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A theory of media bias and disinformation

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Abstract

The digital revolution has fundamentally transformed the news industry. To capture these developments, we build a model of media bias in which consumers with heterogeneous beliefs can choose between a variety of news outlets, biased outlets may spread disinformation, and consumers in turn can engage in fact-checking. We first show that fabricated news and fact-checking of counter-attitudinal news naturally is part of any equilibrium. Second, under weak conditions competition between biased outlets induces moderately biased consumers to follow the outlet that is biased against their belief. We also show how competition in many cases reduces disinformation considerably. Finally, in presence of a neutral outlet, echo chambers arise endogenously in equilibrium because only partisans with extreme beliefs follow biased outlets.

JEL classification: C72, D82, D83, L82.

Keywords: Disinformation, media bias, competition, news consumption, fabrication, echo chambers.

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1 Introduction

The internet and digital devices like smartphones and tablets have fundamentally changed the way people consume news. Instead of from newspapers and television, many people today commonly get news via news websites/apps and social media platforms, with the latter being particularly popular among young people.[1] Over the last two decades, these developments have not only led to a fragmentation of the media landscape but also facilitated the spreading of disinformation, i.e., fabricated or false news stories purposely spread to deceive people.[2] Growing evidence suggests that they are widespread particularly on social media, with the vast majority of people regularly encountering such stories.[3] Moreover, rapidly advancing AI technology allowing for the fabrication of image and video content exacerbates the problem.[4] At the same time, the digital revolution has also facilitated (informal) fact-checking, e.g., through cross-checking sources. Nevertheless, fabricated or false news stories cause confusion about basic facts and many people are concerned about the impact that they could have on democracy.[5]

In this paper, we build a model of media bias that captures these stylized facts. Consumers with heterogeneous beliefs can choose between a variety of news outlets. Biased outlets benefit politically or financially from consumers taking a certain action; examples include (not) consuming a credence good like a medical treatment, (not) approving a proposed policy such as social-distancing policies in a pandemic, or voting for a party in line with its ideology. To this end, the outlet may strategically spread disinformation, including the possibility of fabrication in case there is no actual news, and consumers in turn can engage in fact-checking.

[1] See Pew Research Center (2021b) for a recent survey on news consumption in the US.

[2] Our terminology follows Lazer et al. (2018); Allcott and Gentzkow (2017) employ essentially the same definition for its close cousin "fake news". See Nichols (2017) and Sunstein (2018) for a comprehensive description of the news industry and how it fundamentally changed over the last two decades.

[3] See Allcott and Gentzkow (2017) and Vosoughi et al. (2018) for evidence regarding fabricated or fake stories on Facebook and Twitter. Furthermore, in a survey of 25,000 respondents in over 25 economies, 86% stated that they have been exposed to fake news (CIGI-Ipsos, 2019). In the EU, 68% stated that they encounter fake news at least once a week (European Commission, 2018).

[4] Such fabricated content, also referred to as 'deepfakes', has by now become at least difficult to identify, see https://www.nytimes.com/2023/04/08/business/media/ai-generated-images.html, accessed April 18, 2023. In a recent article, van der Sloot and Wagensveld (2022) provide an overview on deepfakes and discuss regulatory responses to their potential harms.

[5] 64% of US adults said that "fabricated news stories cause a great deal of confusion about the basic facts of current issues and events" (Pew Research Center, 2016). In November 2019, 48% (34%) of Americans said they were "very" ("somewhat") concerned about the impact made-up news could have on the election (Pew Research Center, 2021a). In the EU, 83% stated that fake news is a problem for democracy in general (European Commission, 2018).

In this setting, we show how competition between biased outlets can reduce disinformation considerably, because moderately biased consumers follow (or subscribe to) the "different-minded" outlet that is biased against their belief and fact-check counter-attitudinal news. In presence of a neutral outlet, however, "echo chambers" wherein consumers avoid counter-attitudinal news (Sunstein, 2007) arise endogenously in equilibrium because only partisans with extreme beliefs follow biased outlets.

In our baseline model there is a large population of consumers with heterogeneous prior beliefs who must each choose one of two actions and a single news outlet operated by a media firm with uncertain bias toward the high action. The media firm may receive a private signal ("news") about the state of the world and then submits a report to consumers; we can interpret the firm's report as news posted prominently on the outlet's website or social media account or featured on television. In particular, in absence of (actual) news the firm may either honestly report "no news", which may be interpreted as posting news that is not related to the state like trivial gossip news, or fabricate a news story.

After having observed the report, consumers can verify ("fact-check") it at a (low) cost. Verification reveals the media firm's information if and only if it has reported news; consumers thus do not search for informative news on their own, e.g., due to limited attention (Simon, 1971). The firm incurs a reputational cost that depends on the "size" of the lie (in terms of the effect on posterior beliefs) if a consumer discovers that the report has been false, i.e., does not match the media firm's information. Finally, each consumer chooses her action as to match the state.

We first establish that bias toward the high action induces the media firm to either suppress or distort a low signal, since suppression induces more consumers to take its preferred action than honesty while avoiding verification. Second, there is fabricated news in any equilibrium. The reason is that fabricating a high report is a smaller lie than distorting a low signal, and hence associated with lower reputational costs.

Next, we characterize equilibria. If reputational costs are high (relative to the importance of the firm's biased agenda), the media firm sometimes fabricates high reports and suppresses low signals whenever possible. In turn, consumers who are moderately biased toward the low action verify high reports. To understand why, note that Bayesian updating implies that consumers with a low prior belief perceive a high report as less accurate than those with a high prior belief.[6] Now, for

[6] This is consistent with the idea that Liberals perceive a liberal news outlet as more accurate

a consumer to verify a high report requires, first, that she is sufficiently uncertain about her optimal action given such report. Second, verification being costly means also uncertainty about the report's accuracy must be sufficiently large. Since a high report shifts beliefs upwards, the consumers who, *interim*, are the most uncertain are those (ex-ante) moderately biased toward the low action. In particular, some of them verify because they would switch from the high action to the low action if the report were fabricated, while others verify because they would switch from the low action to the high action if it were confirmed.

If reputational costs are low, however, the media firm fabricates high reports whenever possible and sometimes distorts low signals. The firm is willing to report a high signal more often in this case because the loss in reputation due to consumers' verification is small. A high report thus shifts beliefs less upwards, such that potentially even consumers who are biased toward the high action verify. We then conduct comparative statics, which show that lowering verification costs decreases disinformation in the equilibrium with the least disinformation. Lower verification costs induce more consumers to verify high reports, reducing incentives to produce disinformation.

Next, we introduce competition between media firms who each operate one news outlet. After consumers have selected which outlet to follow (or subscribe to), the game proceeds as described above.

We first consider competition between two media firms that are biased toward the high and the low action, respectively. As in the monopoly model, both media firms sometimes fabricate favorable reports and suppress unfavorable signals whenever possible in the equilibrium with the least disinformation if reputational costs are high. In turn, two types of consumers follow the different-minded outlet that is biased against their belief: First, centrist consumers who are slightly biased do so because what matters to them is whether the signal is counter-attitudinal, in which case they would choose the action they initially did not prefer. With a low level of fabrication, the different-minded outlet is very informative on this matter, while the "like-minded" outlet that is biased in favor of one's belief is not since it suppresses counter-attitudinal signals, and hence pools them with uninformative "no news" signals. Second, moderately biased consumers follow the different-minded outlet because they anticipate that they will verify counter-attitudinal reports, and thus learn whether the signal is counter-attitudinal. This

than Conservatives and vice versa, cf. the discussion in Gentzkow and Shapiro (2006). It is further in line with evidence that people are most susceptible to forming false memories for fake news that align with their prior beliefs (Murphy et al., 2019).

is optimal given that the like-minded outlet is not very informative on this matter and verification costs are low.

Otherwise, if reputational costs are low, there is also distortion in the equilibrium with the least disinformation, and in turn only a part of the consumers who would verify counter-attitudinal reports follows the outlet that is biased against their belief. With low levels of distortion, following the like-minded outlet is rather informative on whether the signal is counter-attitudinal or not, such that less consumers follow the different-minded outlet and verify counter-attitudinal news. This makes high levels of distortion likely to occur, in which case (again) more consumers follow the different-minded outlet and verify counter-attitudinal reports. These results show that consumers' choice which outlet to follow is non-monotonic in the level of disinformation. Overall, some consumers commonly follow the different-minded outlet and verify counter-attitudinal reports in equilibrium.

We then show that because some consumers follow the different-minded outlet, competition can reduce disinformation considerably, in particular if reputational costs are high. Consumers who follow the different-minded outlet are moderately biased, and hence may, in principle, be persuaded into taking either action. Thus, under competition each outlet has less followers that it can persuade into taking its preferred action as compared to the monopoly model, which makes fabrication less attractive.

Finally, we introduce a neutral media firm which generally reports truthfully (due to strong incentives to do so). We show that in equilibrium all moderate consumers – those who may be persuaded into taking either action – follow the neutral outlet, while partisan consumers with extreme beliefs follow the like-minded outlet. Clearly, no consumer will choose to follow the different-minded outlet and verify counter-attitudinal reports if she can get the same information from the neutral outlet for free. Biased firms thus have no incentives to report honestly, such that echo chambers in which consumers only receive uninformative reports arise endogenously in equilibrium.[7] Nevertheless, we show that introducing the neutral media firm generates a Pareto-improvement for consumers, since all moderate consumers (those for whom information may matter) then follow the neutral media firm and hence receive no more disinformation.

[7] As we will discuss in detail in Section 4, the model readily extends to the case where the neutral firm is biased with some probability. In this case, we obtain verification and echo chambers at the same time.

1.1 Related literature and empirical implications

Our paper contributes to several strands of the growing literature on the political economy of mass media and media bias (Prat and Strömberg, 2013; Anderson et al., 2015). The first strand is that on media bias as distortion of private information. In these models, media firms distort their reports because consumers like to see their priors confirmed (Mullainathan and Shleifer, 2005), because of political capture (Besley and Prat, 2006; Denter et al., 2021), or to build a reputation for quality (Gentzkow and Shapiro, 2006); see Gentzkow et al. (2015) for a survey. In Besley and Prat (2006) the media firm may not receive a signal similar to our model, but they explicitly rule out fabrication: "If we allowed the media to [fabricate] news, and we wanted to maintain the assumption that voters are rational, we would need to get into a complex signalling game." (p. 723) To our knowledge, we are the first to study a model of media bias in which media firms can also fabricate news.

Our monopoly model further shares some features with contemporary work by Gitmez and Molavi (2022), who consider a biased news outlet that tries to persuade consumers with heterogeneous preferences and beliefs. Their focus is on how polarization of prior beliefs affects media slant, showing that a more polarized society may lead to less biased news.[8]

Second, our model is related to the literature on consumers' choice of news outlet. A main insight from this literature is that for agents with strong (enough) prior beliefs, it is typically advantageous to follow like-minded news sources because such outlets are more informative regarding when to switch to the other – initially not favored – action (Calvert, 1985; Suen, 2004). Oliveros and Várdy (2015) study consumers' choice of news outlet in a strategic voting environment and show that the option to abstain from voting leads to non-monotonic choices of which outlet to follow. Che and Mierendorff (2019) study the same question in a dynamic model and find that the agent allocates her attention to like-minded news when her belief is extreme while she chooses different-minded news when her belief is moderate. This "anti-echo-chamber" effect for moderates arises because following different-minded news delays their decision until they receive conclusive news. Different from these papers, we consider strategic media firms and show that similar results obtain when these firms are biased in opposite directions and

[8]On the other hand, empirical evidence on political polarization suggests that it may be driven by biased news on television (Martin and Yurukoglu, 2017; Bursztyn et al., 2022). Moreover, recent work by Bowen et al. (2023) shows that biased news is not necessary for polarization to occur if agents hold (minor) misperceptions about others' sharing behavior.

may receive uninformative signals. In particular, the rationale for following the different-minded outlet in our model is twofold: Firstly, if outlets pool counter-attitudinal with uninformative signals, then the like-minded outlet is *not* very informative regarding when to switch to the other action. Secondly, moderately biased consumers anticipate that they will verify counter-attitudinal reports.

Third, our model is also related to the literature on the effect of competition between strategic news outlets. In general, competition may have positive (Anderson and McLaren, 2012; Besley and Prat, 2006; Gentzkow and Shapiro, 2006) as well as negative (Baron, 2006; Bernhardt et al., 2008; Mullainathan and Shleifer, 2005) effects on consumer welfare and media bias. In recent work by Chen and Suen (2019), consumers' allocation of attention does not only depend on but also affects the quality choices of biased news outlets. They show that increasing competition diverts attention from existing outlets, reducing incentives to improve news quality.[9]

Closely related and contemporary work by Innocenti (2021) studies competition between two media firms with opposite biases. In a model of information design, he shows that heterogeneous beliefs lead to the endogenous formation of echo chambers, as consumers devote their limited attention to like-minded news sources, who in turn have no incentives to provide valuable information. In our model, such an echo-chamber effect obtains once there is also a neutral media firm in the market, but only for strongly biased consumers. This result relates our model to Richardson and Stähler (2021), who study price competition between a media firm providing true news and two fake-news providers that create echo chambers. Although fake news providers do not provide any information, consumers with extreme beliefs still choose to consume fake news in their model to have their prior beliefs confirmed. In our model, the echo-chamber effect arises endogenously because biased firms have no incentives to provide valuable information when moderates follow the neutral outlet.[10]

Another related paper is Nimark and Pitschner (2019), who study how consumers devote attention to news outlets who report information selectively. They show that news outlets not only convey information via the content of their news but also via the reporting decision itself. Perego and Yuksel (2022) study competition between unbiased media firms that endogenously acquire political information

[9]Galperti and Trevino (2020) and Strömberg (2004) study competition between unbiased outlets in related models.

[10]Jann and Schottmüller (2022) highlight a potential positive aspect of echo chambers, namely that, to the extent that people in echo chambers have similar preferences, they facilitate truthful communication; cf. Foerster (2019) for similar results on networks.

on different issues. They show that competition leads to informational specialization and an increase in social disagreement. Finally, Acemoglu et al. (2021) focus on the role of consumers in spreading existing misinformation. Agents sequentially observe an article and must decide whether to share it with others. They derive value from future shares but fear sharing misinformation, and can fact-check articles. Similarly to our model, they find that consumers are more likely to verify counter-attitudinal news. They further show that homophily fosters the spread of misinformation because it creates echo chambers.

Empirical implications. We also contribute to the empirical literature on media bias and news consumption with several predictions. First, our model predicts that biased news outlets suppress unfavorable news, i.e., report news selectively. Bursztyn et al. (2022) document that opinion programs on television adopted opposing narratives about the threat posed by the COVID-19 pandemic, and show that consumers turn to such programs for information about objective facts. Levy (2021) finds that social media algorithms may limit exposure to counter-attitudinal news outlets (conditional on subscribing to them). Furthermore, many studies suggest that exposure to selective or polarizing news is higher on social media compared to traditional media (Allcott et al., 2020; Dejean et al., 2022; Steppat et al., 2022), a finding that is even more pronounced for the youngest and both far-left and far-right news consumers (Dejean et al., 2022).

Second, we predict that some consumers follow different-minded outlets. Gentzkow and Shapiro (2011) and Pew Research Center (2021a) have found that a significant share of conservative voters consults liberal news outlets and vice versa, see also Oliveros and Várdy (2015) for a discussion. Third, we predict that only a minority of consumers verifies news – those who, interim, are the most uncertain. According to Eurostat (2021), only one in four Europeans verifies information found on online news sites. Furthermore, Guess, Nyhan, and Reifler (2020) found that consumers of fake news sites almost never see fact checks.

Fourth, we predict that lowering the costs of verification decreases disinformation in equilibrium. From a policy perspective, to lower these costs would mean improving people's fact-checking skills via investments in media and information literacy education,[11] which according to UNESCO "is an interrelated set of competencies that help people to maximize advantages and minimize harm in the new

[11] There is evidence that information and media literacy helps people to identify fake news, see, e.g., Guess, Lerner, Lyons, Montgomery, Nyhan, Reifler, and Sircar (2020); Jones-Jang et al. (2021).

information, digital and communication landscapes."[12] Our results thus suggest that improving media and information literacy may not only be beneficial on the individual level but also result in a better media environment. Although there is no direct empirical evidence for this mechanism, media literacy levels at least seem to be negatively correlated with people's perceived exposure to disinformation and fake news.[13]

Finally, we predict that competition between diverse (biased and neutral) outlets results in echo chambers, wherein partisan consumers with extreme beliefs avoid counter-attitudinal news. These findings are in line with Sunstein (2007), who argues that people sort themselves into echo chambers, which are "enclaves in which their own views and commitments are constantly reaffirmed" (p. xii). Furthermore, Gentzkow and Shapiro (2011) found that a large share of consumers consults centrist outlets, and thus does not end up in an echo chamber, see also Oliveros and Várdy (2015). In this light, our findings also speak to the literature studying how social media affects political polarization (Allcott et al., 2020; Barberá, 2020; Settle, 2018). Our results suggest that social media may increase polarization among partisan but not centrist consumers, and thus support the more nuanced view put forward in Barberá (2020).

The paper is organized as follows. In Section 2 we present the monopoly model. Section 3 introduces competition. We first investigate competition between two biased firms and then introduce a neutral firm. Section 4 concludes and discusses some of our modelling choices and an extension in which we allow consumers to follow multiple outlets.

2 Disinformation in a monopoly

In our baseline model, there is a binary state of the world $\theta \in \{0, 1\}$, a large population of consumers $N = [0, 1]$ who must each choose an action $a \in A = \{0, 1\}$, and a media firm M that provides information via a single news outlet. M has a type $t \in T = \{\text{neutral}, \text{biased}\}$, where $\lambda = Pr(t = \text{biased}) \in (0, 1]$. Consumers have *heterogeneous prior beliefs* π on the true state being $\theta = 1$ distributed according to a continuous and strictly increasing cdf F on $[0, 1]$. We will frequently identify a consumer with her prior π.

[12] See https://www.unesco.org/en/media-information-literacy/about, accessed April 28, 2023.

[13] There is a fairly strong negative correlation of $\rho = -.787$ between an EU country's score in the Media Literacy Index 2022 (Lessenski, 2022) and its share of participants in a survey by the European Parliament (2022) who think they have been personally exposed to disinformation and fake news over the past 7 days either often or very often.

At the beginning of the game, M privately learns its type and then receives a private signal $s \in \{l, h\}$ with probability $p_0 \in (0, 1)$. We interpret the signal s as news about θ, with precision $p_1 = Pr(s = l|\theta = 0) = Pr(s = h|\theta = 1) > \frac{1}{2}$. For convenience, we write $s = \emptyset$ if M has not received a signal and let $S = \{\emptyset, l, h\}$. Next, M submits a report $\hat{s} \in \hat{S} = \{\emptyset, l, h\}$ to consumers. In order to introduce payoff consequences from misrepresenting ones information, we impose the common understanding that message $\hat{s}$ means '$s = \hat{s}$' ("exogenous meaning", cf. Gordon et al. (2022)); message $\hat{s} = \emptyset$ may then be interpreted as reporting news that is not related to θ, e.g., trivial gossip news. In particular, we refer to $\hat{s} = s$ as *truthful* reporting.[14]

After a consumer has observed M's report $\hat{s}$, she may *verify* (or fact-check) it at cost $c > 0$. Verification reveals the true realization of the signal s if $\hat{s} \in \{l, h\}$ and simply confirms the report if $\hat{s} = \emptyset$; as we will discuss in more detail in Section 4.1, we hence assume that consumers do not search for informative news on their own accord. Let $v_\pi \in \{0, 1\}$ denote the verification decision and μ_π the posterior of a consumer π. If a consumer π discovers that $\hat{s} \in \{l, h\} \backslash \{s\}$, then M incurs a *reputation cost* $\alpha(\hat{s}, s, \mu_\pi) \in (0, 1)$ that lowers its continuation payoff (explained below). We assume that $\alpha(\hat{s}, s, \mu_\pi)$ measures the "size" of the lie:[15]

(i) $\alpha(\hat{s}, s, \mu_\pi)$ is weakly increasing in $|\mu_\pi(\hat{s}) - \mu_\pi(s)|$ for all $\hat{s} \in \{l, h\} \backslash \{s\}$,

(ii) $\alpha(\hat{s}, s', \mu_\pi) \geq \alpha(\hat{s}, \emptyset, \mu_\pi)$ if and only if $|\mu_\pi(\hat{s}) - \mu_\pi(s = s')| \geq |\mu_\pi(\hat{s}) - \mu_\pi(s = \emptyset)|$ for all $\hat{s}, s' \in \{l, h\}$, $\hat{s} \neq s'$.

We will frequently employ $\alpha(\hat{s}, s, \mu_\pi) = \alpha^\Delta(\hat{s}, s, \mu_\pi) \equiv |\mu_\pi(\hat{s}) - \mu_\pi(s)|$ in examples. Finally, each consumer π chooses her action $a_\pi \in A$ and receives a payoff of 1 if $a_\pi = \theta$ and 0 otherwise. M receives a continuation payoff of

$$\beta \left(1 - \int_0^1 v_\pi \alpha(\hat{s}, s, \mu_\pi) dF(\pi)\right)$$

that may represent future revenue from advertising or subscriptions, where $\beta > 0$. If M is neutral, it derives an additional payoff normalized to 1 from reporting truthfully, $\hat{s} = s$, reflecting intrinsic motivation to inform consumers. If M is biased, it derives an additional payoff from consumers choosing the high action normalized to $\int_0^1 a_\pi dF(\pi)$.

To summarize, the timing of events is as follows:

[14] Note that the main deviation from a "pure" cheap-talk model is that we will allow consumers to verify reports. The neutral media firm will further face direct payoff consequences from misreporting.

[15] See Section 4.1 for a discussion of this assumption.

1. Nature draws the state $\theta \in \{0, 1\}$ and the type $t \in T$ of M.

2. M privately learns its type and receives a private signal $s \in \{l, h\}$ with probability $p_0 \in (0, 1)$.

3. M submits a report $\hat{s} \in \hat{S}$ to consumers.

4. After having observed M's report, consumers can verify it at cost $c > 0$.

5. Each consumer chooses her action $a \in A$.

6. Payoffs realize.

The solution concept we employ is perfect Bayesian equilibrium.

2.1 Equilibrium analysis

In our setting with exogenous meaning of messages ($\hat{s}$ means '$s = \hat{s}$'), it is natural to require that beliefs are monotonic, i.e., $\mu_\pi(\hat{s} = h) > \mu_\pi(\hat{s} = \emptyset) > \mu_\pi(\hat{s} = l)$ for all $\pi \in (0, 1)$; see Gordon et al. (2022) for a discussion of this assumption. We henceforth restrict attention to $\pi \in (0, 1)$ and refer to equilibria that induce monotonic beliefs as *monotonic equilibria*.

In a first step to a characterization of equilibria, we narrow down the firm's equilibrium strategy. For the neutral media firm, truthful reporting $\hat{s} = s$ is a strictly dominant strategy, as it obtains a positive (direct) payoff from doing so while obtaining the highest possible continuation payoff.[16] The biased media firm, on the other hand, benefits from consumers choosing the high action and may to this end produce disinformation. We distinguish between the distortion and the fabrication of news about the state:

Definition 1 (Disinformation)**.** *We refer to M's report $\hat{s} \in \{l, h\}$ as* disinformation *if $\hat{s} \neq s$. Furthermore, $\hat{s} \in \{l, h\}$*

(i) distorts *the private signal if $\hat{s} \neq s \in \{l, h\}$.*

(ii) is fabricated *if $s = \emptyset$.*

We further say that M's report $\hat{s} = \emptyset$ *suppresses* the private signal if $s \in \{l, h\}$. We show that the biased firm reports a high signal honestly and either suppresses or distorts a low signal. With a low signal, suppression is strictly better than

[16]Note that even without the positive payoff from honesty, truthful reporting would always be a best reply for the neutral firm.

honesty under monotonic beliefs because it induces more consumers to take its preferred action while avoiding verification. We thus obtain:

Lemma 1. *Any monotonic equilibrium is such that the neutral media firm reports truthfully and the biased media firm reports $s = h$ truthfully and either suppresses or distorts $s = l$.*

All proofs are relegated to Appendix A. We can thus subsequently focus on the biased firm and represent her strategy by a function $q : S \to [0, 1]$ that maps the signal s to the probability that it submits $\hat{s} = h$ (and $\hat{s} = \emptyset$ otherwise). By Lemma 1 we have $q(h) = 1$, such that the biased firm's strategy will be characterized by the probabilities $q(l)$ and $q(\emptyset)$ of distortion and fabrication, respectively, given the possibility to do so.

We next establish that there will be fabricated news in any monotonic equilibrium: First, note that informative communication by the biased firm requires that some (a positive mass of) consumers verify. Second, by monotonicity verifying $\hat{s} = h$ induces less of a change in a consumer's belief, and thus yields a higher continuation payoff, when $s = \emptyset$ than when $s = l$. Thus, reporting $\hat{s} = h$ yields a higher continuation payoff when $s = \emptyset$ than when $s = l$, implying $q(\emptyset) = 1$ if $q(l) > 0$. Third, truth-telling cannot be an equilibrium, as then no consumer would verify.

Lemma 2. *Any monotonic equilibrium is such that*

(i) $q^*(\emptyset) > 0$,

(ii) $q^*(\emptyset) = 1$ *whenever* $q^*(l) > 0$.

We henceforth impose the following upper bound on verification costs to ensure that at least some consumers verify if there is enough fabricated news:

Assumption 1.

$$c < \frac{\lambda p_0(1-p_0)(2p_1-1)}{2\big(\lambda(1-p_0)(\lambda(1-p_0)+p_0)+p_0^2p_1(1-p_1)\big)}.$$

Note that for $p_1 = 1$, i.e., M's signal perfectly reveals the state, Assumption 1 simplifies to $c < \frac{p_0}{2(\lambda(1-p_0)+p_0)}$. In a second step, we determine consumers' behavior upon observing $\hat{s} = h$. Observe that Bayesian updating implies that the perceived accuracy of the firm's report depends on the prior belief (cf. Gentzkow and Shapiro, 2006):

Remark 1. *Given strategy q, the posterior belief of consumer π that a high report $\hat{s}=h$ has been accurate $Pr_\pi(s=h \mid \hat{s}=h) =$*

$$\frac{p_0(\pi p_1 + (1-\pi)(1-p_1))}{\lambda q(\emptyset)(1-p_0) + p_0\big(\pi(p_1+\lambda q(l)(1-p_1)) + (1-\pi)(1-(1-\lambda q(l))p_1)\big)} \tag{1}$$

is strictly increasing in π, i.e., consumers with a low prior belief perceive the firm's report to be less accurate compared to consumers with a high prior belief.

A necessary condition for a consumer to verify $\hat{s}=h$ is that her subsequent action would depend on the outcome of the verification; for instance, she could take action 1 if the report were accurate and action 0 if it were fabricated. This requires that, *interim*, the consumer is sufficiently uncertain about her optimal action and thus expects to obtain low utility.[17] Furthermore, because verification is costly, the expected gain must be large enough, which roughly requires uncertainty about the report's accuracy (1) to be sufficiently large. Now, since $\hat{s}=h$ shifts beliefs upwards (under an informative strategy q), the typical consumer who verifies is (ex-ante) moderately biased toward the low action.

Formally, we establish that under the biased firm's strategy q, consumers with prior in the non-empty interval $\mathcal{V}(q) \subset (1-p_1, p_1)$ verify $\hat{s}=h$, where

$$\underline{\mathcal{V}}(q) = \frac{c\lambda\left((1-p_0)q(\emptyset) + p_0p_1q(l)\right) + (1+c)p_0(1-p_1)}{p_0\left(1-c(2p_1-1)(1-\lambda q(l))\right)}$$

and

$$\overline{\mathcal{V}}(q) = \begin{cases} \frac{((1-p_0)q(\emptyset)+p_0p_1q(l))\lambda(1-c)-cp_0(1-p_1)}{\lambda(2(1-p_0)q(\emptyset)+p_0q(l))+cp_0(2p_1-1)(1-\lambda q(l))}, & \text{if } q(l) \le \frac{c(2\lambda(1-p_0)q(\emptyset)+p_0)}{\lambda p_0(2p_1-1-c)} \\ \frac{\lambda p_0p_1q(l)(1-c)-c(\lambda(1-p_0)q(\emptyset)+p_0(1-p_1))}{\lambda p_0q(l)+cp_0(2p_1-1)(1-\lambda q(l))}, & \text{otherwise} \end{cases}.$$

Note that $\overline{\mathcal{V}}(q) > \frac{1}{2}$ if and only if $q(l) > \frac{c(2\lambda(1-p_0)q(\emptyset)+p_0)}{\lambda p_0(2p_1-1-c)}$ (>0 by Assumption 1), i.e., consumers who are biased toward action 1 may also verify, but only if the biased firm distorts low signals sufficiently often. We will refer to $\mathcal{V}(q)$ as the *verification interval.* All consumers with prior above $\overline{\mathcal{V}}(q)$ take action 1 upon receiving $\hat{s}=h$, and those with prior above

$$\Pi^{\emptyset}(q) \equiv \frac{(1-p_0)(1-\lambda q(\emptyset)) + \lambda p_0p_1(1-q(l))}{2(1-p_0)(1-\lambda q(\emptyset)) + \lambda p_0(1-q(l))}$$

take action 1 upon receiving $\hat{s}=\emptyset$. Note that $\Pi^{\emptyset}(q) > \frac{1}{2}$ if $q(l) < 1$. The type of equilibrium depends on the value of the continuation payoff: The biased firm

[17] Note that expected utility is convex in the consumer's (interim) belief with minimum at 1/2.

fabricates but does not distort news if it is high. Otherwise, if the continuation payoff is low, it both fabricates and distorts news.

Proposition 1. *There exist* $\overline{\beta}_2 \geq \underline{\beta}_1 > 0$ *such that there is a monotonic equilibrium* q^* *such that*

(i) $q^*(\emptyset) > 0 = q^*(l)$ *if and only if* $\beta \geq \underline{\beta}_1$.

(ii) $q^*(\emptyset) = 1 \geq q^*(l) > 0$ *if and only if* $\beta < \overline{\beta}_2$.

Consumer π *verifies* $\hat{s} = h$ *if and only if* $\pi \in \mathcal{V}(q^*)$ *and takes action* 1 *upon* $\hat{s} = h$ *(*$\hat{s} = \emptyset$*) if and only if* $\pi > \overline{\mathcal{V}}(q^*)$ $(\Pi^{\emptyset}(q^*))$.

The biased firm reports a high signal more often when the continuation payoff is low because then the resulting loss from consumers' verification is small compared to the benefit from consumers choosing the high action. Some remarks seem in order. First, both types of equilibria may exist at the same time if the continuation payoff is intermediate. Second, the consumer π whose interim belief after observing $\hat{s} = h$ is $\mu_\pi(\hat{s} = h|q) = \frac{1}{2}$ will verify $\hat{s} = h$, i.e., it is indeed the consumers who interim are the most uncertain about the optimal action who verify. At least with high continuation payoff, consumers who verify are thus moderately biased toward the low action. In particular, they choose to verify for different reasons: those in the upper part of the verification interval $\mathcal{V}(q^*)$ do so because they would switch from the high to the low action if they discovered that supposed news were false, while those in the lower part do so because they would switch from the low to the high action if it were confirmed, see Figure 1 for an illustration. With low

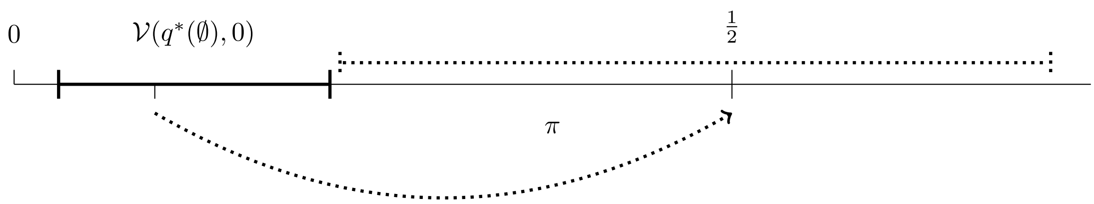

Figure 1: Verification interval $\mathcal{V}(q^*(\emptyset), 0) \approx (0.031, 0.22)$ for $q^*(\emptyset) \approx 0.244$, see Example 1 below for details. The dotted line and arrow indicate the corresponding interim beliefs after observing $\hat{s} = h$.

continuation payoff, the report $\hat{s} = h$ shifts beliefs much less upwards, such that also consumers who are slightly biased toward the high action may verify. Third, the biased firm's strategy q^* essentially (up to a set of measure zero) uniquely determines consumer behavior, such that we can henceforth identify a monotonic equilibrium with q^*. The following example illustrates Proposition 1.

Example 1. *Suppose that* $F = \mathcal{U}(0,1)$*,* $\alpha(\cdot) = \alpha^{\Delta}(\cdot)$*,* $p_0 = \frac{1}{2}$*,* $\lambda = \frac{1}{2}$*,* $p_1 = 1$*, and* $c = \frac{1}{5}$*. Then there is a monotonic equilibrium* q^* *such that*

(i) $q^*(\emptyset) > 0 = q^*(l)$ *if and only if* $\beta \geq \underline{\beta}_1 \approx 3.44$*.*

(ii) $q^*(\emptyset) = 1 \geq q^*(l) > 0$ *if and only if* $\beta < \underline{\beta}_1$*.*

For $\beta = 5$ *one equilibrium is such that* $q^*(\emptyset) \approx 0.244$ *and* $q^*(l) = 0$*, see Figure 1 above for an illustration of the verification interval and the corresponding interim beliefs in this case; note that consumers who verify appear to be rather strongly biased toward the low action due to the signal being perfect.*[18]

There is also a second equilibrium such that $q^*(\emptyset) \approx 0.619$ *and* $q^*(l) = 0$*, see Figure 2 for an illustration of the payoff from reporting* $\hat{s} = \emptyset$ *and* $\hat{s} = h$ *in case* $s = \emptyset$ *as a function of* $q(\emptyset)$*. Notably, the payoff from reporting* $\hat{s} = h$ *is*

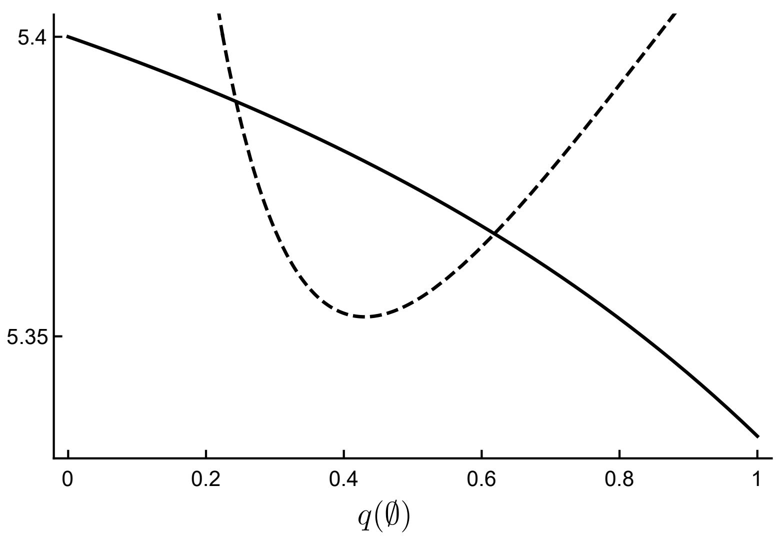

Figure 2: Payoff from reporting $\hat{s} = \emptyset$ (solid line) and $\hat{s} = h$ (dashed line) in case $s = \emptyset$ as a function of $q(\emptyset)$ in Example 1 for $\beta = 5$.

first decreasing and then increasing in $q(\emptyset)$*; this is because, as* $\alpha^{\Delta}(h, \emptyset, \mu_\pi(\cdot|q))$ *is decreasing in* $q(\emptyset)$*, the firm's loss from consumers' verification is first increasing and then decreasing in* $q(\emptyset)$*. Finally, for* $\beta = 2$ *the unique equilibrium is such that* $q^*(l) \approx 0.343$*, see Figure 3 for an illustration of the payoff from reporting* $\hat{s} = \emptyset$ *and* $\hat{s} = h$ *in case* $s = l$ *as a function of* $q(l)$*.*

[18] If we had instead $p_1 = \frac{3}{4}$ and $c = \frac{1}{25}$, then one equilibrium were such that $q^*(\emptyset) \approx 0.275$ and $q^*(l) = 0$, with consumers who verify being less biased toward the low action, $\mathcal{V}(q^*) \approx (0.271, 0.414)$.

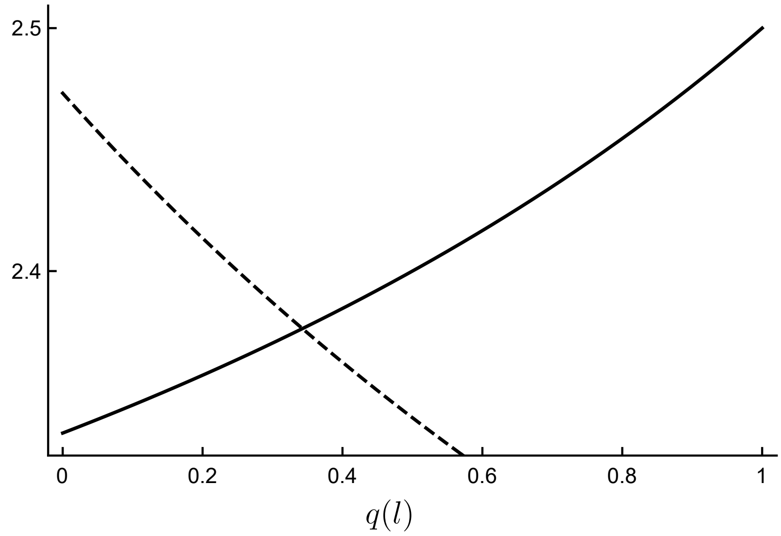

Figure 3: Payoff from reporting $\hat{s} = \emptyset$ (solid line) and $\hat{s} = h$ (dashed line) in case $s = l$ as a function of $q(l)$ in Example 1 for $\beta = 2$.

As we have seen there may exist several equilibria at the same time. The equilibrium with the least disinformation may be considered a focal point:

Definition 2 (Measure of disinformation). *(i) The monotonic equilibrium q^* has* less disinformation *than the monotonic equilibrium q' if $q^*(l) \leq q'(l)$ and $q^*(\emptyset) \leq q'(\emptyset)$, and at least one inequality is strict.*

(ii) The monotonic equilibrium q^* has the least disinformation *if there does not exist another monotonic equilibrium q' with less disinformation.*

Note however that an equilibrium with less disinformation is not necessarily better for all consumers. This is because what matters for consumers is whether they can identify the signal upon which they would switch to the other, initially not preferred, action. For consumers with (moderate) bias toward the low action this is the high signal, such that for these consumers an equilibrium with less disinformation is indeed better. For consumers with (moderate) bias toward the high action, on the other hand, this is the low signal, such that these consumers benefit from fabrication (but not from distortion), which helps them identifying suppressed low signals. These observations will become important for the analysis once we consider competition between media firms in Section 3.

It follows immediately from Proposition 1 that there is an essentially unique, that is, unique in terms of the biased firm's strategy q^* and payoffs for all agents, monotonic equilibrium with the least disinformation. In particular, since reporting

$\hat{s} = h$ yields a higher continuation payoff when $s = \emptyset$ than when $s = l$, there may be an intermediate range of β on which the biased firm fabricates news whenever possible but never distorts news. Recall from Proposition 1 that the first type of equilibrium exists if and only if $\beta \geq \underline{\beta}_1$.

Corollary 1. *There exists $\underline{\beta}_0 \geq \underline{\beta}_1$ such that the (essentially unique) monotonic equilibrium with the least disinformation q^* is such that*

(i) $1 \geq q^*(\emptyset) > q^*(l) = 0$ *if* $\beta \geq \underline{\beta}_0$,

(ii) $1 = q^*(\emptyset) > q^*(l) = 0$ *if* $\beta \in [\underline{\beta}_1, \underline{\beta}_0)$,

(iii) $1 = q^*(\emptyset) \geq q^*(l) > 0$ *if* $\beta < \underline{\beta}_1$.

For instance, in Example 1, we have $\underline{\beta}_0 \approx 4.65 > \underline{\beta}_1 \approx 3.44$; note further that the intermediate range of β were empty, $\underline{\beta}_0 = \underline{\beta}_1$, if we had $\lambda \geq \frac{7}{10}$ instead of $\lambda = \frac{1}{2}$.

2.2 Comparative statics

We finally derive some comparative statics results. We restrict attention to the essentially unique equilibrium with the least disinformation (Corollary 1). Increasing the continuation payoff β increases the weight of the loss from consumers' verification in the biased firm's payoff. This implies that there will exist an equilibrium with less disinformation:

Proposition 2. *Increasing the continuation payoff β (strictly) decreases disinformation in the monotonic equilibrium with the least disinformation q^* (if $\beta \geq \underline{\beta}_0$).*

We revisit Example 1 to illustrate this result.

Example 2. *Suppose that $F = \mathcal{U}(0,1)$, $\alpha(\cdot) = \alpha^{\Delta}(\cdot)$, $p_0 = \frac{1}{2}$, $\lambda = \frac{1}{2}$, $p_1 = 1$, and $c = \frac{1}{5}$. Consider $\beta \geq \underline{\beta}_1 \approx 3.44$, such that the monotonic equilibrium with the least disinformation q^* is such that $q^*(\emptyset) > 0 = q^*(l)$, see Figure 4 for an illustration. Note that the discontinuity at $\underline{\beta}_0$ stems from the fact that the dashed line in Figure 2 shifts upwards as β decreases. Once $\beta < \underline{\beta}_0$, the payoff from reporting $\hat{s} = \emptyset$ is lower than that from reporting $\hat{s} = h$ in case $s = \emptyset$ for any $q(\emptyset)$, while the reverse is true in case $s = l$.*

Since $\underline{\mathcal{V}}(q)$ and $\overline{\mathcal{V}}(q)$ are strictly increasing and strictly decreasing, respectively, in the verification costs c, decreasing c has the same effect as increasing β:

Corollary 2. *Decreasing the verification costs c decreases disinformation in the monotonic equilibrium with the least disinformation q^*.*

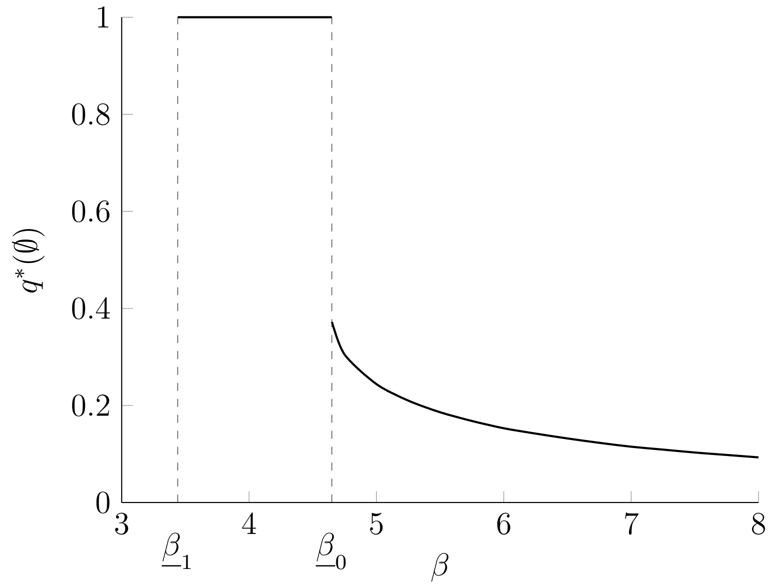

Figure 4: $q^*(\emptyset)$ in the equilibrium with the least disinformation q^* as a function of $\beta \geq \underline{\beta}_1$ in Example 1.

3 Media competition

In this section, we introduce competition between media firms. Instead of one media firm that is either biased or neutral, there are at most three media firms: a neutral media firm N and two media firms L and H that are biased in opposite directions; the set of media firms thus is $\mathcal{M} \subseteq \{N, L, H\}$, with $|\mathcal{M}| \geq 2$. Each media firm operates a single news outlet; we will subsequently employ the terms media firm and news outlet interchangeably.

At the beginning of the game, each consumer selects which news outlet $M \in \mathcal{M}$ to *follow* (or subscribe to); as we will discuss in more detail in Section 4.1, we hence assume that media firms compete for consumers' scarce attention. We relax this assumption and allow consumers to follow multiple outlets ("multi-homing") in Appendix B. Let F^M denote the distribution of prior beliefs among firm M's followers. Each media firm M only observes the total mass of its followers $F^M(1)$. Next, each firm M receives the private signal $s \in \{l, h\}$ with probability $p_0 \in (0, 1)$, where $p_1 = Pr(s = l|\theta = 0) = Pr(s = h|\theta = 1) > \frac{1}{2}$, and then submits a report $\hat{s}_M \in \hat{S}$ to its followers. After a follower of outlet M has observed the report $\hat{s}_M$, she may verify it at cost $c > 0$ as described in Section 2. Finally, each consumer π chooses her action $a_\pi \in A$ and receives a payoff of 1 if $a_\pi = \theta$ and 0 otherwise.

M receives a continuation payoff of

$$\beta\left(F^M(1)-\int_0^1 v_\pi\alpha(\hat{s}_M,s,\mu_\pi)dF^M(\pi)\right),$$

where $\beta>0$. If $M=N$, it derives an additional payoff normalized to 1 from reporting truthfully, $\hat{s}_N=s$. If $M\in\{L,H\}$, it derives an additional payoff normalized to

$$\int_0^1 a_\pi+\mathbf{1}_{\{M=L\}}(1-2a_\pi)dF(\pi),$$

which reflects that firm H (L) is biased toward action 1 (0).

The solution concept we employ is trembling-hand perfect Bayesian equilibrium.[19] To ease the exposition, we incorporate a weak form of confirmation bias: A consumer π whose actions are affected by neither media firm (despite having introduced trembles) chooses as to maximize the share of news that confirm her prior belief π, i.e., the share of high (low) messages if $\pi\geq(<)\frac{1}{2}$.

3.1 Equilibrium analysis

We again consider monotonic equilibria. Take any media firm $M\in\mathcal{M}$, fix the total mass of followers $F^M(1)$ and suppose that M holds a correct belief about F^M. Since F is strictly increasing, the expected distribution of beliefs among M's followers is strictly increasing if consumers employ completely mixed strategies. Thus, Lemma 2 extends to the model with competition:

Lemma 3. *Any monotonic equilibrium is such that media firm $M\in\mathcal{M}$ reports truthfully if $M=N$, reports $s=h$ truthfully and either suppresses or distorts $s=l$ if $M=H$, and vice versa if $M=L$.*

Similarly to Section 2, we can thus represent the biased firms' mixed strategies by two functions $q_H:S\to[0,1]$ and $q_L:S\to[0,1]$ that map the signal s to the probability that they submit $\hat{s}_H=h$ (and $\hat{s}_H=\emptyset$ otherwise) and $\hat{s}_L=l$ (and $\hat{s}_L=\emptyset$ otherwise), respectively. By Lemma 3, media firm H's (L's) strategy will be characterized by the probabilities $q_H(l)$ and $q_H(\emptyset)$ ($q_L(h)$ and $q_L(\emptyset)$) of distortion and fabrication, respectively, given the possibility to do so.

[19] As we will see below in Section 3.1, the trembling-hand refinement allows us to build on the analysis of the baseline model in Section 2.

3.2 Competition between biased firms

We first investigate competition between two biased firms, i.e., $\mathcal{M} = \{L, H\}$. To ensure that at least some consumers verify even if the level of fabrication is below a half, we impose a slightly stronger upper bound on verification costs than in Section 2:

Assumption 2.

$$c < \frac{p_0(1-p_0)(2p_1-1)}{\max\left\{2\big(1-p_0+p_0^2p_1(1-p_1)\big), (1-p_0)^2+4p_0^2p_1(1-p_1)\right\}}.$$

Note that for $p_1 = 1$, Assumption 2 simplifies to $c < \frac{p_0}{2}$ and coincides with Assumption 1 (for $\lambda = 1$).[20] Recall from Section 2 that under media firm H's strategy $q_H = (q_H(\emptyset), q_H(l))$, consumers with prior $\pi \in \mathcal{V}(q_H) \subset (1-p_1, p_1)$ (and who follow outlet H) verify $\hat{s}_H = h$, where

$$\underline{\mathcal{V}}(q_H) = \frac{c\left((1-p_0)q_H(\emptyset) + p_0p_1q_H(l)\right) + (1+c)p_0(1-p_1)}{p_0\left(1-c(2p_1-1)(1-q_H(l))\right)}$$

and

$$\overline{\mathcal{V}}(q_H) = \begin{cases} \frac{((1-p_0)q_H(\emptyset)+p_0p_1q_H(l))(1-c)-cp_0(1-p_1)}{2(1-p_0)q_H(\emptyset)+p_0q_H(l)+cp_0(2p_1-1)(1-q_H(l))}, & \text{if } q_H(l) \le \frac{c(2(1-p_0)q_H(\emptyset)+p_0)}{p_0(2p_1-1-c)} \\ \frac{p_0p_1q_H(l)(1-c)-c((1-p_0)q_H(\emptyset)+p_0(1-p_1))}{p_0q_H(l)+cp_0(2p_1-1)(1-q_H(l))}, & \text{otherwise} \end{cases}.$$

Furthermore, all consumers with prior above $\overline{\mathcal{V}}(q_H)$ take action 1 upon receiving $\hat{s}_H = h$, and those with prior above

$$\Pi^{\emptyset}(q_H) = \frac{(1-p_0)(1-q_H(\emptyset)) + p_0p_1(1-q_H(l))}{2(1-p_0)(1-q_H(\emptyset)) + p_0(1-q_H(l))}$$

take action 1 upon receiving $\hat{s}_H = \emptyset$. The respective terms for media firm L obtain by reflection at $\frac{1}{2}$: under strategy $q_L = (q_L(\emptyset), q_L(h))$, consumers with prior $\pi \in \mathcal{V}^*(q_L) \equiv \left(1-\overline{\mathcal{V}}(q_L), 1-\underline{\mathcal{V}}(q_L)\right)$ (and who follow outlet L) verify $\hat{s}_L = l$, i.e.,

$$\underline{\mathcal{V}}^*(q_L) = \begin{cases} \frac{((1-p_0)q_L(\emptyset)+p_0(1-p_1)q_L(h))(1+c)+cp_0p_1}{2(1-p_0)q_L(\emptyset)+p_0q_L(h)+cp_0(2p_1-1)(1-q_L(h))}, & \text{if } q_L(h) \le \frac{c(2(1-p_0)q_L(\emptyset)+p_0)}{p_0(2p_1-1-c)} \\ \frac{p_0(1-p_1)q_L(h)(1+c)+c((1-p_0)q_L(\emptyset)+p_0p_1)}{p_0q_L(h)+cp_0(2p_1-1)(1-q_L(h))}, & \text{otherwise} \end{cases}$$

[20] More generally, Assumption 2 coincides with Assumption 1 (for $\lambda = 1$) if and only if $p_0^2(1 + 2p_1(1-p_1)) \le 1$.

and

$$\overline{\mathcal{V}}^*(q_L) = \frac{(1-c)p_0p_1 - c\left((1-p_0)q_L(\emptyset) + p_0(1-p_1)q_L(h)\right)}{p_0\left(1 - c(2p_1-1)(1-q_L(h))\right)}.$$

Furthermore, all consumers with prior below $\underline{\mathcal{V}}^*(q_L)$ take action 0 upon receiving $\hat{s}_L = l$, and those with prior below

$$\Pi^{\emptyset,*}(q_L) \equiv 1 - \Pi^{\emptyset}(q_L) = \frac{(1-p_0)(1-q_L(\emptyset)) + p_0(1-p_1)(1-q_L(h))}{2(1-p_0)(1-q_L(\emptyset)) + p_0(1-q_L(h))}$$

take action 0 upon receiving $\hat{s}_L = \emptyset$. To ease the exposition, we henceforth omit consumer behavior upon observing $\hat{s}_H$ or $\hat{s}_L$ in the statement of the results. Let $N_0^H(q) \equiv \{\pi \in [0, \frac{1}{2}) \mid \pi \text{ follows } H \text{ under } q\}$ and $N_1^L(q) \equiv \{\pi \in (\frac{1}{2}, 1] \mid \pi \text{ follows } L \text{ under } q\}$ denote the subsets of consumers who are biased toward the low and high action but choose to follow outlet H and L, respectively, under the firms' strategies $q = (q_L, q_H)$.

In a first step, we characterize equilibria in which both firms fabricate but do not distort news. We show that there are two types of equilibria, which each require the continuation payoff to be high enough. In the first type of equilibrium, the level of fabrication is low and in turn both centrist and moderately biased consumers follow the outlet that is biased against their belief. In particular, moderately biased consumers do so because they anticipate that they will verify counter-attitudinal reports, so that low levels of fabrication are optimal for firms. In the second type of equilibrium, the level of fabrication is high and in turn fewer consumers follow the outlet that is biased against their belief.

Proposition 3. *Suppose that $\mathcal{M} = \{L, H\}$. There exist $\underline{\beta}_1^c > 0$ and $\underline{\beta}_2^c > 0$ such that there is a monotonic equilibrium q^* such that $q_H^*(l) = q_L^*(h) = 0$,*

(i) $q_L^*(\emptyset) + q_H^*(\emptyset) < 1$, $N_0^H(q^*) = (\underline{\mathcal{V}}(q_H^*), \frac{1}{2})$, *and* $N_1^L(q^*) = (\frac{1}{2}, \overline{\mathcal{V}}^*(q_L^*))$ *if and only if* $\beta \geq \underline{\beta}_1^c$,[21]

(ii) $q_L^*(\emptyset) + q_H^*(\emptyset) \geq 1$, $N_0^H(q^*) = \big(\underline{\mathcal{V}}(q_H^*), \widetilde{\Pi}(q_L^*(\emptyset), q_H^*(\emptyset))\big)$, *and* $N_1^L(q^*) = \big(1 - \widetilde{\Pi}(q_H^*(\emptyset), q_L^*(\emptyset)), \overline{\mathcal{V}}^*(q_L^*)\big)$ *if and only if* $\beta \geq \underline{\beta}_2^c$, *where*

$$\widetilde{\Pi}(q_L^*(\emptyset), q_H^*(\emptyset)) \equiv \frac{(1-p_0)(1-q_L^*(\emptyset)) - c\big((1-p_0)q_H^*(\emptyset) + p_0(1-p_1)\big)}{2(1-p_0)(1-q_L^*(\emptyset)) + cp_0(2p_1-1)}.$$

[21] In this result, and throughout the analysis, we ignore knife-edge cases where, given $N_0^H(q) = (\underline{\mathcal{V}}(q_H), \frac{1}{2})$ and $N_1^L(q) = (\frac{1}{2}, \overline{\mathcal{V}}^*(q_L))$, $q_L(\emptyset) + q_H(\emptyset) = 1$ is optimal for both firms. In this case, the stated result may only hold if β strictly exceeds the threshold $\underline{\beta}_1^c$.

Some remarks seem in order. First, centrist consumers who are slightly biased follow the outlet that is biased against their belief if and only if the level of fabrication is low, $q_L(\emptyset) + q_H(\emptyset) < 1$. To see why, consider a consumer who is slightly biased toward the low action and note that for her the only relevant information is whether the signal is high, in which case she would choose the action that she initially did not prefer. Since $q_L(\emptyset) + q_H(\emptyset) < 1 \Leftrightarrow q_H(\emptyset) < 1 - q_L(\emptyset)$, outlet H is less likely to pool $s = \emptyset$ with $s = h$ (via message $\hat{s}_H = h$) than outlet L (via message $\hat{s}_L = \emptyset$), which makes $\hat{s}_H = h$ a better indicator of $s = h$ than $\hat{s}_L = \emptyset$. Second, if the level of fabrication is high, $q_L(\emptyset) + q_H(\emptyset) \geq 1$, then not all consumers who would verify counter-attitudinal reports will follow the outlet that is biased against their belief. To see this, take a consumer who is biased toward the low action and note that $\hat{s}_L = \emptyset$ now is a better indicator of $s = h$ than $\hat{s}_H = h$. Since further the expected probability of verification conditional on following outlet H increases in the prior while the expected loss from wrongly choosing the high action conditional on following outlet L decreases in the prior, the more moderate consumers in $\mathcal{V}(q_H)$ will follow outlet L.

Third, note that $\underline{\mathcal{V}}(\cdot, 0)$ is strictly increasing and $\widetilde{\Pi}(\cdot, \cdot)$ is strictly decreasing in each argument, and vice versa for $\overline{\mathcal{V}}^*(\cdot, 0)$ and $1 - \widetilde{\Pi}(\cdot, \cdot)$. This implies that the share of consumers following the outlet that is biased against their belief is shrinking in the levels of fabrication:

Remark 2. *Suppose that $q_H(\emptyset) > 0 = q_H(l)$ and $q_L(\emptyset) > 0 = q_L(h)$. If $N_0^H(q) \neq \emptyset$, then $q'_H(\emptyset) > q_H(\emptyset) > 0 = q'_H(l)$ and $q'_L(\emptyset) \geq q_L(\emptyset) > 0 = q'_L(h)$ imply $N_0^H(q') \subsetneq N_0^H(q)$, and vice versa for media firm L.*

We cannot say much about equilibria in which one or both media firms distort its signal for general distributions of prior beliefs and hence refrain from a discussion of these equilibria at this point.

We next extend our measure of disinformation to competition:

Definition 3 (Extended measure of disinformation)**.** *(i) The monotonic equilibrium q^* has* less disinformation *than the monotonic equilibrium q' if $q_L^*(l) + q_H^*(h) \leq q'_L(l) + q'_H(h)$ and $q_L^*(\emptyset) + q_H^*(\emptyset) \leq q'_L(\emptyset) + q'_H(\emptyset)$, and at least one inequality is strict.*

(ii) The monotonic equilibrium q^* has the least disinformation *if there does not exist another monotonic equilibrium q' with less disinformation.*

Note first that this notion appears natural in light of Proposition 3, where consumers' choice which outlet to follow depends on whether $q_L(\emptyset) + q_H(\emptyset) < 1$.

Second, unlike in Section 2, we only obtain a partial order of equilibria. Nevertheless, it follows from Proposition 3 that there is an essentially unique equilibrium with the least disinformation if the continuation payoff is high. In this equilibrium, the level of fabrication is low and in turn both centrist and moderately biased consumers follow the outlet that is biased against their belief. Otherwise, the levels of fabrication will be high in any equilibrium with the least disinformation, and there may be distortion. In particular, if the continuation payoff is very low, then any equilibrium is uninformative. In this case, all consumers who would verify counter-attitudinal reports follow the outlet that is biased against their belief.

Proposition 4. *Suppose that $\mathcal{M} = \{L, H\}$. There exists $\underline{\beta}_0^c \leq \underline{\beta}_1^c$ such that*

(i) the essentially unique monotonic equilibrium with the least disinformation q^* is such that $q_L^*(\emptyset) + q_H^*(\emptyset) < 1$, $q_H^*(l) = q_L^*(h) = 0$, $N_0^H(q^*) = (\underline{\mathcal{V}}(q_H^*), \frac{1}{2})$, and $N_1^L(q^*) = (\frac{1}{2}, \overline{\mathcal{V}}^*(q_L^*))$ if $\beta \geq \underline{\beta}_1^c$,

(ii) any monotonic equilibrium with the least disinformation q^* is such that $q_L^*(\emptyset) + q_H^*(\emptyset) \geq 1$, either $q_H^*(l) < 1$ or $q_L^*(h) < 1$, $N_0^H(q^*) \subseteq (\underline{\mathcal{V}}(q_H^*), \frac{1}{2})$, and $N_1^L(q^*) \subseteq (\frac{1}{2}, \overline{\mathcal{V}}^*(q_L^*))$ if $\beta \in [\underline{\beta}_0^c, \underline{\beta}_1^c)$,

(iii) the essentially unique monotonic equilibrium with the least disinformation q^* is such that $q_L^* = q_H^* = (1,1)$, $N_0^H(q^*) = (\underline{\mathcal{V}}^*(q_L^*), \frac{1}{2})$, and $N_1^L(q^*) = (\frac{1}{2}, \overline{\mathcal{V}}(q_H^*))$ if $\beta < \underline{\beta}_0^c$.

Interestingly, these results show that consumers' choice which outlet to follow is non-monotonic in the level of disinformation. Both for a low level and a very high level of disinformation (Proposition 4 (i) and (iii), respectively) all consumers who would verify counter-attitudinal reports follow the outlet that is biased against their belief, while less consumers may do so for intermediate levels of disinformation (see Proposition 3 (ii)). In particular, as we illustrate below in Example 3, we may even have $\underline{\beta}_0^c = \underline{\beta}_1^c$, such that intermediate levels of disinformation (Proposition 4 (ii)) do not occur in the equilibrium with the least disinformation.

In order to obtain more concrete results, we now consider the special case in which the initial belief distribution F is symmetric around $\frac{1}{2}$. This case is interesting for at least two reasons: First, it levels the playing field for the two media firms. Second, we can then consider equilibria in which the media firms' strategies are symmetric, which not only simplifies the analysis but also yields a total order of equilibria in terms of the level of disinformation. For simplicity, let $q = (q_f, q_d)$ denote the media firms' strategy, where $q_f = q_H(\emptyset) = q_L(\emptyset)$ and $q_d =$

$q_H(l) = q_L(h)$ are the probabilities of fabrication and of distortion, respectively, given the possibility to do so. We already know from Proposition 4 that the level of fabrication is low in the equilibrium with the least disinformation if the continuation payoff is high. In particular, all consumers who would verify counter-attitudinal news follow the outlet that is biased against their belief. Otherwise, if the continuation payoff is low, we show that both the level of fabrication and of distortion is high and only a subset of the consumers who would verify counter-attitudinal reports follows the outlet that is biased against their belief.

Corollary 3. *Suppose that $\mathcal{M} = \{L, H\}$ and that F is symmetric around $\frac{1}{2}$. The essentially unique symmetric monotonic equilibrium with the least disinformation q^* is such that*

(i) $\frac{1}{2} > q_f^* > 0 = q_d^*$, $N_0^H(q^*) = (\underline{\mathcal{V}}(q^*), \frac{1}{2})$, *and* $N_1^L(q^*) = (\frac{1}{2}, \overline{\mathcal{V}}^*(q^*))$ *if* $\beta \geq \underline{\beta}_1^c$,

(ii) $q_f^* = 1 \geq q_d^* > \frac{c(2-p_0)}{p_0(2p_1-1-c)}$, $N_0^H(q^*) = (\widetilde{\Pi}'(q_d^*), \frac{1}{2})$, *and* $N_1^L(q^*) = (\frac{1}{2}, 1-\widetilde{\Pi}'(q_d^*))$ *otherwise, where*

$$\widetilde{\Pi}'(q_d^*) \equiv \frac{q_d^* p_0(1-p_1) + c\big(1 - p_0 p_1(1-q_d^*)\big)}{p_0\left(q_d^* - c(2p_1-1)(1-q_d^*)\right)}.$$

Note that in part (ii) all consumers who follow the outlet that is biased against their belief verify counter-attitudinal reports (as $\overline{\mathcal{V}}(q^*) > \frac{1}{2} > \widetilde{\Pi}'(q_d^*) \geq \underline{\mathcal{V}}(q^*)$). The intuition behind this part is the following. Suppose that the continuation payoff is low, $\beta < \underline{\beta}_1^c$. First, with a high level of fabrication (and no distortion), less consumers who would verify counter-attitudinal reports follow the outlet that is biased against their belief compared to a low level of fabrication, and no centrist consumer does so (Proposition 3). Under a symmetric belief distribution, this implies that both media firms also have more to gain from fabrication in terms of consumers who take their preferred action. Thus, if we have an equilibrium with a high level of fabrication, then there must also be an equilibrium with a low level of fabrication. Second, with a high level of fabrication and a low level of distortion, no consumer who would verify counter-attitudinal reports follows the outlet that is biased against their belief, and so this cannot be an equilibrium. To see why, consider a consumer who would verify $\hat{s}_H = h$ and recall that for this consumer the only relevant information is whether the signal is high or not. With a low level of distortion, $\hat{s}_L = \emptyset$ is a good enough indicator of the high signal for consumers to avoid verification. Thus, both the level of fabrication and of distortion must be high in the equilibrium with the least disinformation.

In turn, consumers with larger biases avoid verification by following the outlet that conforms to their bias unless the equilibrium is uninformative (in which case $\widetilde{\Pi}'(q_d^*) = \underline{\mathcal{V}}(q^*)$), because for these consumers the expected loss from wrongly choosing the low action conditional on following outlet L is low compared to the expected probability of verification conditional on following outlet H.

The following example illustrates our result. It turns out that under uniformly distributed beliefs, there are not enough consumers who follow the outlet that is biased against their belief and verify counter-attitudinal reports, i.e., moderately biased consumers located around the center, for communication to be informative when the continuation payoff is low.

Example 3. *Suppose that* $\mathcal{M} = \{L, H\}$*,* $F = \mathcal{U}(0,1)$*,* $\alpha(\cdot) = \alpha^{\Delta}(\cdot)$*,* $p_0 = \frac{1}{2}$*,* $p_1 = 1$*, and* $c = \frac{1}{5}$*. The essentially unique symmetric monotonic equilibrium with the least disinformation* q^* *is such that*

(i) $\frac{1}{2} > q_f^* > 0 = q_d^*$*,* $N_0^H(q^*) = (\underline{\mathcal{V}}(q^*), \frac{1}{2}) = (\frac{q_f^*}{4}, \frac{1}{2})$*, and* $N_1^L(q^*) = (\frac{1}{2}, \overline{\mathcal{V}}^*(q^*)) = (\frac{1}{2}, \frac{4-q_f^*}{4})$ *if* $\beta \geq \underline{\beta}_1^c \approx 2.98$*,*

(ii) $q_f^* = q_d^* = 1$*,* $N_0^H(q^*) = (\underline{\mathcal{V}}(q^*), \frac{1}{2}) = (\frac{2}{5}, \frac{1}{2})$*, and* $N_1^L(q^*) = (\frac{1}{2}, \overline{\mathcal{V}}^*(q^*)) = (\frac{1}{2}, \frac{3}{5})$ *otherwise.*

In case $\beta = 4$*, this equilibrium is such that* $q_f^* \approx 0.096 > 0 = q_d^*$*, see Figure 5 for an illustration of* $N_0^H(q^*)$ *and* $N_1^L(q^*)$*; note that similar to Example 1 consumers who verify appear to be rather strongly biased due to the signal being perfect.*

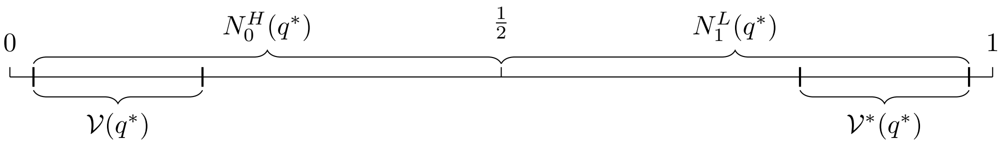

Figure 5: Subsets of consumers $N_0^H(q^*)$ and $N_1^L(q^*)$ who are biased toward the low and high action but choose to follow outlet H and L, respectively, for $\beta = 4$ in Example 3.

Finally, we summarize consumers' choice which outlet to follow. Recall from Proposition 4 that some (in this case even all) consumers who would verify counter-attitudinal reports follow the outlet that is biased against their belief in the equilibrium with the least disinformation if the continuation payoff is either high or (very) low. As we have shown in Corollary 3, the same also holds if the distribution of beliefs is symmetric. Thus, this pattern obtains on a broad range of parameters:

Corollary 4. *Suppose that $\mathcal{M} = \{L, H\}$ and that either $\beta \geq \underline{\beta}_1^c$, $\beta < \underline{\beta}_0^c$, or F is symmetric around $\frac{1}{2}$. The essentially unique (symmetric) monotonic equilibrium with the least disinformation q^* is such that $N_0^H(q^*) \cap \mathcal{V}(q_H^*) \neq \emptyset$ and $N_1^L(q^*) \cap \mathcal{V}^*(q_L^*) \neq \emptyset$.*

3.3 The effect of competition on disinformation

We now ask whether competition helps reduce disinformation. To do so, we compare the model with competition with the monopoly model (with $\lambda = 1$). We continue to impose Assumption 2. We show that competition reduces disinformation regardless of the distribution of consumers' beliefs if the continuation payoff is high:

Proposition 5. *Introducing competition (between biased outlets) to the monopoly model with $\lambda = 1$ strictly reduces disinformation associated with the incumbent firm in the essentially unique monotonic equilibrium with the least disinformation if $\beta \geq \underline{\beta}_1^c$.*

With a high continuation payoff, introducing media firm L does not alter the share of consumers that verifies high messages of the incumbent media firm H (Proposition 4 (i)). However, there then are less consumers who may be persuaded by fabrication into taking action 1, because they now follow the other outlet. Thus, there are less incentives to fabricate news in the model with competition. Note however that we know from Example 3 that Proposition 5 does not extend beyond high continuation payoff, as communication otherwise may be uninformative under competition. The following example shows that competition may yield to significantly less disinformation in equilibrium.

Example 4. *Suppose that $F = \mathcal{U}(0, 1)$, $\alpha(\cdot) = \alpha^{\Delta}(\cdot)$, $p_0 = \frac{1}{2}$, $p_1 = 1$, and $c = \frac{1}{5}$. In case $\beta = 4 > \underline{\beta}_1^c \approx 2.98$, the essentially unique monotonic equilibrium with the least disinformation in the monopoly model with $\lambda = 1$ is such that $q^*(\emptyset) = q^*(l) = 1$, i.e., uninformative, while after introducing competition it is such that $q_f^* \approx 0.096 > 0 = q_d^*$. Note that communication is uninformative in both models if $\beta < \underline{\beta}_1^c$.*

3.4 Competition between neutral and biased firms

We next investigate competition between a neutral and one or two biased media firms, i.e., $N \in \mathcal{M}$. As we will see, we can dispense with an upper bound on verification costs in this part.

We show that in equilibrium all moderate consumers – those for whom information matters in the sense that their action depends on the actual signal – follow the neutral outlet, while partisan consumers with extreme beliefs follow the outlet that conforms to their bias (whenever possible). In turn, the biased firms' communication is uninformative. Thus, echo chambers in which people only hear opinions similar to their own arise endogenously in equilibrium.

Proposition 6. *Suppose that $N \in \mathcal{M}$. The essentially unique monotonic equilibrium q^* is such that $q^*_M = (1, 1)$ for all $M \in \mathcal{M} \backslash \{N\}$. Any consumer*

(i) $\pi \leq 1 - p_1$ *follows outlet L if $L \in \mathcal{M}$ and outlet N otherwise,*

(ii) $\pi \in (1 - p_1, p_1)$ *follows outlet N,*

(iii) $\pi \geq p_1$ *follows outlet H if $H \in \mathcal{M}$ and outlet N otherwise.*

Some remarks seem in order. First, Proposition 6 holds regardless of the size of both the verification costs and the continuation payoff. Second, the extent of the echo chambers, $F(1 - p_1)$ and $1 - F(p_1)$ (if $L \in \mathcal{M}$ and if $H \in \mathcal{M}$, respectively), depends on the distribution of prior beliefs F and the signal precision p_1; in particular, it is strictly decreasing in p_1 and vanishes at $p_1 = 1$. The intuition behind this result is straightforward: Any consumer who would verify some message when following one of the biased outlets is better off when following the neutral outlet, as the latter perfectly reveals the underlying information even without verification. Thus, no consumer will verify in equilibrium, such that the biased firms' communication is uninformative. In turn, all moderate consumers follow the neutral outlet, while consumers with extreme prior beliefs end up in an echo chamber only hearing uninformative messages whenever the respective biased firm is present in the market. Finally, note that the model readily extends to the case where the neutral firm is biased with some probability, see Section 4 for details.

3.5 The effect of a neutral media firm on disinformation and social welfare

We now ask whether introducing media firm N to the model with one or two biased firms, i.e., either the monopoly model with $\lambda = 1$ or the model with $\mathcal{M} = \{L, H\}$, is beneficial to consumers. First, by Lemma 2 and Lemma 3 any equilibrium with one or two biased firms is such that all firms produce disinformation. By Proposition 6, introducing the neutral firm N thus reduces disinformation for moderate consumers who then follow the neutral outlet but increases it for consumers with extreme prior beliefs who continue following a biased outlet. However, since information does not matter for the latter consumers anyway, we obtain a clear result in terms of social welfare in this case. Disinformation reduces the expected utility of moderate consumers compared to truthful communication, which are hence better off in the model with a neutral outlet regardless of which equilibria we select:

Corollary 5. *Introducing media firm N either to the monopoly model with $\lambda = 1$ or to the model with $\mathcal{M} = \{L, H\}$ generates a Pareto-improvement for consumers (with respect to ex-ante expected equilibrium payoffs).*

Just as Proposition 6, Corollary 5 holds regardless of the size of both the verification costs and the continuation payoff.

4 Conclusion

We have developed a model of media bias that captures several stylized facts about today's news industry, which has been fundamentally transformed over the last two decades. First, in our baseline model with a single media firm, there is fabricated news in any equilibrium, and in turn some consumers verify high reports – typically those moderately biased toward the low action because they, interim, are the most uncertain. Comparative statics suggest that improving people's fact-checking skills may not only help those who fact-check but also result in a media environment with less disinformation.

Second, competition between biased firms can reduce disinformation considerably, because moderately biased consumers follow the different-minded outlet that is biased against their belief and fact-check counter-attitudinal news. Once a neutral firm is present, however, only partisans follow the biased outlets, such that echo chambers arise endogenously in equilibrium. Nevertheless, introducing the neutral media firm generates a Pareto-improvement for consumers.

Our findings are in line with Sunstein (2007), who argues that people sort themselves into echo chambers wherein they avoid counter-attitudinal news. This occurs in our model once a neutral media firm is present, in which case partisans with extreme prior beliefs will follow biased outlets. Moderates, on the other hand, will follow the neutral outlet and thus not end up in an echo chamber, a result that is supported by evidence from Gentzkow and Shapiro (2011).

We now briefly comment on one extension and two possible alternative interpretations of our model. First, the model with a neutral firm readily extends to the case where the latter is biased with some probability, as in the baseline model. In this case, it is an equilibrium that the potentially neutral firm plays the same strategy and the same consumers verify as in an equilibrium of the baseline model, while partisans follow the biased outlets and thus end up in echo chambers.[22] Thus, this extension could generate verification of counter-attitudinal news and endogenous echo chambers at the same time.

Second, a news outlet may not only be interpreted as a website or a social media account but also as a specific type of news feed on a social media platform. On these platforms, consumers indirectly "choose" the type of news feed through their behavior, e.g., by endorsing or sharing certain content. Thus, choosing to follow a biased news outlet may be interpreted as endorsing or sharing biased content, resulting in a biased news feed (Levy, 2021). Third, our model applies to communication of a politician with voters. Insofar as the politician runs, e.g., a social media account, our model applies directly, as we can interpret a biased news outlet as a politician who wants to convince voters to support her platform.

4.1 Discussion of modelling choices

Finally, we discuss some of our modelling choices. First, we assume that consumers have heterogeneous prior beliefs, ranging from one extreme of the bias spectrum to the other. This is in line with evidence that people differ widely on many public policy issues that have been debated for decades (DiMaggio et al., 1996; Fiorina and Abrams, 2008); the same is true of rather novel issues such as those that came up during the COVID-19 pandemic (Rodriguez et al., 2022). In recent papers, Levy (2021) and Prummer (2020) have pointed out that social media may, if anything, contribute to an increase in belief heterogeneity.

Second, we assume that consumers fact-check only if they have seen news on the issue, and thus do not search for informative news on their own accord upon seeing "no news" being reported, which may be interpreted as posting trivial gossip news that distract from the issue. This assumption reflects that because information consumes the attention of its recipients, consumers' attention to a specific issue is scarce in an information-rich world such as that we live in today (Simon, 1971; Falkinger, 2008).

Third, we assume that the reputational cost which the media firm incurs if a consumer discovers that its report has been false depends on the "size" of the lie in

[22] This is because consumers for whom information matters in equilibrium, and who thus affect the incentives of the potentially neutral firm, would still follow the latter.

terms of the effect on her posterior belief; in particular, this implies that distortion (e.g., reporting a low signal as high) is a larger lie than fabrication (e.g., reporting an empty signal as high). We interpret the change in consumers' posterior beliefs upon verification as a measure for the change in the perceived credibility of the news, and thus indirectly for the change in the perceived credibility of the source (see, e.g., Visentin et al. (2019) for evidence). More generally, there is evidence that people perceive larger lies as worse, for instance in terms of their intrinsic costs (Gneezy et al., 2018).

Finally, in the model with competition we assume that consumers have to select which of the news outlets to follow. Related to the discussion on our assumptions on fact-checking, this reflects that in an information-rich world media firms compete for consumers' scarce attention.

Nevertheless, we relax this assumption and allow consumers to follow multiple outlets (multi-homing) in Appendix B. With high continuation payoff and relatively high costs of following multiple outlets, we show that a part of the consumers who would follow the different-minded outlet and verify counter-attitudinal reports under single-homing will multi-home in order to avoid verification. In turn, the level of disinformation is higher than under single-homing. Our results further show that, at least for high continuation payoff, only few consumers multi-home even if the costs of doing so are relatively low compared to those of verification. We did not analyze equilibria with lower costs of following multiple outlets, but it is clear from the proof of Proposition 7 in Appendix B that then also some consumers who would not verify counter-attitudinal reports under single-homing may choose to multi-home. Furthermore, some consumers then may verify counter-attitudinal reports despite multi-homing. This is because a consumer who observes a high (an empty) report from outlet H and an empty (a low) report from outlet L is still uncertain about the underlying signal.

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A Appendix: Proofs

Proof of Lemma 1. Consider monotonic beliefs. The first part follows immediately from truthful reporting being a strictly dominant strategy for the neutral firm. For the biased firm, reporting $\hat{s} = h$ maximizes her payoff from consumers' actions while avoiding costs from verification if $s = h$. Furthermore, F being strictly increasing implies that there is $\tilde{N}_1 \subset N$ with positive mass such that each consumer $\pi \in \tilde{N}_1$ chooses $a = 1$ if and only if $\hat{s} = h$. Hence, any message $\hat{s} \neq h$ yields a lower expected payoff, which establishes the first claim. Similarly, the second claim follows because reporting $\hat{s} = \emptyset$ yields a strictly higher payoff from consumers' actions than reporting $\hat{s} = l$ (there is $\tilde{N}_2 \subset N$ with positive mass such that each consumer $\pi \in \tilde{N}_2$ chooses $a = 1$ if and only if $\hat{s} \neq l$) while avoiding costs from verification if $s = l$. □

Proof of Lemma 2. Consider monotonic beliefs and assume without loss of generality that either $q(\emptyset) < 1$ or $q(l) < 1$. We first show that a positive mass of consumers then must verify $\hat{s} = h$. Suppose the contrary is true, then by monotonicity there is $\tilde{N} \subset N$ with positive mass such that each consumer $\pi \in \tilde{N}$ chooses $a = 1$ if and only if $\hat{s} = h$. Hence, the biased firm with signal $s = \emptyset$ has incentives to deviate to $\hat{s} = h$, a contradiction.

Suppose now that $q(l) > 0$ and note that $\mu_\pi(\hat{s} = h|q) \geq \mu_\pi(s = \emptyset) = \pi > \mu_\pi(s = l)$. Thus, weakly more consumers take action 1 upon $\hat{s} = h$ when $s = \emptyset$ compared to $s = l$. Further, by monotonicity $|\mu_\pi(\hat{s} = h) - \mu_\pi(s = \emptyset)| < |\mu_\pi(\hat{s} = h) - \mu_\pi(s = l)|$ and thus $\alpha(h, \emptyset, \mu_\pi) < \alpha(h, l, \mu_\pi)$ for all $\pi \in (0, 1)$, which implies that $\hat{s} = h$ also yields a higher continuation payoff when $s = \emptyset$ compared to $s = l$. Thus, $q(\emptyset) = 1$, which proves the second part. If $q(\emptyset) = q(l) = 0$, then no consumer verifies message $\hat{s} = h$, which cannot be an equilibrium. Thus, $q(\emptyset) > 0$ in any equilibrium, which proves the first part. □

Proof of Proposition 1. Consider any q such that $q(h) = 1$. The posterior belief of a consumer π upon observing $\hat{s} = \emptyset$ and $\hat{s} = h$ is

$$\begin{aligned} \mu_\pi(\hat{s} = \emptyset|q) =& Pr_\pi(\theta = 1 \mid \hat{s} = \emptyset) \\ =& \frac{Pr_\pi(\hat{s} = \emptyset \mid \theta = 1) Pr_\pi(\theta = 1)}{Pr_\pi(\hat{s} = \emptyset)} \\ =& \frac{[\lambda p_0(1 - p_1)(1 - q(l)) + (1 - p_0)(1 - \lambda q(\emptyset))]\, \pi}{\lambda p_0(1 - q(l)) [(1 - p_1)\pi + p_1(1 - \pi)] + (1 - p_0)(1 - \lambda q(\emptyset))} \end{aligned} \tag{2}$$

and

$$\mu_\pi(\hat{s} = h|q) = Pr_\pi(\theta = 1 \mid \hat{s} = h)$$

$$
\begin{aligned}
&= \frac{Pr_\pi(\hat{s}=h \mid \theta=1) Pr_\pi(\theta=1)}{Pr_\pi(\hat{s}=h)} \\
&= \frac{\left[\lambda(1-p_0)q(\emptyset)+p_0(p_1+\lambda(1-p_1)q(l))\right]\pi}{\lambda(1-p_0)q(\emptyset)+p_0\left[\pi p_1+(1-\pi)(1-p_1)+\lambda q(l)((1-\pi)p_1+\pi(1-p_1))\right]},
\end{aligned} \tag{3}
$$

respectively. We next determine the consumers who choose to verify upon observing report $\hat{s}=h$. Note first that consumer π would choose action $a=1$ without verification if

$$
\mu_\pi(\hat{s}=h|q) > \frac{1}{2} \Leftrightarrow \pi > \frac{\lambda(1-p_0)q(\emptyset)+p_0(1-p_1+\lambda p_1 q(l))}{2\lambda(1-p_0)q(\emptyset)+p_0(1+\lambda q(l))} \equiv \hat{\Pi}^v(q).
$$

In particular, $\hat{\Pi}^v(q) \in (0, \frac{1}{2})$ as $p_1 > \frac{1}{2}$. Second, consumer π needs to benefit from verification in expectation,which requires that it is strictly optimal to take action 1 if $s=h$ and action 0 if $s=l$, i.e.,

$$
\begin{aligned}
\mu_\pi(s=h) = Pr_\pi(\theta=1 \mid s=h) &= \frac{\pi p_1}{\pi p_1+(1-\pi)(1-p_1)} > \frac{1}{2}, \\
\mu_\pi(s=l) = Pr_\pi(\theta=1 \mid s=l) &= \frac{\pi(1-p_1)}{\pi(1-p_1)+(1-\pi)p_1} < \frac{1}{2}.
\end{aligned}
$$

Hence, expected utility from verification is

$$
\begin{aligned}
& Pr_\pi(s=l \mid \hat{s}=h) Pr_\pi(\theta=0 \mid s=l) + Pr_\pi(s=\emptyset \mid \hat{s}=h) \max\big\{Pr_\pi(\theta=0 \mid s=\emptyset), \\
& Pr_\pi(\theta=1 \mid s=\emptyset)\big\} + Pr_\pi(s=h \mid \hat{s}=h) Pr_\pi(\theta=1 \mid s=h) - c \\
=& \frac{Pr_\pi(\hat{s}=h \mid s=l) Pr_\pi(s=l \mid \theta=0) Pr_\pi(\theta=0)}{Pr_\pi(\hat{s}=h)} \\
&+ \frac{Pr_\pi(\hat{s}=h \mid s=\emptyset) Pr_\pi(s=\emptyset) \max\{Pr_\pi(\theta=0), Pr_\pi(\theta=1)\}}{Pr_\pi(\hat{s}=h)} \\
&+ \frac{Pr_\pi(\hat{s}=h \mid s=h) Pr_\pi(s=h \mid \theta=1) Pr_\pi(\theta=1)}{Pr_\pi(\hat{s}=h)} - c \\
=& \frac{\lambda p_0 p_1 q(l)(1-\pi)+\lambda(1-p_0)q(\emptyset)\max\{1-\pi,\pi\}+p_0 p_1 \pi}{\lambda(1-p_0)q(\emptyset)+p_0\left[\pi p_1+(1-\pi)(1-p_1)+\lambda q(l)((1-\pi)p_1+\pi(1-p_1))\right]} - c.
\end{aligned} \tag{4}
$$

If $\pi > \hat{\Pi}^v(q)$, we obtain with (3) that verification is beneficial if

$$
\begin{aligned}
& \frac{\lambda p_0 p_1 q(l)(1-\pi)+\lambda(1-p_0)q(\emptyset)\max\{1-\pi,\pi\}+p_0 p_1 \pi}{\lambda(1-p_0)q(\emptyset)+p_0\left[\pi p_1+(1-\pi)(1-p_1)+\lambda q(l)((1-\pi)p_1+\pi(1-p_1))\right]} - c \\
& > \frac{\left[\lambda(1-p_0)q(\emptyset)+p_0(p_1+\lambda(1-p_1)q(l))\right]\pi}{\lambda(1-p_0)q(\emptyset)+p_0\left[\pi p_1+(1-\pi)(1-p_1)+\lambda q(l)((1-\pi)p_1+\pi(1-p_1))\right]}
\end{aligned}
$$

$$\begin{aligned}&\Leftrightarrow \pi\left[\lambda(1-p_0)q(\emptyset)+\lambda p_0 q(l)+cp_0(2p_1-1)(1-\lambda q(l))\right]-\lambda(1-p_0)q(\emptyset)\max\{1-\pi,\pi\}\\&\quad<\lambda p_0p_1q(l)-c\left[\lambda(1-p_0)q(\emptyset)+p_0(1-p_1+\lambda p_1 q(l))\right].\end{aligned}$$

For consumers $\pi<\frac{1}{2}$ we obtain

$$\pi<\frac{((1-p_0)q(\emptyset)+p_0p_1q(l))\lambda(1-c)-cp_0(1-p_1)}{\lambda(2(1-p_0)q(\emptyset)+p_0q(l))+cp_0(2p_1-1)(1-\lambda q(l))}.$$

Note that

$$\begin{aligned}&\frac{((1-p_0)q(\emptyset)+p_0p_1q(l))\lambda(1-c)-cp_0(1-p_1)}{\lambda(2(1-p_0)q(\emptyset)+p_0q(l))+cp_0(2p_1-1)(1-\lambda q(l))}\leq\frac{1}{2}\\ \Leftrightarrow\, &q(l)\leq\frac{c\left(2\lambda(1-p_0)q(\emptyset)+p_0\right)}{\lambda p_0\left(2p_1-1-c\right)},\end{aligned}\tag{5}$$

where the denominator is positive by Assumption 1. Thus, the upper bound on π for verification being beneficial is

$$\overline{\Pi}^v(q)\equiv\frac{((1-p_0)q(\emptyset)+p_0p_1q(l))\lambda(1-c)-cp_0(1-p_1)}{\lambda(2(1-p_0)q(\emptyset)+p_0q(l))+cp_0(2p_1-1)(1-\lambda q(l))}\leq\frac{1}{2}$$

if (5) holds and

$$\overline{\Pi}^v(q)\equiv\frac{\lambda p_0p_1q(l)(1-c)-c(\lambda(1-p_0)q(\emptyset)+p_0(1-p_1))}{\lambda p_0q(l)+cp_0(2p_1-1)(1-\lambda q(l))}>\frac{1}{2}$$

otherwise. If $\pi\leq\hat{\Pi}^v(q)$, we obtain with (3) that verification is beneficial if

$$\begin{aligned}&\frac{\lambda p_0p_1q(l)(1-\pi)+\lambda(1-p_0)q(\emptyset)(1-\pi)+p_0p_1\pi}{\lambda(1-p_0)q(\emptyset)+p_0\left[\pi p_1+(1-\pi)(1-p_1)+\lambda q(l)((1-\pi)p_1+\pi(1-p_1))\right]}-c\\&\quad>1-\frac{\left[\lambda(1-p_0)q(\emptyset)+p_0(p_1+\lambda(1-p_1)q(l))\right]\pi}{\lambda(1-p_0)q(\emptyset)+p_0\left[\pi p_1+(1-\pi)(1-p_1)+\lambda q(l)((1-\pi)p_1+\pi(1-p_1))\right]}\\&\Leftrightarrow\frac{p_0(p_1\pi-(1-\pi)(1-p_1))}{\lambda(1-p_0)q(\emptyset)+p_0\left[\pi p_1+(1-\pi)(1-p_1)+\lambda q(l)((1-\pi)p_1+\pi(1-p_1))\right]}>c\\&\Leftrightarrow\pi>\frac{c\lambda\left((1-p_0)q(\emptyset)+p_0p_1q(l)\right)+(1+c)p_0(1-p_1)}{p_0\left[1-c(2p_1-1)(1-\lambda q(l))\right]}\equiv\underline{\Pi}^v(q).\end{aligned}$$

Note that $\underline{\Pi}^v(q)>1-p_1$ by Assumption 1. Thus, consumers in the interval

$$\mathcal{V}(q)\equiv\left(\min\{\underline{\Pi}^v(q),\hat{\Pi}^v(q)\},\max\{\overline{\Pi}^v(q),\hat{\Pi}^v(q)\}\right)$$

verify $\hat{s}=h$. Note further that $\mathcal{V}(q)\neq\emptyset$ if and only if $\hat{\Pi}^v(q)<\overline{\Pi}^v(q)$ (if and only if $\underline{\Pi}^v(q) < \hat{\Pi}^v(q)$). In particular, at $q(\emptyset) > 0 = q(l)$, $\mathcal{V}(q) \neq \emptyset$ is equivalent to

$$\begin{aligned}
&\frac{\lambda(1-p_0)q(\emptyset)+p_0(1-p_1)}{2\lambda(1-p_0)q(\emptyset)+p_0} < \frac{\lambda(1-p_0)q(\emptyset)(1-c)-cp_0(1-p_1)}{2\lambda(1-p_0)q(\emptyset)+cp_0(2p_1-1)} \\
\Leftrightarrow & c < \frac{\lambda(1-p_0)p_0(2p_1-1)q(\emptyset)}{2\left[\lambda(1-p_0)q(\emptyset)\left(\lambda(1-p_0)q(\emptyset)+p_0\right)+p_0^2p_1(1-p_1)\right]} \equiv \overline{c}_1(q(\emptyset)). \qquad (6)
\end{aligned}$$

Observe that $\frac{d}{dq(\emptyset)}\overline{c}_1(q(\emptyset)) > 0 \Leftrightarrow q(\emptyset) < \frac{p_0\sqrt{p_1(1-p_1)}}{\lambda(1-p_0)}$ and that $c < \overline{c}_1(1)$ by Assumption 1. Thus, there exists $\underline{q}(\emptyset) \in [0,1)$ such that (6) holds if and only if $q(\emptyset) > \underline{q}(\emptyset)$. Similarly, at $q(l) \leq 1 = q(\emptyset)$, $\mathcal{V}(q) \neq \emptyset$ is equivalent to

$$\begin{aligned}
&\frac{p_0(1-p_1)+\lambda(1-p_0(1-p_1q(l)))}{\lambda(2(1-p_0)+p_0q(l))+p_0} < \frac{\lambda(1-c)\left[1-p_0+q(l)p_0p_1\right]-cp_0(1-p_1)}{\lambda(2(1-p_0)+p_0q(l))+cp_0(1-\lambda q(l))(2p_1-1)} \\
\Leftrightarrow & c < \frac{\lambda p_0(2p_1-1)\left(1-p_0+p_0q(l)\right)}{\begin{array}{l}2\big[\lambda^2(1-p_0(1-p_1q(l)))(1-p_0(1-(1-p_1)q(l))) \\ \quad +\lambda\left[1-p_0+p_0q(l)(1-2p_1(1-p_1))\right]+p_0^2p_1(1-p_1)\big]\end{array}} \equiv \overline{c}_2(q(l)). \qquad (7)
\end{aligned}$$

Observe that (7) always holds as $\overline{c}_2(q(l))$ is strictly increasing and $c < \overline{c}_2(0) = \overline{c}_1(1)$ by Assumption 1.

We next determine M's payoff. Upon receiving report $\hat{s} = \emptyset$, consumer π takes action 1 if and only if (2) exceeds $\frac{1}{2}$, i.e.,

$$\begin{aligned}
&\frac{\left[\lambda p_0(1-p_1)(1-q(l))+(1-p_0)(1-\lambda q(\emptyset))\right]\pi}{\lambda p_0(1-q(l))\left[(1-p_1)\pi+p_1(1-\pi)\right]+(1-p_0)(1-\lambda q(\emptyset))} > \frac{1}{2} \\
\Leftrightarrow & \pi > \frac{(1-p_0)(1-\lambda q(\emptyset))+\lambda p_0p_1(1-q(l))}{2(1-p_0)(1-\lambda q(\emptyset))+\lambda p_0(1-q(l))} \equiv \Pi^{\emptyset}(q).
\end{aligned}$$

Note that $\Pi^{\emptyset}(q) > \frac{1}{2}$ if and only if $q(l) < 1$, as $p_1 > \frac{1}{2}$. Next, we determine the equilibria. By Lemma 2, we only need to consider the cases $q(\emptyset) > 0 = q(l)$ and $q(\emptyset) = 1 > q(l)$. Consider first $q(\emptyset) > 0 = q(l)$. The payoff from reporting $\hat{s} = \emptyset$ is

$$1 - F(\Pi^{\emptyset}(q(\emptyset), 0)) + \beta.$$

Similarly, the payoff from reporting $\hat{s} = h$ in case $s = \emptyset$ is

$$1 - F(\overline{\mathcal{V}}(q(\emptyset), 0)) + \beta\left(1 - \int_{\underline{\mathcal{V}}(q(\emptyset),0)}^{\overline{\mathcal{V}}(q(\emptyset),0)} \alpha(h, \emptyset, \mu_\pi(\cdot|q))dF(\pi)\right).$$

Hence, the biased firm is indifferent between $\hat{s} = \emptyset$ and $\hat{s} = h$ in case $s = \emptyset$ if and only if

$$1 - F(\Pi^{\emptyset}(q(\emptyset), 0)) = 1 - F(\overline{\mathcal{V}}(q(\emptyset), 0)) - \beta \int_{\underline{\mathcal{V}}(q(\emptyset),0)}^{\overline{\mathcal{V}}(q(\emptyset),0)} \alpha(h, \emptyset, \mu_\pi(\cdot|q))dF(\pi). \quad (8)$$

Recall that $\Pi^{\emptyset}(q(\emptyset), 0) > \frac{1}{2} > \overline{\mathcal{V}}(q(\emptyset), 0)$, which implies that at $q(\emptyset) = \underline{q}(\emptyset)$ the right-hand side of (8) exceeds the left-hand side. Thus, there exists $\underline{\beta}_0 > 0$ such that (8) holds for some $q^*(\emptyset) \in (\underline{q}(\emptyset), 1]$ if and only if $\beta \geq \underline{\beta}_0$. Note that $q(l) = 0$ in case $s = l$ then is optimal since $\alpha(h, \emptyset, \mu_\pi(\cdot|q)) < \alpha(h, l, \mu_\pi(\cdot|q))$ by monotonicity.

Next consider $q(\emptyset) = 1 \geq q(l)$. The payoff from reporting $\hat{s} = \emptyset$ then is

$$1 - F(\Pi^{\emptyset}(1, q(l))) + \beta.$$

Similarly, the payoff from reporting $\hat{s} = h$ in case $s = l$ is

$$1 - F(\overline{\mathcal{V}}(1, q(l))) + \beta \left(1 - \int_{\underline{\mathcal{V}}(1,q(l))}^{\overline{\mathcal{V}}(1,q(l))} \alpha(h, l, \mu_\pi(\cdot|q))dF(\pi)\right).$$

Hence, the biased firm is indifferent between $\hat{s} = \emptyset$ and $\hat{s} = h$ in case $s = l$ if and only if

$$1 - F(\Pi^{\emptyset}(1, q(l))) = 1 - F(\overline{\mathcal{V}}(1, q(l))) - \beta \int_{\underline{\mathcal{V}}(1,q(l))}^{\overline{\mathcal{V}}(1,q(l))} \alpha(h, l, \mu_\pi(\cdot|q))dF(\pi). \quad (9)$$

Suppose that $\beta < \underline{\beta}_0$ and $q(l) = 0$. Note that the right-hand side of (8) strictly exceeds the left-hand side, i.e., $q(\emptyset) = 1$ is optimal. Now two cases are possible:

1. There exists $0 < \underline{\beta}_1 < \underline{\beta}_0$ such that the left-hand side of (9) weakly exceeds the right-hand side if and only if $\beta \geq \underline{\beta}_1$, i.e., $q(l) = 0$ is optimal. (Note that this is possible since $\alpha(h, \emptyset, \mu_\pi(\cdot|q)) < \alpha(h, l, \mu_\pi(\cdot|q))$ by monotonicity.)

2. the right-hand side of (9) exceeds the left-hand side for all $\beta < \underline{\beta}_0$, i.e., $q(l) = 0$ is never optimal.

In sum, there exists $0 < \underline{\beta}_1 \leq \underline{\beta}_0$ such that there exists an equilibrium in which $q^*(\emptyset) > 0 = q^*(l)$ if and only if $\beta \geq \underline{\beta}_1$. Consumers $\pi \in \mathcal{V}(q^*(\emptyset, 0))$ verify $\hat{s} = h$. Note that the biased firm's strategy induces monotonic beliefs. Thus, by Lemma 1, reporting $s = h$ truthfully is optimal.

Finally, suppose that $\beta < \underline{\beta}_1$ and recall that then the right-hand side of (9) exceeds the left-hand side at $q(l) = 0$, which hence is not optimal. Thus, there exists $\overline{\beta}_2 \geq \underline{\beta}_1$ such that either there is $q^*(l) > 0$ such that (9) holds or the right-hand side of (9) exceeds the left-hand side for all $q(l) \in (0,1]$, such that $q^*(l) = 1$ is optimal. In both cases, consumers $\pi \in \mathcal{V}(1, q^*(l))$ verify $\hat{s} = h$. Again, the biased firm's strategy induces monotonic beliefs. Thus, by Lemma 1, reporting $s = h$ truthfully is optimal, and $q(\emptyset) = 1$ in case $s = \emptyset$ is optimal by Lemma 2. $\square$

Proof of Proposition 2. Let q^* denote the essentially unique monotonic equilibrium with the least disinformation and define

$$
\begin{aligned}
G_s(q;\beta) \equiv & 1 - F(\Pi^{\emptyset}(q)) \\
& - \left(1 - F(\overline{\mathcal{V}}(q)) - \beta \int_{\underline{\mathcal{V}}(q)}^{\overline{\mathcal{V}}(q)} \alpha(h, s, \mu_\pi(\cdot|q)) dF(\pi)\right).
\end{aligned}
$$

Suppose first that $\beta < \underline{\beta}_1$ and $q^*(l) < 1$ (there is nothing to show if $q^*(l) = 1$, as disinformation cannot increase in this case). Note that we have $G_l(1, q^*(l); \beta) = 0$ and $G_l(1, q(l); \beta) < 0$ for all $q(l) < q^*(l)$ since $\beta < \underline{\beta}_1$. Consider any $\beta' > \beta$ and note that $G_l(1, q^*(l); \beta') > 0$ since $\mathcal{V}(1, q^*(l)) \neq \emptyset$. The claim follows immediately if there exists $0 < q'(l) < q^*(l)$ such that $G_l(1, q'(l); \beta') = 0$. Otherwise, we have $G_l(1, q'(l); \beta') > 0$ for all $0 < q'(l) < q^*(l)$. In this case, since $G_{\emptyset}(0, 0; \beta') < 0$, there exists $0 < q'(\emptyset) \leq 1$ such that $G_{\emptyset}(q'(\emptyset), 0; \beta') = 0$, which establishes the claim.

Second, (the level of) disinformation is constant in β on $\left[\underline{\beta}_1, \underline{\beta}_0\right)$. Finally, suppose that $\beta \geq \underline{\beta}_0$. Analogously to the first part, consider any $\beta' > \beta$ and note that $G_{\emptyset}(q^*(\emptyset), 0; \beta') > 0$ since $\mathcal{V}(q^*(\emptyset), 0) \neq \emptyset$. Since $G_{\emptyset}(0, 0; \beta') < 0$, there exists $0 < q'(\emptyset) < q^*(\emptyset)$ such that $G_{\emptyset}(q'(\emptyset), 0; \beta') = 0$, which establishes the claim. $\square$

Proof of Proposition 3 and Proposition 4. Consider media firm H (analogue for L) and the information set that is reached after consumers have chosen which news outlet to follow, where each firm M learns its total mass of followers $F^M(1)$. Given correct beliefs about F^H, we can treat the remaining game as equivalent to the monopoly model with $\lambda = 1$ and the expected distribution of prior beliefs F^H: First, since F is strictly increasing, so is F^H if consumers employ completely mixed strategies. Second, the possibility of small trembles that lead firm H to report $\hat{s}_H = l$ does not affect optimal behavior in the subsequent game in case $\hat{s}_H \in \{\emptyset, h\}$. Note further that, as media firms only observe the total mass of their followers, neither trembles nor a deviation by a consumer will lead to a different information set; we can thus ignore off-path information sets. To ease the exposition, we will henceforth suppress trembles unless they refine equilibria.

It then follows from Proposition 1 that under Assumption 2 any equilibrium is such that either $q_H(\emptyset) > 0 = q_H(l)$ or $q_H(\emptyset) = 1 \geq q_H(l) > 0$; in particular, all consumers with prior $\pi \in \mathcal{V}(q_H) \subset (1-p_1, p_1)$ and who observe $\hat{s}_H = h$ verify it, and consumer $\Pi^{\emptyset}(q_H)$ is indifferent between the two actions upon receiving report $\hat{s}_H = \emptyset$. We can henceforth assume that $q = (q_L, q_H)$ is such that either $q_H(\emptyset) > 0 = q_H(l)$ or $q_H(\emptyset) = 1 \geq q_H(l) > 0$ and either $q_L(\emptyset) > 0 = q_L(h)$ or $q_L(\emptyset) = 1 \geq q_L(h) > 0$.

In a second step, we determine the consumers' choices which news outlet to follow. Consider without loss of generality $\pi < \frac{1}{2}$ and note that we have $\Pi^{\emptyset,*}(q_L) < \underline{\mathcal{V}}^*(q_L)$ and $\underline{\mathcal{V}}(q_H) < \underline{\mathcal{V}}^*(q_L)$. We proceed by case distinction (ignoring knife-edge priors):

(a) $\max\left\{\overline{\mathcal{V}}(q_H), \underline{\mathcal{V}}^*(q_L)\right\} < \pi < \frac{1}{2}$. This implies that $q_L(\emptyset) = 1 \geq q_L(h) > \frac{c(2-p_0)}{p_0(2p_1-1-c)}$ and $q_H(l) \leq \frac{c(2-p_0)}{p_0(2p_1-1-c)}$. As in this case the consumer would verify $\hat{s}_L = l$, expected utility from following media firm L is

$$
\begin{aligned}
&Pr_\pi(\hat{s}_L = l)\Big(Pr_\pi(s = h \mid \hat{s}_L = l)Pr_\pi(\theta = 1 \mid s = h) \\
&\quad + Pr_\pi(s = \emptyset \mid \hat{s}_L = l)Pr_\pi(\theta = 0 \mid s = \emptyset) \\
&\quad + Pr_\pi(s = l \mid \hat{s}_L = l)Pr_\pi(\theta = 0 \mid s = l) - c\Big) + Pr_\pi(\hat{s}_L = \emptyset)Pr_\pi(\theta = 1 \mid \hat{s}_L = \emptyset) \\
=&\Big(1 - p_0 + p_0\left((p_1 q_L(h) + 1 - p_1)\pi + (p_1 + (1-p_1)q_L(h))(1-\pi)\right)\Big) \cdot \\
&\left(\frac{p_0 p_1(1-\pi) + (1-p_0)(1-\pi) + p_0 p_1 q_L(h)\pi}{1 - p_0 + p_0\left((p_1 q_L(h) + 1 - p_1)\pi + (p_1 + (1-p_1)q_L(h))(1-\pi)\right)} - c\right) \\
&\quad + p_0 p_1(1 - q_L(h))\pi \\
=&p_0 p_1 + (1-p_0)(1-\pi) - c\big(1 - p_0 + p_0\big((p_1 q_L(h) + 1 - p_1)\pi \\
&\quad + (p_1 + (1-p_1)q_L(h))(1-\pi)\big)\big).
\end{aligned}
$$

Expected utility from following media firm H is

$$
\begin{aligned}
&Pr_\pi(\hat{s}_H = h)Pr_\pi(\theta = 1 \mid \hat{s}_H = h) + Pr_\pi(\hat{s}_H = \emptyset)Pr_\pi(\theta = 0 \mid \hat{s}_H = \emptyset) \\
=&Pr_\pi(\hat{s}_H = h \mid \theta = 1)Pr_\pi(\theta = 1) + Pr_\pi(\hat{s}_H = \emptyset \mid \theta = 0)Pr_\pi(\theta = 0) \\
=&\big(p_0(p_1 + (1-p_1)q_H(l)) + (1-p_0)q_H(\emptyset)\big)\pi \\
&\quad + \big(p_0 p_1(1 - q_H(l)) + (1-p_0)(1 - q_H(\emptyset))\big)(1-\pi) \\
=&p_0 p_1(1 - q_H(l)) + p_0 q_H(l)\pi + (1-p_0)\left(q_H(\emptyset)\pi + (1 - q_H(\emptyset))(1-\pi)\right). \quad (10)
\end{aligned}
$$

Hence, the consumer prefers media firm H to media firm L if

$$\begin{aligned}
&p_0p_1(1-q_H(l))+p_0q_H(l)\pi+(1-p_0)\left(q_H(\emptyset)\pi+(1-q_H(\emptyset))(1-\pi)\right)\\
>&p_0p_1+(1-p_0)(1-\pi)-c\big(1-p_0+p_0\big((p_1q_L(h)+1-p_1)\pi\\
&+(p_1+(1-p_1)q_L(h))(1-\pi)\big)\big)\\
\Leftrightarrow&\pi\big(2(1-p_0)q_H(\emptyset)+p_0q_H(l)-cp_0(2p_1-1)(1-q_L(h))\big)\\
>&(1-p_0)q_H(\emptyset)+p_0p_1q_H(l)-c\big(1-p_0+p_0\big(p_1+(1-p_1)q_L(h)\big)\big).
\end{aligned}$$

If $2(1-p_0)q_H(\emptyset)+p_0q_H(l)<cp_0(2p_1-1)(1-q_L(h))$, we obtain

$$\pi<\check{\Pi}(q_L(h),q_H)\equiv\frac{(1-p_0)q_H(\emptyset)+p_0p_1q_H(l)-c\big(1-p_0+p_0\big(p_1+(1-p_1)q_L(h)\big)\big)}{2(1-p_0)q_H(\emptyset)+p_0q_H(l)-cp_0(2p_1-1)(1-q_L(h))},$$

which always holds as $\check{\Pi}(q_L(h),q_H)>\frac{1}{2}$. If $2(1-p_0)q_H(\emptyset)+p_0q_H(l)>cp_0(2p_1-1)(1-q_L(h))$, we obtain $\pi>\check{\Pi}(q_L(h),q_H)$.

(b) $\max\left\{\overline{\mathcal{V}}(q_H),\Pi^{\emptyset,*}(q_L)\right\}<\pi<\underline{\mathcal{V}}^*(q_L)$. Again we have $q_H(l)\leq\frac{c(2-p_0)}{p_0(2p_1-1-c)}$ and expected utility from following media firm H is given by (10). As in this case the consumer would not verify $\hat{s}_L=l$, expected utility from following media firm L is

$$\begin{aligned}
&Pr_\pi(\hat{s}_L=l)Pr_\pi(\theta=0\mid\hat{s}_L=l)+Pr_\pi(\hat{s}_L=\emptyset)Pr_\pi(\theta=1\mid\hat{s}_L=\emptyset)\\
=&Pr_\pi(\hat{s}_L=l\mid\theta=0)Pr_\pi(\theta=0)+Pr_\pi(\hat{s}_L=\emptyset\mid\theta=1)Pr_\pi(\theta=1)\\
=&\big((1-p_0)q_L(\emptyset)+p_0(p_1+(1-p_1)q_L(h)\big)(1-\pi)\\
&+\big((1-p_0)(1-q_L(\emptyset))+p_0p_1(1-q_L(h))\big)\pi\\
=&p_0p_1(1-q_L(h))+p_0q_L(h)(1-\pi)+(1-p_0)(q_L(\emptyset)(1-\pi)+(1-q_L(\emptyset))\pi).
\end{aligned}\tag{11}$$

Hence, the consumer prefers media firm H to media firm L if

$$\begin{aligned}
&p_0p_1(1-q_H(l))+(1-p_0)(1-q_H(\emptyset))+\big(p_0q_H(l)-(1-p_0)(1-2q_H(\emptyset))\big)\pi\\
>&p_0p_1(1-q_L(h))+p_0q_L(h)(1-\pi)+(1-p_0)(q_L(\emptyset)(1-\pi)+(1-q_L(\emptyset))\pi)\\
\Leftrightarrow&\pi\big(p_0(q_H(l)+q_L(h))-2(1-p_0)(1-q_H(\emptyset)-q_L(\emptyset))\big)\\
>&p_0(p_1q_H(l)+(1-p_1)q_L(h))+(1-p_0)(q_H(\emptyset)+q_L(\emptyset)-1)
\end{aligned}$$

If $p_0(q_H(l)+q_L(h))>2(1-p_0)(1-q_H(\emptyset)-q_L(\emptyset))$, we obtain

$$\pi>\check{\Pi}'(q)\equiv\frac{p_0(p_1q_H(l)+(1-p_1)q_L(h))-(1-p_0)(1-q_H(\emptyset)-q_L(\emptyset))}{p_0(q_H(l)+q_L(h))-2(1-p_0)(1-q_H(\emptyset)-q_L(\emptyset))}.$$

In particular, $\check{\Pi}'(q) \leq \frac{1}{2} \Leftrightarrow q_H(l) \leq q_L(h)$. If $p_0(q_H(l)+q_L(h)) < 2(1-p_0)(1-q_H(\emptyset)-q_L(\emptyset))$, we obtain $\pi < \check{\Pi}'(q)$; in particular, $\check{\Pi}'(q) \leq \frac{1}{2} \Leftrightarrow q_H(l) \geq q_L(h)$. Otherwise, if $p_0(q_H(l) + q_L(h)) = 2(1-p_0)(1-q_H(\emptyset) - q_L(\emptyset))$, we obtain

$$(1-p_0)(1-q_H(\emptyset)-q_L(\emptyset)) > p_0(p_1 q_H(l) + (1-p_1)q_L(h)) \Leftrightarrow q_H(l) < q_L(h).$$

Thus, if $q_H(l) = q_L(h) = 0$, then the consumer prefers media firm H to media firm L if and only if $q_L(\emptyset) + q_H(\emptyset) < 1$.

(c) $\overline{\mathcal{V}}(q_H) < \pi < \Pi^{\emptyset,*}(q_L)$. Note that in this case $q_L(h) = 0 < q_L(\emptyset) < 1$. Expected utility from following media firm L is $1-\pi$ while that from following media firm H is given by (10), exceeding $1-\pi$ as $\pi > \overline{\mathcal{V}}(q_H)$.

(d) $\underline{\mathcal{V}}^*(q_L) < \pi < \overline{\mathcal{V}}(q_H)$. Note that in this case $q_L(\emptyset) = 1 \geq q_L(h) > \frac{c(2-p_0)}{p_0(2p_1-1-c)}$. As the consumer would verify $\hat{s}_L = l$, expected utility from following media firm L is given by

$$\begin{aligned}
&Pr_\pi(\hat{s}_L = l)\Big(Pr_\pi(s=h \mid \hat{s}_L = l)Pr_\pi(\theta = 1 \mid s = h) \\
&+ Pr_\pi(s=\emptyset \mid \hat{s}_L = l)Pr_\pi(\theta = 0 \mid s = \emptyset) \\
&+ Pr_\pi(s=l \mid \hat{s}_L = l)Pr_\pi(\theta = 0 \mid s = l) - c\Big) + Pr_\pi(\hat{s}_L = \emptyset)Pr_\pi(\theta = 1 \mid \hat{s}_L = \emptyset) \\
=&\Big(1-p_0+p_0\left((p_1 q_L(h)+1-p_1)\pi + (p_1+(1-p_1)q_L(h))(1-\pi)\right)\Big)\cdot \\
&\left(\frac{p_0p_1(1-\pi)+(1-p_0)(1-\pi)+p_0p_1q_L(h)\pi}{1-p_0+p_0\left((p_1q_L(h)+1-p_1)\pi+(p_1+(1-p_1)q_L(h))(1-\pi)\right)} - c\right) \\
&+ p_0p_1(1-q_L(h))\pi \\
=&p_0p_1 + (1-p_0)(1-\pi) - c\big(1-p_0+p_0\big((p_1q_L(h)+1-p_1)\pi \\
&+ (p_1+(1-p_1)q_L(h))(1-\pi)\big)\big).
\end{aligned}$$

As the consumer would also verify $\hat{s}_H = h$, expected utility from following media firm H is, using (4), given by

$$\begin{aligned}
&Pr_\pi(\hat{s}_H = h)\Big(Pr_\pi(s=l \mid \hat{s}_H = h)Pr_\pi(\theta = 0 \mid s = l) \\
&+ Pr_\pi(s=\emptyset \mid \hat{s}_H = h)Pr_\pi(\theta = 0 \mid s = \emptyset) \\
&+ Pr_\pi(s=h \mid \hat{s}_H = h)Pr_\pi(\theta = 1 \mid s = h) - c\Big) + Pr_\pi(\hat{s}_H = \emptyset)Pr_\pi(\theta = 0 \mid \hat{s}_H = \emptyset) \\
=&\Big((1-p_0)q_H(\emptyset)+p_0\left((p_1+(1-p_1)q_H(l))\pi + (1-p_1+p_1q_H(l))(1-\pi)\right)\Big)\cdot \\
&\left(\frac{((1-p_0)q_H(\emptyset)+q_H(l)p_0p_1)(1-\pi)+p_0p_1\pi}{(1-p_0)q_H(\emptyset)+p_0\left((p_1+(1-p_1)q_H(l))\pi+(1-p_1+p_1q_H(l))(1-\pi)\right)} - c\right)
\end{aligned}$$

$$
\begin{aligned}
&+ \left(p_0p_1(1-q_H(l)) + (1-p_0)(1-q_H(\emptyset))\right)(1-\pi) \\
=&p_0p_1 + (1-p_0)(1-\pi) - c\big((1-p_0)q_H(\emptyset) \\
&+ p_0\left((p_1+(1-p_1)q_H(l))\pi + (1-p_1+p_1q_H(l))(1-\pi)\right)\big).
\end{aligned} \tag{12}
$$

Hence, the consumer prefers media firm L to media firm H if

$$
\begin{aligned}
&p_0p_1 + (1-p_0)(1-\pi) - c\big(1-p_0+p_0\big((p_1q_L(h)+1-p_1)\pi \\
&\quad + (p_1+(1-p_1)q_L(h))(1-\pi)\big)\big) \\
&\quad \geq p_0p_1 + (1-p_0)(1-\pi) - c\big((1-p_0)q_H(\emptyset) \\
&\quad + p_0\left((p_1+(1-p_1)q_H(l))\pi + (1-p_1+p_1q_H(l))(1-\pi)\right)\big) \\
\Leftrightarrow&\pi p_0(2p_1-1)(2-q_H(l)-q_L(h)) \\
&\quad \geq (1-p_0)(1-q_H(\emptyset)) + p_0(p_1(1-q_H(l)) - (1-p_1)(1-q_L(h))).
\end{aligned} \tag{13}
$$

If $q_H(l) = q_L(h) = 1$ (and hence also $q_H(\emptyset) = 1$), then (13) holds with equality. Otherwise, we obtain

$$
\pi \geq \check{\Pi}''(q_L(h), q_H) \equiv \frac{(1-p_0)(1-q_H(\emptyset)) + p_0(p_1(1-q_H(l)) - (1-p_1)(1-q_L(h)))}{p_0(2p_1-1)(2-q_L(h)-q_H(l))}.
$$

In particular, if $q_H(\emptyset) = 1$, then $\check{\Pi}''(q_L(h), (1, q_H(l))) < \frac{1}{2} \Leftrightarrow q_L(h) < q_H(l)$.

(e) $\max\left\{\underline{\mathcal{V}}(q_H), \Pi^{\emptyset,*}(q_L)\right\} < \pi < \min\left\{\overline{\mathcal{V}}(q_H), \underline{\mathcal{V}}^*(q_L)\right\}$. Expected utility from following media firm H and L is given by (12) and (11), respectively. Hence, the consumer prefers media firm H to media firm L if and only if

$$
\begin{aligned}
&p_0p_1 + (1-p_0)(1-\pi) - c\Big((1-p_0)q_H(\emptyset) \\
&\quad + p_0\left((p_1+(1-p_1)q_H(l))\pi + (1-p_1+p_1q_H(l))(1-\pi)\right)\Big) \\
>&p_0p_1(1-q_L(h)) + p_0q_L(h)(1-\pi) + (1-p_0)\left(q_L(\emptyset)(1-\pi) + (1-q_L(\emptyset))\pi\right) \\
\Leftrightarrow&q_L(h)p_0(\pi-(1-p_1)) + (1-p_0)(1-q_L(\emptyset))(1-2\pi) \\
&\quad > c\Big((1-p_0)q_H(\emptyset) + p_0\left((p_1+(1-p_1)q_H(l))\pi + (1-p_1+p_1q_H(l))(1-\pi)\right)\Big) \\
\Leftrightarrow&\pi\Big(q_L(h)p_0 - 2(1-p_0)(1-q_L(\emptyset)) - cp_0(2p_1-1)(1-q_H(l))\Big) \\
&\quad > q_L(h)p_0(1-p_1) - (1-p_0)(1-q_L(\emptyset)) + c\Big((1-p_0)q_H(\emptyset) + p_0(1-p_1+p_1q_H(l))\Big).
\end{aligned}
$$

If $q_L(h) > \frac{2(1-p_0)(1-q_L(\emptyset))}{p_0} + c(2p_1-1)(1-q_H(l))$, we obtain

$$
\pi > \check{\Pi}'''(q) \equiv \frac{q_L(h)p_0(1-p_1) - (1-p_0)(1-q_L(\emptyset)) + c\big((1-p_0)q_H(\emptyset) + p_0(1-p_1+p_1q_H(l))\big)}{q_L(h)p_0 - 2(1-p_0)(1-q_L(\emptyset)) - cp_0(2p_1-1)(1-q_H(l))}.
$$

If $q_L(h) < \frac{2(1-p_0)(1-q_L(\emptyset))}{p_0} + c(2p_1-1)(1-q_H(l))$, then $\pi < \check{\Pi}'''(q)$. If $q_L(h) = \frac{2(1-p_0)(1-q_L(\emptyset))}{p_0} + c(2p_1-1)(1-q_H(l))$, then necessarily $q_L(\emptyset) = 1$ (otherwise we had $q_L(h) = 0$, a contradiction) and we thus obtain

$$0 > q_L(h)p_0(1-p_1) + c\big((1-p_0)q_H(\emptyset) + p_0(1-p_1+p_1q_H(l))\big),$$

which never holds, i.e., all consumers prefer media firm L. In particular, if $q_H(l) = q_L(h) = 0$, then the consumer prefers media firm H to the L if

$$\pi < \widetilde{\Pi}(q_L(\emptyset), q_H(\emptyset)) \equiv \frac{(1-p_0)(1-q_L(\emptyset)) - c\big((1-p_0)q_H(\emptyset) + p_0(1-p_1)\big)}{2(1-p_0)(1-q_L(\emptyset)) + cp_0(2p_1-1)}.$$

Note that $\widetilde{\Pi}((q_L(\emptyset),0),(q_H(\emptyset),0)) > \overline{\mathcal{V}}(q_H) \Leftrightarrow q_L(\emptyset) + q_H(\emptyset) < 1$.

(f) $\underline{\mathcal{V}}(q_H) < \pi < \min\{\Pi^{\emptyset,*}(q_L), \overline{\mathcal{V}}(q_H)\}$. Note that in this case $q_L(h) = 0 < q_L(\emptyset) < 1$. Expected utility from following media firm L is $1-\pi$ while that from following media firm H is given by (18), exceeding $1-\pi$ as $\pi \in \mathcal{V}(q_H)$.

(g) $\Pi^{\emptyset,*}(q_L) < \pi < \underline{\mathcal{V}}(q_H)$. Expected utility from following media firm H is $1-\pi$ while that from following media firm L is given by (11), exceeding $1-\pi$ as $\pi > \Pi^{\emptyset,*}(q_L)$.

(h) $\pi < \min\{\underline{\mathcal{V}}(q_H), \Pi^{\emptyset,*}(q_L)\}$. Expected utility is $1-\pi$ in both cases. In particular, she will choose action zero regardless of which firm she follows even after slightly perturbing the firms' strategies, such that the consumer chooses media firm L by assumption (weak form of confirmation bias).

Thus, up to a null set under F (since we have, for simplicity, ignored knife-edge priors) consumers $\pi \in (\underline{\mathcal{V}}(q_H), \Pi^{\emptyset,*}(q_L))$ follow media firm H (case (c) and (f)), $\pi \in (\max\{\underline{\mathcal{V}}(q_H), \Pi^{\emptyset,*}(q_L)\}, \frac{1}{2})$ follow either firm (case (a), (b), (d) and (e)), while all other consumers $\pi < \frac{1}{2}$ follow media firm L (case (g) and (h)). Hence, $N_0^H(q) \subseteq (\underline{\mathcal{V}}(q_H), \frac{1}{2})$ and, analogously, $N_1^L(q) \subseteq (\frac{1}{2}, \overline{\mathcal{V}}^*(q_L))$.

In particular, if $q_H(l) = q_L(h) = 0$, we have that $\underline{\mathcal{V}}^*(q_L) > \frac{1}{2}$ (case (a) and (d) do not exist). Thus, if $q_L(\emptyset) + q_H(\emptyset) < 1$, then $N_0^H(q) = (\underline{\mathcal{V}}(q_H), \frac{1}{2})$ (case (b), (c), (e) and (f)), and analogously $N_1^L(q) = (\frac{1}{2}, \overline{\mathcal{V}}^*(q_L))$. Otherwise, if $q_L(\emptyset)+q_H(\emptyset) \geq 1$, then

$$\begin{aligned} N_0^H(q) &= \big(\underline{\mathcal{V}}(q_H), \Pi^{\emptyset,*}(q_L)\big) \cup \Big(\max\{\underline{\mathcal{V}}(q_H), \Pi^{\emptyset,*}(q_L)\}, \widetilde{\Pi}(q_L(\emptyset), q_H(\emptyset))\Big) \\ &= \Big(\underline{\mathcal{V}}(q_H), \max\Big\{\Pi^{\emptyset,*}(q_L), \widetilde{\Pi}(q_L(\emptyset), q_H(\emptyset))\Big\}\Big) \end{aligned}$$

$$= \left(\underline{\mathcal{V}}(q_H), \widetilde{\Pi}(q_L(\emptyset), q_H(\emptyset))\right),$$

where the last inequality follows from $\underline{\mathcal{V}}(q_H) \leq \widetilde{\Pi}(q_L(\emptyset), q_H(\emptyset)) \Leftrightarrow \Pi^{\emptyset,*}(q_L) \leq \widetilde{\Pi}(q_L(\emptyset), q_H(\emptyset))$ together with $\underline{\mathcal{V}}(\cdot)$ being strictly increasing and $\Pi^{\emptyset,*}(\cdot)$ and $\widetilde{\Pi}(\cdot,\cdot)$ being strictly decreasing in each argument. Analogously, $N_1^L(q) = \big(1-\widetilde{\Pi}(q_H(\emptyset), q_L(\emptyset)), \overline{\mathcal{V}}^*(q_L)\big)$.

In a third step, we characterize equilibria in which $q \in Q_1 \equiv \{q' = (q'_L, q'_H) \mid q'_H(\emptyset) < 1 - q'_L(\emptyset), q'_H(l) = q'_L(h) = 0\}$. Recall from (6) that $\mathcal{V}(q_H) \neq \emptyset$ if and only if $c < \overline{c}_1(q_H(\emptyset))$. In particular, $\frac{d}{dq_H(\emptyset)}\overline{c}_1(q_H(\emptyset)) > 0 \Leftrightarrow q_H(\emptyset) < \frac{p_0\sqrt{p_1(1-p_1)}}{1-p_0}$ and $c < \min\left\{\overline{c}_1(\frac{1}{2}), \overline{c}_1(1)\right\}$ by Assumption 2. Thus, there exists $\underline{q}(\emptyset) \in [0, \frac{1}{2})$ such that $c < \overline{c}_1(q_H(\emptyset))$, and hence $\mathcal{V}(q_H) \neq \emptyset$, if and only if $q_H(\emptyset) > \underline{q}(\emptyset)$. By symmetry, $\mathcal{V}^*(q_L) \neq \emptyset$ if and only if $q_L(\emptyset) > \underline{q}(\emptyset)$.

Analogously to the proof of Proposition 1, media firm H is indifferent between $\hat{s}_H = \emptyset$ and $\hat{s}_H = h$ in case $s = \emptyset$ if and only if

$$1 - F^H(\Pi^\emptyset(q_H)) = 1 - F^H(\overline{\mathcal{V}}(q_H)) - \beta \int_{\underline{\mathcal{V}}(q_H)}^{\overline{\mathcal{V}}(q_H)} \alpha(h, \emptyset, \mu_\pi(\cdot|q_H))dF^H(\pi) \tag{14}$$

and media firm L is indifferent between $\hat{s}_L = \emptyset$ and $\hat{s}_L = l$ in case $s = \emptyset$ if and only if

$$F^L(\Pi^{\emptyset,*}(q_L)) = F^L(\underline{\mathcal{V}}^*(q_L)) - \beta \int_{\underline{\mathcal{V}}^*(q_L)}^{\overline{\mathcal{V}}^*(q_L)} \alpha(l, \emptyset, \mu_\pi(\cdot|q_L))dF^L(\pi). \tag{15}$$

Note that we have

$$\begin{aligned}\underline{\mathcal{V}}(q_H) < \hat{\Pi}^v(q_H) = & \frac{(1-p_0)q_H(\emptyset) + p_0(1-p_1)}{2(1-p_0)q_H(\emptyset) + p_0} \\ & < \frac{(1-p_0)(1-q_L(\emptyset)) + p_0(1-p_1)}{2(1-p_0)(1-q_L(\emptyset)) + p_0} = \Pi^{\emptyset,*}(q_L)\end{aligned}$$

as $q \in Q_1$,[23] and analogously $\overline{\mathcal{V}}^*(q_L) > \Pi^\emptyset(q_H)$. Since further $N_0^H(q) = (\underline{\mathcal{V}}(q_H), \frac{1}{2})$ and $N_1^L(q) = (\frac{1}{2}, \overline{\mathcal{V}}^*(q_L))$, (14) and (15) are equivalent to

$$0 = F\left(\frac{1}{2}\right) - F(\overline{\mathcal{V}}(q_H)) - \beta \int_{\underline{\mathcal{V}}(q_H)}^{\overline{\mathcal{V}}(q_H)} \alpha(h, \emptyset, \mu_\pi(\cdot|q_H))dF(\pi), \tag{16}$$

$$0 = F(\underline{\mathcal{V}}^*(q_L)) - F\left(\frac{1}{2}\right) - \beta \int_{\underline{\mathcal{V}}^*(q_L)}^{\overline{\mathcal{V}}^*(q_L)} \alpha(l, \emptyset, \mu_\pi(\cdot|q_L))dF(\pi). \tag{17}$$

Since $\overline{\mathcal{V}}(q_H) \leq \overline{\mathcal{V}}(1,0) < \frac{1}{2}$ and $\underline{\mathcal{V}}^*(q_L) \geq \underline{\mathcal{V}}^*(1,0) > \frac{1}{2}$, and ignoring the knife-edge

[23] See the proof of Proposition 1 for details on $\hat{\Pi}^v(q_H)$.

case where (16) and (17) hold for $q_H(\emptyset) = 1 - q_L(\emptyset)$ and $q_H(l) = q_L(h) = 0$, there exists $\underline{\beta}_1^c > 0$ such that (16) and (17) hold for some $q \in Q_1$ if and only if $\beta \geq \underline{\beta}_1^c$. Note that $q_H(l) = q_L(h) = 0$ then is optimal by Lemma 2. Thus, there exists a monotonic equilibrium in which $q \in Q_1$ if and only if $\beta \geq \underline{\beta}_1^c$.

Fourth, consider $q \in Q_2 \equiv \{q' = (q'_L, q'_H) \mid q'_H(\emptyset) \geq 1 - q'_L(\emptyset), q'_H(l) = q'_L(h) = 0\}$ and recall that $\mathcal{V}(q_H) \neq \emptyset$ if and only if $q_H(\emptyset) > \underline{q}(\emptyset)$ and $\mathcal{V}^*(q_L) \neq \emptyset$ if and only if $q_L(\emptyset) > \underline{q}(\emptyset)$. Since in this case $N_0^H(q) = \big(\underline{\mathcal{V}}(q_H), \widetilde{\Pi}(q_L(\emptyset), q_H(\emptyset))\big)$ and $N_1^L(q) = \big(1 - \widetilde{\Pi}(q_H(\emptyset), q_L(\emptyset)), \overline{\mathcal{V}}^*(q_L)\big)$, (14) and (15) are equivalent to

$$\begin{aligned} 0 =& F\left(\min\{1 - \widetilde{\Pi}(q_H(\emptyset), q_L(\emptyset)), \overline{\mathcal{V}}^*(q_L)\}\right) - F\left(\frac{1}{2}\right) \\ &+ \max\left\{F(\Pi^{\emptyset}(q_H)) - F(\overline{\mathcal{V}}^*(q_L)), 0\right\} - \beta \int_{N_0^H(q)} \alpha(h, \emptyset, \mu_\pi(\cdot|q_H)) dF(\pi) \end{aligned} \tag{18}$$

and

$$\begin{aligned} 0 =& \max\left\{F(\underline{\mathcal{V}}(q_H)) - F(\Pi^{\emptyset,*}(q_L)), 0\right\} + F\left(\frac{1}{2}\right) \\ &- F\left(\max\{\widetilde{\Pi}(q_L(\emptyset), q_H(\emptyset)), \underline{\mathcal{V}}(q_H)\}\right) - \beta \int_{N_1^L(q)} \alpha(l, \emptyset, \mu_\pi(\cdot|q_L)) dF(\pi). \end{aligned} \tag{19}$$

Note first that if $q_H(\emptyset) = 1 - q_L(\emptyset) \in (\underline{q}(\emptyset), 1 - \underline{q}(\emptyset))$, then $\widetilde{\Pi}(q_L(\emptyset), q_H(\emptyset)) = \overline{\mathcal{V}}(q_H(\emptyset), 0)$ and $1 - \widetilde{\Pi}(q_H(\emptyset), q_L(\emptyset)) = \underline{\mathcal{V}}^*(q_L(\emptyset), 0)$, such that $N_0^H(q) = \mathcal{V}(q_H)$ and $N_1^L(q) = \mathcal{V}^*(q_L)$. Second, $\widetilde{\Pi}(1,1) < \underline{\mathcal{V}}(1,0)$ and $1 - \widetilde{\Pi}(1,1) > \overline{\mathcal{V}}^*(1,0)$, such that $N_0^H(1,0;1,0) = N_1^L(1,0;1,0) = \emptyset$. Since further $\underline{\mathcal{V}}(q_H) \leq \underline{\mathcal{V}}(1,0) < \frac{1}{2}$ and $\overline{\mathcal{V}}^*(q_L) \geq \overline{\mathcal{V}}^*(1,0) > \frac{1}{2}$, there exists $\underline{\beta}_2^c > 0$ such that (18) and (19) hold for some $q \in Q_2$ if and only if $\beta \geq \underline{\beta}_2^c$. Again $q_H(l) = q_L(h) = 0$ then is optimal by Lemma 2. Thus, there exists a monotonic equilibrium in which $q \in Q_2$ if and only if $\beta \geq \underline{\beta}_2^c$, which finishes the proof of Proposition 3.

The first part of Proposition 4 then follows immediately. We next prove existence. Suppose to the contrary that there does not exist an equilibrium such that either $q_H(l) < 1$ or $q_L(h) < 1$. Consider without loss of generality $q = (q_L, q_H)$ such that $q_H(\emptyset) = q_L(\emptyset) = 1$ and $q_d = q_H(l) = q_L(h) > \frac{c(2-p_0)}{p_0(2p_1-1-c)}$. Note that

$$\check{\Pi}'''(q) = \frac{p_0(1-p_1) + c\big(1 - p_0 + p_0(1 - p_1 + p_1 q_d)\big)}{p_0 - cp_0(2p_1 - 1)(1 - q_d)} \to \frac{p_0(1-p_1) + c}{p_0} = \underline{\mathcal{V}}^*(1,1)$$

as $q_d \to 1$, i.e., in case (e) all consumers prefer media firm L as $q_d \to 1$. Thus, $N_0^H(q) \to (\underline{\mathcal{V}}^*(1,1), \frac{1}{2})$ and $N_1^L(q) \to (\frac{1}{2}, \overline{\mathcal{V}}(1,1))$ as $q_d \to 1$ (case (d)). Therefore, we have an equilibrium in which $q_d = 1$, $N_0^H(q) = (\underline{\mathcal{V}}^*(q_L), \frac{1}{2})$ and $N_1^L(q) =$

$(\frac{1}{2}, \overline{\mathcal{V}}(q_H))$.

The last part now follows since there exists $\underline{\beta}_0^c \leq \underline{\beta}_1^c$ such that the essentially unique monotonic equilibrium with the least disinformation is uninformative, i.e., such that $q_H = q_L = (1,1)$, if $\beta < \underline{\beta}_0^c$. Finally, the second part follows because $N_0^H(q) \subseteq (\underline{\mathcal{V}}(q_H), \frac{1}{2})$ and $N_1^L(q) \subseteq (\frac{1}{2}, \overline{\mathcal{V}}^*(q_L))$ in any equilibrium. □

Proof of Corollary 3. Suppose that F is symmetric around $\frac{1}{2}$ and note that in this case Proposition 4 (i) holds for symmetric strategies, which finishes the first part.

Second, we show that we cannot have $q_f > \frac{1}{2}$ and $q_d = 0$ in the equilibrium with the least disinformation.[24] Take an equilibrium such that $q_f > \frac{1}{2}$ and $q_d = 0$, i.e., (18) and (19) hold. Recall from Proposition 3 (ii) that in this case $N_0^H(q) = \big(\underline{\mathcal{V}}(q), \widetilde{\Pi}(q_f)\big)$ and $N_1^L(q) = \big(1 - \widetilde{\Pi}(q_f), \overline{\mathcal{V}}^*(q)\big)$. By symmetry, this is equivalent to

$$\begin{aligned} 0 =& F\left(\min\{1 - \widetilde{\Pi}(q_f), \overline{\mathcal{V}}^*(q)\}\right) - F\left(\frac{1}{2}\right) \\ &+ \max\left\{F(\Pi^{\emptyset}(q)) - F(\overline{\mathcal{V}}^*(q)), 0\right\} - \beta \int_{N_0^H(q)} \alpha(h, \emptyset, \mu_\pi(\cdot|q_H)) dF(\pi). \end{aligned} \tag{20}$$

Since $\min\{1 - \widetilde{\Pi}(q_f), \overline{\mathcal{V}}^*(q)\} \geq \underline{\mathcal{V}}^*(q) \geq \underline{\mathcal{V}}^*(1,0) > \frac{1}{2}$, this requires

$$N_0^H(q) \neq \emptyset \Leftrightarrow \underline{\mathcal{V}}(q) < \widetilde{\Pi}(q_f) \Leftrightarrow 1 - \widetilde{\Pi}(q_f) < \overline{\mathcal{V}}^*(q).$$

We can thus rewrite (20) as

$$\begin{aligned} 0 =& F\big(1 - \widetilde{\Pi}(q_f)\big) - F\left(\frac{1}{2}\right) \\ &+ \max\left\{F(\Pi^{\emptyset}(q)) - F(1 - \underline{\mathcal{V}}(q)), 0\right\} - \beta \int_{\underline{\mathcal{V}}(q)}^{\widetilde{\Pi}(q_f)} \alpha(h, \emptyset, \mu_\pi(\cdot|q)) dF(\pi). \end{aligned}$$

Note first that $\alpha(h, \emptyset, \mu_\pi(\cdot|q))$ is weakly increasing in

$$|\mu_\pi(\hat{s} = h|q) - \mu_\pi(s = \emptyset)| = \frac{p_0(2p_1 - 1)(1 - \pi)\pi}{(1 - p_0)q_f + p_0(\pi p_1 + (1 - \pi)(1 - p_1))},$$

and thus weakly decreasing in q_f. Second, $\underline{\mathcal{V}}(\cdot, 0)$ and $\Pi^{\emptyset}(\cdot, 0)$ are strictly increasing

[24] Recall that we ignore the knife-edge case where, given $N_0^H(q) = (\underline{\mathcal{V}}(q), \frac{1}{2})$ and $N_1^L(q) = (\frac{1}{2}, \overline{\mathcal{V}}^*(q))$, $q_f^* = \frac{1}{2}$ is optimal for both firms. Under symmetry, $q_f = \frac{1}{2}$ and $q_d = 0$ then cannot be part of an equilibrium.

and $\widetilde{\Pi}(\cdot)$ is strictly decreasing. Therefore, we obtain for $q' = \left(\frac{1}{2}, 0\right)$

$$\begin{aligned}
0 >& F\big(1 - \widetilde{\Pi}(q'_f)\big) - F\left(\frac{1}{2}\right) \\
&+ \max\left\{F(\Pi^{\emptyset}(q')) - F(1 - \underline{\mathcal{V}}(q')), 0\right\} - \beta \int_{\underline{\mathcal{V}}(q')}^{\widetilde{\Pi}(q'_f)} \alpha(h, \emptyset, \mu_\pi(\cdot|q)) dF(\pi) \\
=& F\left(\underline{\mathcal{V}}^*(q')\right) - F\left(\frac{1}{2}\right) + \max\left\{F(\Pi^{\emptyset}(q')) - F(1 - \underline{\mathcal{V}}(q')), 0\right\} \\
&- \beta \int_{\underline{\mathcal{V}}(q')}^{\overline{\mathcal{V}}(q')} \alpha(h, \emptyset, \mu_\pi(\cdot|q)) dF(\pi) \\
=& F\left(\frac{1}{2}\right) - F\left(\overline{\mathcal{V}}(q')\right) - \beta \int_{\underline{\mathcal{V}}(q')}^{\overline{\mathcal{V}}(q')} \alpha(h, \emptyset, \mu_\pi(\cdot|q)) dF(\pi).
\end{aligned}$$

where the first equality follows from $\widetilde{\Pi}(q'_f) = \overline{\mathcal{V}}(q') = 1 - \underline{\mathcal{V}}^*(q')$ and the second equality from $\Pi^{\emptyset}(q') < \overline{\mathcal{V}}^*(q')$. Since $\overline{\mathcal{V}}(q_f, 0) \leq \overline{\mathcal{V}}(1, 0) < \frac{1}{2}$ for all $q_f \leq \frac{1}{2}$, there exists $q'' = (q''_f, 0)$ with $q''_f < \frac{1}{2}$ such that

$$0 = F\left(\frac{1}{2}\right) - F\left(\overline{\mathcal{V}}(q'')\right) - \beta \int_{\underline{\mathcal{V}}(q'')}^{\overline{\mathcal{V}}(q'')} \alpha(h, \emptyset, \mu_\pi(\cdot|q)) dF(\pi),$$

i.e., (16) and, by symmetry, (17) hold. Given q'', consumers in turn choose such that $N_0^H(q'') = (\underline{\mathcal{V}}(q''), \frac{1}{2})$ and $N_1^L(q'') = (\frac{1}{2}, \overline{\mathcal{V}}^*(q''))$, which proves the claim.

Third, consider $q_f = 1$ and $q_d \leq \frac{c(2p_1-1)}{1+c(2p_1-1)}$. Then, in particular, $q_d < \frac{c(2-p_0)}{p_0(2p_1-1-c)}$ and thus $\underline{\mathcal{V}}^*(q) > \frac{1}{2}$. Since further $\Pi^{\emptyset,*}(q) = 1 - p_1 < \underline{\mathcal{V}}(q)$, it follows from the proof of Proposition 3 that $N_0^H(q) = \emptyset$ (only cases (b), (e) and (g) are relevant), and analogously $N_1^L(q) = \emptyset$. Thus, q is not part of an equilibrium.

Finally, consider $q_f = 1$ and $q_d > \frac{c(2p_1-1)}{1+c(2p_1-1)}$. It follows from the proof of Proposition 3 that $N_0^H(q) = (\widetilde{\Pi}'(q_d), \frac{1}{2})$ since $\widetilde{\Pi}'(q_d) < \underline{\mathcal{V}}^*(q)$ if and only if $\underline{\mathcal{V}}^*(q) < \frac{1}{2}$ (cases (d) and (e)), where

$$\widetilde{\Pi}'(q_d) = \frac{q_d p_0(1 - p_1) + c\big(1 - p_0 p_1(1 - q_d)\big)}{q_d p_0 - c p_0(2p_1 - 1)(1 - q_d)}.$$

In particular, since $\widetilde{\Pi}'(q_d) < \frac{1}{2}$ if and only if $\overline{\mathcal{V}}(q) > \frac{1}{2}$, we have that $N_0^H(q^*) \neq \emptyset$ if and only if $q_d > \frac{c(2-p_0)}{p_0(2p_1-1-c)}$. Thus, if $\beta < \underline{\beta}_1^c$, then the essentially unique symmetric monotonic equilibrium with the least disinformation is such that $q_f^* = 1 \geq q_d^* > \frac{c(2-p_0)}{p_0(2p_1-1-c)}$, $N_0^H(q^*) = (\widetilde{\Pi}'(q_d^*), \frac{1}{2})$ and, by symmetry, $N_1^L(q^*) = (\frac{1}{2}, 1 - \widetilde{\Pi}'(q_d^*))$. $\square$

Proof of Proposition 5. Suppose that $\beta \geq \underline{\beta}_1^c$, such that in the model with competition the essentially unique monotonic equilibrium with the least disinformation is given by Proposition 4 (i). Let $q^c = (q_L^c, q_H^c)$ denote the firms' strategies in this equilibrium and recall that q^c solves (16) and (17), i.e.,

$$\begin{aligned}
0 =& F\left(\frac{1}{2}\right) - F(\overline{\mathcal{V}}(q_H^c)) - \beta \int_{\underline{\mathcal{V}}(q_H^c)}^{\overline{\mathcal{V}}(q_H^c)} \alpha(h, \emptyset, \mu_\pi(\cdot|q_H^c))dF(\pi), \\
0 =& F(\underline{\mathcal{V}}^*(q_L^c)) - F\left(\frac{1}{2}\right) - \beta \int_{\underline{\mathcal{V}}^*(q_L^c)}^{\overline{\mathcal{V}}^*(q_L^c)} \alpha(l, \emptyset, \mu_\pi(\cdot|q_L^c))dF(\pi).
\end{aligned}$$

Suppose now that in the monopoly model with $\lambda = 1$ the essentially unique monotonic equilibrium with the least disinformation is such that $q^*(\emptyset) > 0 = q^*(l)$ (otherwise the claim follows immediately). By Equation (8),

$$\begin{aligned}
1 - F(\Pi^\emptyset(q^*)) =& 1 - F(\overline{\mathcal{V}}(q^*)) - \beta \int_{\underline{\mathcal{V}}(q^*)}^{\overline{\mathcal{V}}(q^*)} \alpha(h, \emptyset, \mu_\pi(\cdot|q^*))dF(\pi) \\
>& 1 - F(\Pi^\emptyset(q^*)) + F\left(\frac{1}{2}\right) - F(\overline{\mathcal{V}}(q^*)) - \beta \int_{\underline{\mathcal{V}}(q^*)}^{\overline{\mathcal{V}}(q^*)} \alpha(h, \emptyset, \mu_\pi(\cdot|q^*))dF(\pi),
\end{aligned}$$

where the inequality follows from $\Pi^\emptyset(q^*) > \frac{1}{2}$. Analogously to the proof of Proposition 3, there thus exists q' with $q'(\emptyset) < q^*(\emptyset)$ and $q'(l) = q^*(l) = 0$ such that

$$0 = F\left(\frac{1}{2}\right) - F(\overline{\mathcal{V}}(q')) - \beta \int_{\underline{\mathcal{V}}(q')}^{\overline{\mathcal{V}}(q')} \alpha(h, \emptyset, \mu_\pi(\cdot|q'))dF(\pi),$$

i.e., in the model with competition there is an equilibrium such that (q_L^c, q'). Finally, by definition of q^c, we must have $q_H^c(\emptyset) \leq q'(\emptyset)$. $\square$

Proof of Proposition 6. Analogously to the proof of Proposition 3 and Proposition 4, consider the information set that is reached after consumers have chosen which news outlet to follow, where each firm $M \in \mathcal{M}$ learns its total mass of followers $F^M(1)$. By Lemma 3, media firm N communicates truthfully. Suppose now that $H \in \mathcal{M}$ (analogue for L). Recall that, given correct beliefs about F^H, we can treat the remaining game for media firm H as equivalent to the monopoly model with $\lambda = 1$ and the expected distribution of prior beliefs F^H. To ease the exposition, we will again suppress trembles unless they refine equilibria.

Recall further from Proposition 1 that any equilibrium in which H plays q_H is such that all consumers with prior $\pi \in \mathcal{V}(q_H) \subset (1 - p_1, p_1)$ and who observe

$\hat{s}_H = h$ verify it. If $\pi \in \mathcal{V}(q_H)$, then following outlet H implies incurring a cost in expectation while being at most as well informed as when following N. Thus, in equilibrium consumer π will not follow H. Since informative communication requires that a positive mass of consumers follows H and verifies $\hat{s}_H = h$, we obtain $q_H^* = (1, 1)$, which establishes the first part.

Any consumer $\pi \leq 1 - p_1$ will choose action 0 regardless of which firm she follows, and hence follows L if $L \in \mathcal{M}$ and N otherwise by assumption (weak form of confirmation bias). Analogously, any consumer $\pi \geq p_1$ will follow H if $H \in \mathcal{M}$ and N otherwise. Finally, any consumer $\pi \in (1 - p_1, p_1)$ will choose $a_\pi = 0$ if $s = l$ and $a_\pi = 1$ if $s = h$. Thus, the expected utility from following N ($p_0 p_1 + (1 - p_0) \max\{1 - \pi, \pi\}$) exceeds that from following $M \in \{L, H\}$ ($\max\{1 - \pi, \pi\}$). □

B Appendix: Extension to multi-homing

We extend the model with competition introduced in Section 3 to multi-homing, that is, we allow consumers to follow multiple news outlets at a cost. Suppose that following more than one outlet comes at a cost $\tilde{c} > 0$ per additional outlet, e.g., because it is time-consuming to follow multiple outlets. The rest of the game proceeds as before. In particular, the private signal $s \in S$ is identical across all firms $M \in \mathcal{M}$; we can interpret an informative signal $s \in \{l, h\}$ as some event that has happened. We again employ trembling-hand perfect Bayesian equilibrium and incorporate a weak form of confirmation bias (see Section 3 for details).

Note first that Lemma 3 extends to the model with multi-homing, such that media firm H's (L's) strategy will again be characterized by the probabilities $q_H(l)$ and $q_H(\emptyset)$ ($q_L(h)$ and $q_L(\emptyset)$) of distortion and fabrication, respectively, given the possibility to do so. Second, if $N \in \mathcal{M}$, then no consumer will multi-home, because for moderate consumers following the neutral outlet is sufficient to learn the underlying information. In turn, the biased firms' communication is uninformative and partisan consumers with extreme beliefs follow the outlet that conforms to their bias (whenever possible). Thus, Proposition 6 extends to multi-homing.

We now turn to the interesting case of competition between two biased firms, i.e., $\mathcal{M} = \{L, H\}$. We again impose Assumption 2 on verification costs. Recall from Section 3 that under the media firms' strategies $q = (q_L, q_H)$, consumers $\pi \in \mathcal{V}(q_H)$ who follow outlet H verify $\hat{s}_H = h$, and consumers $\pi \in \mathcal{V}^*(q_L)$ who follow outlet L verify $\hat{s}_L = l$. Recall further that $N_0^H(q)$ and $N_1^L(q)$ denote the subsets of consumers who are biased toward the low and high action but choose to follow outlet H and L, respectively, under q. Similarly, let $N_0^{MH}(q) \equiv \{\pi \in [0, \frac{1}{2}) \mid \pi \text{ multi-homes under } q\}$ and $N_1^{MH}(q) \equiv \{\pi \in (\frac{1}{2}, 1] \mid \pi \text{ multi-homes under } q\}$ denote the subsets of consumers who are biased toward the low and high action, respectively, but choose to multi-home under q. We restrict attention to high continuation payoff and relatively high costs of following multiple outlets; the latter reflects that a consumer's attention is scarce.[25]

We show that the essentially unique equilibrium with the least disinformation features low levels of fabrication. Furthermore, a part of the consumers who would follow the outlet that is biased against their belief and verify counter-attitudinal reports under single-homing will multi-home in order to avoid verification.

Proposition 7. *Suppose that $\mathcal{M} = \{L, H\}$. There exists $\underline{\beta}^{mh} > 0$ and $\underline{\tilde{c}}(\beta) > 0$ such that for any $\beta \geq \underline{\beta}_1^{mh}$ and $\tilde{c} > \underline{\tilde{c}}(\beta)$ the essentially unique monotonic equilibrium with the least disinformation q^* is such that $q_L^*(\emptyset) + q_H^*(\emptyset) < 1$ and $q_H^*(l) = q_L^*(h) = 0$. In particular,*

$$N_0^{MH}(q^*) = \big(\widetilde{\Pi}''(q_H^*(\emptyset), q_L^*(\emptyset)), \overline{\mathcal{V}}(q_H^*)\big), N_1^{MH}(q^*) = \big(\underline{\mathcal{V}}^*(q_L^*), 1 - \widetilde{\Pi}''(q_L^*(\emptyset), q_H^*(\emptyset))\big),$$
$$N_0^H(q^*) = \left(\underline{\mathcal{V}}(q_H^*), \frac{1}{2}\right) \Big\backslash N_0^{MH}(q^*), \text{ and } N_1^L(q^*) = \left(\frac{1}{2}, \overline{\mathcal{V}}^*(q_L^*)\right) \Big\backslash N_1^{MH}(q^*),$$

where

$$\widetilde{\Pi}''(q_H^*(\emptyset), q_L^*(\emptyset)) \equiv \frac{(1-p_0)q_H^*(\emptyset)(1-q_L^*(\emptyset)) - c\big((1-p_0)q_H^*(\emptyset) + p_0\,(1-p_1)\big) + \tilde{c}}{2(1-p_0)q_H^*(\emptyset)(1-q_L^*(\emptyset)) + cp_0\,(2p_1-1)}.$$

Proof. Analogously to the proof of Proposition 3 and Proposition 4, consider media firm H (analogue for L) and the information set that is reached after consumers have chosen which news outlets to follow, where each firm $M \in \mathcal{M}$ learns its total mass of followers $F^M(1)$. Given correct beliefs about F^H and F^L, we let $\tilde{F}^H$ and $\tilde{F}^{MH}$ denote the implied distributions of consumers who follow only H and multi-home, respectively; since F is strictly increasing, so are $\tilde{F}^H$ and $\tilde{F}^{MH}$ if consumers employ completely mixed strategies. To ease the exposition, we will again suppress trembles unless they refine equilibria.

Suppose now that $q = (q) \in Q_1 = \{q' = (q'_L, q'_H) \mid q'_H(\emptyset) < 1 - q'_L(\emptyset), q'_H(l) = q'_L(h) = 0\}$. Recall first that a consumer π who follows only H verifies $\hat{s}_H = h$ if $\pi \in \mathcal{V}(q_H) \subset \big(1 - p_1, \frac{1}{2}\big)$, and that she is indifferent between the two actions upon

[25] We briefly discuss how the results would change with lower costs of following multiple outlets in Section 4.

receiving report $\hat{s}_H = \emptyset$ if $\pi = \Pi^{\emptyset}(q_H)$. Second, a consumer π who follows only L verifies $\hat{s}_L = l$ if $\pi \in \mathcal{V}^*(q_L) \subset \left(\frac{1}{2}, p_1\right)$, and is indifferent between the two actions upon receiving report $\hat{s}_H = \emptyset$ if $\pi = \Pi^{\emptyset,*}(q_L)$. Third, consider a consumer π who multi-homes. We proceed by case distinction with respect to the outlets' reports:

(a) $\hat{s}_H = h$ and $\hat{s}_L = l$. The consumer will conclude that $s = \emptyset$ (since otherwise at least one of the outlets would be expected to report an empty signal).

(b) $\hat{s}_H = h$ and $\hat{s}_L = \emptyset$. The consumer can only rule out $s = l$, and may hence verify $\hat{s}_H = h$. The consumer's posterior belief is

$$\begin{aligned}\mu_\pi(\hat{s}_H = h, \hat{s}_L = \emptyset|q) =& Pr_\pi(\theta = 1 \mid \hat{s}_H = h, \hat{s}_L = \emptyset) \\ =& \frac{Pr_\pi(\hat{s}_H = h, \hat{s}_L = \emptyset \mid \theta = 1) Pr_\pi(\theta = 1)}{Pr_\pi(\hat{s}_H = h, \hat{s}_L = \emptyset)} \\ =& \frac{((1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + p_0 p_1)\,\pi}{(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + p_0\,(\pi p_1 + (1-\pi)(1-p_1))}.\end{aligned}$$

Note that the only difference to the case without multi-homing is that, conditional on $s = \emptyset$, the event that may yield to verification is less likely to occur, now also requiring that outlet L does not fabricate a low signal. The verification interval thus obtains by substituting $q_H(\emptyset)(1 - q_L(\emptyset))$ for $q_H(\emptyset)$, i.e., consumers with prior in $\mathcal{V}_{MH}(q) \subset \left(1 - p_1, \frac{1}{2}\right)$ verify $\hat{s}_H = h$ (conditional on $\hat{s}_L = \emptyset$), where

$$\underline{\mathcal{V}}_{MH}(q) = \frac{c(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + (1+c)p_0(1-p_1)}{p_0\,(1 - c(2p_1 - 1))}$$

and

$$\overline{\mathcal{V}}_{MH}(q) = \frac{(1-p_0)q_H(\emptyset)(1-q_L(\emptyset))(1-c) - cp_0(1-p_1)}{2(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + cp_0(2p_1-1)}.$$

(c) $\hat{s}_H = \emptyset$ and $\hat{s}_L = \emptyset$. Similarly to case (a), the consumer will conclude that $s = \emptyset$.

(d) $\hat{s}_H = \emptyset$ and $\hat{s}_L = l$. Analogously to case (b), consumers with prior in $\mathcal{V}^*_{MH}(q) \subset \left(\frac{1}{2}, p_1\right)$ verify $\hat{s}_L = l$ (conditional on $\hat{s}_H = \emptyset$), where

$$\underline{\mathcal{V}}^*_{MH}(q) = \frac{(1-p_0)q_L(\emptyset)(1-q_H(\emptyset))(1+c) + cp_0 p_1}{2(1-p_0)q_L(\emptyset)(1-q_H(\emptyset)) + cp_0(2p_1-1)}$$

and

$$\overline{\mathcal{V}}^*_{MH}(q) = \frac{(1-c)p_0p_1 - c(1-p_0)q_L(\emptyset)(1-q_H(\emptyset)))}{p_0\,(1-c(2p_1-1))}.$$

Next, we determine the consumers' choices which news outlet to follow. Consider without loss of generality $\pi < \frac{1}{2}$ and recall that in this case the consumer prefers media firm H over L if and only if $\pi > \underline{\mathcal{V}}(q_H)$. Note further that $\underline{\mathcal{V}}_{MH}(q) < \underline{\mathcal{V}}(q_H) < \Pi^{\emptyset,*}(q_L)$ (the latter inequality holds since $q \in Q_1$) and $\overline{\mathcal{V}}_{MH}(q) < \overline{\mathcal{V}}(q_H)$. We proceed by case distinction (ignoring knife-edge priors):

(a) $\overline{\mathcal{V}}(q_H) < \pi < \frac{1}{2}$. Note that in this case π prefers media firm H over L. Expected utility from following outlet H is given by (10). As in this case the consumer would not verify $\hat{s}_H = h$ conditional on $\hat{s}_L = \emptyset$, expected utility from multi-homing is

$$\begin{aligned}
&Pr_\pi(\hat{s}_H = h, \hat{s}_L = \emptyset)Pr_\pi(\theta = 1 \mid \hat{s}_H = h, \hat{s}_L = \emptyset) \\
&\quad + Pr_\pi(\hat{s}_H = h, \hat{s}_L = l)Pr_\pi(\theta = 0 \mid \hat{s}_H = h, \hat{s}_L = l) \\
&\quad + Pr_\pi(\hat{s}_H = \emptyset, \hat{s}_L = \emptyset)Pr_\pi(\theta = 0 \mid \hat{s}_H = \emptyset, \hat{s}_L = \emptyset) - \tilde{c} \\
&\quad + Pr_\pi(\hat{s}_H = \emptyset, \hat{s}_L = l)Pr_\pi(\theta = 0 \mid \hat{s}_H = \emptyset, \hat{s}_L = l) \\
=&Pr_\pi(\hat{s}_H = h, \hat{s}_L = \emptyset \mid \theta = 1)Pr_\pi(\theta = 1) + \Big(Pr_\pi(\hat{s}_H = h, \hat{s}_L = l \mid \theta = 0) \\
&\quad + Pr_\pi(\hat{s}_H = \emptyset, \hat{s}_L = \emptyset \mid \theta = 0) + Pr_\pi(\hat{s}_H = \emptyset, \hat{s}_L = l \mid \theta = 0)\Big)Pr_\pi(\theta = 0) - \tilde{c} \\
=&(p_0p_1 + (1-p_0)q_H(\emptyset)(1-q_L(\emptyset)))\pi + \Big((1-p_0)(1-q_H(\emptyset)(1-q_L(\emptyset))) \\
&\quad + p_0p_1\Big)(1-\pi) - \tilde{c} \\
=&p_0p_1 + (1-p_0)(1-\pi) - (1-p_0)q_H(\emptyset)(1-q_L(\emptyset))(1-2\pi) - \tilde{c}.
\end{aligned} \tag{21}$$

Hence, the consumer prefers media firm H to multi-homing if

$$\begin{aligned}
&p_0p_1 + (1-p_0)\left(q_H(\emptyset)\pi + (1-q_H(\emptyset))(1-\pi)\right) \\
&\quad > p_0p_1 + (1-p_0)(1-\pi) - (1-p_0)q_H(\emptyset)(1-q_L(\emptyset))(1-2\pi) - \tilde{c} \\
\Leftrightarrow &2\pi(1-p_0)q_H(\emptyset)q_L(\emptyset) > (1-p_0)q_H(\emptyset)q_L(\emptyset) - \tilde{c} \\
\Leftrightarrow &\pi > \frac{(1-p_0)q_H(\emptyset)q_L(\emptyset) - \tilde{c}}{2(1-p_0)q_H(\emptyset)q_L(\emptyset)} \equiv \check{\Pi}^{(iv)}(q_H(\emptyset), q_L(\emptyset)).
\end{aligned}$$

Note that $\check{\Pi}^{(iv)}(q_H(\emptyset), q_L(\emptyset)) < \overline{\mathcal{V}}(q_H)$ if

$$\check{\Pi}^{(iv)}(q_H(\emptyset), q_L(\emptyset)) < \hat{\Pi}^v(q_H) = \frac{(1-p_0)q_H(\emptyset) + p_0(1-p_1)}{2(1-p_0)q_H(\emptyset) + p_0}(< \overline{\mathcal{V}}(q_H)),^{26}$$

which is equivalent to

$$\tilde{c} > \frac{p_0(1-p_0)(2p_1-1)q_H(\emptyset)q_L(\emptyset)}{2(1-p_0)q_H(\emptyset) + p_0}. \tag{22}$$

Note that by Assumption 2, (22) implies $\tilde{c} > c(1-p_0)q_H(\emptyset)q_L(\emptyset)$.

(b) $\max\{\overline{\mathcal{V}}_{MH}(q), \underline{\mathcal{V}}(q_H)\} < \pi < \overline{\mathcal{V}}(q_H)$. As in case (a), π prefers media firm H over L and expected utility from multi-homing is given by (21). As in this case the consumer would verify $\hat{s}_H = h$ conditional on not observing $\hat{s}_L$, expected utility from following media firm H is given by (12). Hence, the consumer prefers media firm H to multi-homing if

$$\begin{aligned}
&p_0p_1 + (1-p_0)(1-\pi) - c\big((1-p_0)q_H(\emptyset) + p_0\left(p_1\pi + (1-p_1)(1-\pi)\right)\big)\\
&\quad > p_0p_1 + (1-p_0)(1-\pi) - (1-p_0)q_H(\emptyset)(1-q_L(\emptyset))(1-2\pi) - \tilde{c}\\
\Leftrightarrow &(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) - c\big((1-p_0)q_H(\emptyset) + p_0\left(1-p_1\right)\big)\\
&\quad > 2\pi(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + c\pi p_0\left(2p_1-1\right) - \tilde{c}\\
\Leftrightarrow &\pi < \frac{(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) - c\big((1-p_0)q_H(\emptyset) + p_0\left(1-p_1\right)\big) + \tilde{c}}{2(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + cp_0\left(2p_1-1\right)}\\
&\quad \equiv \widetilde{\Pi}''(q_H(\emptyset), q_L(\emptyset)).
\end{aligned}$$

Note first that $\widetilde{\Pi}''(q_H(\emptyset), q_L(\emptyset)) > \overline{\mathcal{V}}_{MH}(q) \Leftrightarrow \tilde{c} > c(1-p_0)q_H(\emptyset)q_L(\emptyset)$. Second,

$$\begin{aligned}
&\widetilde{\Pi}''(q_H(\emptyset), q_L(\emptyset)) > \underline{\mathcal{V}}(q_H)\\
\Leftrightarrow &\frac{(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) - c\big((1-p_0)q_H(\emptyset) + p_0\left(1-p_1\right)\big) + \tilde{c}}{2(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + cp_0\left(2p_1-1\right)}\\
&\quad > \frac{c(1-p_0)q_H(\emptyset) + (1+c)p_0(1-p_1)}{p_0\left(1-c(2p_1-1)\right)}\\
\Leftrightarrow &\tilde{c}p_0\left(1-c(2p_1-1)\right) > c\Big[2(1-p_0)^2q_H(\emptyset)^2(1-q_L(\emptyset)) + 2p_0^2p_1(1-p_1)\\
&\qquad + p_0(1-p_0)q_H(\emptyset)(2-q_L(\emptyset))\Big] - p_0(1-p_0)(2p_1-1)q_H(\emptyset)(1-q_L(\emptyset))\\
\Leftrightarrow &\tilde{c} > \frac{\begin{array}{l} c\big[(1-p_0)q_H(\emptyset)(2(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + p_0(2-q_L(\emptyset)))\\ \quad + 2p_0^2p_1(1-p_1)\big] - p_0(1-p_0)(2p_1-1)q_H(\emptyset)(1-q_L(\emptyset))\end{array}}{p_0\left(1-c(2p_1-1)\right)}.
\end{aligned} \tag{23}$$

[26] See the proof of Proposition 1 for details on $\hat{\Pi}^v(q_H)$.

(c) $\underline{\mathcal{V}}(q_H) < \pi < \overline{\mathcal{V}}_{MH}(q)$. As in case (b), π prefers media firm H over L and expected utility from following media firm H is given by (12). As in this case the consumer would verify $\hat{s}_H = h$ conditional on $\hat{s}_L = \emptyset$, expected utility from multi-homing is

$$\begin{aligned}
&Pr_\pi(\hat{s}_H = h, \hat{s}_L = \emptyset)\Big(Pr_\pi(s = \emptyset \mid \hat{s}_H = h, \hat{s}_L = \emptyset)Pr_\pi(\theta = 0 \mid s = \emptyset)\\
&\quad + Pr_\pi(s = h \mid \hat{s}_H = h, \hat{s}_L = \emptyset)Pr_\pi(\theta = 1 \mid s = h) - c\Big)\\
&\quad + Pr_\pi(\hat{s}_H = h, \hat{s}_L = l)Pr_\pi(\theta = 0 \mid \hat{s}_H = h, \hat{s}_L = l)\\
&\quad + Pr_\pi(\hat{s}_H = \emptyset, \hat{s}_L = \emptyset)Pr_\pi(\theta = 0 \mid \hat{s}_H = \emptyset, \hat{s}_L = \emptyset)\\
&\quad + Pr_\pi(\hat{s}_H = \emptyset, \hat{s}_L = l)Pr_\pi(\theta = 0 \mid \hat{s}_H = \emptyset, \hat{s}_L = l) - \tilde{c}\\
=&Pr_\pi(\hat{s}_H = h, \hat{s}_L = \emptyset \mid s = \emptyset)Pr_\pi(s = \emptyset \mid \theta = 0)Pr_\pi(\theta = 0)\\
&\quad + Pr_\pi(\hat{s}_H = h, \hat{s}_L = \emptyset \mid s = h)Pr_\pi(s = h \mid \theta = 1)Pr_\pi(\theta = 1)\\
&\quad - cPr_\pi(\hat{s}_H = h, \hat{s}_L = \emptyset) + \Big(Pr_\pi(\hat{s}_H = h, \hat{s}_L = l \mid \theta = 0)\\
&\quad + Pr_\pi(\hat{s}_H = \emptyset, \hat{s}_L = \emptyset \mid \theta = 0) + Pr_\pi(\hat{s}_H = \emptyset, \hat{s}_L = l \mid \theta = 0)\Big)Pr_\pi(\theta = 0) - \tilde{c}\\
=&(1 - p_0)q_H(\emptyset)(1 - q_L(\emptyset))(1 - \pi) + p_0p_1\pi - c\big((1 - p_0)q_H(\emptyset)(1 - q_L(\emptyset))\\
&\quad + p_0\left(p_1\pi + (1 - p_1)(1 - \pi)\right)\big) + \big((1 - p_0)(1 - q_H(\emptyset)(1 - q_L(\emptyset)))\\
&\quad + p_0p_1\big)(1 - \pi) - \tilde{c}\\
=&p_0p_1 + (1 - p_0)(1 - \pi)\\
&\quad - c\big((1 - p_0)q_H(\emptyset)(1 - q_L(\emptyset)) + p_0\left(p_1\pi + (1 - p_1)(1 - \pi)\right)\big) - \tilde{c}.
\end{aligned} \tag{24}$$

Hence, the consumer prefers media firm H to multi-homing if and only if

$$\begin{aligned}
&p_0p_1 + (1 - p_0)(1 - \pi) - c\big((1 - p_0)q_H(\emptyset) + p_0\left(p_1\pi + (1 - p_1)(1 - \pi)\right)\big)\\
&\quad > p_0p_1 + (1 - p_0)(1 - \pi)\\
&\qquad - c\big((1 - p_0)q_H(\emptyset)(1 - q_L(\emptyset)) + p_0\left(p_1\pi + (1 - p_1)(1 - \pi)\right)\big) - \tilde{c}\\
&\Leftrightarrow \tilde{c} > c(1 - p_0)q_H(\emptyset)q_L(\emptyset).
\end{aligned}$$

(d) $\overline{\mathcal{V}}_{MH}(q) < \pi < \underline{\mathcal{V}}(q_H)$. Note that in this case π prefers L over H. Expected utility from following outlet L is $1 - \pi$ since $\pi < \underline{\mathcal{V}}(q_H) < \Pi^{\emptyset,*}(q_L)$, while that from multi-homing is given by (21). Hence, the consumer prefers media firm L to multi-homing if and only if

$$1 - \pi > p_0p_1 + (1 - p_0)\big(q_H(\emptyset)(1 - q_L(\emptyset))\pi + (1 - q_H(\emptyset)(1 - q_L(\emptyset)))(1 - \pi)\big) - \tilde{c}$$

$$\Leftrightarrow \pi < \frac{(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + p_0(1-p_1) + \tilde{c}}{2(1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + p_0} \equiv \check{\Pi}^{(v)}.$$

Analogously to case (a), $\check{\Pi}^{(v)}(q_H(\emptyset), q_L(\emptyset)) > \underline{\mathcal{V}}(q_H)$ if $\check{\Pi}^{(v)}(q_H(\emptyset), q_L(\emptyset)) > \hat{\Pi}^v(q_H)$, which is equivalent to (22).

(e) $\underline{\mathcal{V}}_{MH}(q) < \pi < \min\{\overline{\mathcal{V}}_{MH}(q), \underline{\mathcal{V}}(q_H)\}$. As in case (d), π prefers L over H and expected utility from following outlet L is $1-\pi$, while that from multi-homing in this case is given by (24). Hence, the consumer prefers media firm L to multi-homing if and only if

$$\begin{aligned}
&1-\pi > p_0p_1 + (1-p_0)(1-\pi) \\
&\quad - c\big((1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + p_0\left(p_1\pi + (1-p_1)(1-\pi)\right)\big) - \tilde{c} \\
&\Leftrightarrow \pi p_0(1-c(2p_1-1)) < p_0(1-p_1) \\
&\quad + c\big((1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + p_0\left(1-p_1\right)\big) + \tilde{c} \\
&\Leftrightarrow \pi < \frac{p_0(1-p_1) + c\big((1-p_0)q_H(\emptyset)(1-q_L(\emptyset)) + p_0\left(1-p_1\right)\big) + \tilde{c}}{p_0(1-c(2p_1-1))} \equiv \check{\Pi}^{(vi)}(q_H(\emptyset), q_L(\emptyset)).
\end{aligned}$$

Note that $\check{\Pi}^{(vi)}(q_H(\emptyset), q_L(\emptyset)) > \underline{\mathcal{V}}(q_H) \Leftrightarrow \tilde{c} > c(1-p_0)q_H(\emptyset)q_L(\emptyset)$.

(f) $\pi < \underline{\mathcal{V}}_{MH}(q)$. Expected utility is $1-\pi$ in all three cases. In particular, she will choose action zero regardless of which firm she follows even after slightly perturbing the firms' strategies, such that the consumer chooses media firm L by assumption (weak form of confirmation bias).

Suppose now that (22) and (23) hold. Then, up to a null set under F (since we have, for simplicity, ignored knife-edge priors) consumers

$$\pi \in N_0^H(q) = \underbrace{\left(\underline{\mathcal{V}}(q_H), \min\left\{\widetilde{\Pi}''(q_H(\emptyset), q_L(\emptyset)), \overline{\mathcal{V}}(q_H)\right\}\right)}_{\neq\emptyset \text{ by (23), verify } \hat{s}_H = h} \cup \left(\overline{\mathcal{V}}(q_H), \frac{1}{2}\right)$$

follow media firm H (case (a), (b) and (c)), consumers

$$\pi \in N_0^{MH}(q) = \left(\widetilde{\Pi}''(q_H(\emptyset), q_L(\emptyset)), \overline{\mathcal{V}}(q_H)\right)$$

multi-home (case (b)), while consumers $\pi < \underline{\mathcal{V}}(q_H)$ follow media firm L (case (d) and (e)). Analogously, we obtain

$$N_1^L(q) = (\frac{1}{2}, \underline{\mathcal{V}}^*(q_L)) \cup \underbrace{\left(\max\left\{1 - \widetilde{\Pi}''(q_L(\emptyset), q_H(\emptyset)), \underline{\mathcal{V}}^*(q_L)\right\}, \overline{\mathcal{V}}^*(q_L)\right)}_{\neq\emptyset \text{ by (23), verify } \hat{s}_L = l}$$

and

$$N_1^{MH}(q) = \left(\underline{\mathcal{V}}^*(q_L), 1 - \widetilde{\Pi}''(q_L(\emptyset), q_H(\emptyset))\right).$$

In a third step, we characterize equilibria in which $q \in Q_1$. Recall from the proof of Proposition 3 and Proposition 4 that, by Assumption 2, there exists $\underline{q}(\emptyset) \in [0, \frac{1}{2})$ such that $\mathcal{V}(q_H) \neq \emptyset$ if and only if $q_H(\emptyset) > \underline{q}(\emptyset)$ and, by symmetry, $\mathcal{V}^*(q_L) \neq \emptyset$ if and only if $q_L(\emptyset) > \underline{q}(\emptyset)$.

Thus, media firm H is indifferent between $\hat{s}_H = \emptyset$ and $\hat{s}_H = h$ in case $s = \emptyset$ if and only if

$$\begin{aligned}
&1 - \tilde{F}^H(\Pi^\emptyset(q_H)) + q_L(\emptyset)\left(1 - \tilde{F}^{MH}(\underline{\mathcal{V}}^*_{MH}(q))\right) + (1 - q_L(\emptyset))\left(1 - \tilde{F}^{MH}\left(\frac{1}{2}\right)\right) \\
=&1 - \tilde{F}^H(\overline{\mathcal{V}}(q_H)) - \beta \int_{\underline{\mathcal{V}}(q_H)}^{\overline{\mathcal{V}}(q_H)} \alpha(h, \emptyset, \mu_\pi(\cdot|q_H)) d\tilde{F}^H(\pi) + q_L(\emptyset)\left(1 - \tilde{F}^{MH}\left(\frac{1}{2}\right)\right) \\
&+ (1 - q_L(\emptyset))\left(1 - \tilde{F}^{MH}(\overline{\mathcal{V}}_{MH}(q)) - \beta \int_{\underline{\mathcal{V}}_{MH}(q)}^{\overline{\mathcal{V}}_{MH}(q)} \alpha(h, \emptyset, \mu_\pi(\cdot|q)) d\tilde{F}^{MH}(\pi)\right)
\end{aligned} \tag{25}$$

and media firm L is indifferent between $\hat{s}_L = \emptyset$ and $\hat{s}_L = l$ in case $s = \emptyset$ if and only if

$$\begin{aligned}
&\tilde{F}^L(\Pi^{\emptyset,*}(q_L)) + q_H(\emptyset)\tilde{F}^{MH}(\overline{\mathcal{V}}_{MH}(q)) + (1 - q_H(\emptyset))\tilde{F}^{MH}\left(\frac{1}{2}\right) \\
=&\tilde{F}^L(\underline{\mathcal{V}}^*(q_L)) - \beta \int_{\underline{\mathcal{V}}^*(q_L)}^{\overline{\mathcal{V}}^*(q_L)} \alpha(l, \emptyset, \mu_\pi(\cdot|q_L)) d\tilde{F}^L(\pi) + q_H(\emptyset)\tilde{F}^{MH}\left(\frac{1}{2}\right) \\
&+ (1 - q_H(\emptyset))\left(\tilde{F}^{MH}(\underline{\mathcal{V}}^*_{MH}(q)) - \beta \int_{\underline{\mathcal{V}}^*_{MH}(q)}^{\overline{\mathcal{V}}^*_{MH}(q)} \alpha(l, \emptyset, \mu_\pi(\cdot|q)) d\tilde{F}^{MH}(\pi)\right).
\end{aligned} \tag{26}$$

Recall that we have $\underline{\mathcal{V}}(q_H) < \Pi^{\emptyset,*}(q_L)$ and $\overline{\mathcal{V}}^*(q_L) > \Pi^\emptyset(q_H)$ as $q \in Q_1$. Note further that $\pi \in N_0^{MH}(q)$ implies $\pi > \overline{\mathcal{V}}_{MH}(q)$, such all consumers who multi-home take action 1 without verification upon $\hat{s}_H = h$ and $\hat{s}_L = \emptyset$. By symmetry, all consumers who multi-home take action 0 without verification upon $\hat{s}_H = \emptyset$ and

$\hat{s}_L = l$. Thus, (25) and (26) are equivalent to

$$\begin{aligned}
0 =& F\left(\frac{1}{2}\right) - F(\overline{\mathcal{V}}(q_H)) - \beta \int_{\underline{\mathcal{V}}(q_H)}^{\min\left\{\widetilde{\Pi}''(q_H(\emptyset), q_L(\emptyset)), \overline{\mathcal{V}}(q_H)\right\}} \alpha(h, \emptyset, \mu_\pi(\cdot|q_H)) dF(\pi) \\
&+ (1 - q_L(\emptyset)) \left(F\left(\overline{\mathcal{V}}(q_H)\right) - F\left(\min\left\{\widetilde{\Pi}''(q_H(\emptyset), q_L(\emptyset)), \overline{\mathcal{V}}(q_H)\right\}\right)\right) \\
&+ q_L(\emptyset)\left(F\left(\max\left\{1 - \widetilde{\Pi}''(q_L(\emptyset), q_H(\emptyset)), \underline{\mathcal{V}}^*(q_L)\right\}\right) - F\left(\underline{\mathcal{V}}^*(q_L)\right)\right),
\end{aligned} \tag{27}$$

$$\begin{aligned}
0 =& F(\underline{\mathcal{V}}^*(q_L)) - F\left(\frac{1}{2}\right) - \beta \int_{\max\left\{1-\widetilde{\Pi}''(q_L(\emptyset), q_H(\emptyset)), \underline{\mathcal{V}}^*(q_L)\right\}}^{\overline{\mathcal{V}}^*(q_L)} \alpha(l, \emptyset, \mu_\pi(\cdot|q_L)) dF(\pi) \\
&+ (1 - q_H(\emptyset)) \left(F\left(\max\left\{1 - \widetilde{\Pi}''(q_L(\emptyset), q_H(\emptyset)), \underline{\mathcal{V}}^*(q_L)\right\}\right) - F\left(\underline{\mathcal{V}}^*(q_L)\right)\right) \\
&+ q_H(\emptyset)\left(F\left(\overline{\mathcal{V}}(q_H)\right) - F\left(\min\left\{\widetilde{\Pi}''(q_H(\emptyset), q_L(\emptyset)), \overline{\mathcal{V}}(q_H)\right\}\right)\right).
\end{aligned} \tag{28}$$

Recall that $\overline{\mathcal{V}}(q_H) \leq \overline{\mathcal{V}}(1,0) < \frac{1}{2}$, $\underline{\mathcal{V}}^*(q_L) \geq \underline{\mathcal{V}}^*(1,0) > \frac{1}{2}$, and that we had assumed that (22) and (23) hold. Ignoring the knife-edge case where (27) and (28) hold for $q_H(\emptyset) = 1 - q_L(\emptyset)$ and $q_H(l) = q_L(h) = 0$, there thus exists $\underline{\beta}_1^{mh} > 0$ such that for any $\beta \geq \underline{\beta}_1^{mh}$ there exists $\underline{\tilde{c}}(\beta) > 0$ such that for any $\tilde{c} > \underline{\tilde{c}}(\beta)$ there exists $q \in Q_1$ such that (22), (23), (27) and (28) hold. In particular, we can choose $\underline{\tilde{c}}(\beta)$ with respect to the solution $q \in Q_1$ to (27) and (28) with the least disinformation. Second, $q_H(l) = q_L(h) = 0$ then is optimal by Lemma 2. □

Compared to Proposition 4 (i), less consumers follow outlet H (L) and verify high (low) reports. Instead, the more moderate consumers in $\mathcal{V}(q_H)$ and $\mathcal{V}^*(q_L)$ multi-home and thereby avoid verification. To see why, consider a consumer who is biased toward the low action and recall that for this consumer the only relevant information is whether the signal is high or not. Following outlet H and verifying high reports is thus more informative in this respect than multi-homing, where "$\hat{s}_H = h, \hat{s}_L = \emptyset$" induces the consumer to choose the high action although it is possible that $s = \emptyset$. Now, since the expected probability of verification under single-homing increases in the prior while the expected loss from wrongly choosing the high action under multi-homing decreases in the prior, it is the more moderate consumers in $\mathcal{V}(q_H)$ who will multi-home.

We now briefly discuss the prevalence of multi-homing. First, conditional on $\hat{s}_H = h$, $\hat{s}_L = \emptyset$ is likely to occur if the level of fabrication is low, as $\hat{s}_H = h$ precludes $s = l$. Thus, in this case multi-homing is not particularly attractive. Second, clearly no consumer will multi-home if it is too costly to do so, since $\widetilde{\Pi}''(q_H(\emptyset), q_L(\emptyset))$ is increasing in $\tilde{c}$; in this case, Proposition 4 (i) obtains. The following example illustrates these findings, showing that only few consumers multi-home even if the costs of doing so are relatively low compared to those of verification.

Example 5. *Suppose that $\mathcal{M} = \{L, H\}$, $F = \mathcal{U}(0,1)$, $\alpha(\cdot) = \alpha^{\Delta}(\cdot)$, $p_0 = \frac{1}{2}$, $p_1 = 1$, and $c = \frac{1}{5}$. If further $\beta = 4$ and $\tilde{c} = \frac{1}{500} > \underline{\tilde{c}}(4) \approx 0.0014$, then the essentially unique symmetric monotonic equilibrium with the least disinformation q^* is such that $q_f^* \approx 0.118 > 0 = q_d^*$, see Figure 6 for an illustration of $N_0^{MH}(q^*)$ and $N_0^H(q^*)$.*

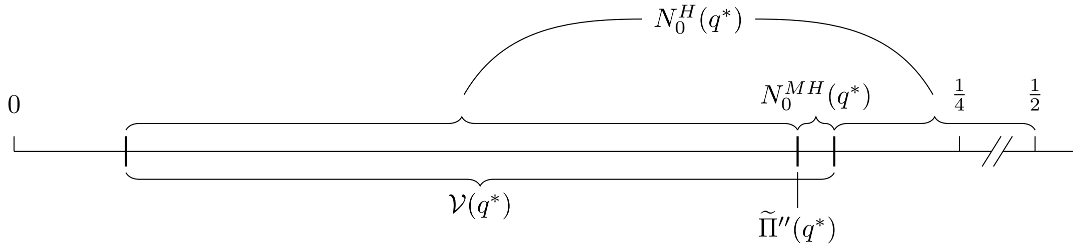

Figure 6: Subsets of consumers $N_0^{MH}(q^*)$ and $N_0^H(q^*)$ who are biased toward the low action and choose to multi-home and to follow outlet H, respectively, for $\beta = 4$ in Example 5.

Note that introducing multi-homing has increased disinformation in Example 5 as compared to Example 3. The reason is that now some consumers choose to multi-home in order to avoid verification. This makes fabrication more beneficial because it not only decreases the subsequent loss from verification but also increases the expected share of consumers who are persuaded into taking a firm's preferred action. Finally, we show that this result generally holds under the conditions in Proposition 7:

Proposition 8. *Introducing multi-homing to the model with $\mathcal{M} = \{L, H\}$ weakly (strictly) increases disinformation associated with each media firm in the essentially unique monotonic equilibrium with the least disinformation if $\beta \geq \underline{\beta}_1^{mh}$ and $\tilde{c} > \underline{\tilde{c}}(\beta)$ (and a positive mass of consumers multi-homes).*

Proof. Suppose that $\beta \geq \underline{\beta}_1^{mh}$ and $\tilde{c} > \underline{\tilde{c}}(\beta)$, such that in the model with $\mathcal{M} = \{L, H\}$ and multi-homing the essentially unique monotonic equilibrium with the least disinformation is given by Proposition 7. Let $q^{mh} = (q_L^{mh}, q_H^{mh})$ denote the firms' strategies in this equilibrium and recall that q^{mh} solves (27) and (28). We thus have

$$
\begin{aligned}
0 =& F\left(\frac{1}{2}\right) - F(\overline{\mathcal{V}}(q_H^{mh})) - \beta \int_{\underline{\mathcal{V}}(q_H^{mh})}^{\min\left\{\widetilde{\Pi}''(q_H^{mh}(\emptyset), q_L^{mh}(\emptyset)), \overline{\mathcal{V}}(q_H^{mh})\right\}} \alpha(h, \emptyset, \mu_\pi(\cdot | q_H^{mh})) dF(\pi) \\
&+ (1 - q_L^{mh}(\emptyset)) \left(F\left(\overline{\mathcal{V}}(q_H^{mh})\right) - F\left(\min\left\{\widetilde{\Pi}''(q_H^{mh}(\emptyset), q_L^{mh}(\emptyset)), \overline{\mathcal{V}}(q_H^{mh})\right\}\right)\right) \\
&+ q_L^{mh}(\emptyset) \left(F\left(\max\left\{1 - \widetilde{\Pi}''(q_L^{mh}(\emptyset), q_H^{mh}(\emptyset)), \underline{\mathcal{V}}^*(q_L^{mh})\right\}\right) - F\left(\underline{\mathcal{V}}^*(q_L^{mh})\right)\right) \\
\geq & \left(\frac{1}{2}\right) - F(\overline{\mathcal{V}}(q_H^{mh})) - \beta \int_{\underline{\mathcal{V}}(q_H^{mh})}^{\overline{\mathcal{V}}(q_H^{mh})} \alpha(h, \emptyset, \mu_\pi(\cdot | q_H^{mh})) dF(\pi),
\end{aligned}
\tag{29}
$$

$$
\begin{aligned}
0 =& F(\underline{\mathcal{V}}^*(q_L^{mh})) - F\left(\frac{1}{2}\right) - \beta \int_{\max\left\{1 - \widetilde{\Pi}''(q_L^{mh}(\emptyset), q_H^{mh}(\emptyset)), \underline{\mathcal{V}}^*(q_L^{mh})\right\}}^{\overline{\mathcal{V}}^*(q_L^{mh})} \alpha(l, \emptyset, \mu_\pi(\cdot | q_L^{mh})) dF(\pi) \\
&+ (1 - q_H^{mh}(\emptyset)) \left(F\left(\max\left\{1 - \widetilde{\Pi}''(q_L^{mh}(\emptyset), q_H^{mh}(\emptyset)), \underline{\mathcal{V}}^*(q_L^{mh})\right\}\right) - F\left(\underline{\mathcal{V}}^*(q_L^{mh})\right)\right) \\
&+ q_H^{mh}(\emptyset) \left(F\left(\overline{\mathcal{V}}(q_H^{mh})\right) - F\left(\min\left\{\widetilde{\Pi}''(q_H^{mh}(\emptyset), q_L^{mh}(\emptyset)), \overline{\mathcal{V}}(q_H^{mh})\right\}\right)\right) \\
\geq & F(\underline{\mathcal{V}}^*(q_L^{mh})) - F\left(\frac{1}{2}\right) - \beta \int_{\underline{\mathcal{V}}^*(q_L^{mh})}^{\overline{\mathcal{V}}^*(q_L^{mh})} \alpha(l, \emptyset, \mu_\pi(\cdot | q_L^{mh})) dF(\pi).
\end{aligned}
\tag{30}
$$

Note that the inequalities (29) and (30) are strict if and only if either

$$\widetilde{\Pi}''(q_H^{mh}(\emptyset), q_L^{mh}(\emptyset)) < \overline{\mathcal{V}}(q_H^{mh}) \text{ or } 1 - \widetilde{\Pi}''(q_L^{mh}(\emptyset), q_H^{mh}(\emptyset)) > \underline{\mathcal{V}}^*(q_L^{mh}),$$

i.e., if and only if a positive mass of consumers multi-homes. Analogously to the proof of Proposition 3, there thus exists $q^c = (q_L^c, q_H^c)$ with $q_M^c(\emptyset) \leq q_M^{mh}(\emptyset)$ and $q_M^c(l) = q_M^{mh}(l) = 0$ for all $M \in \mathcal{M}$ such that

$$
\begin{aligned}
0 =& F\left(\frac{1}{2}\right) - F(\overline{\mathcal{V}}(q_H^c)) - \beta \int_{\underline{\mathcal{V}}(q_H^c)}^{\overline{\mathcal{V}}(q_H^c)} \alpha(h, \emptyset, \mu_\pi(\cdot | q_H^c)) dF(\pi), \\
0 =& F(\underline{\mathcal{V}}^*(q_L^c)) - F\left(\frac{1}{2}\right) - \beta \int_{\underline{\mathcal{V}}^*(q_L^c)}^{\overline{\mathcal{V}}^*(q_L^c)} \alpha(l, \emptyset, \mu_\pi(\cdot | q_L^c)) dF(\pi).
\end{aligned}
$$

i.e., by (16) and (17) q^c is an equilibrium in the model without multi-homing; in particular, $q_M^c(\emptyset) < q_M^{mh}(\emptyset)$ for all $M \in \mathcal{M}$ if and only if a positive mass of consumers multi-homes. □

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