Primetime Spin:

Media Bias and Belief Confirming Information*

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Abstract

This paper develops a model of media bias in which rational agents acquire all their news from the source that is most likely to confirm their prior beliefs. Despite only wishing to make the correct decision, agents act as if they enjoy receiving news that supports their preconceptions. By exclusively gathering information from a source biased towards his prior, there is little chance an agent will be persuaded to change his mind. Moreover, it is shown that even an *unbiased* agent prefers to receive biased news as it is unlikely to produce conflicting reports. The media caters to the informational demands of consumers and accordingly slants its reporting. It is shown that competition may not decrease bias, but may actually enhance it. Finally, even when it increases bias, competition may improve welfare by expanding the market for news.

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1 Introduction

There is a widespread belief that news coverage is politically biased.[1,2] Perhaps because of this impression, the television news market is becoming increasingly polarized.[3] Fox News' audience is becoming more and more conservative while CNN's audience is becoming increasingly liberal. Despite being largely distrustful of the news media, many people get the majority of their news from the source that is most likely to confirm their prior beliefs.[4] Why would rational agents confine themselves to a biased source they know is likely to tell them what they already believe? Moreover, shouldn't competition eliminate biased sources of news?

This paper seeks to provide a theoretical foundation for these recent trends. It is shown that it can be, in fact, optimal for a rational agent to acquire all his information from the source that is most likely to confirm his prior beliefs. As he receives more confirmatory reports, there is less incentive to seek out contradictory information. Thus in a biased population, likeminded consumers will receive their news from the same outlet. Moreover, in a dynamic setting, even an *unbiased* agent prefers to receive biased news. An unbiased agent correctly realizes that after receiving his first bit of information, he will no longer be unbiased. Thus, he prefers to receive biased information from the start. Additionally, it is shown that competition may not diminish bias, but actually enhance it. Finally, despite increasing bias, competition may improve social welfare by increasing the number of agents who watch the news.

Bias can come in many forms. News organizations can allot more time to one viewpoint, cover only stories that support a particular opinion, or simply present false information that favors one perspective. In this paper, bias refers to the tendency to disproportionately search for, and hence report, information supporting a particular alternative. For example, a station biased towards conservatives will look for and report reasons why a Republican proposal should be enacted. By doing so, they will claim that Republicans have the best alternative more often than warranted.

In the formal model, rational agents, who only want to make the correct decision, must choose

[1] See Alterman(2003), Coulter(2003), Franken(2003) or Goldberg(2003) for examples.
[2] Groseclose and Milyo (2005) provides a measure of media bias for many outlets.
[3] http://people-press.org/reports/display.php3?ReportID=215.
[4] http://65.109.167.118/pipa/pdf/oct03/IraqMedia_Oct03_quaire.pdf.

between two alternatives. Prior to making a decision, they can receive noisy signals from two news stations. The news stations decide how to slant their coverage in order to maximize profit. The paper first examines a heterogenous biased population, then examines a homogenous unbiased population. In both settings it is shown that consumers seek biased news, particularly news that is biased towards their prior beliefs.

There are several recent studies on media bias related to this paper. Mullainathan and Shleifer (2005) examine the market for news under the assumption that consumers receive utility from reading news that confirms their prior beliefs. They find that when readers are homogenous, a competitive media slants towards their beliefs. When readers are heterogenous, news firms segment the market and slant towards extreme positions. In Baron (2006), bias arises as journalists slant their reporting towards their preferred state. Despite competition between profit maximizing news sources, bias persists. Additionally, bias can be greater in a competitive news market than in a monopoly. Both these works differ from this paper by introducing agents with an inherent preference for bias. In this paper, agents simply want to choose the correct alternative and firms only want to maximize profits, yet bias arises.

Topically, this work is most closely related to Gentzkow and Shapiro (2006). In their model, media bias arises as firms distort their reports towards the beliefs of a biased populace in order to form a reputation for quality. Consumers only wish to determine the truth, yet bias remains and potentially decreases the welfare of all market participants. When consumers have heterogenous priors, a segmented equilibrium exists in which consumers only read news biased towards their beliefs. This paper differs in several important respects. First, in this model, firms seek to maximize viewership, not reputation. If firms were concerned with the number of customers in the Gentzkow and Shapiro model, the segmented equilibria would disappear as a biased firm would receive a zero market share when competing with an unbiased news source. Secondly, Gentzkow and Shapiro show how competition may mitigate bias, yet in this model bias remains no matter how competitive the market becomes. Finally, and most importantly, by introducing dynamics this work shows that media bias will tend to arise even when the population is homogenous and initially *unbiased*.

While not focused on media bias, there are several other works that are related to this paper. Meyer (1991) examines a firm's promotion decision between two employees when the firm can bias noisy rank-order contests in an attempt to identify the worker with the highest ability. Under certain conditions, the firm finds it optimal to bias the contests towards the employee with the highest probability of being best. Consumers display similar informational desires in this paper, but must rely on profit maximizing firms to provide information.

Suen (2004) also demonstrates why agents may prefer to receive information from advisors biased toward their prior beliefs.[5] However, this work differs primarily from Suen (2004) in two important respects. First, in the previous literature, agents select an advisor from an exogenously given set of information providers. This work endogenizes the media market to examine how competition impacts the type of information consumers receive. It is shown that a monopolist may find it optimal to cater to the middle and provide unbiased news. However, in a competitive marketplace, whether the population is heterogenous and biased or homogenous and unbiased, news providers find it optimal to induce an extreme form of market segmentation by providing highly biased news. Second, and perhaps more importantly, this work expands on the previous literature by providing a fully dynamic analysis of information acquisition and provision with rational consumers. While not providing a complete analysis, Suen (2004) suggests that in a dynamic environment the incentive for rational agents to acquire biased information will be mitigated. However, in this work, when agents are given multiple opportunities to gather news, the incentive to acquire biased information is actually *strengthened*. Biased consumers still prefer to receive highly biased news, and moreover, even *unbiased* agents prefer to receive biased information from the start since they correctly infer that once they receive their first report, they will no longer be unbiased.

The following section discusses the primitives of the model. Sections 3 and 4 contain the analysis of the biased and unbiased populations, respectively. A welfare discussion is presented in Section 5. Section 6 presents a brief analysis of the trade-offs between quality and biased news and Section 7 concludes. Any proof not appearing in the text has been relegated to the Appendix. The Robustness section of the Appendix shows that similar results are obtained when considering a variety extensions.

[5] Calvert (1985) also identifies similar incentives in a static environment.

2 The Model

Consider a market with two types of agents, consumers and news firms. There are two states and two alternatives, 0 and 1. A consumer must select between the two alternatives and receives a payoff normalized to 1 if he selects alternative i when the true state is i, and -1 otherwise.[6]

In each period, a consumer can receive information about the true state from one of two profit maximizing news firms, A or B.[7] The focus of the paper is the market for television news, so it is assumed that the firms do not charge a price directly to their consumers. Hence, firms compete only through content. Additionally, it is assumed that revenue is strictly increasing in the number of viewers, so firms seek to maximize their market share. Since investigating a story is costly, and reporters are prone to errors, the firms can only send noisy signals. Thus, each firm must decide on the probability that they send the correct signal in each state. Specifically, let p_k^j be the probability firm j sends signal k when the true state is k. Each firm must assign total errors of $1-q$, $q \in (0,1)$, between the two states, i.e. $p_0^j + p_1^j = 1 + q$.[8] An important implication of this assumption is that firms are only able to make announcements about which alternative is most likely to be best and cannot convey information about the relative expected benefits. Since it is costly in terms of time to both produce and provide a highly detailed analysis, news firms often prefer (or are forced) to provide coarse information. Further, this assumption can substantively reflect a discussion of complicated policy issues, such as health care or social security, in which viewers are unlikely to be able to evaluate the relative merits of different proposals on their own, but are able to determine which policy has been presented in the most favorable light.

An equivalent interpretation of the information technology is that a firm observes and sends the correct signal with probability q and with probability $1-q$ does not observe a signal and must choose what message to send. A news outlet would have a dominant strategy to provide a report, even when uninformed, if news telecasts had some entertainment value in addition to their role as information conduits. Additionally, the same incentive would be present if the lack of a signal was

[6] The Appendix shows that the results generalize to a setting in which consumers have continuous action spaces.

[7] Neither firm has an inherent desire for the population to select one alternative over the other, yet as will be shown, they still find it optimal to provide biased information.

[8] This assumption is related to those made in the "rational inattention" literature. News firms cannot observe the true state, but they can control, to some extent, the stochastic properties of their signals. For examples in this line of research see Sims (2003), Sims (2006), or Maćkowiak and Wiederholt (2007).

indicative of a poor quality news outlet, as would be the case if there were multiple types of firms with different abilities to ascertain information. In either case, any reporting strategy that placed positive probability on not delivering a report would lead to a loss in consumers in a competitive environment.

Before proceeding it will be useful to formalize the concept of bias and provide some definitions. Traditionally, the term bias has referred to a manipulation of information after it has been received (omission of information in Mullainathan and Shleifer (2005), misrepresentation of received signals in Baron (2006) and Gentzkow and Shapiro (2006), or a coarsening of a continuous signal into a binary recommendation as in Suen (2004) or Calvert (1985)).[9] However, since firms often must choose how and where to gather news, this work focuses on bias in the search for information. As an example, suppose each state is equally likely to occur. If firm j decides to focus its search primarily for information supporting state 0 by increasing p_0^j, then it will correctly identify state 0 with relatively high probability. However, it will also incorrectly identify state 1 as state 0 with high probability as well. Therefore, firm j will be biased as it will report state 0 to be the true state with probability strictly greater than $\frac{1}{2}$. An unbiased firm will treat the two states equally by assigning the same research intensity (conversely, same amount of error) to each. This gives rise to the following definitions.

Definition 1. Firm j is unbiased if $p_0^j = \frac{1+q}{2}$.

Definition 2. Firm j is an extremist if $p_i^j = 1$, $i \in \{0, 1\}$

An extremist always correctly identifies one of the states, but misinterprets the other state with high probability. For example, an extremist biased towards liberals will always support a liberal

[9] Different assumptions on how bias is manifested produces markedly different welfare implications for consumers. A misrepresentation of an informative signal (as in Baron (2006) or Gentzkow and Shapiro (2006)) reduces welfare as consumers choose incorrectly when the signal is misreported. However, in Mullainathan and Shleifer (2005), Suen (2004), and Calvert (1985) bias can *increase* consumer welfare. In Mullainathan and Shleifer (2005) a conscientious reader can attain a more accurate picture by sampling from two sources biased in opposite directions, while in Suen (2004) and Calvert (1985) an agent benefits by selecting the source that filters information optimally given his bias. As will be seen, this work fits into the latter category as consumers prefer to acquire biased news since it leads to more informed decisions.

position if it is best, yet it will also frequently recommend the liberal position when a conservative proposal is better.[10]

Consumer surveys suggest that political beliefs vary widely. As a useful starting point, the following section analyzes market behavior in a heterogenous biased population. Section 4 presents the analysis of a homogenous unbiased population.

3 Biased Consumers

Consider a continuum of agents with beliefs distributed over the unit interval according to the truncated normal distribution, F $\sim$ N($\frac{1}{2}$,σ^2). Let $\alpha_i \in [0,1]$ denote agent i's belief that the true state is 0.

3.1 One Period

Suppose each consumer can receive only one signal from one of the news firms. Notice that consumer i's expected benefit from watching news firm j is given by,[11]

$$\alpha_i(p_0^j(1) + (1-p_0^j)(-1)) + (1-\alpha_i)(p_1^j(1) + (1-p_1^j)(-1)). \tag{1}$$

That is, consumer i believes that with probability α_i the true state is 0, in which case he will make the correct decision if message 0 is sent. Similarly, if the true state is 1, he chooses correctly following a report of 1. Should he refrain from watching any news, consumer i will simply select the alternative he believes is most likely to be correct leading to an expected utility of

$$\begin{cases} \alpha_i - (1-\alpha_i) = 2\alpha_i - 1 & \text{if } \alpha_i \geq \frac{1}{2} \\ 1 - 2\alpha_i & \text{if } \alpha_i < \frac{1}{2}. \end{cases}$$

Thus, if $\alpha_i \geq \frac{1}{2}$, consumer i would not receive any benefit from firm j if

$$2\alpha_i - 1 \geq \alpha_i(p_0^j + (1-p_0^j)(-1)) + (1-\alpha_i)(p_1^j + (1-p_1^j)(-1)).$$

[10] Notice that if a firm was ideologically biased towards alternative 0, then it would choose to be an extremist for that state. This search intensity produces the most signals of 0, leading to the greatest chance of consumers supporting the desired policy.

[11] Clearly an agent benefits from receiving news only if he chooses the alternative suggested by the signal.

Noting $p_1^j = 1 + q - p_0^j$, the above reduces to

$$\alpha_i \geq \overline{\alpha} = \frac{1 - p_0^j + q}{2(1 - p_0^j) + q}. \tag{2}$$

Consumers with beliefs above $\overline{\alpha}$ are so heavily biased towards state 0 that firm j cannot convince them state 1 is more likely regardless of the signal it sends. Therefore, it is assumed these agents do not watch firm j as it does not provide them any benefit.[12]

Notice that $\overline{\alpha}$ is increasing in p_0^j. Consumers who believe that state 0 is highly likely to occur are only willing to watch news that is biased towards state 0. The intuition is as follows. These agents believe so strongly that state 0 is correct that they would prefer to make all their errors in state 1. Therefore, they are willing to sacrifice accuracy in state 1 (i.e. more false signals of 0) in order to minimize the number of mistakes they make in the state they believe to be more likely. For instance, a liberal may believe so strongly in his convictions that he is unwilling to watch any news that may fool him into supporting a conservative position.

A similar calculation reveals that all agents with priors below

$$\underline{\alpha} = \frac{p_0^j - q}{2p_0^j - q} \tag{3}$$

also prefer not to get information from firm j. Thus, only consumers with $\underline{\alpha} \leq \alpha_i \leq \overline{\alpha}$ consult firm j prior to making a decision.

Before analyzing a competitive market, it is useful to know how a monopolist would act.

3.1.1 Monopoly

Suppose only firm A is active and must decide how to slant its coverage in order to maximize its viewership. As shown in the last section, only consumers with $\underline{\alpha} \leq \alpha_i \leq \overline{\alpha}$ will watch the news.

[12]This assumption is only of importance in a monopolistic setting and ensures that a monopolist is not indifferent between providing all types of news.

Therefore firm A solves

$$\max_{p_0^A} F\left(\frac{(1-p_0^A)+q}{2(1-p_0^A)+q}\right) - F\left(\frac{p_0^A - q}{2p_0^A - q}\right). \tag{4}$$

When deciding how to slant its coverage, firm A must be acutely aware of the population distribution. If it produces news that is too extreme in one direction, it risks alienating a large segment of the market. This leads to the following proposition.

Proposition 1. *If the population isn't too extreme, namely if $\sigma^2 \leq \frac{q^2}{8}$, than a monopolist is unbiased.*

Proof. Differentiating the objective function leads to the following first order condition

$$\frac{q}{(2-2p_0^A+q)^2} f\left(\frac{(1-p_0^A)+q}{2(1-p_0^A)+q}\right) - \frac{q}{(2p_0^A-q)^2} f\left(\frac{p_0^A-q}{2p_0^A-q}\right) = 0$$

Noting that $f(x) \propto \exp\{-\frac{(x-\frac{1}{2})^2}{2\sigma^2}\}$ yields

$$\frac{q}{(2-2p_0^A+q)^2} \exp\left[-\left(\frac{\frac{1}{2}q}{2-2p_0^A+q}\right)^2 /2\sigma^2\right] - \frac{q}{(2p_0^A-q)^2} \exp\left[-\left(\frac{\frac{1}{2}q}{2p_0^A-q}\right)^2 /2\sigma^2\right] = 0$$

One can easily verify that setting $p_0^A = \frac{1+q}{2}$ solves the above equation. However, only under certain conditions is this a maximum. Notice that the objective function is decreasing if

$$\frac{1}{(2p_0^A-q)^2} \exp\left[-\left(\frac{\frac{1}{2}q}{2p_0^A-q}\right)^2 /2\sigma^2\right] > \frac{1}{(2-2p_0^A+q)^2} \exp\left[-\left(\frac{\frac{1}{2}q}{2-2p_0^A+q}\right)^2 /2\sigma^2\right]$$

$$\left(\frac{2-2p_0^A+q}{2p_0^A-q}\right)^2 > \exp\left[\frac{q^2}{8\sigma^2}\left(\frac{1}{(2p_0^A-q)^2} - \frac{1}{(2-2p_0^A+q)^2}\right)\right]$$

Now, if $p_0^A > \frac{1+q}{2}$

$$\frac{1}{(2p_0^A-q)^2} - \frac{1}{(2-2p_0^A+q)^2} < 0$$

Therefore, if $\sigma^2 < \frac{q^2}{8}$

$$\exp\left[\frac{1}{(2p_0^A-q)^2} - \frac{1}{(2-2p_0^A+q)^2}\right] > \exp\left[\frac{q^2}{8\sigma^2}\left(\frac{1}{(2p_0^A-q)^2} - \frac{1}{(2-2p_0^A+q)^2}\right)\right]$$

Finally, it is straightforward to show that

$$\left(\frac{2-2p_0^A+q}{2p_0^A-q}\right)^2 > \exp\left[\frac{1}{(2p_0^A-q)^2} - \frac{1}{(2-2p_0^A+q)^2}\right]$$

for all $\frac{1+q}{2} < p_0^A \leq 1$.

A similar argument can be used to show that the objective function is increasing in p_0^A for all $q \leq p_0^A < \frac{1+q}{2}$. This completes the proof.

□

When σ^2 is small, so that the population is relatively unbiased, a monopolist finds it optimal not to slant its reporting. The intuition behind the result is straightforward. Should the monopolist bias its coverage towards state 0, it will gain a few consumers who are heavily biased in that direction. However, since there is a high concentration of individuals with little bias, it will lose a larger number of consumers who believe state 1 to be more likely. Thus, when the beliefs of the population are not too extreme, a monopolist caters to the middle.

If the distribution of consumer preferences were more uniform, a monopolist would be biased. Notice that agents with little bias have the most to gain from watching the news since they are the most unsure of which alternative to support. Hence, these consumers are relatively easy to attract. When there are many extremists, a monopolist would find it optimal to release biased reports in order to capture the extremists on one side of the market and some of the relatively unbiased consumers on the other.

The following section shows that once competition is introduced, unbiased news organizations disappear. Moreover, in a duopoly each firm produces extremely biased news regardless of the population distribution.

3.1.2 Duopoly

Now suppose firms A and B compete to try and maximize their respective market shares. Consumer i prefers firm A if

$$\alpha_i(2p_0^A - 1) + (1-\alpha_i)(2p_1^A - 1) > \alpha_i(2p_0^B - 1) + (1-\alpha_i)(2p_1^B - 1)$$

$$\alpha_i(p_0^A - p_0^B) > (1-\alpha_i)(p_1^B - p_1^A)$$

$$\alpha_i(p_0^A - p_0^B) > (1-\alpha_i)(p_0^A - p_0^B). \tag{5}$$

Thus, if $\alpha_i > \frac{1}{2}$, agent i prefers firm A if $p_0^A > p_0^B$; i.e. if firm A is more biased towards state 0.[13] This leads to the following proposition.

Proposition 2. *In a duopoly, there exists a unique equilibrium. Moreover, in this equilibrium each firm is an extremist for an opposing alternative.*

Proof. If firm A chooses p_0^A such that $p_0^A > p_0^B$, then all agents with priors above $\frac{1}{2}$ will prefer firm A and all agents with beliefs below $\frac{1}{2}$ will prefer firm B. Therefore, firm A would receive

$$F\left(\frac{1-p_0^A+q}{2(1-p_0^A)+q}\right) - \frac{1}{2},$$

which is strictly increasing in p_0^A. Thus, should it be more biased towards state 0 than firm B, firm A finds it strictly optimal to be an extremist. Conversely, since the model is symmetric around $\frac{1}{2}$, if firm A decides to be more biased towards state 1, it will set $p_1^A = 1$. Clearly, regardless of its opponent's decision, each firm will choose to be an extremist.

It remains to be shown that both firms will not slant their reporting in the same direction. Suppose $p_0^A = p_0^B = 1$. In this case, the firms will split the market equally and each receive a share of

$$\frac{1}{2}\left[1 - F\left(\frac{1-q}{2-q}\right)\right].$$

However, should they take opposing biases, each firm will receive a share of $\frac{1}{2}$. This establishes the claim.

□

When faced with competition, each firm finds it optimal to be highly biased and target one segment of the market, irrespective of the population distribution. By taking an extreme approach, a firm is able to capture *all* agents with like-bias.[14] As a result all consumers watch the news.

[13] If the two firms provide an agent the same expected benefit, it is assumed he randomizes between them equally.

[14] At first glance this finding may appear similar to the maximal differentiation result in a Hotelling model where price competition induces the duopolists to locate at each end of the spectrum of consumer tastes. In the current setting, however, there is no price competition, and the maximal differentiation observed in this setting contrasts sharply with the minimal differentiation observed in the equilibrium of a Hotelling model without prices.

Moreover, every consumer is receiving the type of news he most desires. Notice that if $\alpha_i > \frac{1}{2}$, consumer i's utility from watching news firm A,

$$\alpha_i(2p_0^A - 1) + (1 - \alpha_i)(2p_1^A - 1)$$

$$= (2\alpha_i - 1)(2p_0^A - 1) + (1 - \alpha_i)(2q) \tag{6}$$

is strictly increasing in p_0^A. If an agent believes that state 0 is most likely to occur, he would like to commit all his errors in state 1. Specifically, he would like his news never to erroneously convince him that alternative 1 is best. If an agent is to switch his support to the alternative he initially found undesirable, he wants to be absolutely sure he is making the correct decision.

Despite only wishing to ascertain the truth, consumers act as if they enjoy confirming their prior beliefs. An agent who believes state 0 is more likely to occur will select the news station that recommends alternative 0 with the highest probability. By doing so, the agent ensures that should he receive a message of 1, it is not spin and as such is a very strong signal. Therefore, he is much more likely to change his mind and choose the alternative he initially disliked. For example, consider a conservative trying to decide whether or not to support Harriet Miers' nomination to the U.S. Supreme Court. Should he watch CNN and hear a liberal commentator claim Miers is unqualified, he will be unsure whether that is indeed the case or if it is just liberal bias. However, should he hear a conservative commentator criticizing her qualifications, this is a much stronger signal and more likely to convince him to oppose the nomination.

Notice that no amount of competition will mitigate this extremism. As noted above, all agents prefer this type of reporting. Hence, any firm that tries to give the issues a more balanced treatment will not garner any viewers. To see this suppose a third firm enters the market, firm C, and sets $q < p_0^C < 1$. If firm A is the extremist towards state 0, then agent i will prefer firm A if

$$\alpha_i + (1 - \alpha_i)(2q - 1) \geq \alpha_i(2p_0^C - 1) + (1 - \alpha_i)(2p_1^C - 1)$$

$$\alpha_i(1 - p_0^C) \geq (1 - \alpha_i)(1 - p_0^C)$$

$$\alpha_i \geq \frac{1}{2}.$$

A similar calculation reveals that all agents with beliefs below $\frac{1}{2}$ prefer firm B. Thus, should another news firm enter the market, it will also be an extremist.

In the static setting, agents have only been allowed to receive news from one of the two firms. However, even if an agent were able to watch both firms, he would not derive any extra benefit. Suppose agent i has beliefs $\alpha_i \geq \frac{1}{2}$ so that he would receive his first signal from the firm biased towards state 0. Should he receive a signal of 1, he knows the true state with certainty. Should he receive a signal of 0, no message from the other firm can convince him state 1 is more likely. In either case, the second firm will not provide consumer i with any information that will alter his decision.[15] The following sections add dynamics to the analysis and verify that the main results hold in this setting as well.

3.2 Two Periods

Suppose there are two periods in which an agent can receive information prior to choosing an alternative. For expositional purposes, suppose firm A is an extremist towards state 0 and that firm B sets $q < p_0^B < 1$. From the previous section, we know that in the last period an agent will select the station with the largest bias towards his preferred alternative. Therefore, letting $J^*(\alpha, n)$ denote the expected utility of a consumer with beliefs α entering period n,

$$J^*(\alpha, 2) = \begin{cases} \alpha + (1-\alpha)(2q-1), & \text{if } \alpha \geq \frac{1}{2} \\ \alpha(2p_0^B - 1) + (1-\alpha)(1 - 2p_0^B + 2q), & \text{if } \alpha < \frac{1}{2}. \end{cases} \tag{7}$$

To determine what happens in the first period, suppose consumer i is biased towards state 0 so that $\alpha_i > \frac{1}{2}$. If he decides to watch firm A, his expected utility is given by

$$(\alpha_i + (1-\alpha_i)(1-q))J^*\left(\frac{\alpha_i}{\alpha_i + (1-\alpha_i)(1-q)}, 2\right) + (1-\alpha_i)q.$$

Consumer i expects to receive message 0 with probability $(\alpha_i + (1-\alpha_i)(1-q))$, in which case he

[15] In fact, extreme polarization would be the unique equilibrium in this setup as well. As in the case in which consumers can select only one outlet, should a firm take a moderate stance it will simply lose viewers irrespective of its competitor's choice.

will watch firm A again in the second period. Should he receive a message of 1, consumer i knows the true state and ends his search. Substituting for his expected benefit from watching the news in the second period yields

$$(\alpha_i + (1-\alpha_i)(1-q))\left[\frac{\alpha_i}{\alpha_i + (1-\alpha_i)(1-q)} + \frac{(1-\alpha_i)(1-q)(2q-1)}{\alpha_i + (1-\alpha_i)(1-q)}\right] + (1-\alpha_i)q$$

$$= \alpha_i + (1-\alpha_i)(1-2(1-q)^2). \tag{8}$$

If the true state is 0, consumer i is ensured of making the correct decision by watching the station that is biased towards state 0. If the true state is 1, he selects the correct alternative unless he receives two incorrect reports of 0.

Now suppose consumer i watches firm B in the first period. If agent i is strongly biased towards state 0 so that $\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)} \geq \frac{1}{2}$, then no signal from firm B can convince him state 1 is more likely. In this case, regardless of the message sent in the first period, consumer i will choose firm A in the second period. Therefore, his expected utility from selecting B in the first period is

$$(\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q))J^*\left(\frac{\alpha_i p_0^B}{\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q)}, 2\right)$$

$$+(\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B))J^*\left(\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B)}, 2\right)$$

$$= \alpha_i + (1-\alpha_i)(1-2(1-q)). \tag{9}$$

If consumer i would choose firm A in the second period regardless of what he hears from firm B in the first period, then firm B's report is worthless as he will simply make his decision according to the information received from firm A. Clearly, this type of agent would prefer to watch firm A in the first period.

Now suppose $\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)} < \frac{1}{2}$, so that consumer i will believe state 1 is more likely should he receive a report of 1 from firm B. If $\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)} < \frac{p_0^B-q}{2p_0^B-q}$, then following a message of 1 from firm B, consumer i will not receive any news in the second period as neither firm can convince him alternative 0 is best. Suppose $\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)} \geq \frac{p_0^B-q}{2p_0^B-q}$, so that should consumer i receive a message of 1 from firm B in the first period, he will draw again from B in the second period. His expected utility from starting at firm B is given by

$$(\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q))J^*\left(\frac{\alpha_i p_0^B}{\alpha_i p_0^B + (1-\alpha_i)(p_0^B-q)}, 2\right)$$

$$+(\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B))J^*\left(\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)}, 2\right)$$

$$= \alpha_i(1-2(1-p_0^B)^2) + (1-\alpha_i)(2q(2-p_0^B) - (1-2(1-p_0^B)^2)). \tag{10}$$

Agent i prefers to watch firm A in the first period if

$$\alpha_i + (1-\alpha_i)(1-2(1-q)^2) \geq \alpha_i(1-2(1-p_0^B)^2) + (1-\alpha_i)(2q(2-p_0^B) - (1-2(1-p_0^B)^2))$$

$$\alpha_i(1-p_0^B)^2 \geq (1-\alpha_i)((1-q)^2 + (1-p_0)^2 - 1 + q(2-p_0^B))$$

$$\alpha_i(1-p_0^B)^2 \geq (1-\alpha_i)((1-p_0^B)^2 - q(p_0^B - q))$$

which holds for all agents with $\alpha_i \geq \frac{1}{2}$.

The Appendix shows that if $\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)} < \frac{p_0^B-q}{2p_0^B-q}$, then again consumer i would prefer to receive his news from firm A in the first period. Thus, if $\alpha_i > \frac{1}{2}$, an agent who can receive two signals would prefer they both came from an extremist biased towards his preferred alternative. The following section shows that regardless of the time horizon, consumers prefer to get all their news from the station that is most likely to confirm their prior beliefs.

3.3 N Periods

As seen in the last section, when an agent is restricted to two signals, he strictly prefers to receive all his news from an extremist biased towards his preferred alternative. However, in many situations of interest, an election for example, agents have an opportunity to view many newscasts prior to making a decision. When given a long horizon, consumers may wish to allocate some time to entertain an opposing viewpoint. Therefore, it is important to examine whether or not a dynamic environment can mitigate the incentive to acquire biased news. However, as the next proposition establishes, even when given many opportunities to hear different viewpoints, consumers prefer to have all their news slanted from the same perspective.

Proposition 3. *When given $N \geq 2$ opportunities to watch the news, all biased agents strictly prefer to receive information exclusively from an extremist biased towards their prior beliefs.*

Proof. The proof is by induction. As before, suppose firm A is an extremist towards state 0 and that firm B sets $q < p_0^B < 1$. We have seen that when $N = 2$, an agent with beliefs $\alpha_i > \frac{1}{2}$ strictly prefers to receive all signals from firm A. Suppose this continues to hold when $N = k$. When $N = k + 1$, in the first period agent i's expected utility is given by

$$J^*(\alpha_i, N-k) = \max\Bigg[(\alpha_i + (1-\alpha_i)(1-q))J^*\left(\frac{\alpha_i}{\alpha_i + (1-\alpha_i)(1-q)}, N-k+1\right) + (1-\alpha_i)q,$$

$$(\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q))J^*\left(\frac{\alpha_i p_0^B}{\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q)}, N-k+1\right) \tag{11}$$

$$+ (\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B))J^*\left(\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B)}, N-k+1\right)\Bigg].$$

Suppose agent i draws from firm A in the first period. If he receives a message of 1, then he knows the true state and has no more use for news. If he receives a message of 0, then by supposition he will continue to watch firm A until either he has taken N draws or received a message of 1. Therefore, if consumer i selects firm A in the first period he will never watch firm B and expects

$$J^*(\alpha_i, N-k) = \alpha_i + (1-\alpha_i)(1 - 2(1-q)^{k+1}). \tag{12}$$

By only watching firm A, consumer i will make the correct decision unless the true state is 1 and he receives $k+1$ messages of 0.

Now suppose agent i initially watches firm B. If $\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)} \geq \frac{1}{2}$, then even if he receives a message of 1 from firm B in the first period, consumer i will still believe alternative 0 is best in the second period. Therefore, regardless of the signal received in the first period, agent i will exclusively watch firm A in all subsequent periods. By selecting firm B in the first period, agent i expects

$$(\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q))\left[\frac{\alpha_i p_0^B}{\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q)} + \frac{(1-\alpha_i)(p_0^B - q)}{\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q)}(1-2(1-q)^k)\right]$$

$$+ (\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B))\left[\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B)}\right.$$

$$\left. + \frac{(1-\alpha_i)(1+q-p_0^B)}{\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B)}(1-2(1-p)^k)\right]$$

$$= \alpha_i + (1-\alpha_i)(1-2(1-q)^k). \tag{13}$$

Since all ensuing messages will come from firm A, agent i simply wastes a signal by viewing firm B in the first period. If consumer i's beliefs cannot be switched with one signal from firm B, then he prefers to receive all his news from firm A.

Now suppose that $\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)} < \frac{1}{2}$. If agent i chooses firm B in the first period, his expected utility is given by

$$(\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q))J^*\left(\frac{\alpha_i p_0^B}{\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q)}, N-k+1\right)$$

$$+ (\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B))J^*\left(\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B)}, N-k+1\right).$$

We know from before that

$$(\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q))J^*\left(\frac{\alpha_i p_0^B}{\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q)}, N-k+1\right)$$

$$= \alpha_i p_0^B + (1-\alpha_i)(p_0^B - q)(1-2(1-q)^k).$$

Should he receive a signal of 1 in the first period, consumer i will believe that alternative 1 is most likely correct. Since the model is symmetric around $\frac{1}{2}$, we know that now he would strictly prefer to draw exclusively from an extremist biased towards state 1. Since this option is not available,

$$J^*\left(\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)}\right) < \frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)}(1-2(1-q)^k)$$

$$+\frac{(1-\alpha_i)(1+q-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)}$$

Substituting, we see that agent i's utility is strictly less than

$$\alpha_i(1-2(1-p_0^B)(1-q)^k)+(1-\alpha_i)(1-2(p_0^B-q)(1-q)^k) \tag{14}$$

Therefore, consumer i would prefer selecting firm A in the first period if

$$\alpha_i+(1-\alpha_i)(1-2(1-q)^{k+1}) \geq \alpha_i(1-2(1-p_0^B)(1-q)^k)+(1-\alpha_i)(1-2(p_0^B-q)(1-q)^k)$$

$$\alpha_i(1-p_0^B)(1-q)^k \geq (1-\alpha_i)((1-q)^{k+1}-(p_0^B-q)(1-q)^k)$$

$$\alpha_i(1-p_0^B)(1-q)^k \geq (1-\alpha_i)(1-p_0^B)(1-q)^k$$

$$\alpha_i \geq \frac{1}{2}$$

□

In a dynamic setting, prior beliefs can become self-perpetuating. As an agent receives more confirmatory information from a station biased towards his beliefs, it will take an increasing number of contradictory reports from another station to overturn his prior. As such, he has less of an incentive to entertain different viewpoints. Moreover, when an agent becomes highly biased, *only* an extremist biased towards his beliefs can change his mind. These effects combine, inducing an agent to gather all his information from the source most likely to confirm his prior beliefs.[16]

We have seen that agents wish to receive all their news from extremists biased towards their

[16] If consumers faced an information constraint as well, for example were only able to randomly remember some of the previous signals received, the desire for biased information would be strengthened. The more unbiased a firm is the more important the entire history of reports becomes for making a decision. However, by watching an extremist, a consumer will not suffer from his limited recall as it is optimal to continue watching the news until one unexpected report is received, at which point the true state is revealed. I thank an anonymous referee for pointing this out.

point of view. The next proposition shows this is precisely the type of news firms provide.

Proposition 4. *In an N period duopoly, there exists a unique equilibrium. Moreover, in this equilibrium each firm is an extremist for an opposing alternative.*

Proof. Suppose firm B sets $q < p_0^B < 1$. If firm A sets $p_0^A = 1$, then consumers with beliefs $\alpha_i > \frac{1}{2}$ will get all their news from firm A. Firm B, however, will earn less than $\frac{1}{2}$ the market as some of the agents biased towards state 1 will not watch the news. Should firm B become an extremist for state 1, it would increase its market share to $\frac{1}{2}$. Therefore, no equilibrium can exist in which only one firm is an extremist.

Additionally, there is no equilibrium in which neither firm is an extremist. If neither firm were an extremist at least one firm would earn a market share less than $\frac{1}{2}$ as not all consumers would watch the news. If this firm were to become an extremist, it would earn at least $\frac{1}{2}$ the market as seen above.

Thus, if there is an equilibrium it must be that both firms are extremists. Suppose firm A sets $p_0^A = 1$ and firm B sets $p_1^B = 1$. In this case all agents with $\alpha_i \geq \frac{1}{2}$ would watch firm A and the rest would watch firm B. As seen above, neither firm would deviate to any interior strategy. Additionally, should the firms be biased in the same direction, say towards state 0, they would split a smaller market since all agents with priors such that $\frac{\alpha_i}{\alpha_i + (1-\alpha_i)(1-q)^N} \leq \frac{1}{2}$ wouldn't watch the news as no stream of reports can overturn their prior beliefs. Therefore, the proposed strategy is an equilibrium, and it is unique.

□

Like the static setting, in a dynamic framework all firms will produce highly biased news and consumers will only watch the station that is most likely to confirm their prior beliefs. Despite an increased number of chances to receive reports, each agent finds it optimal to stick to one source of information to ensure that he doesn't receive any wasted signals. Moreover, increased competition will not overturn this result, nor will it decrease bias. Thus, a biased populace begets a biased news media. Interestingly, as the next section shows, even in an unbiased population we can expect media bias to arise.

4 Unbiased Consumers

Suppose there is a mass of consumers of size 1 all of whom believe each state is equally likely. In a static setting, these consumers would be indifferent between biased and unbiased news as they expect to make the same amount of errors by watching either. However, in a dynamic setting, these agents realize that in the second period, they will no longer be unbiased. Therefore, all agents strictly prefer to receive biased information from the start.

In fact, when given multiple opportunities to gather information, unbiased consumers prefer *any* biased source, no matter how biased, over an unbiased outlet. To see this consider a two period environment in which firm A is biased towards alternative 0, $p_0^A > \frac{1+q}{2}$, and firm B is unbiased. If a signal of 1 is received in the first period from either firm, neither outlet will be able to convince the consumer to select alternative 0 in the second period. Should a signal of 0 be received in the first period, then as demonstrated in previous sections, the agent will find it optimal to watch firm A in the second period. Therefore, the expected utility of selecting firm A initially is given by,

$$\frac{1}{2}(p_0^A(2p_0^A-1)-(1-p_0^A))+\frac{1}{2}(1+q-p_0^A+(p_0^A-q)(2(1+q-p_0^A)-1))$$
$$= 2p_0^A q - q^2. \tag{15}$$

Should an unbiased agent choose firm B initially, expected utility is given by,

$$\frac{1}{2}\left(\frac{1+q}{2}(2p_0^A-1)-\left(1-\frac{1+q}{2}\right)\right)+\frac{1}{2}\left(\frac{1+q}{2}+\left(1-\frac{1+q}{2}\right)(2(1+q-p_0^A)-1)\right)$$
$$= p_0^A q + \frac{1}{2}q - \frac{1}{2}q^2. \tag{16}$$

In either case, the consumer will choose correctly in state 0 if he receives two signals of 0 and will choose correctly in state 1 if he receives at least one signal of 1. Simple algebra reveals that an unbiased agent prefers to receive information exclusively from a biased firm if,

$$2p_0^A q - q^2 > p_0^A q + \frac{1}{2}q - \frac{1}{2}q^2,$$

$$p_0^A > \frac{1+q}{2}.$$

While an unbiased agent prefers any biased firm to an unbiased firm, it remains to be seen how biased he wants his news to be. To investigate this suppose that in a two period environment firm A is an extremist for state 0 and that firm B sets $\frac{1+q}{2} \leq p_0^B < 1$. All agents know that should they draw from A in the first period, they will not hear any other point of view. Either they will become informed about the true state or draw from firm A again in the second period. By choosing A in the first period an agent expects

$$\frac{1}{2} + \frac{1}{2}(q + (1-q)(2q-1)) = 1 - (1-q)^2. \tag{17}$$

Since firm B is also (weakly) biased towards state 0, a signal of 1 is relatively strong. Should an agent receive a signal of 1 in the first period, neither firm can convince him that alternative 0 is best in the second period. Therefore, by choosing firm B in the first period an agent expects

$$\frac{1}{2}(p_0^B + (1-p_0^B)(-1)) + \frac{1}{2}((1+q-p_0^B) + (p_0^B - q)(2q-1)).$$

When the true state is 0, which occurs with probability $\frac{1}{2}$, the agent will make the correct choice if he receives a signal of 0 in the first period as he will receive the same signal in period 2 with certainty. If he receives a signal of 1, he will forgo the news in the second period and erroneously select alternative 1. Similarly, when the true state is 1, the agent makes the correct decision if he receives message 1, yet should he receive a report of 0, he will draw from firm A in the second period and make the correct decision with probability q. By performing routine algebra, the above reduces to

$$q(1 + p_0^B - q). \tag{18}$$

Therefore, all agents prefer firm A if

$$1 - (1-q)^2 > q(1 + p_0^B - q)$$

$$p_0^B < 1.$$

When firms have like bias, even an unbiased agent prefers to get all his news from an extremist.

Now suppose firm B is biased towards state 1 so that $q < p_0^B < \frac{1+q}{2}$. In this case, should an agent receive a signal of 1 from firm B in the first period, he finds it optimal to watch firm B again in the second. Therefore, by choosing B in the first period an agent expects

$$\frac{1}{2}(p_0^B + (1-p_0^B)(2p_0^B - 1)) + \frac{1}{2}((1+q-p_0^B)(1+2q-2p_0^B) + (p_0^B - q)(2q-1)).$$

If the true state is 0, the agent makes the correct decision as long as he receives at least one signal of 0. If the true state is 1, he chooses correctly if he receives two signals of 1 from firm B or one signal of 1 from firm A. After some tedious algebra, the above reduces to

$$q(2 - p_0^B). \tag{19}$$

Therefore, all agents prefer firm A if

$$1 - (1-q)^2 > q(2 - p_0^B)$$

$$p_0^B > q.$$

In a 2 period setting, even an unbiased agent prefers to receive news from an extremist. The agent realizes that once the first signal is received, he will no longer be neutral and will desire biased news. By choosing an extremist at the start, the agent will receive all his news from the same source, ensuring that he doesn't receive any useless signals. The same incentives are present in an N period horizon as the following proposition establishes.

Proposition 5. *When given $N \geq 2$ opportunities to watch the news, unbiased agents strictly prefer to receive information exclusively from an extremist.*

Proof. The proof is analogous to the proof for Proposition 3 and is omitted.

□

Whether the population is heterogenous and biased or homogenous and unbiased, all consumers prefer highly biased news. When a news firm is an extremist, all agents are aware of what type of mistakes are being made. By gathering all their information from the source that is most likely to confirm their prior beliefs, consumers are ensured that they will never be mislead away from their preferred alternative when it is actually best. Additionally, by exclusively watching an extremist, every signal received will be useful in making a decision.

In all settings, competition will not mitigate bias and may actually enhance it. However, since agents prefer news slanted towards their prior beliefs, an increase in media bias may increase the number of consumers who watch the news. Therefore, as the next section shows, an increase in bias can actually increase welfare.

5 Welfare

Consider a social planner who believes each state will occur with equal probability. The social planner's goal is to maximize welfare, or analogously the number of consumers who make the correct decision. In a static monopolistic setting, the social planner solves

$$\max_{p_0} \left[F\left(\frac{(1-p_0)+q}{2(1-p_0)+q}\right) - F\left(\frac{p_0-q}{2p_0-q}\right)\right] \left(\frac{1}{2}(p_0+(1-p_0+q)) - \frac{1}{2}((1-p_0)+(p_0-q))\right)$$

$$+\frac{1}{2}\left(1-F\left(\frac{(1-p_0)+q}{2(1-p_0)+q}\right) - F\left(\frac{p_0-q}{2p_0-q}\right)\right) + \frac{1}{2}\left(F\left(\frac{p_0-q}{2p_0-q}\right) - \left(1-F\left(\frac{(1-p_0)+q}{2(1-p_0)+q}\right)\right)\right)$$

All agents that watch the news make the correct decision when they receive the correct signal. In addition, some of the consumers who don't watch will choose correctly based on their prior beliefs. Simple algebra reveals the above is equivalent to

$$\max_{p_0} \left[F\left(\frac{(1-p_0)+q}{2(1-p_0)+q}\right) - F\left(\frac{p_0-q}{2p_0-q}\right)\right] q, \tag{20}$$

which is analogous to the monopolist's problem. Since it is sending an informative message, a monopolist acts like a social planner by maximizing its profit and, hence, viewership.

Similarly, in a duopoly, the social planner solves

$$\max_{p_0^A, p_0^B} \left[F\left(\frac{(1-p_0^A)+q}{2(1-p_0^A)+q}\right) - \frac{1}{2}\right] q + \left[\frac{1}{2} - F\left(\frac{p_0^B-q}{2p_0^B-q}\right)\right] q \tag{21}$$

which is clearly maximized when $p_0^A = 1$ and $p_0^B = q$.

Competition may increase bias, yet it also increases welfare as it expands the market and provides more agents with an informative signal. While the news an agent receives is very likely to confirm his prior beliefs, it will also, on occasion, change his decision when his beliefs are erroneous. This increases the probability an agent makes the correct choice and enhances social welfare.

6 Differing Qualities

In the paper, quality across firms has been held constant. However, in a slightly altered setting in which one firm provides higher quality news, the incentives to acquire biased information would remain.[17] Moreover, even *unbiased* agents would be willing to sacrifice quality in order to get biased news.

To see this, suppose firms A and B have to assign errors of $1-q$ and $1-\overline{q}$ respectively, where $\overline{q} > q$. Additionally, suppose firm A is an extremist towards state 0 and firm B is unbiased. Clearly in a one period setting an unbiased agent would prefer firm B as it produces higher quality information. However, in a multi-period setting, an unbiased agent may prefer to receive biased news from the start.

Suppose that in a two period setting an unbiased agent has received a signal of 0 from firm A in the first period. He now believes the true state to be 0 with probability $\frac{\frac{1}{2}}{\frac{1}{2}+\frac{1}{2}(1-q)} = \frac{1}{2-q}$. In the second period, he will prefer firm A if

$$\frac{1}{2-q} + \frac{1-q}{2-q}(2q-1) > \frac{1}{2-q}(2p_0^B - 1) + \frac{1-q}{2-q}(1 + 2\overline{q} - 2p_0^B).$$

Noting that $p_0^B = \frac{1+\overline{q}}{2}$ and reducing yields

$$\overline{q} < \frac{q(3-2q)}{2-q}. \tag{22}$$

[17]The Appendix extends this analysis by showing that even if increasing bias *decreases* informativeness, even unbiased consumers may still strictly prefer to gather information exclusively from an extremist.

If firm B is not too much more informative than firm A, an unbiased consumer will prefer firm A in the second period following a signal of 0 in the first period.

If $\overline{q} < \frac{q(3-2q)}{2-q}$, then by selecting firm A in the first period, an unbiased agent expects

$$\frac{1}{2} + \frac{1}{2}(q + (1-q)(2q-1)) = 1 - (1-q)^2. \tag{23}$$

From selecting firm B initially, he expects

$$\frac{1}{2}(p_0^B - (1-p_0^B)) + \frac{1}{2}(1 + \overline{q} - p_0^B + (p_0^B - \overline{q})(2q-1)).$$

If an unbiased agent receives a signal of 0 in the first period, he will watch firm A in the second period. However, should he receive a message of 1, he will not watch any news in the second period since no signal can convince him state 0 is more likely. Reducing the above yields

$$\overline{q}(1-q) + \frac{q(1+\overline{q})}{2}. \tag{24}$$

Therefore, an unbiased consumer will prefer lower quality biased news if

$$1 - (1-q)^2 > \overline{q}(1-q) + \frac{q(1+\overline{q})}{2}$$

$$\overline{q} < \frac{q(3-2q)}{2-q}.$$

If the difference in quality is not too large, even an unbiased consumer will prefer the more biased, less accurate firm. Although the biased firm is less accurate, the agent is fully aware of what type of errors it will make. By selecting an extremist initially, the consumer is ensured that all his news will come from the same source so that he will not receive any wasted signals.

7 Conclusion

In June of 2006, the FCC began re-evaluating its controversial media ownership rules in order to determine their impact on competition and diversity.[18] Given the significance of the review, it is

[18] http://www.fcc.gov/ownership/

important to understand the cause and effects of biased news. This paper has tried to provide such an analysis and suggests that media bias can arise to satisfy the informational demands of rational consumers. Although agents are only interested in making the correct decision, they desire news slanted towards their prior beliefs, and *only* this type of news. Competition, therefore, will not inhibit bias and may actually enhance it. However, despite potentially increasing bias, competition can enhance welfare by bringing news to more of the market, more often. This paper suggests bias is inherent to any news media, but that may not be such a bad thing after all.

Appendix

Lemma 1. *When* $\alpha_i \geq \frac{1}{2}$ *and* $\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B)+(1-\alpha_i)(1+q-p_0^B)} < \frac{p_0^B-q}{2p_0^B-q}$, *agent* i *prefers an extremist biased towards state 0 to any other firm in the first period.*

Proof. Suppose firm A is an extremist towards state 0 and that firm B sets $q < p_0^B < 1$. Should agent i receive a signal of 1 from firm B, news will no longer be useful to him as no message in the second stage can convince him that alternative 0 is best. Therefore, should he choose firm B in the first period, his expected utility is

$$(\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q))\left[\frac{\alpha_i p_0^B}{\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q)} + \frac{(1-\alpha_i)(p_0^B - q)(2q-1)}{\alpha_i p_0^B + (1-\alpha_i)(p_0^B - q)}\right]$$

$$+(\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B))\left[1 - 2\frac{\alpha_i(1-p_0^B)}{\alpha_i(1-p_0^B) + (1-\alpha_i)(1+q-p_0^B)}\right]$$

$$= \alpha_i(1 - 2(1-p_0^B)) + (1-\alpha_i)(1 - 2(p_0^B - q)(1-q)) \qquad \text{(A-1)}$$

Agent i prefers to watch firm A in the first period if

$$\alpha_i + (1-\alpha_i)(1-2(1-q)^2) > \alpha_i(1-2(1-p_0^B)) + (1-\alpha_i)(1-2(p_0^B-q)(1-q))$$

$$\alpha_i(1-p_0^B) > (1-\alpha_i)((1-q)^2 - (p_0^B - q)(1-q))$$

$$\alpha_i > (1-\alpha_i)(1-q)$$

which holds for all $\alpha_i \geq \frac{1}{2}$.

□

Robustness

This section of the Appendix provides robustness checks on the analysis presented in the text by considering three extensions: (1) Decreasing Informativeness, (2) Risk-Averse Consumers, and (3) Imperfect Precision.

7.1 Decreasing Informativeness

Consider a two period duopoly in which

$$p_0^i + p_1^i = \begin{cases} 1 + \overline{q} - f(p_0^i), & \text{if } p_0^i \geq \frac{1+\overline{q}}{2} \\ 1 + \overline{q} - f(p_1^i), & \text{if } p_1^i > \frac{1+\overline{q}}{2} \end{cases} \tag{A-2}$$

where $f' > 0$ and $f(\frac{1+\overline{q}}{2}) = 0$. Now, as bias increases, informativeness decreases. Let $f(1) = \underline{q}$ and denote $q^e = \overline{q} - \underline{q}$. As seen in Section 6, if $\overline{q} < \frac{q^e(3-2q^e)}{2-q^e}$, then when one firm is unbiased and the other is an extremist, an unbiased consumer would get all his news from the extremist.

Suppose firm A is an extremist towards state 0 and firm B sets $\frac{1+\overline{q}}{2} < p_0^B < 1$. Should an unbiased consumer receive a signal of 0 in the first period from firm A, he will prefer to draw from firm A in the second period if,

$$\frac{1}{2-q^e} + \frac{1-q^e}{2-q^e}(2q^e - 1) \geq \frac{1}{2-q^e}(2p_0^B - 1) + \frac{1-q^e}{2-q^e}(2p_1^B - 1)$$

$$\frac{1}{2-q^e} + \frac{1-q^e}{2-q^e}(2q^e - 1) \geq \frac{1}{2-q^e}(2p_0^B - 1) + \frac{1-q^e}{2-q^e}(2(1+\overline{q} - f(p_0^B) - p_0^B) - 1).$$

If $p_0^B = 1$ the two expressions are equal. Additionally, the expression on the right hand side of the inequality is increasing in p_0^B if

$$\frac{2}{2-q^e} - \frac{2(1-q^e)}{2-q^e}(-1 - f'(p_0^B)) > 0$$

$$\frac{q^e}{1-q^e} > f'(p_0^B). \tag{A-3}$$

If $f'(p_0^B) < \frac{q^e}{1-q^e}$, increasing bias does not decrease informativeness by too much. This condition ensures that following a signal of 0 from firm A in the first period an unbiased consumer would prefer to draw from firm A again in the second. Moreover, since firm A is an extremist, it sends the weakest possible signal of 0. Therefore, an unbiased consumer would prefer to draw from an extremist biased towards 0 in the second period following a signal of 0 from *any* firm.

Now suppose inequality (A-3) holds and that firm B is biased towards state 1 so that $\frac{1+\overline{q}}{2} < p_1^B \leq 1$. Should an unbiased consumer watch firm B in the first period, his expected utility is given by,

$$\frac{1}{2}(p_0^B + (1-p_0^B)(2p_0^B - 1)) + \frac{1}{2}(p_1^B(2p_1^B - 1) + (1-p_1^B)(2q^e - 1)).$$

In the second period, the consumer will draw from firm A following a signal of 0 and will draw from firm B following a signal of 1. Collapsing the expression above yields,

$$q^e(1-p_1^B) + 2p_1^B(\overline{q} - f(p_1^B)) - (\overline{q} - f(p_1^B))^2.$$

When $p_1^B = 1$, the expression above is equal to the expected utility of drawing exclusively from an extremist. Additionally, the expression is increasing in p_1^B if

$$f'(p_1^B) < \frac{2\overline{q} - q^e - 2f(p_1^B)}{2(p_1 - \overline{q} + f(p_1^B))}.$$

Notice that the right hand side of the inequality is decreasing in p_1^B. Therefore, the inequality is satisfied for all p_1^B if

$$f'(p_1^B) < \frac{q^e}{2(1-q^e)}. \quad \text{(A-4)}$$

Therefore if $f'(p_1^B) < \frac{q^e}{2(1-q^e)}$, when firm A is an extremist towards one state and firm B is biased towards the other, an unbiased agent would strictly prefer to get all his news from the extremist. One can easily verify that under the same condition an unbiased agent would also strictly prefer an extremist when both firms are biased towards the same state.

If inequality (A-4) is satisfied, even an unbiased consumer would strictly prefer to receive all his news from an extremist. This ensures that in equilibrium both firms will be extremists for opposing alternatives under any population distribution.

Even if inequality (A-4) is violated for some values of p_1^B, then an unbiased consumer may still prefer to receive information with some bias. Recall from Section 4 that when increasing bias does not decrease informativeness, an unbiased agent prefers *any* biased firm to an unbiased outlet. Therefore, if the loss in informativeness is small for small amounts of bias, but increasing quickly as bias increases, positive but not extreme bias will be optimal. Specifically, if $f'\left(\frac{1+q}{2}\right) = 0$, $f'' > 0$ and $f'(1) = \infty$, then maximal bias will not be optimal as a firm's signals will have lost all informativeness. But, even unbiased agents will prefer at least some bias since $f'\left(\frac{1+q}{2}\right) = 0$, i.e. not much information is lost when a firm is close to neutral.

7.2 Risk Aversion

Instead of choosing either alternative 0 or 1, suppose consumers now choose a fraction $x \in [0, 1]$. Substantively, this can represent a situation in which a citizen has to choose how much to invest in each proposal. Additionally, suppose consumers are risk-averse and have utility functions defined by,

$$U(x) = \begin{cases} \sqrt{x} & \text{if the state is 0} \\ \sqrt{1-x} & \text{if the state is 1} \end{cases} \tag{A-5}$$

As before, the news firms must decide how to search for information subject to the technology constraint $p_0^j + p_1^j = 1 + q$.

Notice that if a consumer believes that the true state of the world is 0 with probability α, he will choose,

$$\max_x \ \alpha\sqrt{x} + (1-\alpha)\sqrt{1-x}$$

$$\frac{1}{2}\alpha x^{-\frac{1}{2}} - \frac{1}{2}(1-\alpha)(1-x)^{-\frac{1}{2}} = 0$$

$$x = \frac{\alpha^2}{\alpha^2 + (1-\alpha)^2}. \tag{A-6}$$

Therefore, letting x_0 and x_1 represent an agent's choice following a signal of 0 or 1 respectively, a consumer's expected benefit to watching firm j in a one period setting is given by,

$$\alpha(p_0^j\sqrt{x_0} + (1-p_0^j)\sqrt{x_1}) + (1-\alpha)((1+q-p_0^j)\sqrt{1-x_1} + (p_0^j - q)\sqrt{1-x_0}).$$

Substituting for the consumers optimal choice after Bayesian updating following each signal yields,

$$\sqrt{(\alpha p_0^j)^2 + (1-\alpha)^2(p_0^j - q)^2} + \sqrt{(\alpha(1-p_0^j))^2 + (1-\alpha)^2(1+q-p_0^j)^2}. \quad \text{(A-7)}$$

Notice equation (A-7) is convex in p_0^j and is minimized when $p_0^j = p_{min} = \frac{1}{2} + \frac{q(1-\alpha)^2}{1-2\alpha(1-\alpha)}$. Therefore, depending on the consumer's prior beliefs α, one of three cases arises. Either $p_{min} \leq q$, in which case (A-7) is strictly increasing in p_0^j, $p_{min} \geq 1$ in which case (A-7) is strictly decreasing in p_0^j, or $q < p_{min} < 1$ in which case (A-7) is decreasing, then increasing. In any case, a consumer finds it optimal to receive information from an extremist, *even if he is unbiased*. Specifically, a consumer would prefer an extremist biased towards state 0 if,

$$\sqrt{\alpha^2 + (1-\alpha)^2(1-q)^2} + (1-\alpha)q \geq \alpha q + \sqrt{(\alpha(1-q))^2 + (1-\alpha)^2}$$
$$\alpha \geq \frac{1}{2}.$$

When consumers are risk-averse, they still prefer to receive information from an extremist biased towards their prior beliefs. Moreover, even unbiased risk-averse consumers prefer extremists, even in a static setting, because they have the capability of alleviating all uncertainty.

Further, just like with risk neutral consumers, a dynamic environment does not temper the desire to acquire biased information. To see this, now suppose a consumer has two periods in which to gather information. Additionally, assume that firm A is an extremist biased towards state 0, firm B sets $1 > p_0^B > q$, and that the agent is (weakly) biased towards state 0 so that, $\alpha \geq \frac{1}{2}$. As demonstrated in the preceding discussion, if a signal of 0 is received in the first period, the consumer will find it optimal to draw from firm A in the second period. Therefore, if the agent selects firm A in the first period, his expected utility is given by,

$$\alpha\sqrt{\frac{\alpha^2}{\alpha^2+(1-\alpha)^2(1-q)^4}}+(1-\alpha)\left(q^2+2q(1-q)+(1-q)^2\sqrt{\frac{(1-\alpha)^2(1-q)^4}{\alpha^2+(1-\alpha)^2(1-q)^4}}\right).$$

If 0 is the true state, the consumer will receive two signals of 0 and act accordingly. If the true state is 1, it will be perfectly revealed if a signal of 1 is received, in which case the consumer will derive a payoff of 1, otherwise he will receive two signals of 0 and choose accordingly given this message profile. Simplifying the expression above yields,

$$\sqrt{\alpha^2+(1-\alpha)^2(1-q)^4}+(1-\alpha)(1-(1-q)^2). \tag{A-8}$$

If the consumer selects firm B in the first period, then following a signal of 1, either it is optimal to draw again from firm B in the second period, or it is optimal to draw from firm A. However, in either case, a consumer (weakly) biased towards state 0 prefers to gather his information exclusively from an extremist biased towards his prior beliefs.

To see that this is indeed the case, first suppose that the agent would draw again from firm B in the second period following a signal of 1 in the first. By following this strategy, the agent expects,

$$\alpha\Bigg[p\sqrt{\frac{(\alpha p)^2}{(\alpha p)^2+((1-\alpha)(p-q)(1-q))^2}}+(1-p)\Bigg(p\sqrt{\frac{(\alpha p(1-p))^2}{(\alpha p(1-p))^2+((1-\alpha)(p-q)(1+q-p))^2}}$$
$$+(1-p)\sqrt{\alpha^2(1-p)^4}\alpha^2(1-p)^4+(1-\alpha)^2(1+q-p)^4\Bigg)\Bigg]$$

$$+(1-\alpha)\Bigg[(1+q-p)\Bigg((1+q-p)\sqrt{\frac{(1-\alpha)^2(1+q-p)^4}{\alpha^2(1-p)^4+(1-\alpha)^2(1+q-p)^4}}$$
$$+(p-q)\sqrt{\frac{((1-\alpha)(p-q)(1+q-p))^2}{(\alpha p(1-p))^2+((1-\alpha)(p-q)(1+q-p))^2}}\Bigg)$$
$$+(p-q)\left(q+(1-q)\sqrt{\frac{((1-\alpha)(p-q)(1-q))^2}{(\alpha p)^2+((1-\alpha)(p-q)(1-q))^2}}\right)\Bigg]$$

where p_0^B has been replaced with p to economize on notation. Simplifying the expression yields,

$$\sqrt{(\alpha p)^2 + ((1-\alpha)(p-q)(1-q))^2} + \sqrt{(\alpha p(1-p))^2 + ((1-\alpha)(p-q)(1+q-p))^2}$$
$$+ \sqrt{\alpha^2(1-p)^4 + (1-\alpha)^2(1+q-p)^4} + (1-\alpha)(p-q)q. \tag{A-9}$$

The consumer prefers to start at firm A in the first period if (A-8) > (A-9), which holds for all $q < p < 1$.

Now suppose that the agent chooses firm A in the second period irrespective of the signal he receives from firm B in the first. By doing so the consumer expects,

$$\alpha \left[p\sqrt{\frac{(\alpha p)^2}{(\alpha p)^2 + ((1-\alpha)(p-q)(1-q))^2}} + (1-p)\sqrt{\frac{(\alpha(1-p))^2}{(\alpha(1-p))^2 + ((1-\alpha)(1+q-p)(1-q))^2}} \right]$$

$$+ (1-\alpha) \left[(1+q-p) \left(q + (1-q)\sqrt{\frac{((1-\alpha)(1+q-p)(1-q))^2}{(\alpha(1-p))^2 + ((1-\alpha)(1+q-p)(1-q))^2}} \right) \right.$$

$$\left. (p-q) \left(q + (1-q)\sqrt{\frac{((1-\alpha)(p-q)(1-q))^2}{(\alpha p)^2 + ((1-\alpha)(p-q)(1-q))^2}} \right) \right]$$

which simplifies to,

$$\sqrt{(\alpha p)^2 + ((1-\alpha)(p-q)(1-q))^2} + \sqrt{(\alpha(1-p))^2 + ((1-\alpha)(1+q-p)(1-q))^2} + (1-\alpha)q. \tag{A-10}$$

Since (A-8) > (A-10) for all $q < p < 1$, a consumer (weakly) biased towards state 0 prefers to gather all his information from an extremist biased towards his prior beliefs.

Whether risk neutral or risk-averse, consumers prefer to receive all their news from a source highly biased towards their prior beliefs. By receiving information exclusively from an extremist, an agent ensures that all the messages he receives will be of use. Additionally, risk-averse consumers attain an added benefit from extremists as they have the potential to completely eliminate all uncertainty.

7.3 Imperfect Bias

Suppose that extremism is not possible so that a firm is confined to make mistakes in both states of the world. Specifically, assume $p_0^j + p_1^j = 1 + q$ as before, but that now $p_k^j \leq \overline{p} < 1$ for $k = 0, 1$. Thus, a firm has some discretion over how it conducts its search for information, but is unable to perfectly identify either state. Even in this setting, consumers prefer biased news, particularly news that is as biased as possible towards their prior beliefs. Moreover, in a dynamic setting, unbiased consumers still prefer maximal bias.

Suppose an unbiased consumer has two periods in which to acquire information. Further suppose firm A is as biased as possible towards alternative 0, $p_0^A = \overline{p}$, and firm B is also weakly biased towards state 0 but takes a less extreme approach, $\frac{1+q}{2} \leq p_0^B < \overline{p}$. As demonstrated in the text, if a signal of 0 is received in the first period, the consumer will prefer firm A in the second as it is more heavily biased towards state 0. Additionally, since both firms are (weakly) biased towards state 0, a signal of 1 is relatively strong. Should an agent receive a signal of 1 in the first period, neither firm will be able to convince him to choose alternative 0 in the second. By choosing firm A in the first period an unbiased agent expects,

$$\frac{1}{2}(\overline{p}(\overline{p} - (1 - \overline{p})) + (1 - \overline{p})(-1)) + \frac{1}{2}((1 + q - \overline{p}) + (\overline{p} - q)((\overline{p} - q)(-1) + (1 + q - \overline{p})))$$

$$= (2\overline{p} - q)q. \tag{A-11}$$

If the true state is 0, the consumer will choose correctly if he receives two signals of 0. If alternative 1 should be selected, the correct choice will be made if at least one signal of 1 is received.

Now suppose an unbiased agent chooses firm B initially. By doing so he expects,

$$\frac{1}{2}(p_0^B(\overline{p} - (1 - \overline{p})) - (1 - p_0^B)) + \frac{1}{2}(1 + q - p_0^B + (p_0^B - q)(1 + q - \overline{p} - (\overline{p} - q)))$$

$$= (p_0^B + \overline{p} - q)q. \tag{A-12}$$

Therefore, an unbiased consumer would prefer firm A in the first period if,

$$(2\overline{p} - q)q > (p_0^B + \overline{p} - q)q$$

$$p_0^B < \overline{p}.$$

Now suppose firm B is biased towards state 1 so that $1 + q - \overline{p} < p_0^B < \frac{1+q}{2}$. In this case, should an agent receive a signal of 1 in the first period from firm B, he will find it optimal to watch firm B again in the second. Therefore, by choosing B in the first period an agent expects,

$$\frac{1}{2}(p_0^B(2\overline{p} - 1) + (1 - p_0^B)(2p_0^B - 1)) + \frac{1}{2}((1 + q - p_0^B)(1 + 2q - 2p_0^B) + (p_0^B - q)(1 + 2q - 2\overline{p}))$$

$$= (1 - p_0^B + \overline{p})q. \tag{A-13}$$

Thus, an unbiased agent prefers firm A initially if,

$$(2\overline{p} - q)q > (1 - p_0^B + \overline{p})q$$

$$p_0^B > 1 + q - \overline{p}.$$

In a dynamic environment, even unbiased consumers prefer to receive the most biased news possible. While perfect revelation of any state is impossible, maximal bias still minimizes the number of mistakes a consumer will make in expectation.

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