Targeted media bias and voting*

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Abstract

In this study, we investigate the political effect of media bias and targeted news release on the voting behavior of a group of heterogeneous voters. We build a model to study how tailored news report and target release of a politically driven firm can bring different implications for the equilibrium outcome of media bias and voter behavior. With full commitment in both target group and disclosure rule, targeted media does not necessarily provide more biased report than traditional media, which depends on voter distribution. When the firm cannot commit, however, targeted media provides less media bias than the traditional media. In deciding such comparison in media bias, commitment power in disclosure rule is vital while the commitment power in target group is not.

1 Introduction

The effect of media bias on people's voting behavior has been studied extensively. In many elections, especially nation-wide presidential elections with large electorate, voters try to vote for the candidate best of their interest, but they usually lack information

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about candidates' quality of all the aspects. Media, which is better at searching and collecting pieces of information, is generally regarded as a provider of such information. Although acquiring information is vital in voter's decision, media bias in the news reports has been widely recognized to persistently exist that does not disappear even when people are well aware of its existence. In the recent years, the role of social media like Facebook in the persistence of biased news has been put under microscope.

The use of social networks has been expanding rapidly over the world. As of September, 2017, the number of Facebook users is around 2.06 billion, and the number of twitter users is around 0.328 billion (Statista, 2017). Along with the rapid growth of the social media platforms such as Facebook, the channel of news feeds has shifted its weight from traditional media such as newspapers, radios and televisions to the online platforms, especially social media platforms. Following the growth in traffic of news feeds on social media, a concern regarding fake news has arisen. 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. They find that compared with mainstream news sites, fake news sites rely heavily on social media, 41.8% verse 10.1%. 15% of survey respondents recalled seeing fake stories and among them more than half claimed they believed it.

There are several features of social media that make it distinctive with traditional media: the entry cost into media industry is low (Allcott and Gentzkow, 2017; Madrigal, 2017), the media firm can provide politically targeted information to a select group of voters (Dutton et al., 2017; Lazer et al., 2018) and the friend networks on these platforms are ideologically segregated that there is little information sharing among people having different political preferences which makes the targeted release effective (Bakshy et al., 2015; Dubois and Blank, 2018). To understand what difference in media bias the social media would bring, we develop a model to study how the interaction of media bias and target news release affect the voter behavior and welfare under different settings of disclosure rule. We also compare with traditional media that cannot tailor news reports to viewer's types. In terms of different settings of disclosure rule, we consider the role of commitment in affecting the firm's equilibrium slanting strategies. Here the media firm chooses the target group and also the disclosure policy for each type and hence the commitment also comes in these two dimensions.

The novel feature is that we add a new dimension in the action space of the media firm compared to the existing papers on media bias. We consider signal hiding as the form

of media bias in our main framework. Voters cast there vote sincerely and media firm wants to persuade voters to shift right in their voting decisions. A targeted media firm will add the largest amount of bias possible to persuade swing voters to shift right under full commitment. They do not want to affect the decision of those who already decide to vote for R, while try their best to convince swing voters who would have voted for L or stayed home. The traditional media will be more or less biased under full commitment depending one the distribution of voter ideology. Under no commitment, targeted media still target the same group of voters but truthfully report in equilibrium because the additional dimension of targeting makes voters more skeptical about the strategy of the firm. In comparison, the traditional media will have some amount of bias in their disclosure rule in equilibrium.

2 Related Literature

The persistence of media bias and the effect of competition on these bias has been widely investigated (Gentzkow et al., 2016). Papers on this topic has considered several cases, like homogeneous viewers and heterogeneous viewers, viewers' preference over truth and over own ideology, firm's profit motive and political motive, the effect of competition and entry, the impact of merger. (Mullainathan and Shleifer, 2005) considers the equilibrium media bias with homogeneous readers and heterogeneous readers in terms of their prior beliefs using location model. They show that competition results in lower price but more biased news to cater the beliefs of different readers. The voter welfare, however, will increase if they can access information from both media firms to get unbiased inference. Anand et al. (2007) also considers the effect of competition media bias using a location model with costly entry. They find the competition does not reduce media bias but the increase in verifiability does. In our model, however, the voters do not enjoy the content or bias of the news itself as opposed to these papers. The voters use the news report to make an inference about the state in stead of consuming the content directly.

The idea that the utility of sincere voters is decreasing in the distance between voting decision and true state or between voting decision and own ideology is commonly used in literature on media bias and voting. Bernhardt et al. (2008) discusses the effect of media bias on voters where media firms commit to their reporting strategies on

how to report negative news on either candidate. Voters choose which news to read which has time cost and enjoys more from reading news that are closer to their own ideological position. Purely profit-driven news media provides biased news report to increase readership and the electoral outcome may appear more polarized. Anderson and McLaren (2012) considers homogeneous viewers with the same preference and prior belief with utility determined by an unknown state which firm has private information on. They show that competition will increase consumer welfare by decrease in news report price but a ban on media merger may also increase consumer welfare by keeping diversified reports from media firms with different political preferences. Chan and Suen (2008) find that more consumption of informative news lead to less partisan policies by candidates and media outlets will be biased to attract voters with extreme views. Voter welfare is also higher under competition. In comparison, we focus on strategy of a monopoly firm that provides news free of charge. Another difference is that voters do not enjoy news slant itself.

Several papers consider specifically the effect of media bias on voting behavior and associated polarization. Gal-Or et al. (2012) investigates the role advertising in providing media firms the incentive to increase readership and choose the composition. The profit of media firm comes from both the subscription fee of viewers and the advertising revenue. They show that when viewers are more heterogeneous, the advertisers may drive media firms to provide more partisan news and generate greater polarization. Levy and Razin (2015) builds a model where voters underestimate the correlation between their information sources. Their result is that correlation neglect can be beneficial for information aggregation that the whole electorate may reach better and more informed outcomes despite individual sub-optimality. Voters in our model process information fully rationally in comparison.

Other literature more specifically apply Bayesian persuasion to study news report on voting. Alonso and Câmara (2016b) consider monopoly politician strategically designing a policy experiment (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 the voters. This papers characterizes the voter's preference over different electoral rules. On the one way, they do not want excessive rejection of the proposal; on the other way, they want the the politician to provide more information. Alonso and Câmara (2016a) extends Bayesian persuasion to the case where the

sender and the receiver have different priors. Instead of a discrete number of voters and strategic voting, we consider a continuum of voters and sincere voting, which is more plausible in our motivation of national election.

The targeting feature is mainly discussed in 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 characterizes the impact of targeting under the competitive equilibrium. its viewers and finds a non-monotonic relationship between of the advertising price and targeting ability. As they model the targeting as a way to create desirable match, the social welfare is increasing in their framework. Hoffmann et al. (2017) considers equilibrium persuasion through selective disclosure based on the information the sender collects about receiver's preference to target. They consider competition effect and whether receivers are naive or sophisticated. The receiver in their model is interested to know the value of two attributes, but the informed sender can only get to disclose on of them. The selective disclosure of these two attributes can benefit from targeting when receivers have different values for both attributes. The targeting in advertising is quite different from our model in terms of the goal of the firm and how targeting is implemented.

3 Model

A mass one of voters choose to vote for two candidates Left and Right in a election. The candidates' relative quality is captured by state $\omega \in \Omega = \{-1, 1\}$, where -1 means that the candidate L is better suited for the office and 1 for candidate R. Voters cast their votes sincerely, i.e. the voting decision is not affected by whether the vote is pivotal in determining the winner. They care about not only the relative capability of the two candidates but also their own ideological preferences over them. Each voter knows his/her own ideology but is uncertain about the candidates' qualities. A media firm privately observes an informative signal about the state and releases news reports to selected voters.

3.1 Voter utility

Voters are heterogeneous in their ideological positions θ, distributed on the interval $\Theta = [-1, 1]$ with distribution $F(\theta)$. Larger θ stands for greater preference over candidate R. Each voters makes the decision to vote for candidate R or L, $a \in \mathbb{A} = \{-1, 0, 1\}$, where $a = -1$ means voting for L and $a = 1$ for R, $a = 0$ means staying home or abstention. The ex post utility of voter θ depends both on her action a and the state ω:

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

where $\beta \in (0, 1)$ is the relative weight voters put on voting for the more capable candidate compared to voting for the preferred one. Given the state, voters with extreme ideologies will vote for their favorite candidates while voters with more neutral preferences will stay home. The quadratic loss functional form provides tractability for our analysis and also implies it is costly to vote. Voters stay home when they do not have a strong preference towards either candidate or when they do not have a good knowledge of the relative quality of them.

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 $\mu \equiv \Pr(\omega = 1)$. It may be arguable that the voters would have heterogeneous beliefs about candidates' qualities. We show in the extension section that the heterogeneous belief can be incorporated into voters' ideological positions and the analysis will carry forward. Depending on the disclosure policy of the firm, voters will update their beliefs after the firm releases news reports. For voter θ, when her belief of the state is $p_\theta = \Pr_\theta(\omega = 1|E)$ where E is some event that may affect the voter's belief, the ex ante expected utility of choosing action a is

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

Denote $h(p_\theta) = \beta(1 - 2p_\theta)$ and $\underline{h}(p_\theta) = h(p_\theta) - \frac{1+\beta}{2}$, $\bar{h}(p_\theta) = h(p_\theta) + \frac{1+\beta}{2}$.

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

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

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

Given voter's belief p_θ, those with middle types will stay home while those with more extreme ideologies will vote according to their preferences. To simplify the analysis , we restrict the parameters such that $\underline{h}(p_\theta), \bar{h}(p_\theta) \in (-1, 1)$.

3.2 Media firm

The media firm digs 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 our framework, we consider a specific form of information distortion as the media bias. For the media firm, it is impossible to manipulate an informative signal but easy to hide one. We allow the informative signal to arrive with some exogenous probability. When a voter does not receive a signal, it does not lead to full unrevealing and the firm could distort voter's information acquisition through hiding signal. The probabilistic signal and distortion as concealing is useful for analyzing the role of commitment in target group. When a voter does not receive a news, we need to characterize the posterior belief and voting decision.

The firm also holds the common prior μ about the state, but it receives an additional signal $s \in \mathbb{S} = \{-1, 0, 1\}$ about the state. $s = 0$ means that the news is irrelevant of the state (or the null signal) and the firm receives such signal with probability $1 - \pi$ regardless of the state: $\Pr(s = 0) = \Pr(s = 0|\omega = 1) = \Pr(s = 0|\omega = -1) = 1 - \pi$. 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 cannot manipulate or make up the content of an informative signal but can hide one, i.e. it can choose $r|s \in \mathbb{S}_s = \{s\} \cup \{0\}$. Here $r = 0$ means the firm does not release any news to voters. That is, when the voter receives no news report, it is either she is not in the target group or the firm decides to send $r = 0$ and there is no cost of reading when $r = 0$. The firm chooses a target group $T \subseteq \Theta$ and

a disclosure policy for each type $D_T : T \times \mathbb{S} \to \triangle\mathbb{S}$, i.e. for each type $\theta \in T$ a disclosure rule $D_\theta : \mathbb{S} \to \triangle\mathbb{S}$ such that $D_T = \{D_\theta | \theta \in T\}$. More specifically in our framework, for each type $\theta \in T$, the firm chooses $(b_L^\theta, b_R^\theta) = (\Pr(r = 0|s = 1, \theta), \Pr(r = 0|s = -1, \theta))$. b_L^θ, interpreted as left media bias, is the probability the firm hides signal favorable to candidate R and similarly for b_R^θ. These two terms for media bias fully capture the disclosure rule of the firm. In defining strategies of the media firm for the baseline model, the choice of target group does not depend on the realization of the signal. This can be understood as a media firm always reporting news for a fixed group of viewers. Here we assume the firm does not randomize over the target group either. In the extension, we consider the case where the choice of target group could be contingent on the observed signal s.

When we compare targeted media with traditional media, the disclosure rule of traditional media is $D : \mathbb{S} \to \triangle\mathbb{S}$ independent of type θ and all types of voters receive the same report. The strategy profile for a traditional media firm is just the disclosure rule D. More specifically, the firm chooses $(b_L, b_R) = (\Pr(r = 0|s = 1), \Pr(r = 0|s = -1))$. b_L, interpreted as left media bias, is the probability the firm hides signal favorable to candidate R and similarly for b_R.

A strategy of voter θ is $v_\theta : \mathbb{S} \to \triangle\mathbb{A}$ that for each report $r \in \mathbb{S}$ she reads, she makes a voting decision. Assume for voters who are not in the target group, they are effectively receiving the null signal in terms of information processing. For simplicity, we put restrictions on the parameters such that voters who vote for L under prior belief cannot be persuaded to vote for R and vice versa. In the following analysis, we will refer to "shift right" as voters switching from voting L to staying home and switching form staying home to vote R, "shift left" as voters switching from voting R to staying home and switching form staying home to vote L.

For the media firm, generally there are mainly two goals: maximize the readership (profit motive) and maximize the share of votes to its favorite candidate (political motive). In this paper, we consider mainly firm's equilibrium strategy (or equilibrium bias) under political preference. In terms of maximizing the readership, the firm will maximize the probability of voters reading its news report and hence target the types who are most likely to read the news upon receiving one when faced with a fixed budget. The choice of target group and disclosure rule is straightforward under our setting with fully rational voters. We will briefly talk about it in the appendix. In terms of political

preference, without loss of generality we consider the firm favors candidate R, then it will maximize the probability of voters shifting right in the population and hence target the types who have the largest expected increase in probability of shifting right from receiving and reading the news.

We further impose the following two assumptions on tie-breaking rules to simplify the analysis. These two assumptions are only concerning marginal cases and are not essential to the underlying mechanism of the results. However, they are useful to remove some uninteresting equilibria. The first assumption just says the media firm will not add any bias to its news report if there in no benefit from doing so. The second assumption ensures we can properly define the equilibrium concerning the marginal case.

Assumption 1. *Whenever the firm is indifferent between reporting biased news and unbiased news, it will always choose truthful reporting.*

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

3.3 Timing

The timing of the game under the baseline model with full commitment to both target group and disclosure rule is as follows. When we compare with the case of no commitment in either of the two dimensions, there is no first stage of commitment. When there is only commitment power in one of the dimensions, the firm only commits to that dimension in the first stage.

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

4 Full commitment

4.1 Truthful reporting

First we consider the firm can only report the signal truthfully, i.e. $r|s \in \mathbb{R}_s = \{s\}$. This applies to the case where the news is easily verifiable that any lie including information hiding can be detected. We consider what will be most optimal target group for the firm.

Define $\theta_0 = h(\mu)$ as the voter type with neutral ideological position under the common prior μ, and define $\underline{\theta}_0 = \theta_0 - \frac{1+\beta}{2}$, $\bar{\theta}_0 = \theta_0 + \frac{1+\beta}{2}$ as the cutoff types . Define $x \equiv \Pr(s = 1|s \neq 0) = \mu\rho + (1-\mu)(1-\rho)$ as the probability of firm receiving signal $s = 1$ conditional on the received signal is informative. For the firm, we have the posterior belief as

$$\Pr(\omega = 1|s = 1) = \frac{\mu\rho}{x}$$

$$\Pr(\omega = 1|s = -1) = \frac{\mu(1-\rho)}{1-x}$$

$$\Pr(\omega = 1|s = 0) = \mu$$

and the probability of receiving these news is

$$\Pr(s = 1) = \pi x$$

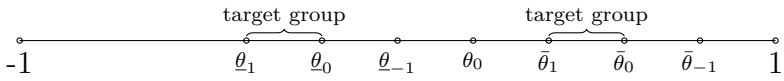
$$\Pr(s = -1) = \pi(1-x)$$

$$\Pr(s = 1) = 1 - \pi$$

Define $\underline{\theta}_{-1} = \beta\frac{\rho-\mu}{1-x} - \frac{1+\beta}{2}$ and $\bar{\theta}_{-1} = \beta\frac{\rho-\mu}{1-x} + \frac{1+\beta}{2}$ as the marginal types that can be persuaded under truthful reporting signal $s = -1$. Define $\underline{\theta}_1 = \beta\frac{1-\rho-\mu}{x} - \frac{1+\beta}{2}$ and $\bar{\theta}_1 = \beta\frac{1-\rho-\mu}{x} + \frac{1+\beta}{2}$ as the marginal types that can be persuaded under truthful reporting signal $s = 1$. Then it will target voters in the range $[\underline{\theta}_1, \underline{\theta}_0)$ who would switch from voting for L to staying home and voters in the range $[\bar{\theta}_1, \bar{\theta}_0)$ who would switch from staying home to voting for R.

Proposition 1. *When the firm can only report truthfully, it will target left-leaning voters with* $[\underline{\theta}_1, \underline{\theta}_0)$ *and right-leaning voters with* $[\bar{\theta}_1, \bar{\theta}_0)$.

Figure 1: Targeting under truthful reporting



If the firm can only truthfully report, voters will not change their beliefs nor actions after receiving null report. The media firm will then target voters who would shift right after receiving a pro-R signal and remain the same action after receiving pro-L or null report.

4.2 Media bias

Now we come to the choice of disclosure rule or media bias. We relax the constraint on firm's action set such that the firm can hide the informative signal $r \in \mathbb{S}_s = \{s\} \cup \{0\}$. The firm chooses and commits to the target group $T \subseteq \Theta$ and disclosure rule $\{b_L^\theta, b_R^\theta\}_{\theta \in T}$ in the first stage. For voter of type θ, the posterior belief given the disclosure rule is

$$\Pr(\omega = 1 | r = 1, \theta) = \frac{\mu\rho}{\mu\rho + (1-\mu)(1-\rho)} = \frac{\mu\rho}{x}$$

$$\Pr(\omega = 1 | r = -1, \theta) = \frac{\mu(1-\rho)}{\mu(1-\rho) + (1-\mu)\rho} = \frac{\mu(1-\rho)}{1-x}$$

$$\Pr(\omega = 1 | r = 0, \theta) = \mu \frac{(1-\pi) + \pi[\rho b_L^\theta + (1-\rho) b_R^\theta]}{1 - \pi + \pi[x b_L^\theta + (1-x) b_R^\theta]}$$

The probability of type θ receiving each signal is

$$\Pr(r = 1 | \theta) = \pi x (1 - b_L^\theta)$$

$$\Pr(r = -1 | \theta) = \pi (1-x)(1 - b_R^\theta)$$

$$\Pr(r = 0 | \theta) = 1 - \pi + \pi[x b_L^\theta + (1-x) b_R^\theta]$$

Given the posterior belief of voters, define $z(b_L^\theta, b_R^\theta) \equiv h(\Pr(\omega = 1 | n = 0, \theta)) = \beta \frac{(1-2\mu)(1-\pi) + \pi[(1-\rho-\mu) b_L^\theta + (\rho-\mu) b_R^\theta]}{1 - \pi + \pi[x b_L^\theta + (1-x) b_R^\theta]} = \frac{(1-\pi)\theta_0 + \pi[x b_L^\theta \theta_1 + (1-x) b_R^\theta \theta_{-1}]}{1 - \pi + \pi[x b_L^\theta + (1-x) b_R^\theta]}$ as the middle type compared with θ_0 under prior belief μ. $z(b_L^\theta, b_R^\theta)$ 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 staying home and between staying home 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. Denote $\kappa = \theta_0 - \frac{\pi(1-x)}{1-\pi+\pi x}(\theta_{-1} - \theta_0)$ and $\underline{\kappa} = \kappa - \frac{1+\beta}{2}$, $\bar{\kappa} = \kappa + \frac{1+\beta}{2}$. Voters $\theta \in [\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ can be persuaded to shift right under pro-R signal, which leaves some room for the media firm to hide pro-R signal and successfully persuade some voters even under null signal. However, as null report for the voters could also come from actually no news $s = 0$, such mixing and persuasion is not possible for all types of voters. $\underline{\kappa}$ and $\bar{\kappa}$ are just the cutoff types of persuasion using null report.

Proposition 2. *If the firm can commit to both target group and disclosure policy ex ante, it will choose to target types same as under truthful reporting and disclose as*

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

Proof. See Appendix A. □

For voters who are closer to the switching point under prior belief, they are easier to persuade under pro-R signal, which leaves room for the firm to persuade using observed null report. The firm will fully mix pro-R signal and partially mix pro-L signal to minimize probability of voter receiving pro-L report while making sure voters voter for R under null signal. For voters who are farther from the switching point under prior belief, they are impossible to persuade using null signal, The firm does not want to reduce the probability of releasing pro-R signal while it does not care about the release of pro-L signal, so it truthfully report to them.

Now to highlight the difference in choice of target group between flexible disclosure rule and truthful reporting, consider that the firm has a fixed budget and can only target a fixed measure T of voters ($T \ll 1$). To find the optimal target group for the media firm, we need to find the maximum of the difference in induced probability of voting for R before and after reading the news. Based on proof of Proposition 2, 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, given

a fixed measure T of the target group, the optimal target group will be $[\underline{c}_1, \underline{\theta}_0) \cup [\bar{c}_1, \bar{\theta}_0)$ such that

$$[F(\underline{\theta}_0) - F(\underline{c}_1)] + [F(\bar{\theta}_0) - F(\bar{c}_1)] = T$$

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

where the second condition can be simplified as $\underline{c}_1 + (1+\beta) = \bar{c}_1$.

Corollary 1. *If the firm can commit to both target group and disclosure policy and has a fixed measure of coverage, it will choose to target types same as under truthful reporting and disclose as*

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

For voters closer to the switching points under prior belief, not only are they easier to persuade, but also the induced probability of shifting right under the optimal disclosure rule is higher. In comparison, under truthful reporting, voters cannot be persuaded to shift right under null signal, and hence the firm is indifferent to targeting any types $[\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$.

4.3 Comparison with traditional media

Now we compare with traditional media where the firm cannot distinguish voter's type and can only release the same message to all types. To be consistent with the analysis above, we restrict the firm to have a fixed budget and hence a fixed measure of target group T. That is, a target group from the entire distribution will be randomly selected.

Facing a fixed budget, the firm maximizes the difference in induced probability of voters shifting right. Given the disclosure rule (b_L, b_R) of the firm, the range of voters who switch from voting for L to not voting after seeing report $r = 1$ will be $[\underline{\theta}_1, \underline{\theta}_0]$, the range of voters who switch from staying home to voting for R after seeing report $r = 1$ will be $[\bar{\theta}_1, \bar{\theta}_0]$, the range of voters who switch from staying home to voting for L after seeing report $r = -1$ will be $[\bar{\theta}_0, \bar{\theta}_{-1}]$, the range of voters who switch from voting for R to staying home after seeing report $r = -1$ will be $[\bar{\theta}_0, \bar{\theta}_{-1}]$ and the range of voters who

switch from voting for L to staying home after seeing report $r = 0$ will be $[\underline{z}(b_L, b_R), \underline{\theta}_0]$, the range of voters who switch from staying home to voting for R after seeing report $r = 0$ will be $[\bar{z}(b_L, b_R), \bar{\theta}_0]$ (or the other way around if $z(b_L, b_R) > \theta_0$). The firm solves the problem

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

The optimal disclosure rule of the firm (b_L^*, b_R^*) depends on the distribution of voters $F(\theta)$. The increase in b_L has two effects: displacement effect which decreases the probability of voters receiving pro-R signal and is bad for the firm as the fraction of voters who switch to R from staying home or to stay home from L is larger when they observe a pro-R report than no report, and persuasion effect which increases voters' belief of state R when they do not receive any report and is good for the firm. The increase in b_R also has two effects: displacement effect which decreases the probability of voters receiving pro-L signal and is good for the firm as the fraction of voters who switch to L from staying home or to stay home from R is larger when they observe a pro-L report than no report, and persuasion effect which decreases voters' belief of state R when they do not receive any report and is bad for the firm.

The first order condition can be rewritten as

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

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

Consider an example of uniform distribution $F \sim U[-1, 1]$. The choice of media bias will not affect probability of voter voting for R. Hence, the optimal disclosure rule will be $(b_L^*, b_R^*) = (0, 0)$ under Assumption 1. Consider the other example that $f(\theta)$ 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 comparison in media bias between targeted media and traditional media is ambiguous. We will come back to this relationship in case of no commitment.

5 Role of commitment

In the above analyses, we maintain the assumption that the media firm can commit to both the target group and the media bias for each group. The commitment power of the firm could come from reputation concerns though repeated interaction in a dynamic environment. The other important case to consider is no commitment. It is more relevant when the news firm is emerging and does not have a long history to back up its credibility. We will consider the cases where the firm can only commit to disclosure rule, where the firm can only commit to target group and where the firm can commit to neither of them.

5.1 No commitment in either dimension

Now we consider the game where the media firm sends news reports to different types of viewers and cannot commit to either the target group or the disclosure rule. A strategy $\sigma = (T, D_T)$ of the firm 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 $D_T = \{D_\theta | \theta \in T\}$. More specifically, for each type $\theta \in T$, the firm chooses $(b_L^\theta, b_R^\theta) = (\Pr(r = 0|s = 1, \theta), \Pr(r = 0|s = -1, \theta))$. A strategy of voter θ is $\tau_\theta : \mathbb{S} \to \triangle\mathbb{A}$ that for each report $r \in \mathbb{S}$ she reads, she decide to vote for either candidate. A collection of voters' strategies constitute the full set of voter's strategy $\tau = \{\tau_\theta | \theta \in \Theta\}$. A belief updating rule of voter θ is $\nu_\theta : \mathbb{S} \to \triangle\not\leqslant$ such that for each report the voter updates her belief. A full belief system is $\nu = \{\nu_\theta | \theta \in \Theta\}$. We are interested in the Perfect Bayesian Equilibria of the game. Thus, an equilibrium is a triple (σ, τ, ν) such that

1. σ maximize the objective function of the firm given voters' strategy τ.

2. τ maximize the utility of each type of voter given the firm's strategy σ and the belief ν.

3. ν is obtained from μ given firm's strategy σ, using Bayes' rule whenever possible.

We restrict that voters only use pure strategies. 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. In the following analysis, we will just focus on these types. If voters vote for R after receiving the null signal $r = 0$, it is optimal for the firm not to target them given voter's strategy, then the corresponding posterior belief of these voters is the same as the prior $\nu_\theta(\omega = 1|r = 0) = \mu$ and the voters voting for R with such belief are $\theta \in [\bar{\theta}_0, \bar{\theta}_{-1})$. Similarly, if voters stay home after receiving the null signal $r = 0$ and after receiving pro-R signal, it is optimal for the firm not to target them given voter's strategy, then the corresponding posterior belief of these voters after receiving null signal is the same as the prior $\nu_\theta(\omega = 1|r = 0) = \mu$ and the voters staying home 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 the null signal, then for the firm it is optimal to choose $b_R^\theta = 1$. Then the posterior belief of voter θ is $\Pr_\theta(\omega = 1|r = 0) = \frac{\mu(1-\pi)+\mu\pi b_L^\theta}{1-\pi+\pi[\mu b_L^\theta+(1-\mu)]}$ and satisfies $\theta < \underline{h}(\Pr_\theta(\omega = 1|r = 0))$ and hence it is optimal for the voter to vote for L instead of staying home after receiving the null signal. If they vote for L after receiving the null signal, then for the firm it is optimal to choose $b_L^{\theta^*} = 0$ and $b_R^{\theta^*} = 0$ under Assumption 1. For voters $\theta \in [\bar{\theta}_1, \bar{\theta}_0)$, if they vote for R after receiving the null signal, then for the firm it is optimal to choose $b_R^\theta = 1$. Then the posterior belief of voter θ is $\Pr_\theta(\omega = 1|r = 0) = \frac{\mu(1-\pi)+\mu\pi b_L^\theta}{1-\pi+\pi[\mu b_L^\theta+(1-\mu)]}$ 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 the null signal. If they stay home after receiving the null signal, then for the firm it is optimal to 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 $\Pr_\theta(\omega = 1|r = 0) = \mu$, $\Pr_\theta(\omega = 1|r = 1) = 1$ and $\Pr_\theta(\omega = 1|r = -1) = 0$. 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 signal $r = 1$ 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 signal $r = 1$ stay home otherwise and $\theta \in [\bar{\theta}_0, 1]$ will vote for R for sure.

Proposition 3. *For a targeted media firm with no commitment power in either target group or disclosure rule, in equilibrium it will target voters of types* $\theta \in [\underline{\theta}_1, \underline{\theta}_0) \cup [\bar{\theta}_1, \bar{\theta}_0)$ *and truthfully report the signal.*

Now we compare with traditional media that cannot target the voter. Again we only need to focus on the 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 the belief ν and strategy profile τ of the 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 voting for L for voters who would switch to vote for L from staying home and those who switch to stay home from voting for R only after receiving signal $r = -1$, while does not change the probability of voting for L for voters who switch to vote for L from staying home and those who switch to stay home from voting for R after receiving signal $r \in \{-1, 0\}$. Hence, we have $b_R^* = 1$. Now suppose $b_L > 0$, then $z(b_L, 1) \in (\theta_0, \theta_{-1})$ and voters with $\theta \in [\bar{z}(b_L, 1), \bar{\theta}_{-1}) \cup [\underline{z}(b_L, 1), \underline{\theta}_{-1})$ will switch right in voting decision 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, 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 no effect on voters $\theta \in [\bar{z}(b_L, 1), \bar{\theta}_{-1}) \cup [\underline{z}(b_L, 1), \underline{\theta}_{-1})$. Hence, the equilibrium media bias will be $(b_L^*, b_R^*) = (0, 1)$.

Proposition 4. *For a traditional media firm with no commitment power in either target group or disclosure rule, in equilibrium it will always reveal pro-R signal and hide pro–L signal.*

Here we have the equilibrium level of bias is higher in traditional media compared with targeted media. This contrasts the ambiguous relationship between these two types of media with full commitment. The role of commitment is crucial not only in determining the equilibrium level of media bias but also in determining whether targeting ability increases or decreases the equilibrium level of bias. Hence, in the next two subsections, we will analyze the limited commitment case where the firm can only commit to one of the dimensions and also whether the commitment power in these two dimensions acts as a substitute or complement.

5.2 Commitment only in target group

Now we turn to the situation where the firm can only commit to the target group but not the disclosure rule. The news firm will focus on covering a fixed set of viewers but the news report does not have a reputation for the way it reports the news. For voters outside of the target group, they still hold the prior belief μ after the news is reported and their decisions will be just based on their prior belief μ. Again we only need to focus on the 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 $\theta \in [\underline{\theta}_1, \underline{\theta}_0)$.

If the firm cannot target, the analysis is the same as the above case in section 5.1 with no commitment in either.

Proposition 5. *Commitment in target group only does not affect the firm's strategy and equilibrium bias compared with no commitment at all either for targeted media or traditional media.*

5.3 Commitment only in disclosure rule

The last case we want to consider is that the firm can only commit to the disclosure rule. A popular media or website may be famous for its ideology but as everyone would get news from it, it may not be clear who it will select to reveal the news. Suppose the firm commits to disclose as (b_L^θ, b_R^θ) for each type θ. After observing the null signal, it could be either that the voter is not in the target group or that the firm is sending a null signal. With only pure strategy allowed in the choice of target group, belief consistency requires that voters who are in the target group will hold the posterior

belief as $\Pr_\theta(\omega = 1|r = 0) = \frac{\mu(1-\pi)+\mu\pi[\rho b_L^\theta+(1-\rho)b_R^\theta]}{1-\pi+\pi[xb_L^\theta+(1-x)b_R^\theta]}$ while voters who are outside of the target group will still hold the prior belief μ.

First, it is never optimal for the firm to target $\theta \in [-1, \underline{\theta}_1) \cup [\underline{\theta}_{-1}, \bar{\theta}_1) \cup [\bar{\theta}_{-1}, 1]$ whose decisions are not 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 would vote for R or stay home and cannot be persuaded to shift right. Suppose not, if voters shift left when they see a null signal 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 we focus on the 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 Bayesian consistency requires the 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 seeing a null signal. They will not change their decisions after seeing null or pro-L signal 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

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

If the firm target voters $\theta \in [\underline{\theta}_1, \underline{\kappa}) \cup [\bar{\theta}_1, \bar{\kappa})$, then voters voters $\theta \in [\underline{\theta}_1, \underline{\kappa}) \cup [\bar{\theta}_1, \bar{\kappa})$ will have posterior belief μ after seeing a null signal and will not change their decisions. They will always keep voting decisions unchanged as they always receive null signal. While voters $\theta \in [\underline{\kappa}, \underline{\theta}_0) \cup [\bar{\kappa}, \bar{\theta}_0)$ hold prior belief μ after seeing a null signal 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. The media firm using traditional news release is the same as in full commitment case as they can only commit to the disclosure rule anyway. Hence, the comparison with firms committing just to disclosure rule is same as in the full commitment case.

Proposition 6. *For a targeted media firm with commitment power only in disclosure rule, in equilibrium it will behave as with full commitment power.*

5.4 Value of commitments

The usual insight we would get from the role of commitment in strategic communication literature is that commitment power is valuable to the media firm in terms of value to the firm (in the current context the ex ante expected probability of voters shifting right. In this paper, we focus instead on the firm's equilibrium (optimal) strategies – choice of target group and media bias. We find that commitment power is also important in the comparison in media bias between targeted media and traditional media. Without commitment the targeted media provides less biased news reports than traditional media, while with commitment the relationship depends on the distribution of voter ideology. The commitment power in 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 media and traditional media.

6 Extensions

6.1 Contingent target group

An immediate extension to the above analysis is that the firm can choose the target group depending on the realized signal. The contingent targeted release on signal realization could be denoted as $T(s) \subseteq \Theta, s \in \Omega$. We argue that it does not affect the outcome for the targeted media.

First, consider the full commitment case. In the previous analysis of uncontingent target group, the firm gets the maximal probability of persuading voters to shift right by mixing pro-R and pro-L signals with null signal so that voters observing null signal still wants to shift right. If the firm choose different target group for different signal s it receives, they cannot hide the pro-L signal and use the null signal to persuade voters. Hence, in order to taking advantage of the benefit from hiding pro-R signal, the firm will choose the target group unconditional on the signal they receive.

For the no commitment case with uncontingent target group, in equilibrium the group the firm targets will shift right when they receive pro-R signal and keep voting decisions unchanged otherwise. Now if the firm can choose different target groups for different news they observe s, they still cannot persuade voters to shift right after observing null signal. The best the firm can get is target groups that can be persuaded using pro-R signal and truthfully report to maximize the probability of sending pro-R signals. In equilibrium, the choice of target group and disclosure rule is still the same as in uncontingent target group case.

6.2 Reading cost

In the above setup, voters are just passive information receiver. In this section, consider voters can choose to read the news or not. With fully rational voters, they are more likely to read news that provide them with valuable information about the state. We include a type independent random reading cost for each voter such that when the voter receives a news report, she can only know the content of the report after paying reading cost ϵ. Assume the cost of reading the news report $\epsilon \sim G(.)$, which includes the time

spent on reading the news and can be negative if the voter enjoys reading news articles. Voters will read the news if and only if the expected increase in utility from changing voting decisions exceed the reading cost. There is no cost of reading when the voter receives the null signal or no news report. We want to show that the introduction does not affect our main insights either.

In the analysis without reading cost, the optimal target group under full commitment are the ones who are most likely to be persuaded to shift right and theses voters also benefit most from getting more information. The introduction 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 null signal persuasive. As making inference from the null signal does not incur any reading cost while the share of making inference from pro-R signal has a weight of reading probability which is weakly less than 1. Hence, the firm wants to increase the probability of null signal inference instead of pro-R signal inference. As a result, they will hide the maximal amount of pro-R signal and pro-L signal from reading probability concern. The active choice of news reading does not affect firm's optimal strategy for the targeted media.

For the no commitment case without reading cost, voters cannot be persuaded to shift right using null signal in equilibrium, so the tradeoff between persuading using null signal versus pro-R signal goes away. For the types in equilibrium target group, they will be persuaded to shift right after seeing pro-R signal and keep voting decisions unchanged otherwise. Hence, the firm will set $b_L^{\theta^*} = 0$ to always report pro-R signal but they will always hide pro-L signal so that the news report is most valuable to voters and hence maximize the reading probability.

The equilibrium strategies of traditional media firm remain to be shown.

6.3 Outright distortion

Another way of modeling media bias is outright distortion that the firm could lie about the state by sending $r = 1$ if $s = -1$ and vice versa. The analysis here considers a simpler setting where voters cannot stay home, i.e. $\mathbb{A} = \{-1, 1\}$. Another difference

is that the firm has both profit motive that it tries to maximizes the readership or the probability of voters reading the news and political motive as discussed above. When considering both motives altogether, we put α weight on the political motive. The main idea is similar but the optimal level of media bias is different. The detailed analysis is included in Appendix C.

Proposition 7. *When the firm can only report truthfully, the profit motive induces it to target types close to the middle θ_0 while the political motive induces it to target only types with $\theta_1 \leq \theta < \theta_0$. For a firm with α weight on political motive, the optimal target interval is*

(1) $[\underline{\theta}^*, \bar{\theta}^*]$ such that $G[4(1-x)(\theta_{-1} - \bar{\theta}^*)] - G[4x(\underline{\theta}^* - \theta_1)] = \frac{\alpha}{1+\alpha x}$ and $\int_{\underline{\theta}^*}^{\bar{\theta}^*} dF(\theta) = T$, $\theta_0 \leq \bar{\theta}^*$ for α not large.

(2) $[\underline{\theta}^*, \bar{\theta}^*]$ such that $\bar{\theta}^* = \theta_0$ and $\int_{\underline{\theta}^*}^{\bar{\theta}^*} dF(\theta) = T$ when α is large.

$\underline{\theta}^*$ and $\bar{\theta}^*$ are both decreasing in α in (1). An increasing concern with political preference shifts the target interval from centered around neutral types to the left.

Proposition 8. *If the firm can commit to both target group and disclosure policy before it sees the signal, the profit motive of induces it to truthfully report and target types close to neutral ideologies θ_0, while the political motive induces it to disclose as*

$$(b_L^{\theta^*}, b_R^{\theta^*}) = \begin{cases} (0, \frac{x(\theta-\theta_1)}{(1-x)(\theta_{-1}-\theta)}) & \text{if } \theta_1 \leq \theta < \theta_0 \\ (0,1) & \text{if } \theta_0 \leq \theta < \theta_{-1} \\ (0,0) & \text{otherwise} \end{cases}$$

and choose to target types close to but to the left of θ_0.

Corollary 2. *For a firm with α weight on political motive, the optimal target interval is left shift of an interval centered around θ_0. When the political preference is strong enough, the optimal target interval is $[\underline{\theta}^*, \bar{\theta}^*]$ such that $\bar{\theta}^* = \theta_0$ and $\int_{\underline{\theta}^*}^{\bar{\theta}^*} dF(\theta) = T$ when α is large.*

The optimal media bias for the group is

$$(b_L^{\theta^*}, b_R^{\theta^*}) = \begin{cases} (0, a_1) & \text{if } \theta_1 \leq \theta < \theta_0 \\ (0, a_2) & \text{if } \theta_0 \leq \theta < \theta_{-1} \\ (0,0) & \text{otherwise} \end{cases}$$

where $0 \leq a_1 \leq \frac{x(\theta-\theta_1)}{(1-x)(\theta_{-1}-\theta)}$ *and* $0 \leq a_2 \leq 1$.

6.4 Heterogeneous belief

Another way of thinking about different political views is that voters have heterogeneous prior beliefs about the state as in Mullainathan and Shleifer (2005). We want to show that the analysis and results will be quite similar. The setup and corresponding analysis is shown in Appendix D. Again we use a simpler model where voters cannot stay home and consider both profit motives and political motives.

7 Conclusion

The topic of media bias has been studied extensively. In this paper we focus on a new dimension that has emerged but not been studied yet – the targeted lease and tailored reports – especially in the context of election which is the center of most discussions. We build a model to study the equilibrium strategies of targeted media firms under different settings of disclosure rules and compare with traditional media. We put the analysis into a framework where media firm acts as a sender which can provide additional information 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 vote for its preferred candidate. We find that if the firm cannot commit to its disclosure rule and target group, 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 of bias depends on the distribution of voter ideology. With regard to commitment in two dimensions – target group and disclosure rule, the target group dimension is more important in determining the relationship in media bias between targeted media and traditional media.

In our paper, there is only one media firm to provide information about a specific piece of news. This applies to the case where the firm is digging 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 in the future research.

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Appendix

A Full commitment

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

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

   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

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

   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

$$\begin{aligned} &\max_{b_L^\theta, b_R^\theta} \Pr_\theta(r=1) \\ &\text{s.t.} \bar{\theta}_1 \le \theta < \min\{\bar{z}(b_L^\theta, b_R^\theta), \bar{\theta}_0\} \end{aligned}$$

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

$$\begin{aligned} &\max_{b_L^\theta, b_R^\theta} \Pr_\theta(r=1) + \Pr_\theta(r=0) \\ &\text{s.t.} \bar{z}(b_L^\theta, b_R^\theta) \le \theta < \bar{\theta}_0 \end{aligned}$$

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.

B Reading cost

For the voter of type θ, the expected utility of not reading the news is

$$EU_\theta^0 = \begin{cases} -(1-\theta)^2 - 4\beta(1-\mu) & \text{if } \theta \geq \bar{\theta}_0 \\ -\theta^2 - \beta & \text{if } \underline{\theta}_0 < \theta < \bar{\theta}_0 \\ -(1+\theta)^2 - 4\beta\mu & \text{if } \theta \leq \underline{\theta}_0 \end{cases}$$

The expected utility of reading the news conditional on $r \neq 0$ is

$$EU_\theta = \begin{cases} -(1+\theta)^2 - 4\beta\mu & \text{if } \theta \in [-1, \underline{\theta}_1) \\ -(1+\theta)^2 - 4\beta\mu + x(2\theta+1-\beta) + 4\beta\mu\rho & \text{if } \theta \in [\underline{\theta}_1, \underline{\theta}_0) \\ -\theta^2 - \beta - (1-x)(2\theta+1-\beta) - 4\beta\mu(1-\rho) & \text{if } \theta \in [\underline{\theta}_0, \underline{\theta}_{-1}) \\ -\theta^2 - \beta & \text{if } \theta \in [\underline{\theta}_{-1}, \bar{\theta}_1) \\ -\theta^2 - \beta + x(2\theta-1+\beta) - 4\beta(1-\mu)(1-\rho) & \text{if } \theta \in [\bar{\theta}_1, \bar{\theta}_0) \\ -(1-\theta)^2 - 4\beta(1-\mu) - (1-x)(2\theta-1+\beta) + 4\beta(1-\mu)\rho & \text{if } \theta \in [\bar{\theta}_0, \bar{\theta}_{-1}) \\ -(1-\theta)^2 - 4\beta(1-\mu) & \text{if } \theta \in [\bar{\theta}_{-1}, 1] \end{cases}$$

- For voters with $\theta \in [-1, \underline{\theta}_1) \cup [\underline{\theta}_{-1}, \bar{\theta}_1) \cup [\bar{\theta}_{-1}, 1]$, they will read if and only if $\epsilon \leq 0$.
- For voters with $\theta \in [\underline{\theta}_1, \underline{\theta}_0)$, they will read if and only if $\epsilon \leq x(2\theta+1-\beta)+4\beta\mu\rho$.
- For voters with $\theta \in [\underline{\theta}_0, \underline{\theta}_{-1})$, they will read if and only if $\epsilon \leq -(1-x)(2\theta+1-\beta) - 4\beta\mu(1-\rho)$.
- For voters with $\theta \in [\bar{\theta}_1, \bar{\theta}_0)$, they will read if and only if $\epsilon \leq x(2\theta-1+\beta)-4\beta(1-\mu)(1-\rho)$.
- For voters with $\theta \in [\bar{\theta}_0, \bar{\theta}_{-1})$, they will read if and only if $\epsilon \leq -(1-x)(2\theta-1+\beta) + 4\beta(1-\mu)\rho$.

For the voter of type θ, the expected utility of reading the news conditional on receiving $r \neq 0$ is

$$EU_\theta = \begin{cases} -(1+\theta)^2 - 4\beta\mu & \text{if } \theta \in [-1, \underline{\theta}_1) \\ -(1+\theta)^2 + \frac{x(1-b_L^\theta)(2\theta+1-\beta)+4\beta\mu(1-\rho)(1-b_R^\theta)}{x(1-b_L^\theta)+(1-x)(1-b_R^\theta)} & \text{if } \theta \in [\underline{\theta}_1, \underline{z}(b_L^\theta, b_R^\theta)) \\ -\theta^2 - \beta - (1-b_R^\theta)\frac{(1-x)(2\theta+1-\beta)-4\beta\mu(1-\rho)}{x(1-b_L^\theta)+(1-x)(1-b_R^\theta)} & \text{if } \theta \in [\underline{z}(b_L^\theta, b_R^\theta), \underline{\theta}_{-1}) \\ -\theta^2 - \beta & \text{if } \theta \in [\underline{\theta}_{-1}, \bar{\theta}_1) \\ -\theta^2 - \beta + (1-b_L^\theta)\frac{(1-x)(2\theta-1+\beta)+4\beta(1-\mu)(1-\rho)}{x(1-b_L^\theta)+(1-x)(1-b_R^\theta)} & \text{if } \theta \in [\bar{\theta}_1, \bar{z}(b_L^\theta, b_R^\theta)) \\ -(1-\theta)^2 - \frac{(1-x)(1-b_R^\theta)(2\theta-1+\beta)+4\beta(1-\mu)(1-\rho)(1-b_L^\theta)}{x(1-b_L^\theta)+(1-x)(1-b_R^\theta)} & \text{if } \theta \in [\bar{z}(b_L^\theta, b_R^\theta), \bar{\theta}_{-1}) \\ -(1-\theta)^2 - 4\beta(1-\mu) & \text{if } \theta \in [\bar{\theta}_{-1}, 1] \end{cases}$$

- For voters with $\theta \in [-1, \underline{\theta}_1) \cup [\underline{\theta}_{-1}, \bar{\theta}_1) \cup [\bar{\theta}_{-1}, 1]$, they will read the news if and only if $\epsilon \leq 0$.

- For voters with $\underline{\theta}_1 \leq \theta < \min\{\underline{z}(b_L^\theta, b_R^\theta), \underline{\theta}_0\}$, they will read if and only if $\epsilon \leq \frac{x(1-b_L^\theta)(2\theta+1-\beta)+4\beta\mu(1-\rho)(1-b_R^\theta)}{x(1-b_L^\theta)+(1-x)(1-b_R^\theta)} + 4\beta\mu$. The optimal distortion will be $b_L^{\theta^*} = 0$ and given that $b_R^\theta \leq b_L^\theta$ we have $b_R^{\theta^*} = 0$. The optimal target group will be the one close to $\underline{z}(0,0) = \underline{\theta}_0$ with maximized probability $G(\pi x(2\theta + 1 - \beta) + 4\pi\beta\mu\rho)$.

- For voters with $\underline{\theta}_1 \leq \theta < \underline{\theta}_0 \leq \underline{z}(b_L^\theta, b_R^\theta)$, they will read if and only if $\epsilon \leq \pi x(2\theta + 1 - \beta) + 4\pi\beta\mu(\rho - \frac{(1-\pi)\mu(2\rho-1)(b_L^\theta - b_R^\theta)}{1-\pi+\pi[xb_L^\theta+(1-x)b_R^\theta]})$. The optimal distortion will be $b_L^{\theta^*} = 0$ and $b_R^{\theta^*} = 1$. The optimal target group will be the one close to $\underline{z}(0,0) = \underline{\theta}_0$ with maximized probability $G(\pi x(2\theta + 1 - \beta) + 4\pi\beta\mu(\rho + \frac{(1-\pi)\mu(2\rho-1)}{1-\pi+\pi(1-x)})$.

- For voters with $\theta \in [\underline{z}(b_L^\theta, b_R^\theta), \underline{\theta}_0)$, they will read if and only if $\epsilon \leq [1 - \pi(1 - x)](2\theta + 1 - \beta) + 4\beta\mu[1 - \pi(1 - \rho)]$. The bias has no effect on the reading decision and hence the optimal distortion will be $(b_L^{\theta^*}, b_R^{\theta^*}) = (0, 0)$ and the optimal target group will be the one close to $\underline{\theta}_0$.

- For voters with $\theta \in [\underline{\theta}_0, \underline{z}(b_L^\theta, b_R^\theta))$, they will read if and only if $\epsilon \leq -(1-\pi x)(2\theta + 1 - \beta) - 4\beta\mu + 4\pi\beta\mu(\rho - \frac{(1-\pi)\mu(2\rho-1)(b_L^\theta - b_R^\theta)}{1-\pi+\pi[xb_L^\theta+(1-x)b_R^\theta]})$. The bias has no effect on the reading decision and hence the optimal distortion will be $(b_L^{\theta^*}, b_R^{\theta^*}) = (0, 0)$ and the optimal target group will be the one close to $\underline{\theta}_0$.

C Outright distortion

C.1 Truthful reporting

First we consider the firm can only report the signal truthfully. This applies to the case where the news is easily verifiable that any lie can be detected. We consider what will be most optimal target group for the firm.

Denote $x \equiv \Pr(s = 1) = \mu\rho + (1 - \mu)(1 - \rho)$. For the firm, we have the posterior belief as

$$\Pr(\omega = 1|s = 1) = \frac{\mu\rho}{x}$$

$$\Pr(\omega = 1|s = -1) = \frac{\mu(1-\rho)}{1-x}$$

Define $\theta_0 = \beta(1-2\mu)$ as the voter type with neutral ideological position under the . For the voter, the expected utility of not reading the news is

$$EU_\theta^0 = \begin{cases} -(1-\theta)^2 - 4\beta(1-\mu) & \text{if } \theta \geq \theta_0 \\ -(1+\theta)^2 - 4\beta\mu & \text{otherwise} \end{cases}$$

Define $\underline{\theta}_1 = \beta\frac{1-\rho-\mu}{x}$ and $\bar{\theta}_1 = \beta\frac{\rho-\mu}{1-x}$The expected utility of reading the news is

$$EU_\theta = \begin{cases} -(1+\theta)^2 - 4\beta\mu & \text{if } \theta < \underline{\theta}_1 \\ -(1+\theta)^2 - 4\beta\mu + 4x(\theta - \underline{\theta}_1) & \text{if } \underline{\theta}_1 \leq \theta < \theta_0 \\ -(1-\theta)^2 - 4\beta(1-\mu) - 4(1-x)(\theta - \bar{\theta}_1) & \text{if } \theta_0 \leq \theta < \bar{\theta}_1 \\ -(1-\theta)^2 - 4\beta(1-\mu) & m\ \theta \geq \bar{\theta}_1 \end{cases}$$

- For voters with $\theta \geq \bar{\theta}_1$ or $\theta \leq \underline{\theta}_1$, they will read if and only if $\epsilon \leq 0$.
- For voters with $\underline{\theta}_1 \leq \theta < \theta_0$, they will read if and only if $\epsilon \leq 4x(\theta - \underline{\theta}_1)$.
- For voters with $\theta_0 \leq \theta < \bar{\theta}_1$, they will read if and only if $\epsilon \leq 4(1-x)(\bar{\theta}_1 - \theta)$.

Hence, when the firm cares only about a larger readership, it will target voters close to the $\theta = \theta_0$ with probability of reading $G(8\beta\mu(\rho - x))$. That is, the firm will target the group of voters who have a relatively neutral attitude towards two candidates and would benefit most from informative signals about the state. The probability of reading will be greater when the firm is more likely to receive an informative signal (large π), when the voters care more about voting "right" (large β), when the common prior is less extreme (μ close to $\frac{1}{2}$, i.e. information more valuable) and whether signal is more precise (large ρ). To be more specific, the firm solves the problem

$$\max_{\underline{\theta},\bar{\theta}} \int_{\underline{\theta}}^{\theta_0} G[4x(\theta - \underline{\theta}_1)]dF(\theta) + \int_{\theta_0}^{\bar{\theta}} G[4(1-x)(\bar{\theta}_1 - \theta)]dF(\theta)$$
$$\text{s.t. } \int_{\underline{\theta}}^{\bar{\theta}} dF(\theta) = T$$

The optimal target interval for the media firm is $[\underline{\theta}^*, \bar{\theta}^*]$ such that $x\underline{\theta}^* + (1-x)\bar{\theta}^* = \theta_0$ and $\int_{\underline{\theta}^*}^{\bar{\theta}^*} dF(\theta) = T$.

If the firm has preference over candidate R, then it will target voters who are close to $\theta = \theta_0$ but the targeted distribution will be shifted to the left compared to the case without political preference. For voters close to but to the left of θ_0, the null signal and pro-L signal will not alter their decisions, but the pro-R signal can make them switch from voting L to R. When the political motive is strong enough compared to the profit or readership motive, a right-leaning firm may release news report exclusively to left-leaning voters with $\theta \leq 0$. To be more specific, the firm solves the problem

$$\begin{aligned}
\max_{\underline{\theta},\bar{\theta}} & \int_{\underline{\theta}}^{\theta_0} G[4x(\theta - \underline{\theta}_1)]dF(\theta) + \int_{\theta_0}^{\bar{\theta}} G[4(1-x)(\bar{\theta}_1 - \theta)]dF(\theta) \\
& + \alpha\{1 - F(\bar{\theta}) + x(\int_{\underline{\theta}}^{\theta_0} G[4x(\theta - \underline{\theta}_1)]dF(\theta) \\
& + \int_{\theta_0}^{\bar{\theta}} G[4(1-x)(\bar{\theta}_1 - \theta)]dF(\theta)]\} \\
\text{s.t.} & \int_{\underline{\theta}}^{\bar{\theta}} dF(\theta) = T \\
& \theta_0 \leq \bar{\theta}
\end{aligned}$$

The second constraint comes from the observation that it is never optimal for the media firm to set $\bar{\theta} < \theta_0$ as the firm can instead shift the interval to the right to increase the readership as well as induce more viewers to voter for R. The optimal target interval for the media firm is $[\underline{\theta}^*, \bar{\theta}^*]$ such that $G[4(1-x)(\bar{\theta}_1 - \bar{\theta}^*)] - G[4x(\underline{\theta}^* - \underline{\theta}_1)] = \frac{\alpha}{1+\alpha x}$ and $\int_{\underline{\theta}^*}^{\bar{\theta}^*} dF(\theta) = T$, $\theta_0 \leq \bar{\theta}^*$. Both $\bar{\theta}^*$ and $\underline{\theta}^*$ are decreasing in α, implying a left shift of the target group when the media firm cares more about the political preference. When the political motive is strong enough, we reach the corner solution that $\bar{\theta}^* = \theta_0$ and $\int_{\underline{\theta}^*}^{\bar{\theta}^*} dF(\theta) = T$. The firm target group with ideologies close to neutral but a bit left-biased.

C.2 Media bias

Now we consider the best disclosure rule for the firm when it is not limited by truthful reporting. The firm commits to a disclosure rule which may lie about the signal it

receives. Denote the disclosure rule as $b_L^\theta = \Pr_\theta(r=-1|s=1)$ and $b_R^\theta = \Pr_\theta(r=1|s=-1)$, which can be seen as left and right bias of the firm.

Denote $y_\theta \equiv \Pr_\theta(r=1|b_L^\theta, b_R^\theta) = \mu[\rho(1-b_L^\theta)+(1-\rho)b_R^\theta]+(1-\mu)[(1-\rho)(1-b_L^\theta)+\rho b_R^\theta] = x(1-b_L^\theta)+(1-x)b_R^\theta$. If the firm commits to (b_L^θ, b_R^θ) before seeing the signal realization, for the voter the updated posterior belief will be

$$\Pr_\theta(\omega=1|r=1) = \frac{\mu[\rho(1-b_L^\theta)+(1-\rho)b_R^\theta]}{y_\theta}$$

$$\Pr_\theta(\omega=1|r=-1) = \frac{\mu[\rho b_L^\theta+(1-\rho)(1-b_R^\theta)]}{1-y_\theta}$$

Without loss of generality, we restrict the bias to be that $b_L^\theta + b_R^\theta \leq 1$. Otherwise the viewer can just treat $r=1$ as a signal favoring candidate L and $r=-1$ as favoring candidate R and the analysis will follow. With such condition, we have $\Pr_\theta(\omega=1|r=-1) \leq \mu \leq \Pr_\theta(\omega=1|r=1)$.

The expected utility of reading the news is

$$EU_\theta = \begin{cases} -(1+\theta)^2 - 4\beta\mu & \text{if } \theta < \beta\frac{(1-\rho-\mu)(1-b_L^\theta)+(\rho-\mu)b_R^\theta}{y_\theta} \\ -(1+\theta)^2 - 4\beta\mu + & \\ 4y(\theta - \beta\frac{(1-\rho-\mu)(1-b_L^\theta)+(\rho-\mu)b_R^\theta}{y_\theta}) & \text{if } \beta\frac{(1-\rho-\mu)(1-b_L^\theta)+(\rho-\mu)b_R^\theta}{y_\theta} \leq \theta < \theta_0 \\ -(1-\theta)^2 - 4\beta(1-\mu) + & \\ 4(1-y)(\beta\frac{(1-\rho-\mu)b_L^\theta+(\rho-\mu)(1-b_R^\theta)}{1-y_\theta} - \theta) & \text{if } \theta_0 \leq \theta < \beta\frac{(1-\rho-\mu)b_L^\theta+(\rho-\mu)(1-b_R^\theta)}{1-y_\theta} \\ -(1-\theta)^2 - 4\beta(1-\mu) & \text{if } \theta \geq \beta\frac{(1-\rho-\mu)b_L^\theta+(\rho-\mu)(1-b_R^\theta)}{1-y_\theta} \end{cases}$$

- For voters with $\theta \geq \beta\frac{(1-\rho-\mu)b_L^\theta+(\rho-\mu)(1-b_R^\theta)}{1-y_\theta}$ or $\theta \leq \beta\frac{(1-\rho-\mu)(1-b_L^\theta)+(\rho-\mu)b_R^\theta}{y_\theta}$, they will read the news if and only if $\epsilon \leq 0$.
- For voters with $\beta\frac{(1-\rho-\mu)(1-b_L^\theta)+(\rho-\mu)b_R^\theta}{y_\theta} < \theta \leq \theta_0$, they will read if and only if $\epsilon \leq 4y_\theta(\theta - \beta\frac{(1-\rho-\mu)(1-b_L^\theta)+(\rho-\mu)b_R^\theta}{y_\theta})$. The optimal distortion will be $(b_L^{\theta^*}, b_R^{\theta^*}) = (0,0)$

and the corresponding probability of reading the news is $G(4x(\theta - \underline{\theta}_1))$. The optimal target group will be the one close to θ_0.

- For voters with $\theta_0 \leq \theta < \beta\frac{(1-\rho-\mu)b_L^\theta+(\rho-\mu)(1-b_R^\theta)}{1-y_\theta}$, they will read if and only if $\epsilon \leq 4(1-y_\theta)(\beta\frac{(1-\rho-\mu)b_L^\theta+(\rho-\mu)(1-b_R^\theta)}{1-y_\theta}-\theta)$. The optimal distortion will be $(b_L^{\theta^*}, b_R^{\theta^*}) = (0,0)$ and the corresponding probability of reading the news is $G(4x(\theta-\underline{\theta}_1))$. The optimal target group will be the one close to θ_0.

The truthful reporting can provide most valuable information to the voter and hence can attract the largest readership. The group with neutral political standpoint is the group that will benefit most from more information. The precise analysis is the same as the one not allowing for media bias.

Now we consider the political motive of the firm. For voters with $\theta \geq \beta\frac{(1-\rho-\mu)b_L^\theta+(\rho-\mu)(1-b_R^\theta)}{1-y_\theta}$ or $\theta \leq \beta\frac{(1-\rho-\mu)(1-b_L^\theta)+(\rho-\mu)b_R^\theta}{y_\theta}$, the firm cannot "persuade" the firm to change their decisions upon receiving the news. For voters with $\beta\frac{(1-\rho-\mu)(1-b_L^\theta)+(\rho-\mu)b_R^\theta}{y_\theta} \leq \theta \leq \beta\frac{(1-\rho-\mu)b_L^\theta+(\rho-\mu)(1-b_R^\theta)}{1-y_\theta}$, the firm solve the problem

$$\begin{aligned}
&\max_{b_L^\theta, b_R^\theta} y_\theta \\
&\quad s.t.\ \theta \geq \beta\frac{(1-\rho-\mu)(1-b_L^\theta)+(\rho-\mu)b_R^\theta}{y_\theta} \\
&\quad \theta \leq \beta\frac{(1-\rho-\mu)b_L^\theta+(\rho-\mu)(1-b_R^\theta)}{1-y_\theta}
\end{aligned}$$

The optimal media bias for the firm is

$$(b_L^{\theta^*}, b_R^{\theta^*}) = \begin{cases} (0, \frac{x\theta-\beta(1-\rho-\mu)}{\beta(\rho-\mu)-(1-x)\theta}) & \text{if } \underline{\theta}_1 \leq \theta < \theta_0 \\ (0,1) & \text{if } \theta_0 \leq \theta < \bar{\theta}_1 \\ (0,0) & \text{otherwise} \end{cases}$$

The difference in induced probability of voting for R before and after reading the news is (here we abuse the notation by defining $y_\theta^0 = 1$ if $\theta \geq \theta_0$ and 0 otherwise.

$$y_\theta^* - y_\theta^0 = \begin{cases} \beta\frac{x(1-2\mu)-(1-\rho-\mu)}{\beta(\rho-\mu)-(1-x)\theta} & \text{if } \underline{\theta}_1 \leq \theta < \theta_0 \\ 0 & \text{otherwise} \end{cases}$$

If the firm has preference over candidate R, then it will target voters who are close to $\theta = \theta_0$ but the targeted distribution will be shifted to the left compared to the case without political preference. For voters close to but to the left of θ_0, the null signal and pro-L signal will not alter their decisions, but the pro-R signal can make them switch from voting L to R. When the political motive is strong enough compared to the profit or readership motive, a right-leaning firm may release news report exclusively to left-leaning voters with $\theta \leq 0$. To be more specific, for a firm with both profit motive and political preference, the optimal bias for type θ will be solving

$$\max_{b_L^\theta, b_R^\theta} G(EU_\theta - EU_\theta^0)[1 + \alpha(y_\theta - y_\theta^0)]$$

and the solution is

$$(b_L^{\theta^*}, b_R^{\theta^*}) = \begin{cases} (0, < \frac{x\theta - \beta(1-\rho-\mu)}{\beta(\rho-\mu)-(1-x)\theta}) & \text{if } \underline{\theta}_1 \leq \theta < \theta_0 \\ (0, < 1) & \text{if } \theta_0 \leq \theta < \bar{\theta}_1 \\ (0, 0) & \text{otherwise} \end{cases}$$

D Heterogeneous belief

Assume a continuum of voters choose to vote for two candidates Left and Right in a election. There are two states $\omega \in \{-1, 1\}$, where -1 means that the Left candidate is better suited for the office and 1 for Right candidate. The 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 voter chooses whether to vote for R or L, $a \in \{-1, 1\}$. 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 $U(1, p) \geq U(-1, p) \iff p \geq \frac{1}{2}$.

Suppose the news firm receives a signal (news) $s \in \{-1, 0, 1\}$ about the state. $s = 0$ means that the news is irrelevant of the state (or the null signal) and the firm receives such signal with probability $1 - \pi$ regardless of the state: $\Pr(s = 0) = \Pr(s = 0|\omega = 1) = \Pr(s = 0|\omega = -1) = 1 - \pi$. With probability π the firm receives an informative signal with precision $\rho > \frac{1}{2}$ such that $\Pr(s = \omega|\omega, s \neq 0) = \rho$. The firm can write a

report $r \in \{-1, 0, 1\}$ based on the news they receive and release the report to some voters. Assume that the firm cannot manipulate the content of an informative signal but can hide it, i.e. it can choose $r \in \{0, 1\}$ when $s = 1$ and $r \in \{-1, 0\}$ when $s = -1$. Also assume that the firm cannot make up an informative signal, i.e. $r \in \{0\}$ when $s = 0$.

The firm commits to its disclosure rule before it observes the signal. The voter chooses to read the news report before they see the content. In addition to the utility related to voting, there is additional term $\epsilon \in G(.)$ for the cost of reading news. The reading cost is independent of the type of the voter and they will read if and only if the expected increase in voting related utility exceeds the reading cost.

First, we focus on the case where the firm cannot hide the informative signal $(r|s \in \{s\})$ either and it only cares about the advertising revenue.

- For voter of type θ, the posterior belief is $\Pr(\omega = 1|r = 1) = \frac{\theta\rho}{\theta\rho+(1-\theta)(1-\rho)}$, $\Pr(\omega = 1|r = 0) = \theta$ and $\Pr(\omega = 1|r = -1) = \frac{\theta(1-\rho)}{\theta(1-\rho)+(1-\theta)\rho}$.
- The voters will choose $a = 1$ if and only if $\theta \geq \frac{1}{2}$ after observing $n = 0$, $\theta \geq 1 - \rho$ after observing $n = 1$ and $\theta \geq \rho$ after observing $n = -1$.
- For voters with $\theta \geq \rho$ or $\theta \leq 1 - \rho$, they will read if and only if $\epsilon \leq 0$.
- For voters with $1-\rho \leq \theta \leq \frac{1}{2}$, they will read if and only if $\epsilon \leq 4[(2-\pi)\theta-1+\pi\rho]$.
- For voters with $\frac{1}{2} \leq \theta \leq \rho$, they will read if and only if $\epsilon \leq 4[1-(2-\pi)\theta-\pi(1-\rho)]$.
- Hence, the firm will target voters close to the $\theta = \frac{1}{2}$.

If the firm cannot hide the informative signal and cares both about advertising revenue and is pro-R, then it will target voters $\theta \leq \frac{1}{2}$ and those who are close to $\frac{1}{2}$. The null signal and pro-L signal will not alter their decisions, but the pro-R signal can make them switch from voting L to R.

Next, suppose the firm can hide the informative signal and only cares about political motive, i.e. it wants to convince more voters to vote for R. Denote $b_L = \Pr(r = 0|s = 1)$ and $b_R = \Pr(r = 0|s = -1)$.

- For voter of type θ, the posterior belief is $\Pr(\omega = 1|r = 1) = \frac{\theta\rho}{\theta\rho+(1-\theta)(1-\rho)}$, $\Pr(\omega = 1|r = 0) = \frac{\theta[1-\pi+\pi(\rho d_L+(1-\rho)d_R)]}{\theta[1-\pi+\pi(\rho d_L+(1-\rho)d_R)]+(1-\theta)[1-\pi+\pi((1-\rho)d_L+\rho)d)]}$ and $\Pr(\omega = 1|r = -1) = \frac{\theta(1-\rho)}{\theta(1-\rho)+(1-\theta)\rho}$.
- Consider the voters $1-\rho \leq \theta \leq \rho$ who may switch their actions under informative signals.
  - The firm solves the problem

$$\max_{b_L,b_R} \Pr(r = 0) + \Pr(r = 1)$$
$$\text{s.t.} \Pr(\omega = 1|r = 0) \geq \frac{1}{2}$$

    The optimal decision is that

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

  - It also solves the problem

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

    The optimal decision is

$$b_L(\theta) = 0$$

If we consider the case where the firm can hide informative signal and only cares about advertising revenue, then the optimal strategy will be not withholding any informative signal and targeting voters close to $\theta = \frac{1}{2}$.