(r=1|\theta, b_L^\theta, b_R^\theta) &= \pi x(1-b_L^\theta), \\
\Pr(r=-1|\theta, b_L^\theta, b_R^\theta) &= \pi(1-x)(1-b_R^\theta), \\
\Pr(r=0|\theta, b_L^\theta, b_R^\theta) &= 1-\pi+\pi[xb_L^\theta + (1-x)b_R^\theta].
\end{aligned}$$

Given the posterior belief of voters, define the middle type compared with θ_0 under prior

belief μ

$$\begin{aligned} z(b_L^\theta, b_R^\theta) &\equiv h(\nu(0|\theta, b_L^\theta, b_R^\theta)) \\ &= \beta \frac{(1-2\mu)(1-\pi)+\pi[(1-\rho-\mu)b_L^\theta + (\rho-\mu)b_R^\theta]}{1-\pi+\pi[xb_L^\theta+(1-x)b_R^\theta]} \\ &= \frac{(1-\pi)\theta_0+\pi[xb_L^\theta\theta_1+(1-x)b_R^\theta\theta_{-1}]}{1-\pi+\pi[xb_L^\theta+(1-x)b_R^\theta]}, \end{aligned}$$

where $z(b_L^\theta, b_R^\theta)$ is decreasing in b_L^θ and increasing in b_R^R. We have $z(b_L^\theta, b_R^\theta) \geq \theta_0 \iff b_R^\theta \geq b_L^\theta$. The corresponding cutoff types of voters between voting L and abstention and between abstention and voting R will be $\underline{z}(b_L, b_R^\theta) = z(b_L^\theta, b_R^\theta) - \frac{1+\beta}{2}$ and $\bar{z}(b_L^\theta, b_R^\theta) = z(b_L^\theta, b_R^\theta) + \frac{1+\beta}{2}$, respectively. The PBE of the game with targeted media is described in Proposition 1.

Proposition 1. *A targeted media firm with no commitment power in either target group or disclosure rule, will in equilibrium target swing voters of types* $\theta \in [\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ *and truthfully report the signal* $(b_L^\theta, b_R^\theta) = (0,0), \forall \theta$.

As in equilibrium, the firm will truthfully report the signal and commit in the the first stage, with choice of target group corresponding to the case where the firm can only truthfully report. These results stem from the assumption of fully rational voters in this model. Voters want to learn about the state and they process information in the same way despite their heterogeneous ideologies. Voters within $[\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ want to shift right if they know the state is pro-R and they cannot be persuaded to shift further left. The right-leaning firm also wants to persuade these voters using pro-R news. In a sense, the firm's interests are aligned with those of voters within $[\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ and conflict with those of voters within $[\underline{\theta}_0, \underline{\theta}_{-1}) \cup [\bar{\theta}_0, \bar{\theta}_{-1})$. If the firm cannot commit, it will target voters with aligned interests and truthfully report in equilibrium.

4.3 Comparison with traditional media

Traditional media, which cannot target its audience, as all voters receive the same news, needs to balance the opposing effects from different voters. For instance, if the firm increases the probability of hiding pro-R news, voters who would only shift right under pro-R news become more likely to shift right, while voters who would have shifted left only under pro-L news may also shift left under pro-R news. Given voters' belief system and voting strategies, the firm will best respond accordingly.

Proposition 2. *A traditional media firm with no commitment power will, in equilibrium it will always reveal a pro-*R *signal and hide a pro–*L *signal* $(b_L, b_R) = (0,1)$.

With positive probability, the firm may receive an uninformative signal and hence voters shifting right under pro-R news always strictly outnumber those under no news and voters shifting left under pro-L news always outnumber those under no news. Therefore, given voter beliefs and strategies, the right-leaning firm would only report pro-R news. In equilibrium, voters have the same posterior belief $\nu(1) = 1$, $\nu(0) = \mu\frac{(1-\pi)+\pi(1-\rho)}{1-\pi+\pi(1-x)}$, $\nu(-1) = 0$. Voters within $[\underline{\theta}_0, \frac{(1-\pi)\underline{\theta}_0+\pi(1-x)\underline{\theta}_{-1}}{1-\pi+\pi(1-x)}) \cup [\underline{\theta}_0, \frac{(1-\pi)\bar{\theta}_0+\pi(1-x)\bar{\theta}_{-1}}{1-\pi+\pi(1-x)})$ would shift left under no news and voters within $[\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ would shift right under pro-R news.

The equilibrium level of traditional media bias is strictly higher than targeted media bias for each voter. Selective targeting can be interpreted as a new form of media bias. When the firm can target their audience in addition to selective disclosure, the firm can more effectively shift voters in the direction of its bias given any beliefs and strategies of voters. Without commitment in the first stage, however, voters would become more skeptical if they were to receive no news as a result of this new dimension of distortion and so the firm must report truthfully as a best response in equilibrium.

5 Role of commitment

In the following analyses, I analyze the case where the media firm can only commit to either the target group or the disclosure rule for each group. The no commitment case is more relevant for an emerging media firm that has not yet established a long-standing reputation of credibility. For other types of firms with commitment power, the power could come from reputation concerns through repeated interaction in a dynamic environment.

5.1 Full commitment

First, I consider the extreme case where the firm has full commitment in both target group and disclosure rule. Voters $\theta \in [\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ can be persuaded to shift right under a pro-R signal, which leaves some room for the media firm to hide a pro-R signal and even persuade some voters under no news. However, as a null report for the voters could also come from an actually uninformative signal $s = 0$, such mixing and persuasion is not possible for all types of voters in these ranges. Denote $\kappa' = \theta_0 - \frac{\pi(1-x)}{1-\pi+\pi x}(\theta_{-1} - \theta_0)$ with cutoff types $\underline{\kappa}' = \kappa' - \frac{1+\beta}{2}$, $\bar{\kappa}' = \kappa' + \frac{1+\beta}{2}$. $\underline{\kappa}'$ for persuasion using a null report.

Lemma 3. *If the firm can commit to both target group and disclosure policy, it will optimally choose to target types* $[\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ *and disclose as*

$$(b_L^\theta, b_R^\theta) = \begin{cases} (1, \frac{\pi x(\theta-\underline{\theta}_1)+(1-\pi)(\theta-\underline{\theta}_0)}{\pi(1-x)(\underline{\theta}_{-1}-\theta)}) & \text{for } \theta \in [\underline{\kappa}', \underline{\theta}_0) \\ (1, \frac{\pi x(\theta-\bar{\theta}_1)+(1-\pi)(\theta-\bar{\theta}_0)}{\pi(1-x)(\bar{\theta}_{-1}-\theta)}) & \text{for } \theta \in [\bar{\kappa}', \bar{\theta}_0) \\ (0,0) & \text{for } \theta \in [\underline{\theta}_1, \underline{\kappa}') \cup [\bar{\theta}_1, \bar{\kappa}'). \end{cases}$$

Voters closer to their type-specific prior belief cutoffs are easier to persuade under a pro-R signal, which leaves room for firm persuasion using an observed null report. The firm will fully mix a pro-R signal and partially mix a pro-L signal to minimize the probability of a voter receiving a pro-L report while making sure voters vote for R under a null signal. Voters farther from their prior belief cutoffs are impossible to persuade using a null signal. Since the firm does not want to reduce the probability of releasing a pro-R signal when it does not care about the release of a pro-L signal, it will truthfully report.

Now to highlight the difference in choice of target group for flexible disclosure rule versus truthful reporting, consider a fixed firm budget. To find the optimal target group for the media firm, we need to maximize the difference in induced probability of voting R before and after reading the news. Based on the proof of Lemma 3, the optimal target group will be the types close to and to the left of $\underline{\theta}_0$ and $\bar{\theta}_0$. To be more specific, the optimal target group will be $[\underline{\kappa}, \underline{\theta}_0) \cup [\bar{\kappa}, \bar{\theta}_0)$ such that

$$[F(\underline{\theta}_0) - F(\underline{\kappa})] + [F(\bar{\theta}_0) - F(\bar{\kappa})] = M,$$

$$1-\pi+\pi x+\frac{\pi x(\bar{\kappa}-\bar{\theta}_1)+(1-\pi)(\bar{\kappa}-\bar{\theta}_0)}{\pi(1-x)(\bar{\theta}_{-1}-\bar{\kappa})} = 1-\pi+\pi x+\frac{\pi x(\underline{\kappa}-\underline{\theta}_1)+(1-\pi)(\underline{\kappa}-\underline{\theta}_0)}{\pi(1-x)(\underline{\theta}_{-1}-\underline{\kappa})},$$

where the second condition can be simplified as $\underline{\kappa}+(1+\beta) = \bar{\kappa}$.

Proposition 3. *If the firm can commit to both target group and disclosure policy and has a fixed measure of coverage* $M \ll 1$*, it will choose to target types* $[\underline{\kappa}, \underline{\theta}_0) \cup [\bar{\kappa}, \bar{\theta}_0)$ *and disclose as*

$$(b_L^\theta, b_R^\theta) = \begin{cases} (1, \frac{\pi x(\theta-\underline{\theta}_1)+(1-\pi)(\theta-\underline{\theta}_0)}{\pi(1-x)(\underline{\theta}_{-1}-\theta)}) & \text{for } \theta \in [\underline{\kappa}, \underline{\theta}_0) \\ (1, \frac{\pi x(\theta-\bar{\theta}_1)+(1-\pi)(\theta-\bar{\theta}_0)}{\pi(1-x)(\bar{\theta}_{-1}-\theta)}) & \text{for } \theta \in [\bar{\kappa}, \bar{\theta}_0), \end{cases}$$

where $\underline{\kappa}$ *and* $\bar{\kappa}$ *satisfy* $[F(\underline{\theta}_0) - F(\underline{\kappa})] + [F(\bar{\theta}_0) - F(\bar{\kappa})] = M$ *and* $\underline{\kappa}+(1+\beta) = \bar{\kappa}$.

Voters closer to their type-specific prior belief cutoff are not only easier to persuade but also have higher induced probability of shifting right under the optimal disclosure rule. In

comparison, under the no commitment benchmark, voters cannot be persuaded to shift right under no news due to the negative inference from both audience targeting and selective disclosure, and hence in equilibrium, the firm truthfully reports and is indifferent to targeting any voter types within $[\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$. As argued above, audience targeting is a new dimension of information distortion. The ability to commit would allow the targeted media firm to additionally persuade voters using the null signal, leading to more influential power and bias.

Now, compare this with a traditional media firm that can only release the same message to all voter types. Likewise facing a fixed budget, the firm maximizes the difference in induced probability of voters shifting right. Given the disclosure rule (b_L, b_R), the range of voters shifting right after seeing report $r = 1$ will be $[\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$, the range of voters shifting left after seeing report $r = -1$ will be $[\underline{\theta}_0, \underline{\theta}_{-1}) \cup [\bar{\theta}_0, \bar{\theta}_{-1})$ and the range of voters shifting right after seeing report $r = 0$ will be $[\underline{z}(b_L, b_R), \underline{\theta}_0) \cup [\bar{z}(b_L, b_R), \bar{\theta}_0)$ (or vice versa if $z(b_L, b_R) > \theta_0$). The firm solves the problem

$$\begin{aligned}\max_{b_L, b_R} \Pi =& \pi x(1-b_L)[F(\underline{\theta}_0) - F(\underline{\theta}_1) + F(\bar{\theta}_0) - F(\bar{\theta}_1)] - \pi(1-x)(1-b_R) \\ & [F(\underline{\theta}_{-1}) - F(\underline{\theta}_0) + F(\bar{\theta}_{-1}) - F(\bar{\theta}_0)] + [1 - \pi + \pi(xb_L + (1-x)b_R)] \\ & [F(\underline{\theta}_0) - F(\underline{z}(b_L, b_R)) + F(\bar{\theta}_0) - F(\bar{z}(b_L, b_R))].\end{aligned}$$

The firm's optimal disclosure rule (b_L^*, b_R^*) depends on the distribution of voters $F(\theta)$. An increase in b_L has two effects: (1) a displacement effect, which decreases the probability of voters receiving a pro-R signal and is bad for the firm as the fraction of voters who shift right is larger when they observe a pro-R report than no report, and (2) a persuasion effect, which increases voter belief of state R when they do not receive any report and more voters would shift right under no news, which is good for the firm. Similarly the increase in b_R also has two effects: (i) a displacement effect, which decreases the probability of voters receiving a pro-L signal and is good for the firm as the fraction of voters shifting left is larger when they observe a pro-L report than no report, and (ii) a persuasion effect, which decreases voter beliefs of state R under no report which is bad for the firm.

The first order condition can be written as

$$\frac{\partial \Pi}{\partial b_L} = \pi x[\int_{\underline{\theta}_1}^{\underline{z}} (f(\underline{z}) - f(\theta))d\theta + \int_{\bar{\theta}_1}^{\bar{z}} (f(\bar{z}) - f(\theta))d\theta],$$

$$\frac{\partial \Pi}{\partial b_R} = \pi(1-x)[\int_{\underline{z}}^{\underline{\theta}_{-1}} (f(\theta) - f(\underline{z}))d\theta + \int_{\bar{z}}^{\bar{\theta}_{-1}} (f(\theta) - f(\bar{z}))d\theta].$$

For example, consider a uniform distribution $F \sim U[-1,1]$. The choice of media bias will not affect the probability of voters voting for R. Hence, the optimal disclosure rule will be $(b_L^*, b_R^*) = (0,0)$ under Assumption 1. In the other example that $f(\theta)$ is strictly increasing in $[\underline{\theta}_1, \underline{\theta}_{-1}) \cup [\bar{\theta}_1, \bar{\theta}_{-1})$, the optimal disclosure rule will be $(b_L^*, b_R^*) = (1,1)$. Hence, under full commitment, the optimal bias for traditional media is ambiguous. When a traditional media firm cannot commit, voters would suspect it to hide pro-L news, and in equilibrium, the firm will actually behave this way. If the firm can commit, however, it will design strategies to its own benefit but this could be either less or more biased news reports for voters depending on the distribution of voter ideology because some voters' interests are aligned with the firm while others may be conflicting.

This ambiguous relationship in the level of media bias between targeted and traditional media under full commitment contrasts that targeted media would bring less biased reports without commitment. Compared with traditional media, targeted media has a new dimension of information distortion. When the media firm can commit to its strategies, targeted media can use tailed reports to refine strategies to its benefit; when the firm cannot commit, this new dimension would backfire and make targeted media suffer from skeptical inference. As the firm's interests are aligned with voters who can be persuaded to shift right and are conflicting with those who can be persuaded to shift left, audience targeting makes the targeted media firm report less biased news under no commitment, while with commitment it would depend on which fraction of voters dominates. The role of commitment is crucial in determining not only the equilibrium level of media bias but also whether audience targeting ability increases or decreases the equilibrium level of bias. In the limited commitment case, I will analyze whether the commitment power in these two dimensions acts as a substitute or complement.

5.2 Limited commitment

If a targeted media firm has limited commitment power, say it can commit to either target group or disclosure rule but not both, the results could potentially lie between the two extreme cases of no and full commitment. Since a traditional media firm does not have the ability to choose its target group, the equilibrium with commitment only in the target group is by definition the same as the no commitment case and the equilibrium with commitment only in the disclosure rule is the same as the full commitment case.

When a targeted media firm can only commit to the target group, it will cover a fixed set

of viewers but does not have a reputation for the way it reports the news. Voters outside of the target group still hold prior belief μ will base their decisions solely on μ. The equilibrium strategy of the targeted media firm is described in Proposition 4.

Proposition 4. *A targeted media firm with commitment only in target group will, in equilibrium, behave the same as with no commitment.*

It is incentive compatible for the firm to reveal the true state to voters with aligned interests in $[\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ but not to voters with conflicting interests $[\underline{\theta}_0, \underline{\theta}_{-1}) \cup [\bar{\theta}_0, \bar{\theta}_{-1})$. Without commitment, the firm would choose the aligned group and, in equilibrium, fully reveal information to this group. The choice of the aligned interest group is already optimal for the firm, so commitment power in the target group alone will not improve the outcome for the firm. With the same target group, the equilibrium disclosure strategy also remains the same.

Now suppose the firm can only commit to the disclosure rule. A popular media or website may be famous for its ideology but, if it is everyone's news source, it is not clear which subgroups it can target for news reveals. In the first stage, the firm commits to the disclosure rule for different types of voters in the first stage and then they play a PBE where the firm privately chooses a target group to which it reports the news according to the committed disclosure rule. The firm's equilibrium strategy is described as follows.

Proposition 5. *A targeted media firm with commitment only in disclosure rule will, in equilibrium, behave the same as with full commitment power.*

In the second stage, there are multiple equilibria even when the firm chooses the optimal strategy as under full commitment. However, for those equilibria where voter beliefs and strategies are not the same as in the optimal full commitment case, as shown in the proofs, the firm can deviate to a different disclosure rule to guarantee a better outcome for itself. Hence, in equilibrium the firm will behave as under full commitment. The commitment in disclosure rule in the first stage enables the firm to choose an equilibrium that is more beneficial to itself. In this framework, it can reach the optimal full commitment outcome.

5.3 Value of commitments

The usual insight concerning the role of commitment in the strategic communication literature is that commitment power is valuable to the media firm in terms of influencing receivers

(in this context the *ex-ante* expected probability of voters shifting right). In this paper, I focus instead on the firm's equilibrium strategies – choice of target group and disclosure policy. The level of bias is more directly related to voter welfare instead of firm welfare as fully rational voters in this model would always benefit from more precise reports. I find commitment power is also important when comparing media bias between targeted and traditional media. Without commitment, targeted media provides less biased news reports than traditional media, while with commitment, the relationship depends on the distribution of voter ideology. Commitment power in the disclosure rule is more important in terms of the equilibrium behavior of the firm and in terms of the relationship in equilibrium bias between targeted and traditional media.

6 Extensions

6.1 Contingent target group

An immediate extension to the above analysis is that the firm can choose its target group depending on the signal it receives. The targeted release contingent on signal realization could be denoted as $T(s) \subseteq \Theta, s \in \Omega$. I argue that neither the no commitment nor full commitment equilibrium outcomes for the targeted media firm are affected by more flexible targeting targeting strategies, so the above analyses are without loss of generality.

First, consider the full commitment case. In the previous analysis of a non-contingent target group, the firm attains the maximal probability of persuading voters to shift right by fully mixing pro-R and pro-L signals with a null signal in such a way that voters observing no news would still shift right. If the firm chooses different target groups for different signals s, it cannot simply hide the pro-L signal and use a null signal to persuade voters. Hence, in order to fully take advantage of the benefit from hiding a pro-R signal, the firm will choose the same target group for all signals it receives.

For the no commitment case with a non-contingent target group, the target audience will shift right in equilibrium when they receive a pro-R signal and keep voting decisions unchanged otherwise. Even if the firm could choose different target groups for different values of s, they still would not be able to persuade voters who observe no news to shift right. The firm can only exert influence over voters that can be persuaded using a pro-R signal and the firm will therefore truthfully report to maximize the probability of sending pro-R news. In equilibrium, the choice of target group and disclosure rule is the same as in non-contingent

target group case.

6.2 Reading cost and profit motive

In the benchmark model of this paper, voters are just passive recipients of information. If there is a type-independent random reading cost for voters and they can choose to read the news or ignore it, fully rational voters are more likely to read news containing valuable information about the state. Voters will read the news if and only if the expected increase in utility from changing their voting decision exceeds the reading cost. There is no cost of reading when the voter receives the null signal or no news report. By defining media bias as the probability of hiding an informative signal, the interpretation of $r = 0$ needs to become uninformative news instead of no news, i.e. the firm now hides an informative signal by sending an uninformative news report that is less valuable to the reader. For consistency about voters not being able to differentiate between not being in the target group and the firm hiding information from the target group, assume that voters outside the target group also receive uninformative news reports that contain no informative signal.

Under full commitment, the optimal target group without reading cost are those most likely persuaded to shift right and theses voters also benefit most from receiving more information. The presence of reading cost still induces the firm to target these same types as they also have the highest probability of reading the news. For the optimal disclosure rule without reading cost, the firm maximizes the probability of voter θ receiving both null and pro-R signals by hiding the maximal amount of pro-R and pro-L signals while keeping the null signal persuasive. However, to attract voters with reading cost, the firm needs to decrease the probability of hiding both pro-R and pro-L signals. As a result, the firm will publish less biased reports to balance the demand of reading and effectiveness of persuasion. Under no commitment, without reading cost, in equilibrium voters cannot be persuaded to shift right with a null signal and the firm will truthfully report to types that can be persuaded to shift right using pro-R news. With reading cost, there is no change in firm strategy because truthful reporting makes the news report most valuable to voters and hence maximize the reading probability.

With reading cost, we can discuss more on the profit motive of the media firm. In the benchmark model, although voters have heterogeneous preferences over the two candidates, they are all fully rational in processing the information. They want to learn about the true state so as to make better voting decisions for themselves. Hence, if a firm only cares about maximizing readership from subscription fees or advertising revenue, it will truthfully report

to maximize the value of information in news reports and target swing voters near $\underline{\theta}_0$ and $\bar{\theta}_0$ who would benefit most from knowing the state. If the firm cares about both profit and political motive under full commitment, this may shift the target interval to the right in the sense that the firm wants to target some swing voters who may shift left but are more likely to read the news. The firm will also reduce its slant to attract voters to read. Under no commitment, the firm will still truthfully report to make the news reports more valuable to voters but may target some swing voters who may shift left if profit motive is strong.

6.3 Heterogeneous belief

Another way of thinking about different political views is that voters have heterogeneous prior beliefs about the state ω as in Mullainathan and Shleifer (2005). I show that the analysis and results will be quite similar. The detailed setup and corresponding analysis is shown in Appendix B. The equilibrium behavior of targeted media is essentially the same as the benchmark model under both no commitment and full commitment. Therefore the results of this paper do not depend on how we interpret the ideological types of voters.

7 Conclusion

The topic of media bias has been studied extensively. In this paper I focus on a new dimension that has emerged but has not been studied yet – the audience targeting and tailored news reports – especially in the context of elections. I build a model to study the equilibrium strategies of targeted media under different commitment settings in contrast to traditional media. In this framework, the media firm provides additional information about the state to voters (receivers). Voters are heterogeneous in their ideologies and process information rationally. The media firm maximizes the *ex-ante* probability of voters shifting to its preferred candidate. I find that if the firm cannot commit *ex-ante*, the targeted media chooses lower level of media bias in equilibrium than traditional media. If the firm can commit, however, the comparison in equilibrium level bias depends on the distribution of voter ideology. With regard to the two dimensions – target group and disclosure rule – commitment in target group is more important in determining the relationship in media bias between targeted media and traditional media.

In this paper, only one media firm provides information about a specific piece of news. This applies to the case where the firm uncovers a specific aspect about the relative quality of

two candidates. Nevertheless, in many other cases, competition in providing the same piece of news should be more relevant. Extension to competition in the current framework should be worth looking at for future research.

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Appendix

A Proofs

A.1 Proposition 1

Given that the firm cannot falsify an informative signal, voters $\theta \in [\underline{\theta}_1, \underline{\theta}_{-1}) \cup [\bar{\theta}_1, \bar{\theta}_{-1})$ will adjust their voting decisions based on the report they read. Hence, in equilibrium the firm must target voters in these ranges. If voters vote for R after receiving no news, it is optimal for the firm not to target them given voter's strategy, and the corresponding posterior belief of these voters is the same as the prior $\nu_\theta(0) = \mu$ and the voters voting for R with prior belief are $\theta \in [\bar{\theta}_0, \bar{\theta}_{-1})$. Similarly, if voters stay home after receiving $r \in \{0,1\}$, it is optimal for the firm not to target them given voter's strategy, and the corresponding posterior belief of these voters after receiving no news is the same as the prior $\nu_\theta(0) = \mu$ and the voters abstention with such beliefs are $\theta \in [\underline{\theta}_0, \underline{\theta}_{-1})$.

For voters $\theta \in [\underline{\theta}_1, \underline{\theta}_0)$, if they stay home after receiving $r = 0$, then for the firm it is optimal to choose $b_R^\theta = 1$. Then the posterior belief of voter θ is $\nu_\theta(0) = \frac{\mu(1-\pi)+\mu\pi b_L^\theta}{1-\pi+\pi[\mu b_L^\theta+(1-\mu)]}$ and satisfies $\theta < \underline{h}(\nu_\theta(0))$ and hence it is optimal for the voter to vote for L instead of abstention after receiving $r = 0$. If they vote for L after receiving $r = 0$, then the firm will optimally choose $b_L^{\theta^*} = 0$ and $b_R^{\theta^*} = 0$ to maximize the probability of voters shifting right under Assumption 1. For voters $\theta \in [\bar{\theta}_1, \bar{\theta}_0)$, if they vote for R after receiving $r = 0$, the firm will choose $b_R^\theta = 1$. Then the posterior belief of voter θ is $\nu_\theta(0) = \frac{\mu(1-\pi)+\mu\pi b_L^\theta}{1-\pi+\pi[\mu b_L^\theta+(1-\mu)]}$ and satisfies $\theta < \bar{h}(\Pr_\theta(\omega = 1|r = 0))$ and hence it is optimal for the voter to stay home instead of voting for R after receiving $r = 0$. If they stay home after receiving $r = 0$, then the firm will optimally choose $b_L^{\theta^*} = 0$ and $b_R^{\theta^*} = 0$ under Assumption 1. In equilibrium, the firm will target voters with $\theta \in [\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ and truthfully report the signal. The posterior belief of voters will be $\nu_\theta(0) = \mu$, $\nu_\theta(1) = 1$ and $\nu_\theta(-1) = 0$. Voters $\theta \in [-1, \underline{\theta}_1)$ will vote for L for sure, voters $\theta \in [\underline{\theta}_1, \underline{\theta}_0)$ will stay home if they receive pro-R news and vote for L otherwise, voters $\theta \in [\underline{\theta}_0, \bar{\theta}_1)$ will always stay home, voters $\theta \in [\bar{\theta}_1, \bar{\theta}_0)$ will vote for R if and only if they receive pro-R stay home otherwise and $\theta \in [\bar{\theta}_0, 1]$ will vote for R for sure.

A.2 Proposition 2

Again we only need to focus on voters $\theta \in [\underline{\theta}_1, \underline{\theta}_{-1}) \cup [\bar{\theta}_1, \bar{\theta}_{-1})$ who may change their votes after receiving some signals. Given any belief system ν and strategy profile τ of voters,

as there is no off-path message from the firm, it is optimal to for the firm to never reveal $r=-1$. In this way, the firm reduces the probability of shifting left for voters who would shift left only after receiving news $r=-1$, while does not change the probability of shifting left for voters who would shift left after receiving signal $r\in\{-1,0\}$. Hence in equilibrium the firm will choose $b_R^*=1$. Now suppose $b_L>0$, then $z(b_L,1)\in(\theta_0,\theta_{-1})$ and voters with $\theta\in[\underline{z}(b_L,1),\underline{\theta}_{-1})\cup[\bar{z}(b_L,1),\bar{\theta}_{-1})$ will shift right after receiving $r\in\{0,1\}$ while voters with $\theta\in[\underline{\theta}_0,\underline{z}(b_L,1))\cup[\bar{\theta}_0,\bar{z}(b_L,1))$ will shift left after receiving $r\in\{0,-1\}$. Hence, given the belief and strategy of voters, the firm can reduce b_L to increase the probability of voters receiving $r=1$, which will decrease the probability of shifting left for voters $\theta\in[\underline{\theta}_0,\underline{z}(b_L,1))\cup[\bar{\theta}_0,\bar{z}(b_L,1))$ and not affect voters $\theta\in[\underline{z}(b_L,1),\underline{\theta}_{-1})\cup[\bar{z}(b_L,1),\bar{\theta}_{-1})$. Hence, the equilibrium media bias will be $(b_L^*,b_R^*)=(0,1)$ and $z(0,1)=\frac{(1-\pi)\theta_0+\pi(1-x)\theta_{-1}]}{1-\pi+\pi(1-x)}$.

A.3 Lemma 3

Consider the induced change in actions of the voters. The firm will only care about voters $\theta\in[\underline{\theta}_1,\underline{\theta}_{-1})\cup[\bar{\theta}_1,\bar{\theta}_{-1})$ who may switch their actions upon receiving informative signals.

1. For voters $\theta\in[\underline{\theta}_1,\min\{\underline{z}(b_L^\theta,b_R^\theta),\underline{\theta}_0\})$ who only switch to not vote from voting for L after seeing signal $r=1$, the firm maximizes the probability of voter θ seeing signal favoring R. It solves the problem

$$\max_{b_L^\theta,b_R^\theta}\ \Pr(r=1|\theta)$$
$$\text{s.t.}\underline{\theta}_1\le\theta<\min\{\underline{z}(b_L^\theta,b_R^\theta),\underline{\theta}_0\}$$

   The optimal decision is that

$$(b_L^{\theta^*},b_R^{\theta^*})=(0,0)\text{ for }\theta\in[\underline{\theta}_1,\underline{\theta}_0)$$

   with maximized probability πx.

2. For voters $\theta\in[\underline{z}(b_L^\theta,b_R^\theta),\underline{\theta}_0)$ who switch to not vote from voting for L after seeing signal $r\in\{0,1\}$, the firm tries to maximize the probability that voter of type θ observes

either signal favoring R or the null signal. It solves the problem

$$\max_{b_L^\theta, b_R^\theta} \Pr(r=1|\theta) + \Pr(r=0|\theta)$$
$$\text{s.t.} \underline{z}(b_L^\theta, b_R^\theta) \leq \theta < \underline{\theta}_0$$

The optimal decision is that

$$(b_L^{\theta^*}, b_R^{\theta^*}) = (1, \frac{\pi x(\theta - \underline{\theta}_1) + (1-\pi)(\theta - \underline{\theta}_0)}{\pi(1-x)(\underline{\theta}_{-1} - \theta)}) \text{ for } \theta \in [\underline{\theta}_0 - \frac{\pi(1-x)}{1-\pi+\pi x}(\theta_{-1} - \theta_0), \underline{\theta}_0)$$

with maximized probability $1 - \pi + \pi x + \frac{\pi x(\theta - \underline{\theta}_1) + (1-\pi)(\theta - \underline{\theta}_0)}{\pi(1-x)(\underline{\theta}_{-1} - \theta)}$, increasing in θ. Compared with first case, we have

$$(b_L^{\theta^*}, b_R^{\theta^*}) = (0,0) \text{ for } \theta \in [\underline{\theta}_1, \underline{\theta}_0 - \frac{\pi(1-x)}{1-\pi+\pi x}(\theta_{-1} - \theta_0))$$

which stands for the case impossible to persuade using uninformative signal.

3. For voters $\theta \in [\underline{\theta}_0, \underline{z}(b_L^\theta, b_R^\theta))$ who switch to vote for L from not voting after seeing signal $r \in \{0, -1\}$, it's never optimal for the firm to target and disclose to them.

4. For voters $\theta \in [\max\{\underline{z}(b_L^\theta, b_R^\theta), \underline{\theta}_0\}, \underline{\theta}_{-1})$ who switch to vote for L from not voting after seeing signal $r = -1$, it's never optimal for the firm to target and disclose to them.

5. For voters $\theta \in [\bar{\theta}_1, \min\{\bar{z}(b_L^\theta, b_R^\theta), \bar{\theta}_0\})$ who only switch to vote for R from not voting after seeing signal $r = 1$, the firm maximizes the probability of voter θ seeing signal favoring R. It solves the problem

$$\max_{b_L^\theta, b_R^\theta} \Pr(r=1|\theta)$$
$$\text{s.t.} \bar{\theta}_1 \leq \theta < \min\{\bar{z}(b_L^\theta, b_R^\theta), \bar{\theta}_0\}$$

The optimal decision is that

$$(b_L^{\theta^*}, b_R^{\theta^*}) = (0,0) \text{ for } \theta \in [\bar{\theta}_1, \bar{\theta}_0)$$

with maximized probability πx.

6. For voters $\theta \in [\bar{z}(b_L^\theta, b_R^\theta), \bar{\theta}_0)$ who switch to vote for R from not voting after seeing

signal $r \in \{0,1\}$, the firm tries to maximize the probability that voter of type θ observes either signal favoring R or the null signal. It solves the problem

$$\max_{b_L^\theta, b_R^\theta} \Pr(r=1|\theta) + \Pr(r=0|\theta)$$
$$\text{s.t.} \bar{z}(b_L^\theta, b_R^\theta) \leq \theta < \bar{\theta}_0$$

The optimal decision is that

$$(b_L^{\theta^*}, b_R^{\theta^*}) = (1, \frac{\pi x(\theta - \bar{\theta}_1) + (1-\pi)(\theta - \bar{\theta}_0)}{\pi(1-x)(\bar{\theta}_{-1} - \theta)}) \text{ for } \theta \in [\bar{\theta}_0 - \frac{\pi(1-x)}{1-\pi+\pi x}(\theta_{-1} - \theta_0), \bar{\theta}_0)$$

with maximized probability $1 - \pi + \pi x + \frac{\pi x(\theta - \bar{\theta}_1) + (1-\pi)(\theta - \bar{\theta}_0)}{\pi(1-x)(\bar{\theta}_{-1} - \theta)}$, increasing in θ. Compared with first case, we have

$$(b_L^{\theta^*}, b_R^{\theta^*}) = (0,0) \text{ for } \theta \in [\bar{\theta}_1, \bar{\theta}_0 - \frac{\pi(1-x)}{1-\pi+\pi x}(\theta_{-1} - \theta_0))$$

which stands for the case impossible to persuade using uninformative signal.

7. For voters $\theta \in [\bar{\theta}_0, \bar{z}(b_L^\theta, b_R^\theta))$ who switch to not vote from voting for R after seeing signal $r \in \{0,-1\}$, it's never optimal for the firm to target and disclose to them.

8. For voters $\theta \in [\max\{\bar{z}(b_L^\theta, b_R^\theta), \bar{\theta}_0\}, \underline{\theta}_{-1})$ who switch to not vote from voting for R after seeing signal $r = -1$, it's never optimal for the firm to target and disclose to them.

A.4 Proposition 4

Again the firm will just consider voters $\theta \in [\underline{\theta}_1, \underline{\theta}_{-1}) \cup [\bar{\theta}_1, \bar{\theta}_{-1})$ who may change their votes after receiving some signals. For a pro-R firm, it will not report to voters $\theta \in [\bar{\theta}_0, \bar{\theta}_{-1})$ who will voter for R based on their prior belief or voters $\theta \in [\underline{\theta}_0, \underline{\theta}_{-1})$ who decide to stay home under null signal and can only be persuaded to vote for L. Hence, it will only target voters with $\theta \in [\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ who might be persuaded to shift right. Given the beliefs of the voters ν and their voting strategies τ, if voter $\theta \in [\bar{\theta}_1, \bar{\theta}_0)$ votes for R after observing the null signal, it is optimal for the firm to choose $b_R = 1$ and hence with similar logic as above, no $b_L^\theta \in [0,1]$ will make voters $\theta \in [\bar{\theta}_1, \bar{\theta}_0)$ vote for R after observing the null signal. Hence, these voters will only vote for R after observing pro-R signal. Then it is optimal for the voter to set $b_L^{\theta^*} = 0$ and $b_R^{\theta^*} = 0$. The same logic applies to voters $\theta \in [\underline{\theta}_1, \underline{\theta}_0)$.

A.5 Proposition 5

Suppose the firm commits to disclose as (b_L^θ, b_R^θ) for each type θ. Belief consistency requires that voters in the target group will hold the posterior belief as $\nu_\theta(0) = \frac{\mu(1-\pi)+\mu\pi[\rho b_L^\theta+(1-\rho)b_R^\theta]}{1-\pi+\pi[xb_L^\theta+(1-x)b_R^\theta]}$ while voters who outside will still hold the prior belief μ. First, consider only voters $\theta \in [\underline{\theta}_1, \underline{\theta}_{-1}) \cup [\bar{\theta}_1, \bar{\theta}_{-1})$ whose decisions are affected by the news received. Second, the firm will not target $\theta \in [\underline{\theta}_0, \underline{\theta}_{-1}) \cup [\bar{\theta}_0, \bar{\theta}_{-1})$ as they cannot be persuaded to shift right. Suppose not, if voters shift left when they receive no news which gives the firm an incentive to target them, then it is optimal for the firm to truthful report which is inconsistent with the updated posterior belief.

Now focus on types $\theta \in [\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ and more specifically on the disclosure rule as in full commitment case.

$$(b_L^{\theta^*}, b_R^{\theta^*}) = \begin{cases} (1, \frac{\pi x(\theta-\underline{\theta}_1)+(1-\pi)(\theta-\underline{\theta}_0)}{\pi(1-x)(\underline{\theta}_{-1}-\theta)}) & \text{for } \theta \in [\underline{\kappa}', \underline{\theta}_0) \\ (1, \frac{\pi x(\theta-\bar{\theta}_1)+(1-\pi)(\theta-\bar{\theta}_0)}{\pi(1-x)(\bar{\theta}_{-1}-\theta)}) & \text{for } \theta \in [\bar{\kappa}', \bar{\theta}_0) \\ (0,0) & \text{otherwise} \end{cases}$$

Given the committed disclosure rule in the first stage, in equilibrium the belief consistency requires voters in the target group correctly update their beliefs and voters outside the group hold the prior belief μ. If the firm target voters $\theta \in [\underline{\theta}_1, \underline{\kappa}') \cup [\bar{\theta}_1, \bar{\kappa}')$, then all voters $\theta \in [\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ will have posterior belief μ after receiving no news. They will not change their decisions after seeing null or pro-L news and shift right after seeing pro-R signal. Hence, the firm has no incentive to deviate in the second stage of choosing target group. The other equilibrium in the second stage is that the firm target voters $\theta \in [\underline{\kappa}, \underline{\theta}_0) \cup [\bar{\kappa}, \bar{\theta}_0)$ and voters $\theta \in [\underline{\kappa}, \underline{\theta}_0) \cup [\bar{\kappa}, \bar{\theta}_0)$ will shift right after seeing null and pro-R signals and not change decisions after seeing a pro-L signal.

Now consider the first stage of commitment in disclosure rule, we want to show that the first equilibrium in the second stage will not occur as the firm can change committed disclosure rule to rule out. Consider a variant of the above disclosure rule

$$(b_L^{\theta^*}, b_R^{\theta^*}) = \begin{cases} (1-\varepsilon, \frac{\pi x(\theta-\underline{\theta}_1)+(1-\pi)(\theta-\underline{\theta}_0)}{\pi(1-x)(\underline{\theta}_{-1}-\theta)}) & \text{for } \theta \in [\underline{\kappa}', \underline{\theta}_0) \\ (1-\varepsilon, \frac{\pi x(\theta-\bar{\theta}_1)+(1-\pi)(\theta-\bar{\theta}_0)}{\pi(1-x)(\bar{\theta}_{-1}-\theta)}) & \text{for } \theta \in [\bar{\kappa}', \bar{\theta}_0) \\ (1,1) & \text{otherwise} \end{cases}$$

If the firm target voters $\theta \in [\underline{\theta}_1, \underline{\kappa}') \cup [\bar{\theta}_1, \bar{\kappa}')$, then voters $\theta \in [\underline{\theta}_1, \underline{\kappa}') \cup [\bar{\theta}_1, \bar{\kappa}')$ will have

posterior belief μ after seeing no news and will not change their decisions. They will always keep voting decisions unchanged as they always receive no news. While voters $\theta \in [\underline{\kappa}', \underline{\theta}_0) \cup [\bar{\kappa}', \bar{\theta}_0)$ hold prior belief μ after seeing no news but shift right after receiving a pro-R signal. Hence, the firm has incentive to deviate and in equilibrium it must be that the firm target voters $\theta \in [\underline{\kappa}', \underline{\theta}_0) \cup [\bar{\kappa}', \bar{\theta}_0)$ and voters $\theta \in [\underline{\kappa}', \underline{\theta}_0) \cup [\bar{\kappa}', \bar{\theta}_0)$ will shift right after seeing null and pro-R signals and not change decisions after seeing a pro-L signal. This is strictly better for the firm compared to the first equilibrium we list above.

The second equilibrium of the second stage remains part of equilibrium as the firm reaches the same outcome under full commitment which is the upper bound in payoffs for the firm.

B Heterogeneous beliefs

Here I consider a simplified version of the benchmark model where voters cannot stay home, i.e. $\mathbb{A} = \{-1, 1\}$. Assume voters are distributed on an interval $\theta \in \Theta = [0, 1]$ with distribution $F(\theta)$, which represents the voters prior belief about state ω being 1. The ex post utility of voter i depends both on her action a and the state of the world ω: $u_i(a, \omega) = -(a - \omega)^2$. Hence the *ex-ante* expected utility of voter with belief p and choosing action a is $U(a, p) = -p(a-1)^2 - (1-p)(a+1)^2 = -(a+1)^2 + 4ap$. The voter will choose $a = 1$ if and only if $U(1, p) \geq U(-1, p) \iff p \geq \frac{1}{2}$. If the firm commits to disclosure rule (b_L^θ, b_R^θ), for voter of type θ, the posterior belief is $\nu_\theta(1) = \frac{\theta\rho}{\theta\rho + (1-\theta)(1-\rho)}$, $\nu_\theta(0) = \frac{\theta[1-\pi+\pi(\rho b_L^\theta + (1-\rho) b_R^\theta)]}{1-\pi+\pi[\theta\rho+(1-\theta)(1-\rho)]b_L^\theta + \pi[\theta(1-\rho)+(1-\theta)\rho]b_R^\theta}$ and $\nu_\theta(-1) = \frac{\theta(1-\rho)}{\theta(1-\rho)+(1-\theta)\rho}$. If the firm can only report truthfully $(b_L^\theta, b_R^\theta) = (0, 0)$, voters will choose $a = 1$ if and only if $\theta \geq \frac{1}{2}$ after observing $r = 0$, $\theta \geq 1 - \rho$ after observing $r = 1$ and $\theta \geq \rho$ after observing $r = -1$. Consider the voters $1 - \rho \leq \theta \leq \rho$ who may switch their actions under informative signals.

The firm solves the problem

$$\begin{aligned} \max_{b_L^\theta, b_R^\theta} \ & \Pr(r = 0) + \Pr(r = 1) \\ \text{s.t.} \ & \nu_\theta(0) \geq \frac{1}{2} \end{aligned}$$

The optimal decision is that

$$b_L^\theta = 1, \ b_L^\theta = \begin{cases} 1 & \text{if } \theta \geq \frac{1}{2} \\ \frac{\rho+\theta-1}{(\rho-\theta)\pi} & \text{if } \frac{1-\pi\rho}{2-\pi} \leq \theta < \frac{1}{2} \end{cases}$$

It also solves the problem

$$\max_{b_L^\theta, b_R^\theta} \Pr(r=1)$$
$$\text{s.t.} \nu_\theta(0) < \frac{1}{2}$$

The optimal decision is

$$b_L^\theta = 0$$

By comparing the maximized value of increased probabilities, the firm will target voters $[\frac{1-\pi\rho}{2-\pi}, \frac{1}{2})$ and disclose as $(b_L^{\theta^*}, b_R^{\theta^*}) = (1, \frac{\rho+\theta-1}{(\rho-\theta)\pi})$. This is similar to the benchmark model that the firm will fully pro-R and pro-L signals with null signal in such way that voters can be persuaded using null signal.

When the firm cannot commit, given that the firm cannot falsify an informative signal, voters $\theta \in [1-\rho, \rho)$ will adjust their voting decisions based on the report they read. Hence, in equilibrium the firm must target voters in these ranges. If voters vote for R after receiving no news, it is optimal for the firm not to target them given voter's strategy, and the corresponding posterior belief of these voters is the same as the prior $\nu_\theta(0) = \theta$ and the voters voting for R with prior belief are $\theta \in [\frac{1}{2}, \rho)$. For voters $\theta \in [1-\rho, \frac{1}{2})$, if they vote for L after receiving $r = 0$, then the firm will optimally choose $b_L^{\theta^*} = 0$ and $b_R^{\theta^*} = 0$ to maximize the probability of voters shifting right under Assumption 1. In equilibrium, the firm will target voters with $\theta \in [1-\rho, \frac{1}{2})$ and truthfully report the signal. The posterior belief of voters will be $\nu_\theta(0) = \theta$, $\nu_\theta(1) = 1$ and $\nu_\theta(-1) = 0$. Voters $\theta \in [0, 1-\rho)$ will vote for L for sure, voters $\theta \in [1-\rho, \frac{1}{2})$ will voter for R if they receive pro-R news and vote for L otherwise.