Unfairly Balanced:

Unbiased News Coverage and Information Loss*

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Abstract

A majority of Americans view news organizations as politically biased, creating a strong incentive for firms to try to present themselves as impartial. This paper argues that the desire to appear unbiased leads to information loss. In the formal model, firms withhold information in an effort to appear neutral. It is shown that information loss is exacerbated by competition, policies that regulate content are welfare reducing, and that regulating the size of the market can increase the amount of information revealed. Finally, the introduction of imperfectly informed sources of news, such as blogs, can decrease the incentives for traditional news outlets to provide information, yet they may also enhance welfare when information is being suppressed.

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1 Introduction

There is a widespread skepticism of the motivations of today's news media. A recent survey by the Pew Research Center found that 75% of Americans feel that news organizations "care more about attracting the biggest audience rather than about keeping the public informed."[1] In addition to this concern, a majority of consumers are also worried about the impartiality of their news outlets.[2,3] Six-in-ten view news organizations as politically biased.[4] Since a large majority of the public prefers to receive information without a political slant, the perception of bias creates a strong incentive for media outlets to try to appear politically neutral.[5]

However, in an attempt to appear objective, news organizations may create a false balance in the news by presenting opposing viewpoints in a more evenhanded manner then the evidence warrants. News organizations often insist on a "spurious balance" and are afraid of "provoking a reaction in which they'll be accused of bias, however unfounded the charge," argues Ken Silverstein, an investigative reporter for the *Los Angeles Times*.

> "I am completely exasperated by this approach to the news. The idea seems to be that we go out to report but when it comes time to write we turn our brains off and repeat the spin from both sides. God forbid we should...attempt to fairly assess what we see with our own eyes. "Balanced" is not fair, it's just an easy way of avoiding real reporting and shirking our responsibility to inform readers."

Unfortunately, heightened competition may be increasing the type of news Silverstein bemoans. Recently, the number of news providers has increased while the audience for each outlet has diminished. This has lead to an increased focus on profitability that journalists claim is "seriously hurting" the quality of the news reporting.[6] The Pew Research Center quotes a Vice President of online news at a local TV station as saying,

> "Journalism is becoming more and more a business operation. What news stories will make our station/newspaper the most profitable? This has always been part of the 'business' but

[1] http://people-press.org/reports/display.php3?ReportID=248
[2] See Alterman(2003), Coulter(2003), Franken(2003) or Goldberg(2003) for examples.
[3] Groseclose and Milyo (2005) provides a measure of media bias for many outlets.
[4] http://people-press.org/reports/display.php3?ReportID=248
[5] http://people-press.org/reports/display.php3?PageID=1067
[6] http://people-press.org/reports/display.php3?ReportID=214

now it has become the major factor."

Journalists are concerned that the increased focus on bottom-line pressures is inducing more factual errors and creating a press corps that is "too timid". "We don't ask 'why' - or 'why not' - nearly as much as we should, particularly when covering our government," says a staff writer as quoted by the Pew Research Center. These concerns have led to a precipitous drop in the percentage of journalists who have a great deal of confidence in the public's election choices from 52% in 1999 to 31% in 2004.[7]

This paper investigates these concerns by developing a model of the news media in which the incentive to appear impartial leads to information loss. Unbiased news firms withhold information so as not to appear ideologically motivated. Moreover, it is argued that competition exacerbates this incentive. When there are many firms in the market, the impact any one outlet has on the public's beliefs is small. Since each firm is unlikely to convince the population to make the correct decision, firms focus on enhancing their reputations rather then providing information. It is shown that even if firms care a lot about "keeping the public informed" and little about their reputations, market forces can lead to information loss as firms are induced to treat inherently unequal alternatives equally in an attempt to appear unbiased.

In the formal model, a population must select between three alternatives: alternative A, alternative B and the status quo. Prior to making a decision, news organizations of unknown preferences send messages to the population about which alternative is best. Each firm can be one of three types: biased towards A, biased towards B, or unbiased. Biased firms only want their desired proposal to be accepted regardless of merit. Unbiased firms want the best alternative to be selected, but also care about their reputation for being unbiased. Each firm receives a signal that perfectly reveals the true state with probability $1 - \epsilon$, and with probability ϵ reveals nothing. The population aggregates the media's messages and then selects the alternative that leads to the largest expected benefit. The paper first analyzes a monopolistic setting, then introduces competition and shows that when there are many firms in the market, information gets suppressed. Further, it is shown that policies that regulate content can be welfare reducing, while limiting the size of the market can increase the amount of information revealed. Finally, the introduction of imperfectly informed sources of news, such as blogs, can decrease the incentives for the mainstream media to provide information, yet they may enhance welfare when information is being suppressed.

[7] ibid

There are several recent studies on media bias related to this paper. Mullainathan and Shleifer (2005) and Bernhardt, Krasa and Polborn (2006) examine the market for news when consumers receive utility from reading news that confirms their prior beliefs. Under this condition, profit maximizing firms may find it optimal to slant their reporting towards consumers' tastes. In Baron (2006), bias arises as journalists shift their reporting towards their preferred state. Despite competition between profit maximizing news sources, bias persists. In Gentzkow and Shapiro (2006), 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. All of these works provide reasons why rational firms may *become* biased. In contrast, the focus of this work is on how the (potential) presence of biased firms affects the amount of information revealed by unbiased firms.

Formally, this paper is related to the literature on sender-receiver games with reputation concerns. Sobel (1985) examines a model of reputation building when a single advisor has preferences that are either identical (a friend) or completely opposed (an enemy) to those of the receiver. When the friendly advisor reports truthfully, the receiver's enemy will sometimes report honestly to invest in his reputation only to misreport when the payoff to deceiving the receiver is sufficiently large. Benabou and Laroque (1992) examines an asset market setting and extends Sobel (1985) by introducing noisy information. Morris (2001) shows that when there are partisans who want the same action taken regardless of the state of the world, even an advisor with preferences identical to those of the receiver may misreport in an attempt to enhance his reputation.[8] Like in Morris (2001), in this work the preferences of the unbiased sender and the receiver are identical, yet distortions exist due to reputation concerns.[9] However, this paper departs from the previous literature by introducing competition among senders with unknown preferences and shows that even if reputation concerns are arbitrarily small, too much competition will lead to information suppression.

Park (2005) provides an alternative rationale for how increased competition may decrease honesty in equilibrium. In his work, there are two types of agents, mechanics and a customer. The preferences of all

[8]See Morgan and Stocken (2003) and Olszewski (2004) for other models in which a single sender is concerned both with his reputation and the receiver's decision.

[9]Ottaviani and Sorensen (2006a, 2006b, 2001) and Sharfstein and Stein (1990) examine situations in which senders are motivated exclusively by reputation concerns.

agents are known. Each period, one of the mechanics is able to provide the customer with a benefit by performing a needed repair, while the rest of the mechanics provide no benefit. Prior to selecting a service provider, the customer can choose any number of mechanics to give consultations as to whom can provide the benefit. Each mechanic knows who is able to provide the service. Since a mechanic only receives a benefit if he is hired to perform the repair, consultants have an incentive to misreport themselves as the capable service provider. As the number of mechanics increases, it becomes less likely any agent will be the capable mechanic next period. This decreases a consultant's continuation payoff from honesty and thereby decreases the maximum honesty level sustainable in equilibrium. While information revelation is decreasing in the number of experts (mechanics), it is not necessarily decreasing in the number of senders (consultants). Indeed, if three or more mechanics are consulted, full information revelation is possible when considering only unilateral deviations. The focus of this work is not on increased competition due to increased specialization, but rather increased competition due to more firms providing information, thereby lessening the value of any individual firm's report. Even in this setting, increased competition can lead to information loss.

Finally, while this work is focused on information *provision*, it is also related to several works that are focused on information *aggregation*. Like in Feddersen and Pesendorfer (1996), uninformed unbiased firms are subject to a "swing voter's curse". When informed unbiased firms are revealing their information with positive probability, uninformed unbiased firms strictly prefer to treat the issues equally, even in the absence of reputation concerns. Should an uninformed firm recommend one alternative over the other, it is more likely to impact the population's decision negatively rather than positively. However, the focus of this work is on the incentives for the *informed* unbiased firms to provide information. As the paper shows, when unbiased firms are concerned about their reputations, even if these concerns are small, informed firms will also withhold information if there is too much competition. Lohmann (1993) examines the incentives to engage in costly political action and Feddersen and Pesendorfer (1997) examines the ability of elections to aggregate information when voters have private information. Both papers show that when information is dispersed throughout the population, even if the population is arbitrarily large, information will be (at least partially) aggregated. In contrast, this work shows that as the number of media firms gets large, valuable information will no longer be provided.

The following section discusses the primitives of the model. Sections 3 and 4 contain the analysis of the monopolistic and competitive settings, respectively. Policies regulating content and competition are analyzed in Section 5. Section 6 introduces imperfectly informed sources of news and Section 7 concludes. Any proof not appearing in the text has been relegated to the Appendix.

2 The Model

A population[10] must select between three mutually exclusive alternatives: A, B, and S.[11] Alternative S is the status quo option which provides the population a utility of 0 in all states, while alternatives A and B are proposals for change. The values to alternatives A and B (v_A and v_B respectively) are given as follows;

$$(v_A, v_B) = \begin{cases} (v_H, v_L) & \text{with probability } \frac{1}{2}\alpha \\ (v_L, v_H) & \text{with probability } \frac{1}{2}\alpha \\ (-v_H, -v_L) & \text{with probability } \frac{1}{2}(1-\alpha) \\ (-v_L, -v_H) & \text{with probability } \frac{1}{2}(1-\alpha), \end{cases}$$

where $v_H > v_L > 0$. With probability α, both alternatives provide a benefit and with probability $1 - \alpha$ they both cause harm. Therefore, α should be interpreted as the probability that it is time for a change. If it is time for a change, the population wants to implement either proposal A or proposal B, whichever provides the greatest benefit. However, if it is not time for a change, then the status quo policy should be maintained.

Notice that this distribution rules out the possibility that the two proposals provide the same benefit. This case is not considered for two reasons. First, in terms of the model, this case is uninteresting as there is only a tension when the two proposals provide different benefits. Second, in reality it is highly unlikely that two distinct proposals will yield exactly the same benefits. Also, in order to simplify the analysis, the case in which one alternative provides a benefit and the other causes harm is excluded. Introducing this configuration would simply complicate the analysis without qualitatively changing the results. Additionally, assuming the absolute values of the proposals are the same regardless of whether or not it is

[10]The population is modelled as one decision maker, however it can represent any number of identical decision makers.
[11]The model can easily be reduced to consider a situation in which one of two alternatives must be implemented.

time for a change also simplifies the exposition without substantively altering the results. If the proposals provided different benefits when negative than when positive, all that would change is the cutoff on α for which the population finds it optimal to follow a firm's recommendation when unbiased informed firms are reporting honestly.

As an example of the situations under study, consider the war in Iraq. The US government can either increase troops, decrease troops, or "stay the course". If the situation in Iraq is a disaster, then either increasing or decreasing troops can provide a benefit. However, if the implemented policy is achieving its goal, then the status quo should be maintained as there is no reason to switch. If the media can credibly convey which alternative provides the highest benefit, then the public can put pressure on the government to implement the optimal policy.[12]

Prior to making a decision, the population receives messages from $N+1$ firms. Each firm $i \in \{1, ..., N+1\}$ can be one of three types, $\theta_i \in \{\theta_A, \theta_B, \theta_U\}$. Firms of type θ_A (θ_B) are biased towards alternative A (B), while firms of type θ_U are unbiased. It is assumed that biased types are ideologically motivated and are willing to sacrifice profits in order to further their agenda. Types are private information and are determined by the realizations of i.i.d. random variables where

$$\theta_i = \begin{cases} \theta_A & \text{with probability } \frac{1}{2}\gamma \\ \theta_B & \text{with probability } \frac{1}{2}\gamma \\ \theta_U & \text{with probability } 1-\gamma. \end{cases}$$

After learning its type, each firm observes the values of the alternatives with probability $1-\epsilon$ and with probability ϵ observes nothing. Subsequently, each outlet sends a message from the following message space: $m_i \in$ {A, B, "Equal", "Both Bad"}. Therefore, a firm can do one of four things. It can recommend alternative A be implemented, recommend alternative B be implemented, claim that the two proposals are equals, or recommend that the status quo be maintained. The population then aggregates the media's reports, updates using Bayes' rule, and selects the alternative that provides the highest expected utility.

Firms biased towards alternative A (B) only receive utility if their desired policy is implemented and

[12]The model assumes the population chooses directly, but it applies equally well to situations like the one described in the example.

are perfectly willing to sacrifice their reputations in order to increase the chance their preferred outcome is realized.[13] Therefore it is assumed that these firms send message "A" ("B") with probability 1. Assuming biased types behave in this way simplifies the analysis by reducing the number of equilibria that need to be considered (i.e. it rules out equilibria in which a message of "A" is construed as a recommendation for alternative B and vice versa). Moreover, the assumption is fairly innocuous since in equilibrium these firms will be acting rationally. Unbiased firms, however, care both about the implemented policy and about their reputation for being unbiased. Specifically, they receive the same utility as the population from the chosen alternative, yet suffer a reputation cost whenever they send message "A" or "B". If an unbiased firm sends message "A" or "B" with positive probability, then upon receipt of either message, the population will be unable to determine whether the firm is actually unbiased or whether it is biased towards its recommended alternative. However, if an unbiased firm were to treat the issues symmetrically by sending either message "Equal" or "Both Bad" it would perfectly separate from the biased types. This model can be interpreted as the first stage of a continuation game in which a firm's ability to attract consumers is increasing in its reputation for being unbiased.

Throughout the paper it is assumed that the loss in reputation from sending message "A" or "B" is valued at c. The second section of the Appendix shows how the reputation cost can be endogenized to be the ex-post probability the population assigns to a firm being a biased type. The main results would continue to hold in this setting. Maintaining a reduced form assumption not only simplifies the analysis, but also allows for stronger comparisons between the incentives to provide information and invest in reputation. Allowing costs to be endogenous places a lower bound on the value of reputation, however, as will be shown, even if reputation concerns are arbitrarily small the incentive to invest in appearance can dominate and induce firms to withhold information.

Like in all models with costless messages there exist "babbling" equilibria in which the senders message doesn't depend on the true state and the receivers decision doesn't depend upon the message sent. In this setting, these equilibria are both uninteresting and implausible, so the paper will restrict attention to informative equilibria, i.e. equilibria in which the informed unbiased sender's message conveys some information about the true state. Additionally, since there are multiple messages, there exist equilibria in

[13] Assuming biased firms receive a negative payoff if the opposing alternative is implemented wouldn't alter the results as long as the payoff from the desired alternative is sufficiently greater than the absolute value of the loss derived from the opposing alternative.

which off-equilibrium path beliefs are used to artificially restrict the message space. For example, equilibria in which no one sends message "A" (even biased types) because the population assigns probability one to a type being biased upon the receipt of that message. These equilibria are also regarded as implausible and ignored.

3 Monopoly

Suppose there is a monopoly in the market for news so that consumers receive only one message prior to making a decision. If the monopolist is uninformed, then it doesn't have any information about which alternative is best beyond the market prior. Therefore, uninformed unbiased firms will regard alternatives A and B as equals since, to the best of their knowledge, each provides the same expected benefit. Suppose for the moment that these firms report honestly by sending message "Equal". Biased firms, on the other hand, want their desired alternative implemented regardless of the state. Whether informed or uninformed, these firms will deterministically send either message "A" or "B" depending on the direction of their bias.

Consider the population's beliefs following the receipt of any report. Should the population receive message "Both Bad", then it knows this message has come from an informed unbiased firm and that the status quo should be maintained. Similarly, should the population receive message "Equal", it knows the signal has come from an unbiased firm, but has no way of differentiating between alternatives A and B.[14] Since each alternative is equally attractive in this case, it is assumed the population randomizes equally between the two if it prefers either to the status quo. However, if an informed unbiased firm sends message "A" or "B" with positive probability, then upon receipt of either message, the population will be unsure whether the recommended alternative is indeed best, or whether the message has come from a biased firm and hence doesn't contain any information about the true state.

Notice that if alternative S is best, then an informed unbiased firm will send message "Both Bad". This both enhances the firms reputation and induces the correct decision. However, if alternative A or B

[14]This is true in any equilibrium in which unbiased informed firms send message "Equal" with same probability when alternative A is best as when alternative B is best.

is best, then an informed unbiased firm must decide whether to invest in its reputation by sending message "Equal" or whether to try and induce the optimal decision at the cost of being perceived as potentially biased. If an informed unbiased firm sends message "A" ("B") with probability 1 when alternative A (B) is best, then the population will implement the recommended alternative if the following inequality is satisfied,

$$\frac{\frac{1}{2}\alpha(1-\gamma)(1-\epsilon)}{\frac{1}{2}\alpha(1-\gamma)(1-\epsilon)+\frac{1}{2}\gamma}v_H + \frac{\alpha\frac{1}{2}\gamma}{\frac{1}{2}\alpha(1-\gamma)(1-\epsilon)+\frac{1}{2}\gamma}\left(\frac{v_H+v_L}{2}\right) \geq \frac{(1-\alpha)\frac{1}{2}\gamma}{\frac{1}{2}\alpha(1-\gamma)(1-\epsilon)+\frac{1}{2}\gamma}\left(\frac{v_H+v_L}{2}\right).$$

The inequality above is simply a comparison between the expected benefit and expected cost of implementing the recommendation. With probability α it's time for a change and selecting the recommended alternative will provide a benefit. If the message has come from an informed unbiased firm, then implementing the recommendation provides a benefit of v_H. If the message has come from a biased firm, then it doesn't contain any information about the true state, so half the time the proposed alternative will provide a benefit of v_H and the other half of the time it will provide a benefit of v_L. However, if it's not time for a change, then the message must have come from a biased firm. In this case, by implementing the recommended alternative the population will lose $\frac{v_H+v_L}{2}$ in expectation. Rearranging the inequality yields the following,

$$\gamma \leq \overline{\gamma} = \frac{\alpha(1-\epsilon)v_H}{\alpha(1-\epsilon)v_H - \alpha\left(\frac{v_H+v_L}{2}\right) + (1-\alpha)\left(\frac{v_H+v_L}{2}\right)}.$$

If γ, the level of bias in the economy, is sufficiently small, then the population would implement a recommendation of A (B) if an informed unbiased firm sent that message with certainty when the corresponding proposal is best. Alternatively, should the message "Equal" be received, it must have come from an unbiased uninformed firm. Therefore, the population will choose randomly between alternatives A and B, if

$$\alpha\left(\frac{v_H+v_L}{2}\right) - (1-\alpha)\left(\frac{v_H+v_L}{2}\right) \geq 0$$

or,

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

When $\alpha > \frac{1}{2}$, alternative A (B) provides a benefit in expectation and will be preferred to the status quo when no other information is revealed. If $\alpha = \frac{1}{2}$, then all alternatives provide the same expected benefit ex-ante, while if $\alpha < \frac{1}{2}$, the status quo will be preferred to either alternative following a message of "Equal".

An informed unbiased firm would follow its supposed strategy if

$$v_H - c > \left(\frac{v_H + v_L}{2}\right)$$

$$c < \frac{v_H - v_L}{2}.$$

If the firm's recommended alternative will be implemented, then it will receive v_H by sending the correct message, yet suffer a reputation cost by not separating from the biased types. However, if the firm sent message "Equal", this would induce the population to select the status quo if $\alpha < \frac{1}{2}$, or randomize equally between alternatives A and B if $\alpha \geq \frac{1}{2}$. Notice that a deviation is most attractive when $\alpha \geq \frac{1}{2}$ since sending message "Equal" would induce a change, which is beneficial, yet the best alternative would be implemented only half of the time. Unless otherwise specified, it is assumed throughout that this last inequality is satisfied so that if its recommendation were to be followed, an informed unbiased firm has an incentive to fully reveal its information. This leads to the following proposition.

Proposition 1. *There exists an equilibrium in which an informed unbiased firm fully reveals its information if and only if* $\gamma \leq \overline{\gamma}$.

Proof. As seen above when $\gamma \leq \overline{\gamma}$, an unbiased firm prefers to fully reveal its information since its recommendation will be followed. Additionally, biased firms have no incentive to deviate as they are getting their most desired outcome with probability 1. Finally, by sending message "Equal", in expectation an uninformed unbiased firm receives

$$\begin{cases} (2\alpha - 1)\left(\frac{v_H + v_L}{2}\right), & \text{if } \alpha \geq \frac{1}{2} \\ 0, & \text{if } \alpha < \frac{1}{2}. \end{cases}$$

In either case, this payoff strictly dominates the expected payoff from sending either message "A" or "B", and weakly dominates the payoff to sending message "Both Bad".

However, if $\gamma > \overline{\gamma}$, then no such equilibrium exists. In this case, even if informed unbiased firms deterministically signal the correct alternative when it is time for a change, the population will find it optimal to stick with the status quo following a message of "A" or "B". Since a recommendation for change would not be followed, informed unbiased firms will withhold information and treat the issues symmetrically to avoid suffering the reputation cost.

□

If the level of bias in the economy is small, an informed unbiased firm can induce the optimal decision. Since the proportion of unbiased types is sufficiently large, the population is willing to implement a recommendation of A or B as the chance of being misled by a biased firm is outweighed by the benefit gained from following an informed unbiased firm's recommendation. However, if $\gamma > \overline{\gamma}$, then information will be suppressed. In this case, even if informed unbiased firms fully reveal their information with certainty, the population will not follow a recommendation of "A" or "B" as it is too likely that this message has come from a biased firm. Therefore, since it's recommendation would not always be followed, when it's time for a change an unbiased informed firm will withhold information and treat the issues symmetrically in order to enhance its reputation.

Notice that setting $\alpha = \frac{1}{2}$ in the expression for $\overline{\gamma}$ yields $\overline{\gamma} = 1$. Therefore, when $\alpha = \frac{1}{2}$, an informed unbiased firm will fully reveal its information no matter what the level of bias in the economy. In this case, following a biased firm's report won't hurt the population in expectation since alternative A (B) is as likely to provide a benefit as it is to cause harm. Consequently, the population is willing to follow any recommendation, no matter how biased the media market. For the remainder of the paper it will be assumed that $\alpha = \frac{1}{2}$ so that the incentive for unbiased informed firms to fully reveal their information is maximized. However, as the next section shows, even in this case, information will be withheld if there is too much competition.

4 N+1 Firms

Suppose there are $N + 1 \geq 2$ firms in the market. Additionally, suppose for the moment that uninformed unbiased firms find it optimal to report honestly by sending message "Equal". As in the case of a monopoly, if the status quo should be maintained, an informed unbiased firm will send message "Both Bad" with probability one. This message both induces the correct decision and separates the sender from the biased types. However, if alternative A or B is best, an informed unbiased firm must decide whether to sacrifice its reputation in an attempt to generate the correct decision, or whether to enhance its reputation by sending message "Equal".[15] Since, the situation in which alternative A is the best option is symmetric to the situation in which alternative B is best, the paper will focus on symmetric equilibria, i.e. equilibria in which informed unbiased firms fully reveal their information with same probability in the two states.

Consider the population's beliefs following the receipt of any message profile.[16] If the message profile contains at least one message of "Both Bad", then the population knows this message has come from an informed unbiased firm and that alternative S is the best option. However, as the next lemma establishes, if the message profile does not contain any reports indicating the status quo should be maintained, it is a best response to select the alternative that has received the most recommendations.

Lemma 1. *If the message profile contains at least one message "Both Bad", the population will select alternative S. However, when the message profile doesn't contain any signals "Both Bad" the population will choose the alternative that has received the most recommendations.*

Proof. See Appendix

□

A message of "Both Bad" is fully revealing as it occurs with positive probability only when the status quo should be maintained. If there aren't any signals indicating the status quo is the best option, the population will prefer the alternative that has received the most reports since each firm is equally likely to be biased in either direction and unbiased firms never signal the incorrect alternative. If alternatives A and B have received the same number of reports, each option will be equally attractive. In this case it is assumed the population randomizes equally between the two.

Suppose alternative A provides the greatest benefit. Let ϕ denote the probability the other informed unbiased firms fully reveal their information and $1-\phi$ denote the probability they send message "Equal". The benefit to an informed unbiased firm from sending message "A" is given by

$$\left(\frac{v_H - v_L}{2}\right) P(\phi, \gamma, N)$$

[15] When it is time for a change, message "Equal" dominates both message "Both Bad" and recommending the alternative that provides v_L.

[16] Notice all message profiles occur with positive probability.

where,

$$P(\phi,\gamma,N)=\sum_{j=0}^{\lfloor\frac{N}{2}\rfloor}\binom{N}{j,j,N-2j}\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{j}\left(\frac{1}{2}\gamma\right)^{j}\left((1-\gamma)(1-\epsilon)(1-\phi)+(1-\gamma)\epsilon\right)^{N-2j}$$

$$+\sum_{j=0}^{\lfloor\frac{N-1}{2}\rfloor}\binom{N}{j,j+1,N-2j-1}\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{j}\left(\frac{1}{2}\gamma\right)^{j+1}\left((1-\gamma)(1-\epsilon)(1-\phi)+(1-\gamma)\epsilon\right)^{N-2j-1}$$

An informed unbiased firm benefits from revealing information whenever its report changes the population's decision. A firm's report is pivotal if either there are an equal number of recommendations of "A" and "B", or if there is one more recommendation for the incorrect alternative than the correct alternative. When A is the best alternative, message "A" is sent if either the firm is biased towards alternative A, or if the firm is informed, unbiased and reveals it's information. Message "B" is sent only if the firm is biased towards alternative B, while message "Equal" is sent if either the firm is informed, unbiased and withholds information or if the firm is unbiased yet uninformed. When its report is pivotal, an unbiased firm increases the probability the correct alternative is chosen by $\frac{1}{2}$, resulting in a gain of $\frac{v_H-v_L}{2}$.[17]

By selecting the alternative that has received the most support, the optimal decision rule balances the biased types as best as possible. This in turn provides the maximum incentives for informed unbiased firms to reveal their information. As the following lemma shows, an informed unbiased firm finds it most attractive to report honestly when all other informed unbiased firms withhold information.

Lemma 2. *$P(\phi,\gamma,N)$ is strictly decreasing in ϕ.*

Proof. See Appendix □

In expectation, the optimal decision rule of the population balances out the biased types. When informed unbiased firms reveal their information with positive probability, this tilts the distribution of reports towards the best alternative, which decreases the incentives to report honestly. As ϕ increases, the probability any firm's report will be pivotal decreases, as does the incentive to provide information. This leads to the following proposition.

[17]Notice this section of the model is similar to a pivotal voting model. While the decision made by the public must be a best response to the amount of information revealed in equilibrium, due to symmetry the resulting optimal cut-off is at $\frac{1}{2}$ regardless of ϕ. Section 6 breaks the symmetry by introducing an imperfectly informed source of news. In this situation, the decision rule adopted by the population will depend endogenously on ϕ, the amount of information revealed.

Proposition 2. *In the symmetric informative equilibrium, uninformed unbiased firms report honestly and informed unbiased firms reveal their information with probability ϕ where,*

$$\phi \begin{cases} = 0, & \text{if } \left(\frac{v_H - v_L}{2}\right) P(0,\gamma,N) < c \\ = 1, & \text{if } \left(\frac{v_H - v_L}{2}\right) P(1,\gamma,N) > c \\ \text{is determined by } \left(\frac{v_H - v_L}{2}\right) P(\phi,\gamma,N) = c, & \text{Otherwise} \end{cases}$$

Proof. See Appendix. □

As assumed, uninformed unbiased firms strictly prefer to report honestly. By sending message "Equal", these firms have no impact on the population's decision. However, the expected benefit from sending message "A" or "B" is negative, even ignoring the reputation costs. Uninformed unbiased agents are subject to a "swing voter's curse". Should they recommend one alternative over the other, it is more likely they will impact the population's decision negatively rather than positively. Additionally, honest reporting also dominates message "Both Bad" as sending signal "Equal" provides positive expected surplus while "Both Bad" delivers 0 with certainty.

When reputation concerns are strong, informed unbiased firms prefer to withhold information and signal to the market that they are unbiased. When they are moderately concerned with their appearance, informed unbiased firms will randomize between revealing and withholding information and, finally, when reputation concerns are weak, they will report honestly as the potential to impact the public's decision outweighs the loss in reputation. However, as the following key result establishes, even if reputation concerns are arbitrarily small, informed unbiased firms will withhold information if there is too much competition.

Proposition 3. *There exists an N^* such that for all $N \geq N^*$, informed unbiased firms withhold information.*

Proof. As Lemma 2 establishes, $P(\phi,\gamma,N)$ is maximized when $\phi = 0$. It needs to be shown that there exists an N^* such that $P(0,\gamma,N) < \frac{2c}{v_H - v_L}$, for all $N \geq N^*$. When $\phi = 0$, the probability an informed unbiased firm would be pivotal if it provided information is given by

$$P(0,\gamma,N) = \sum_{j=0}^{\lfloor \frac{N}{2} \rfloor} \binom{N}{j,j,N-2j} \left(\frac{1}{2}\gamma\right)^{2j} \left(1-\gamma\right)^{N-2j} + \sum_{j=0}^{\lfloor \frac{N-1}{2} \rfloor} \binom{N}{j,j+1,N-2j-1} \left(\frac{1}{2}\gamma\right)^{2j+1} \left(1-\gamma\right)^{N-2j-1}$$

When all other unbiased firms withhold information, a firm's report is pivotal if either the number of firms biased towards A equals the number biased towards B, or there is one extra firm biased towards the incorrect alternative. As the Lemma 3 of the Appendix shows, $P(0, \gamma, N)$ is monotonically decreasing in N. Additionally, since it is bounded below by zero, it has a limit.

Define X_i as the following

$$X_i = \begin{cases} = -1, & \text{with prob } \frac{1}{2}\gamma \\ = 0, & \text{with prob } 1 - \gamma \\ = 1 & \text{with prob } \frac{1}{2}\gamma. \end{cases}$$

X_i is a mean 0 random variable with variance γ. Notice the probability that the number of firms biased towards A equals the number biased towards B is also given by $Prob\left(\sum_{i=1}^{N} X_i = 0\right)$. Using the Central Limit Theorem yields

$$\lim_{N\to\infty} Prob\left(\sum_{i=1}^{N} X_i = 0\right) \simeq \frac{1}{\sqrt{2\pi\gamma N}} \int_{-\frac{1}{2}}^{\frac{1}{2}} e^{-\frac{x^2}{2\gamma N}} dx \simeq \frac{1}{\sqrt{2\pi\gamma N}} \to 0$$

A similar argument can be used to show that the probability there is one more firm biased towards the incorrect alternative than the correct alternative, $Prob\left(\sum_{i=1}^{N} X_i = 1\right)$, also approaches 0 as N gets large.

Since $P(0, \gamma, N)$ is monotonically decreasing and approaches 0 as $N \to \infty$, there exists an N^* such that for all $N \geq N^*$, $P(0, \gamma, N) < \frac{2c}{v_H - v_L}$.

□

As established in Lemma 1, the population will select the alternative that receives the most support when there aren't any messages recommending that the status quo be maintained. Consequently, when it is time for a change and there are many news firms, the chance that one more favorable report alters the population's decision is small. This induces informed unbiased firms to withhold information rather than sacrifice their reputation.

When there is a lot of competition, unbiased firms focus on their bottom-lines rather than informing the public, even if reputation concerns are arbitrarily small. In a highly competitive marketplace, there will be many biased firms creating a lot of noise. The chance any unbiased firm can cut through this noise and inform the public is exceedingly small. Since the chance its message has any impact on the public's decision is infinitesimal, unbiased firms invest in their reputation rather than providing information.

5 Policy Procedures

Biased news organizations can negatively impact consumers' decisions both directly, by providing false information, and indirectly, by inducing unbiased firms to withhold information. However, there are many ways in which society can attempt to mitigate the effects of biased news. This section explores the welfare implications of regulations on content and competition.

5.1 Fairness Doctrine

In an attempt to ensure that media coverage of controversial issues was fair and balanced, the Federal Communications Commission introduced the Fairness Doctrine in 1949. The Fairness Doctrine required that broadcast licensees present controversial issues of public importance in a manner that was deemed equal and balanced. The doctrine was enforced from the inception of the FCC up until 1987 at which point it was repealed. However, as of early 2007, several members of Congress have announced their support for legislation that would reinstate it.[18] This has lead to a heated debate and in June of 2007 the House passed an amendment prohibiting the FCC from using funds to restore the Fairness Doctrine. A similar amendment, however, was blocked in the Senate and both supporters and opponents of the legislation have vowed to continue pressing the issue.[19]

If the Fairness Doctrine were to be renewed, the FCC's broadcast licensees would be unable to openly support one alternative over another on any contentious issue. Therefore, in terms of the model, firms would be restricted to treat the issues symmetrically as the available message space would be reduced to $m_i \in \{$"Equal", "Both Bad"$\}$. Biased firms, however, will still be biased and will only be concerned with sending the message that implements their desired alternative with the highest probability. Since it can no longer directly recommend its preferred policy, a biased firm will now send message "Equal" with probability one. While this will not always induce the population to select the firm's desired alternative,

[18] www.sanders.senate.gov/news/record.cfm?id=269328.
[19] http://www.chicagotribune.com/business/chi-mon_fair_0730jul30,0,7056061.story

it will be a message supporting a change. Additionally, should a new direction be beneficial, informed unbiased firms can only signal that a change is necessary, but cannot provide any information about which alternative is better. Hence, these firms will send message "Both Bad" if the status quo is the best option, and message "Equal" otherwise. As in the previous sections, uninformed unbiased firms strictly prefer not to have an impact on the population's decision and will report honestly.

The population can now receive one of three types of message profiles. Either the message profile is comprised entirely of signals "Equal" or "Both Bad", or it contains some mixture of the two. However, if the message profile contains at least one signal "Both Bad", the population knows this has come from an informed unbiased firm and that the status quo policy is the best option. Otherwise, if the message profile is comprised entirely of recommendations claiming the options are equals, after Bayesian updating, the population will find it optimal to make a change, but has no way of differentiating between alternatives A and B.

Therefore, expected utility under the Fairness Doctrine is given by

$$\frac{1}{2}\left(\frac{v_H + v_L}{2}\right) - \frac{1}{2}\left(\gamma + (1-\gamma)\epsilon\right)^{N+1}\left(\frac{v_H + v_L}{2}\right).$$

If it is time for a change, every firm in the economy will send message "Equal". Subsequently, the population will be induced to make a change, but has no way of determining which alternative is best. Half the time the population will choose the correct alternative and receive v_H, yet the other half the time they will choose incorrectly and receive v_L. If it's not time for a change, the population will correctly stick with the status quo if it receives at least one message "Both Bad". However, if it receives only recommendations for change, the population will erroneously select either A or B and lose $\frac{v_H+v_L}{2}$ in expectation. If the status quo alternative is the best option, the message profile will be comprised entirely of signals "Equal" only if every firm in the economy is either biased or uninformed. This occurs with probability $(\gamma + (1-\gamma)\epsilon)^{N+1}$.

Now consider the population's expected welfare without the Fairness Doctrine when informed unbiased firms reveal their information with probability ϕ. Let $\pi(\phi, \gamma, N+1)$ denote the ex-ante probability the population selects the correct alternative when it is time for a change. In this case, expected welfare is given by

$$\frac{1}{2}\left(\pi(\phi,\gamma,N+1)v_H+(1-\pi(\phi,\gamma,N+1))v_L\right)-\frac{1}{2}\left(\gamma+(1-\gamma)\epsilon\right)^{N+1}\left(\frac{v_H+v_L}{2}\right).$$

If the status quo should be maintained, the population will choose correctly unless every firm in the market is either biased or uninformed. If it's time for a change, then with probability $\pi(\phi,\gamma,N+1)$ the best alternative will be revealed and the population will gain v_H. The following lemma shows that $\pi(\phi,\gamma,N+1)\geq\frac{1}{2}$.

Lemma 4. *The probability the population chooses the correct alternative when it is time for a change, $\pi(\phi,\gamma,N+1)$, equals $\frac{1}{2}$ when $\phi=0$ and is strictly greater than $\frac{1}{2}$ when $\phi>0$.*

Proof. See Appendix. □

If informed unbiased firms are fully revealing their information with any positive probability, when it is time for a change the correct alternative will be chosen more often then not. This leads to the following proposition.

Proposition 4. *If informed unbiased firms are withholding information, implementing the Fairness Doctrine will not provide a benefit. However, if informed unbiased firms are revealing their information with any positive probability, implementing the Fairness Doctrine would be welfare reducing.*

Proof. If $\phi=0$, then $\pi(\phi,\gamma,N+1)=\frac{1}{2}$ and expected utility is given by

$$\frac{1}{2}\left(\frac{v_H+v_L}{2}\right)-\frac{1}{2}\left(\gamma+(1-\gamma)\epsilon\right)^{N+1}\left(\frac{v_H+v_L}{2}\right),$$

which corresponds exactly with expected utility under the Fairness Doctrine. However, if $\phi>0$, the net change in expected utility from introducing the Fairness Doctrine is

$$\frac{1}{2}\left(\frac{v_H+v_L}{2}\right)-\frac{1}{2}\left(\pi(\phi,\gamma,N+1)v_H+(1-\pi(\phi,\gamma,N+1))v_L\right)$$

which is strictly negative since $\pi(\phi,\gamma,N+1)>\frac{1}{2}$.

□

Regulating content will not provide any benefit and may cause harm. While the Fairness Doctrine removes the ability of biased firms to lobby directly for their desired alternative, it does not induce them to provide any information. Moreover, if unbiased firms are signaling the correct alternative with any positive probability, implementing the Fairness Doctrine will reduce the amount of information revealed.

5.2 Regulating Competition

Expanding the size of the market introduces a tradeoff. If the status quo should be maintained, the population will do so as long as there exists at least one informed unbiased firm. Therefore, increasing the number of firms in the market reduces the probability that alternative A or B is erroneously selected when no change is warranted. However, as seen in Section 4, if there is too much competition, unbiased firms will withhold information, which reduces welfare.

Suppose reputation concerns are strong so that $c > \frac{v_H - v_L}{2}$. In this case, no matter what the level of competition in the market, unbiased firms will withhold information so as not to appear biased. As seen in Section 5.1, if unbiased firms are withholding information, expected welfare is given by

$$\frac{1}{2}\left(\frac{v_H + v_L}{2}\right) - \frac{1}{2}\left(\gamma + (1-\gamma)\epsilon\right)^{N+1}\left(\frac{v_H + v_L}{2}\right),$$

which is strictly increasing in N. If unbiased firms are so concerned with their reputations that they won't recommend A or B even if doing so would lead to the correct decision, then competition increases welfare. In this case, increasing the size of the market has no impact on whether or not an informed unbiased firm reveals its information when it is time for a change, but it decreases the chance that a change is made when the status quo is optimal.

If informed unbiased firms have an incentive to provide information, i.e. if $\frac{v_H - v_L}{2} > c$, then welfare may be non-monotonic in N. To see this first consider an extreme comparison between a monopolist and an infinite number of firms. Under a monopolist, expected welfare is determined by

$$\frac{1}{2}\left((1-\gamma)(1-\epsilon)v_H + (\gamma + (1-\gamma)\epsilon)\left(\frac{v_H + v_L}{2}\right)\right) - \frac{1}{2}(\gamma + (1-\gamma)\epsilon)\left(\frac{v_H + v_L}{2}\right).$$

If it is time for a change, the population will choose the best option if the monopolist is unbiased and informed. If the monopolist is biased or uninformed, the correct alternative will be selected with probability

$\frac{1}{2}$ if it is time for a change, while, if the status quo is the best alternative the population will mistakenly choose another alternative and lose $\frac{v_H+v_L}{2}$ in expectation. Under an infinite number of firms expected welfare is

$$\frac{1}{2}\left(\frac{v_H+v_L}{2}\right).$$

When there are an infinite number of firms, informed unbiased firms withhold information so the population is never able to differentiate between alternatives A and B. However, the status quo will always be maintained when it is the best option, since the probability the entire market is biased or uninformed is zero. Simple algebra reveals that the population would prefer a monopolist if

$$(1-\gamma)(1-\epsilon) > \frac{v_H+v_L}{2v_H}.$$

In a monopoly, there is a large chance that the entire market will be either biased or uninformed in which case the population will be frequently misled. However, if γ and ϵ are sufficiently small, this concern is dominated by the increase in welfare derived from an informed unbiased firm with incentives to report honestly.

Suppose $(1-\gamma)(1-\epsilon) > \frac{v_H+v_L}{2v_H}$, so that a monopolist is preferred to an infinite number of firms. As seen in the previous section, when there are $N+1$ firms and unbiased firms are revealing their information with probability ϕ, expected utility is given by

$$\frac{1}{2}\left(\pi(\phi,\gamma,N+1)v_H + (1-\pi(\phi,\gamma,N+1))v_L\right) - \frac{1}{2}\left(\gamma+(1-\gamma)\epsilon\right)^{N+1}\left(\frac{v_H+v_L}{2}\right).$$

When N is small, an informed unbiased firm will find it optimal to provide information with probability one. The following lemma shows that when informed unbiased firms are revealing their information deterministically, the probability the correct alternative is selected when it is time for a change is non-decreasing in N.

Lemma 5. $\pi(1,\gamma,N+1)$ *is non-decreasing in* N.

Proof. See Appendix. □

The preceding lemma also establishes that,

$$\frac{1}{2}\left(\pi(1,\gamma,N+1)v_H + (1-\pi(1,\gamma,N+1))v_L\right) - \frac{1}{2}\left(\gamma + (1-\gamma)\epsilon\right)^{N+1}\left(\frac{v_H+v_L}{2}\right)$$

is strictly increasing in N. As long as informed unbiased firms continue to reveal their information, increasing the number of firms in the market enhances welfare. Therefore, entry should be encouraged at least up to the largest N such that $\left(\frac{v_H-v_L}{2}\right)P(1,\gamma,N) > c$.

When $(1-\gamma)(1-\epsilon) > \frac{v_H+v_L}{2v_H}$, the size of the market should be regulated. Entry should be encouraged as long as unbiased firms still have an incentive to reveal their information with probability one. Increasing competition beyond this point, however, will induce unbiased firms to withhold information, which reduces welfare.

6 Blogs

Many people have access to several different types of news sources and increasingly the public is turning to blogs to receive information. However, blogs are often less informed than the mainstream media as they have far fewer resources to investigate stories. To capture this, suppose the population has access to another source of information, the blogosphere, which is potentially misinformed. Specifically, if alternative A is the best option, blogs will observe and send message "A" with probability $\mu > \frac{1}{2}$ and send message "B" with probability $1-\mu$. If the status quo should be maintained, blogs will transmit complete noise by sending message "A" and "B" each with probability $\frac{1}{2}$.[20]

As in the previous sections, biased firms will deterministically signal their preferred alternative and, as seen in the following lemma, uninformed unbiased firms will strictly prefer to report honestly.

Lemma 6. *When blogs are present, uninformed unbiased firms strictly prefer to report honestly by sending message "Equal".*

Proof. See Appendix. □

When it is time for a change, informed unbiased firms must choose between signaling the correct decision

[20] When the status quo is optimal, there is no distortion in the unbiased firms' reporting strategies. Consequently, in this state the exact form of the blogs' distribution over reports is unimportant.

and investing in their reputations as before, but now have the added benefit that blogs may reveal the correct alternative.

Suppose there is a monopoly in the news market and that an informed unbiased firm would reveal its information. Should the monopolist send message "Both Bad", the population will stick with the status quo as this message is perfectly revealing. Should the monopolist send message "Equal", the population will find it optimal to implement the alternative suggested by the blogosphere, while if the monopolist and the blogs agree on which alternative is best, the population will accept the recommendation. Should they differ, however, the population must consider the reliability of each source and will choose the alternative suggested by the monopolist if,

$$\frac{1}{4}(1-\mu)\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\right)v_H+\frac{1}{4}\mu\left(\frac{1}{2}\gamma\right)v_L-\left(\frac{1}{4}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\gamma\right)v_H-\left(\frac{1}{4}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\gamma\right)v_L$$

$$\geq\frac{1}{4}\mu\left(\frac{1}{2}\gamma\right)v_H+\frac{1}{4}(1-\mu)\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\right)v_L-\left(\frac{1}{4}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\gamma\right)v_H-\left(\frac{1}{4}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\gamma\right)v_L$$

$$u\leq\frac{\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)}{\gamma+(1-\gamma)(1-\epsilon)}.$$

If $u\leq\frac{\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)}{\gamma+(1-\gamma)(1-\epsilon)}$, then when it is time for a change, the monopolist has the ability to send the correct message more often then the blogs. Throughout this section it is assumed that this inequality is satisfied so that news organizations have the capability of being more reliable.

An informed unbiased monopolist would find it optimal to signal the correct alternative if

$$v_H-c\geq\mu v_H+(1-\mu)v_L.$$

Notice that incentive to provide information is now reduced. Since blogs send an informative signal when it is time for a change, news organizations are less apt to do so. Specifically, if

$$(1-\mu)(v_H-v_L)<c<\frac{v_H-v_L}{2},$$

then in the absence of the blogosphere, informed unbiased firms would fully reveal their information while when blogs are present, they withhold. In this situation, the population is worse off as the probability the correct alternative is selected when the monopolist is informed and unbiased drops from one to u with the introduction of blogs.

Now consider a competitive marketplace. As in previous sections, should the population receive at least one signal "Both Bad", then the status quo will be maintained. However, if the news organizations' message profile is comprised entirely of signals "Equal" and recommendations for change, the population must now weigh the overall informativeness of the message profile against the signal received from the blogs. Suppose informed unbiased firms reveal information with probability ϕ. If the news firms send j signals of "A", k signals of "B" and the blogosphere sends message "A", alterative A will be implemented if

$$\frac{1}{4}\mu\binom{N}{j,k,N-j-k}\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{j}\left(\frac{1}{2}\gamma\right)^{k}\left((1-\gamma)(1-\epsilon)(1-\phi)+(1-\gamma)\epsilon\right)^{N-j-k}$$

$$\geq\frac{1}{4}(1-\mu)\binom{N}{j,k,N-j-k}\left(\frac{1}{2}\gamma\right)^{j}\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{k}\left((1-\gamma)(1-\epsilon)(1-\phi)+(1-\gamma)\epsilon\right)^{N-j-k}$$

$$\left(1+\frac{(1-\gamma)(1-\epsilon)\phi}{\frac{1}{2}\gamma}\right)^{j-k}\geq\frac{1-\mu}{\mu},$$ [21]

otherwise alternative B will be selected. Similarly, if news organizations provide j signals of "A", k signals of "B" and the blogosphere sends message "B", alternative A will be selected if

$$\left(1+\frac{(1-\gamma)(1-\epsilon)\phi}{\frac{1}{2}\gamma}\right)^{j-k}>\frac{\mu}{1-\mu}.$$

If the blogosphere recommends implementing alternative A, the population will do so unless news organizations provide sufficiently many more signals of "B" than "A". Notice the net number of "B" signals required depends upon ϕ, the informativeness of each news firm's signal.

Suppose alternative A is the best option. The benefit to an informed unbiased firm from signaling the correct alternative now depends on whether or not the blogosphere sends the correct message. If the blogs send message "A", then an informed unbiased firm will be pivotal if there are exactly $R(\phi)$ more signals

[21] If the population is exactly indifferent between the two alteratives, it is assumed they select the option recommended by the blogs. However, any tie breaking rule would yield the same results.

of "B" than "A". $R(\phi)$ is the net number of signals "B" such that one more signal of "A" will induce the population to select the correct alternative. Similarly, if the blogs send message "B", an informed unbiased firm's message will have an impact if there are exactly $W(\phi)$ more messages of "A" than "B". Therefore, the expected benefit to providing information is given by,

$$(v_H - v_L)\left[\mu P(\phi, \gamma, N, R(\phi)) + (1-\mu) P(\phi, \gamma, N, W(\phi))\right],$$

where

$$P(\phi, \gamma, N, R(\phi)) = \sum_{j=0}^{\lfloor \frac{N-R(\phi)}{2} \rfloor} \binom{N}{j, j+R(\phi), N-2j-R(\phi)} \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^j \left(\frac{1}{2}\gamma\right)^{j+R(\phi)}$$
$$\times \left((1-\gamma)(1-\epsilon)(1-\phi) + (1-\gamma)\epsilon\right)^{N-2j-R(\phi)}$$

$$P(\phi, \gamma, N, W(\phi)) = \sum_{j=0}^{\lfloor \frac{N-W(\phi)}{2} \rfloor} \binom{N}{j+W(\phi), j, N-2j-W(\phi)} \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^{j+W(\phi)} \left(\frac{1}{2}\gamma\right)^{j}$$
$$\times \left((1-\gamma)(1-\epsilon)(1-\phi) + (1-\gamma)\epsilon\right)^{N-2j-W(\phi)}.$$

When ϕ is large, it won't take many contradictory signals to overturn the blogs since news firms' messages are highly informative. However, as $\phi \to 0$, both $R(\phi)$ and $W(\phi) \to \infty$, and the population becomes increasingly reliant on the blogosphere for information. As the next proposition shows, when there is a lot of competition in the news media, informed unbiased firms will withhold information so the population will rely on the blogs to differentiate between alternatives "A" and "B".

Proposition 5. *When N is large, in equilibrium, informed unbiased firms withhold information.*

Proof. Notice that $\phi = 0$ is always an equilibrium regardless of the size of the market. When informed unbiased firms withhold information, the population will simply select the alternative suggested by the blogs when the message profile from the news firms doesn't contain any signals "Both Bad". Hence, when it is time for a change, unbiased firms have no incentive to signal the correct alternative. Additionally, any $\phi > 0$ cannot be an equilibrium when N is sufficiently large. To see this define

$$X_i = \begin{cases} = -1, & \text{with prob } \frac{1}{2}\gamma \\ = 0, & \text{with prob } (1-\gamma)(1-\epsilon)(1-\phi) + (1-\gamma)\epsilon \\ = 1 & \text{with prob } \frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi \end{cases}$$

X_i is a random variable with mean $(1-\gamma)(1-\epsilon)\phi$ and variance $\sigma^2 = \gamma + (1-\gamma)(1-\epsilon)\phi - ((1-\gamma)(1-\epsilon)\phi)^2$. Notice $P(\phi, \gamma, N, R(\phi)) = Prob\left(\sum_{i=1}^{N} X_i = -R(\phi)\right)$. For any ϕ and corresponding cutoff $R(\phi)$, using the Central Limit Theorem yields,

$$\lim_{N\to\infty} Prob\left(\sum_{i=1}^{N} X_i = -R(\phi)\right) \simeq \frac{1}{\sqrt{2\pi\sigma^2 N}} \int_{-R(\phi)-\frac{1}{2}}^{-R(\phi)+\frac{1}{2}} e^{-\frac{(x-(1-\gamma)(1-\epsilon)\phi N)^2}{2\sigma^2 N}} dx < \frac{1}{\sqrt{2\pi\sigma^2 N}} \to 0.$$

A similar argument can be used to show that $Prob\left(\sum_{i=1}^{N} X_i = W(\phi)\right)$, also approaches 0 as N gets large. For any $\phi > 0$ and corresponding cutoffs, the benefit to an informed unbiased firm from signaling the correct alternative approaches zero as the size of the market increases, while the cost to doing so remains strictly positive. Hence, when there are many news organizations, informed unbiased firms will withhold information. □

When the news media is highly competitive, informed unbiased firms will withhold information since the chance of impacting the public's decision is outweighed by the benefits gained from appearing unbiased. Consequently, the population will turn to the blogosphere in order to differentiate between alternatives A and B. Even though blogs are on average less informed than traditional news outlets, they will be providing a more informative, albeit noisy, signal.

While blogs may decrease the incentives for informed unbiased firms to provide information, they also strictly increase welfare when there is too much competition. As seen previously, when the news media is highly competitive, informed unbiased firms will withhold information, regardless of whether or not blogs are present. In the absence of blogs, the population will only select the correct alternative half of the time when a change is necessary. However, when the population also receives information from the blogosphere, even though they are imperfectly informed, blogs increase probability the correct alternative is chosen from $\frac{1}{2}$ to μ.

7 Conclusion

Media outlets spend a significant amount of resources investing in their reputation for neutrality. This paper has shown how the desire to appear unbiased can lead to information loss in the market for news. A firm that is concerned with its appearance has an incentive to withhold information in order to maintain its reputation for impartiality. Moreover, even if firms care arbitrarily little about their reputations, if there is too much competition information will get lost. When there are many voices in the market, no firm is willing to sacrifice its reputation since the chance it has an impact on the public's decision is infinitesimal. Additionally, it was shown that policies regulating content can be welfare reducing, while limiting the size of the market can provide an atmosphere conducive to information revelation. Finally, the introduction of imperfectly informed sources of news, such as blogs, can decrease the incentives for traditional media outlets to provide information, however they may also increase welfare if information is being suppressed.

Appendix

Lemma 1. *If the message profile contains at least one message "Both Bad", the population will select alternative S. However, when the message profile doesn't contain any signals "Both Bad" the population will choose the alternative that has received the most recommendations.*

Proof. As noted in the text, a message of "Both Bad" is fully revealing as it only occurs with positive probability when the status quo should be maintained. Therefore in any message profile with at least one message "Both Bad", alternative S will be selected.

Suppose there are N firms in the market and the message profile contains j messages of "A", k messages of "B" and $N-k-j$ messages of "Equal". Let ϕ denote the probability an informed unbiased firm signals the correct alternative and $1-\phi$ denote the probability it sends message "Equal". Alternative A is preferred to alternative B if and only if the probability that A provides a benefit of v_H and the message profile occurs is greater than the probability that B provides a benefit of v_H and the message profile occurs, where $P(\text{A} = v_H$ and message profile occurs)

$$= \frac{1}{4}\binom{N}{j, k, N-j-k}\left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^j \left(\frac{1}{2}\gamma\right)^k \left((1-\gamma)(1-\epsilon)(1-\phi) + (1-\gamma)\epsilon\right)^{N-j-k}.$$

When A is the best option, message "A" is sent if either the firm is biased towards the correct alternative or if the firm is informed, unbiased and reveals its information. The probability the correct message is sent when it is time for a change is given by $\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi$. Similarly, message "B" is sent only if the firm is biased towards alternative B, and message "Equal" is sent if either the firm is informed, unbiased and withholds information or if the firm is unbiased and uninformed. Therefore, alternative A is preferred to B if

$$\frac{1}{4}\binom{N}{j, k, N-j-k}\left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^j \left(\frac{1}{2}\gamma\right)^k \left((1-\gamma)(1-\epsilon)(1-\phi) + (1-\gamma)\epsilon\right)^{N-j-k}$$

$$\geq \frac{1}{4}\binom{N}{j, k, N-j-k}\left(\frac{1}{2}\gamma\right)^j \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^k \left((1-\gamma)(1-\epsilon)(1-\phi) + (1-\gamma)\epsilon\right)^{N-j-k}$$

$$\left(1 + \frac{(1-\gamma)(1-\epsilon)\phi}{\frac{1}{2}\gamma}\right)^{j-k} \geq 1.$$

Alternative A is strictly preferred to alternative B if $\phi > 0$ and there are more recommendations of A then B. The population is indifferent between the two alternatives if either each has received an equal number of reports or if $\phi = 0$.

Further, if the message profile doesn't contain any messages "Both Bad", then both alternatives A and B are preferred to the status quo. The status quo always provides a payoff of 0, while if the message profile contains j messages of "A", k messages of "B" and $N-k-j$ messages of "Equal", then the expected benefit to implementing alternative A is

$$\frac{1}{4}v_H\binom{N}{j,k,N-j-k}\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^j\left(\frac{1}{2}\gamma\right)^k\left((1-\gamma)(1-\epsilon)(1-\phi)+(1-\gamma)\epsilon\right)^{N-j-k}$$

$$+\frac{1}{4}v_L\binom{N}{j,k,N-j-k}\left(\frac{1}{2}\gamma\right)^j\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^k\left((1-\gamma)(1-\epsilon)(1-\phi)+(1-\gamma)\epsilon\right)^{N-j-k}$$

$$-\frac{1}{4}v_H[1-(1-\gamma)(1-\epsilon)]^N\binom{N}{j,k,N-j-k}\left(\frac{\frac{1}{2}\gamma}{1-(1-\gamma)(1-\epsilon)}\right)^{j+k}\left(\frac{(1-\gamma)\epsilon}{1-(1-\gamma)(1-\epsilon)}\right)^{N-j-k}$$

$$-\frac{1}{4}v_L[1-(1-\gamma)(1-\epsilon)]^N\binom{N}{j,k,N-j-k}\left(\frac{\frac{1}{2}\gamma}{1-(1-\gamma)(1-\epsilon)}\right)^{j+k}\left(\frac{(1-\gamma)\epsilon}{1-(1-\gamma)(1-\epsilon)}\right)^{N-j-k}.$$

If it is not time for a change, then the message profile will not contain any signals "Both Bad" only if there aren't any informed unbiased agents. In this case, the profile of reports is pure noise and is equally likely to occur in each state. Notice that alternative A is preferred to alternative S since both,

$$\left[\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^j\left(\frac{1}{2}\gamma\right)^k\left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-j-k}-\left(\frac{1}{2}\gamma\right)^{j+k}\left((1-\gamma)\epsilon\right)^{N-j-k}\right]$$

and

$$\left[\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^k\left(\frac{1}{2}\gamma\right)^j\left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-j-k}-\left(\frac{1}{2}\gamma\right)^{j+k}\left((1-\gamma)\epsilon\right)^{N-j-k}\right]$$

$$\geq 0.$$

Therefore, if the message profile does not contain any signals "Both Bad", it is a best response to select the alternative that has received the most support and randomize equally between the two if each has received an equal number of reports.

$\square$

Lemma 2. *$P(\phi,\gamma,N)$ is strictly decreasing in ϕ.*

Proof. Suppose N is even. Differentiating $P(\phi,\gamma,N)$ with respect to ϕ and then noting that

$$(1-\gamma)(1-\epsilon)(1-\phi)+(1-\gamma)\epsilon = 1-\gamma-(1-\gamma)(1-\epsilon)\phi,$$

yields

$$(1-\gamma)(1-\epsilon)\left[\sum_{j=0}^{\frac{N}{2}}\binom{N}{j,j,N-2j}j\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{j-1}\left(\frac{1}{2}\gamma\right)^{j}\left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j}\right.$$

$$-\sum_{j=0}^{\frac{N}{2}}\binom{N}{j,j,N-2j}(N-2j)\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{j}\left(\frac{1}{2}\gamma\right)^{j}\left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-1}$$

$$+\sum_{j=0}^{\frac{N-2}{2}}\binom{N}{j,j+1,N-2j-1}j\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{j-1}\left(\frac{1}{2}\gamma\right)^{j+1}\left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-1}$$

$$-\sum_{j=0}^{\frac{N-2}{2}}\binom{N}{j,j+1,N-2j-1}(N-2j-1)\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{j}\left(\frac{1}{2}\gamma\right)^{j+1}$$

$$\left.\times\left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-2}\right].$$

Combining the first and last terms and dropping the common multiplicative constant yields,

$$\sum_{j=1}^{\frac{N}{2}}\binom{N}{j,j,N-2j}j\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{j-1}\left(\frac{1}{2}\gamma\right)^{j}\left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j}$$

$$-\sum_{j=0}^{\frac{N-2}{2}}\binom{N}{j,j+1,N-2j-1}(N-2j-1)\left(\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi\right)^{j}\left(\frac{1}{2}\gamma\right)^{j+1}$$

$$\times\left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-2}.$$

$$= \sum_{j=0}^{\frac{N-2}{2}} \binom{N}{j+1, j+1, N-2j-2} (j+1) \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^{j} \left(\frac{1}{2}\gamma\right)^{j+1} \times \left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-2}$$

$$- \sum_{j=0}^{\frac{N-2}{2}} \binom{N}{j, j+1, N-2j-1} (N-2j-1) \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^{j} \left(\frac{1}{2}\gamma\right)^{j+1} \times \left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-2}.$$

The expression above equals 0 since,

$$\binom{N}{j+1, j+1, N-2j-2} (j+1) = \binom{N}{j, j+1, N-2j-1} (N-2j-1).$$

Therefore, $\frac{\partial P(\phi,\gamma,N)}{\partial \phi}$ is proportional to

$$\sum_{j=0}^{\frac{N-2}{2}} \binom{N}{j, j+1, N-2j-1} j \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^{j-1} \left(\frac{1}{2}\gamma\right)^{j+1} \left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-1}$$

$$- \sum_{j=0}^{\frac{N}{2}} \binom{N}{j, j, N-2j} (N-2j) \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^{j} \left(\frac{1}{2}\gamma\right)^{j} \left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-1}$$

$$= \sum_{j=0}^{\frac{N-2}{2}} \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^{j-1} \left(\frac{1}{2}\gamma\right)^{j} \left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-1}$$
$$\times \left[\binom{N}{j, j+1, N-2j-1} j \left(\frac{1}{2}\gamma\right) - \binom{N}{j, j, N-2j} (N-2j) \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)\right].$$

Notice $\frac{\partial P(\phi,\gamma,N)}{\partial \phi}$ is negative since,

$$\binom{N}{j, j, N-2j} (N-2j) > \binom{N}{j, j+1, N-2j-1} j$$

for all $j \in \{0, \frac{N-2}{2}\}$.

The proof for odd N is exactly analogous.

□

Proposition 2. *In the symmetric informative equilibrium, uninformed unbiased firms report honestly and informed unbiased firms reveal their information with probability ϕ where,*

$$\phi \begin{cases} = 0, & \text{if } \left(\frac{v_H - v_L}{2}\right) P(0,\gamma,N) < c \\ = 1, & \text{if } \left(\frac{v_H - v_L}{2}\right) P(1,\gamma,N) > c \\ \text{is determined by } \left(\frac{v_H - v_L}{2}\right) P(\phi,\gamma,N) = c, & \text{Otherwise} \end{cases}$$

Proof. When it is time for a change, an informed unbiased firm is indifferent between fully revealing its information and sending message "Equal" when $\left(\frac{v_H - v_L}{2}\right) P(\phi,\gamma,N) = c$. Since $P(\phi,\gamma,N)$ is strictly decreasing in ϕ, either there exists an interior solution, or ϕ is determined by the boundary conditions listed above.

Additionally, the supposed behavior of the uninformed unbiased types is in fact optimal. Let $\pi(\phi,\gamma,N)$ denote the ex-ante probability the population chooses correctly when it is time for a change and there are N firms. By sending message "Equal" an uninformed unbiased firm expects

$$\frac{1}{2}\left(\pi(\phi,\gamma,N)v_H + (1-\pi(\phi,\gamma,N))v_L\right) - \frac{1}{2}\bigg(\gamma + (1-\gamma)\epsilon\bigg)^N \left(\frac{v_H + v_L}{2}\right).$$

When an unbiased uninformed firm sends message "Equal", it has no impact on the population's decision. If the status quo should be maintained, the population will choose correctly unless all other firms in the market are either biased or unbiased and uninformed. When there aren't any informed unbiased firms and the status quo is the best option, the population will choose incorrectly and lose $\frac{v_H+v_L}{2}$ in expectation. However, as Lemma 4 shows, when it is time for a change $\pi(\phi,\gamma,N) \geq \frac{1}{2}$. Therefore, an unbiased uninformed firm strictly prefers honest reporting to sending message "Both Bad" since sending message "Equal" provides positive expected surplus.

Additionally, unbiased uninformed firms strictly prefer honest reporting to a message of "A" or "B". By sending message "A" the firm's expected benefit over message "Equal" is

$$\frac{1}{4}\left(\frac{v_H - v_L}{2}\right)\left[\sum_{j=0}^{\lfloor \frac{N}{2} \rfloor}\binom{N}{j, j, N-2j}\left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^j \left(\frac{1}{2}\gamma\right)^j \left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j}\right.$$

$$\left.+\sum_{j=0}^{\lfloor \frac{N-1}{2} \rfloor}\binom{N}{j, j+1, N-2j-1}\left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^j \left(\frac{1}{2}\gamma\right)^{j+1} \left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-1}\right]$$

$$-\frac{1}{4}\left(\frac{v_H - v_L}{2}\right)\left[\sum_{j=0}^{\lfloor \frac{N}{2} \rfloor}\binom{N}{j, j, N-2j}\left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^j \left(\frac{1}{2}\gamma\right)^j \left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j}\right.$$

$$\left.+\sum_{j=0}^{\lfloor \frac{N-1}{2} \rfloor}\binom{N}{j+1, j, N-2j-1}\left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^{j+1} \left(\frac{1}{2}\gamma\right)^{j} \left(1-\gamma-(1-\gamma)(1-\epsilon)\phi\right)^{N-2j-1}\right]$$

$$-\frac{1}{4}\left(\frac{v_H - v_L}{2}\right)\Big(1-(1-\gamma)(1-\epsilon)\Big)^N \left[\sum_{j=0}^{\lfloor \frac{N}{2} \rfloor}\binom{N}{j, j, N-2j}\left(\frac{\frac{1}{2}\gamma}{1-(1-\gamma)(1-\epsilon)}\right)^{2j}\left(\frac{(1-\gamma)\epsilon}{1-(1-\gamma)(1-\epsilon)}\right)^{N-2j}\right.$$

$$\left.+\sum_{j=0}^{\lfloor \frac{N-1}{2} \rfloor}\binom{N}{j, j+1, N-2j-1}\left(\frac{\frac{1}{2}\gamma}{1-(1-\gamma)(1-\epsilon)}\right)^{2j+1}\left(\frac{(1-\gamma)\epsilon}{1-(1-\gamma)(1-\epsilon)}\right)^{N-2j-1}\right]$$

$$+\frac{1}{4}\left(\frac{v_H - v_L}{2}\right)\Big(1-(1-\gamma)(1-\epsilon)\Big)^N \left[\sum_{j=0}^{\lfloor \frac{N}{2} \rfloor}\binom{N}{j, j, N-2j}\left(\frac{\frac{1}{2}\gamma}{1-(1-\gamma)(1-\epsilon)}\right)^{2j}\left(\frac{(1-\gamma)\epsilon}{1-(1-\gamma)(1-\epsilon)}\right)^{N-2j}\right.$$

$$\left.+\sum_{j=0}^{\lfloor \frac{N-1}{2} \rfloor}\binom{N}{j, j+1, N-2j-1}\left(\frac{\frac{1}{2}\gamma}{1-(1-\gamma)(1-\epsilon)}\right)^{2j+1}\left(\frac{(1-\gamma)\epsilon}{1-(1-\gamma)(1-\epsilon)}\right)^{N-2j-1}\right]$$

$$= -\frac{1}{4}(1-\gamma)(1-\epsilon)\phi\left(\frac{v_H + v_L}{2}\right)\left[\sum_{j=0}^{\lfloor \frac{N-1}{2} \rfloor}\binom{N}{j, j+1, N-2j-1}\left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^j\right.$$

$$\left.\times\left(\frac{1}{2}\gamma\right)^j\Big((1-\gamma)(1-\epsilon)(1-\phi)+(1-\gamma)\epsilon\Big)^{N-2j-1}\right] \leq 0$$

□

Lemma 3. *$P(0,\gamma,N)$ is monotonically decreasing in N*

Proof. It needs to be shown that $P(0,\gamma,N) - P(0,\gamma,N+1) > 0$. Suppose N is odd

$$P(0,\gamma,N) - P(0,\gamma,N+1)$$

$$= \sum_{i=0}^{\frac{N-1}{2}} \frac{N!}{(i!)^2(N-2i)!}(1-\gamma)^{N-2i}\left(\frac{1}{2}\gamma\right)^{2i} + \sum_{i=0}^{\frac{N-1}{2}} \frac{N!}{i!(i+1)!(N-2i-1)!}(1-\gamma)^{N-2i-1}\left(\frac{1}{2}\gamma\right)^{2i+1}.$$

$$-\sum_{i=0}^{\frac{N+1}{2}} \frac{(N+1)!}{(i!)^2(N+1-2i)!}(1-\gamma)^{N+1-2i}\left(\frac{1}{2}\gamma\right)^{2i} - \sum_{i=0}^{\frac{N-1}{2}} \frac{(N+1)!}{i!(i+1)!(N-2i)!}(1-\gamma)^{N-2i}\left(\frac{1}{2}\gamma\right)^{2i+1}.$$

The third term in the expression above can be rewritten as

$$\sum_{i=0}^{\frac{N+1}{2}} \frac{(N+1)!}{(i!)^2(N+1-2i)!}(1-\gamma)^{N+1-2i}\left(\frac{1}{2}\gamma\right)^{2i}$$

$$= \sum_{i=0}^{\frac{N-1}{2}} \left(1+\frac{2i}{N-2i+1}\right)\frac{(N)!}{(i!)^2(N-2i)!}(1-\gamma)^{N+1-2i}\left(\frac{1}{2}\gamma\right)^{2i} + \frac{(N+1)!}{\left(\frac{N+1}{2}!\right)^2}\left(\frac{1}{2}\gamma\right)^{N+1}$$

$$= (1-\gamma)\sum_{i=0}^{\frac{N-1}{2}} \frac{N!}{(i!)^2(N-2i)!}(1-\gamma)^{N-2i}\left(\frac{1}{2}\gamma\right)^{2i} + \gamma\sum_{i=0}^{N-3} 2\frac{N!}{i!(i+1)!(N-2i-1)!}(1-\gamma)^{N-2i-1}\left(\frac{1}{2}\gamma\right)^{2i+1}$$

$$+\frac{(N+1)!}{\left(\frac{N+1}{2}!\right)^2}\left(\frac{1}{2}\gamma\right)^{N+1}.$$

Collecting terms from the original equation yields

$$\gamma\sum_{i=0}^{\frac{N-1}{2}} \frac{N!}{(i!)^2(N-2i)!}(1-\gamma)^{N-2i}\left(\frac{1}{2}\gamma\right)^{2i} + (1-\gamma)\sum_{i=0}^{N-3} 2\frac{N!}{i!(i+1)!(N-2i-1)!}(1-\gamma)^{N-2i-1}\left(\frac{1}{2}\gamma\right)^{2i+1}$$

$$+\frac{N!}{\left(\frac{N-1}{2}\right)!\left(\frac{N+1}{2}\right)!}\left(\frac{1}{2}\gamma\right)^{N} - \frac{(N+1)!}{\left(\frac{N+1}{2}!\right)^2}\left(\frac{1}{2}\gamma\right)^{N+1} - \sum_{i=0}^{\frac{N-1}{2}} \frac{(N+1)!}{i!(i+1)!(N-2i)!}(1-\gamma)^{N-2i}\left(\frac{1}{2}\gamma\right)^{2i+1}$$

$$= \sum_{i=0}^{\frac{N-3}{2}} \frac{N!}{(i!)^2(N-2i-1)!}(1-\gamma)^{N-2i}\left(\frac{1}{2}\gamma\right)^{2i+1}\left(\frac{2}{N-2i}+\frac{1}{i+1}-\frac{N+1}{(N-2i)(i+1)}\right)$$

$$+\frac{N!}{\left(\frac{N-1}{2}\right)!\left(\frac{N+1}{2}\right)!}\left(\frac{1}{2}\gamma\right)^{N}-\frac{(N+1)!}{\left(\frac{N+1}{2}!\right)^{2}}\left(\frac{1}{2}\gamma\right)^{N+1}$$

$$=\sum_{i=0}^{\frac{N-3}{2}}\frac{N!}{i!(i+1)!(N-2i)!}(1-\gamma)^{N-2i}\left(\frac{1}{2}\gamma\right)^{2i+1}+\frac{N!}{\left(\frac{N-1}{2}\right)!\left(\frac{N+1}{2}\right)!}\left(\frac{1}{2}\gamma\right)^{N}-\frac{(N+1)!}{\left(\frac{N+1}{2}!\right)^{2}}\left(\frac{1}{2}\gamma\right)^{N+1}>0$$

for all $\gamma < 1$.

The proof for N even is exactly analogous.

□

Lemma 4. *The probability the population chooses the correct alternative when it is time for a change, $\pi(\phi, \gamma, N+1)$, equals $\frac{1}{2}$ when $\phi = 0$ and is strictly greater than $\frac{1}{2}$ when $\phi > 0$.*

Proof. Suppose there are i unbiased firms, $N+1-i$ biased firms and $N+1-i$ is odd. The proof when $N+1-i$ is even is analogous. The probability the correct decision is made is given by

$$\sum_{j=0}^{\frac{N-i}{2}}\binom{N+1-i}{j}\left(\frac{1}{2}\right)^{j}\left(\frac{1}{2}\right)^{N+1-i-j}$$

$$+\sum_{k=1}^{\lfloor\frac{i+1}{2}\rfloor}\binom{N+1-i}{\frac{N-i+2k}{2}}\left(\frac{1}{2}\right)^{N+1-i}\left[\frac{1}{2}\binom{i}{2k-1}((1-\epsilon)\phi)^{2k-1}(1-(1-\epsilon)\phi)^{i-2k+1}\right.$$
$$\left.+\sum_{m=2k}^{i}\binom{i}{m}((1-\epsilon)\phi)^{m}(1-(1-\epsilon)\phi)^{i-m}\right]$$

The first term is the probability less then half the biased types are biased towards the wrong alternative. The second summation is the probability more then half the biased types are biased towards the wrong alternative, but the number of informed unbiased firms revealing information either exactly offsets this difference or creates a surplus of reports for the correct policy.

Notice,

$$\sum_{j=0}^{\frac{N-i}{2}}\binom{N+1-i}{j}\left(\frac{1}{2}\right)^{j}\left(\frac{1}{2}\right)^{N+1-i-j}=\frac{1}{2}.$$

Therefore, in this distribution the probability the correct alternative is selected is

$$\frac{1}{2}+\sum_{k=1}^{\lfloor\frac{i+1}{2}\rfloor}\binom{N+1-i}{\frac{N-i+2k}{2}}\left(\frac{1}{2}\right)^{N+1-i}\left[\frac{1}{2}\binom{i}{2k-1}((1-\epsilon)\phi)^{2k-1}(1-(1-\epsilon)\phi)^{i-2k+1}\right.$$
$$\left.+\sum_{m=2k}^{i}\binom{i}{m}((1-\epsilon)\phi)^{m}(1-(1-\epsilon)\phi)^{i-m}\right]$$

When either $\phi=0$ or $i=0$, the expression above reduces to $\frac{1}{2}$. However, when $i\geq 1$ and $\phi>0$, the second term is strictly positive, so the correct alternative will be implemented with probability strictly greater than $\frac{1}{2}$. Since $\pi(\phi,\gamma,N+1)$ is a weighted sum over all i, if $\phi>0$, then $\pi(\phi,\gamma,N+1)>\frac{1}{2}$.

□

Lemma 5. *$\pi(1,\gamma,N+1)$ is non-decreasing in N.*

Proof. When informed unbiased firms fully disclose with probability 1,

$$\pi(1,\gamma,N)=\sum_{j=0}^{N}\binom{N}{j}(1-(1-\gamma)\epsilon)^{j}((1-\gamma)\epsilon)^{N-j}W(j),$$

where $W(j)$ is given by

$$\begin{cases}\sum_{i=0}^{\frac{j-1}{2}}\binom{j}{i}\left(\frac{\frac{1}{2}\gamma}{\gamma+(1-\gamma)(1-\epsilon)}\right)^{i}\left(\frac{\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)}{\gamma+(1-\gamma)(1-\epsilon)}\right)^{j-i} & \text{if j is odd}\\ \sum_{i=0}^{\frac{j-2}{2}}\binom{j}{i}\left(\frac{\frac{1}{2}\gamma}{\gamma+(1-\gamma)(1-\epsilon)}\right)^{i}\left(\frac{\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)}{\gamma+(1-\gamma)(1-\epsilon)}\right)^{j-i}+\frac{1}{2}\binom{j}{\frac{j}{2}}\left(\frac{\frac{1}{2}\gamma}{\gamma+(1-\gamma)(1-\epsilon)}\right)^{\frac{j}{2}}\left(\frac{\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)}{\gamma+(1-\gamma)(1-\epsilon)}\right)^{\frac{j}{2}} & \text{if j is even}\end{cases}$$

$\pi(1,\gamma,N)$ is the probability j firms are either biased or informed and unbiased, multiplied by the probability the correct alternative is chosen conditional on this type distribution. First, it will be shown that $W(j)$ is non-decreasing in j.

Suppose j is odd and let $x=\frac{\frac{1}{2}\gamma}{\gamma+(1-\gamma)(1-\epsilon)}$.

$$W(j+1)-W(j)=\sum_{i=0}^{\frac{j-1}{2}}\binom{j+1}{i}x^{i}(1-x)^{j+1-i}+\frac{1}{2}\binom{j+1}{\frac{j+1}{2}}x^{\frac{j+1}{2}}(1-x)^{\frac{j+1}{2}}-\sum_{i=0}^{\frac{j-1}{2}}\binom{j}{i}x^{i}(1-x)^{j-i}$$

$$=\sum_{i=0}^{\frac{j-1}{2}}x^{i}(1-x)^{j-i}\left[\binom{j+1}{i}(1-x)-\binom{j}{i}\right]+\frac{1}{2}\binom{j+1}{\frac{j+1}{2}}x^{\frac{j+1}{2}}(1-x)^{\frac{j+1}{2}}$$

$$= \sum_{i=0}^{\frac{j-1}{2}} x^i (1-x)^{j-i} \left[\binom{j}{i-1}(1-x) - \binom{j}{i} x \right] + \frac{1}{2}\binom{j+1}{\frac{j+1}{2}} x^{\frac{j+1}{2}} (1-x)^{\frac{j+1}{2}}$$

$$= \sum_{i=1}^{\frac{j-1}{2}} \binom{j}{i-1} x^i (1-x)^{j+1-i} - \sum_{i=0}^{\frac{j-1}{2}} \binom{j}{i} x^{i+1} (1-x)^{j-i} + \frac{1}{2}\binom{j+1}{\frac{j+1}{2}} x^{\frac{j+1}{2}} (1-x)^{\frac{j+1}{2}}$$

$$= \frac{1}{2}\binom{j+1}{\frac{j+1}{2}} x^{\frac{j+1}{2}} (1-x)^{\frac{j+1}{2}} - \binom{j}{\frac{j-1}{2}} x^{\frac{j+1}{2}} (1-x)^{\frac{j+1}{2}} = 0.$$

Now suppose j is even.

$$W(j+1) - W(j) = \sum_{i=0}^{\frac{j}{2}} \binom{j+1}{i} x^i (1-x)^{j+1-i} - \sum_{i=0}^{\frac{j-2}{2}} \binom{j}{i} x^i (1-x)^{j-i} - \frac{1}{2}\binom{j}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j}{2}}$$

$$= \binom{j+1}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j+2}{2}} + \sum_{i=0}^{\frac{j-2}{2}} x^i (1-x)^{j-i} \left[\binom{j+1}{i}(1-x) - \binom{j}{i} \right] - \frac{1}{2}\binom{j}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j}{2}}$$

$$= \binom{j+1}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j+2}{2}} + \sum_{i=0}^{\frac{j-2}{2}} x^i (1-x)^{j-i} \left[\binom{j}{i-1}(1-x) - \binom{j}{i} x \right] - \frac{1}{2}\binom{j}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j}{2}}$$

$$= \binom{j+1}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j+2}{2}} + \sum_{i=1}^{\frac{j-2}{2}} \binom{j}{i-1} x^i (1-x)^{j+1-i} - \sum_{i=0}^{\frac{j-2}{2}} \binom{j}{i} x^{i+1} (1-x)^{j-i} - \frac{1}{2}\binom{j}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j}{2}}$$

$$= \binom{j+1}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j+2}{2}} - \binom{j}{\frac{j-2}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j+2}{2}} - \frac{1}{2}\binom{j}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j}{2}}$$

$$= \binom{j}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j+2}{2}} - \frac{1}{2}\binom{j}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j}{2}}$$

$$= \binom{j}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j}{2}} \left(\frac{1}{2} - x \right)$$

$$= \binom{j}{\frac{j}{2}} x^{\frac{j}{2}} (1-x)^{\frac{j}{2}} \left(\frac{\frac{1}{2}(1-\gamma)(1-\epsilon)}{\gamma + (1-\gamma)(1-\epsilon)} \right).$$

Now,

$$\pi(1, \gamma, N+1) - \pi(1, \gamma, N)$$

$$= \sum_{j=0}^{N+1} \binom{N+1}{j} (1-(1-\gamma)\epsilon)^j ((1-\gamma)\epsilon)^{N+1-j} W(j) - \sum_{j=0}^{N} \binom{N}{j} (1-(1-\gamma)\epsilon)^j ((1-\gamma)\epsilon)^{N-j} W(j)$$

$$= (1-(1-\gamma)\epsilon)^{N+1} W(N+1) + \sum_{j=0}^{N} (1-(1-\gamma)\epsilon)^j ((1-\gamma)\epsilon)^{N-j} W(j) \left[\binom{N+1}{j} (1-\gamma)\epsilon - \binom{N}{j} \right]$$

$$= (1-(1-\gamma)\epsilon)^{N+1} W(N+1) + \sum_{j=0}^{N} (1-(1-\gamma)\epsilon)^j ((1-\gamma)\epsilon)^{N-j} W(j) \left[\binom{N}{j-1} (1-\gamma)\epsilon - \binom{N}{j} (1-(1-\gamma)\epsilon) \right]$$

$$= (1-(1-\gamma)\epsilon)^{N+1} W(N+1) + \sum_{j=0}^{N} \binom{N}{j-1} (1-(1-\gamma)\epsilon)^j ((1-\gamma)\epsilon)^{N+1-j} W(j)$$

$$- \sum_{j=0}^{N} \binom{N}{j} (1-(1-\gamma)\epsilon)^{j+1} ((1-\gamma)\epsilon)^{N-j} W(j)$$

$$= (1-(1-\gamma)\epsilon)^{N+1} W(N+1) + \sum_{j=0}^{N-1} \binom{N}{j} (1-(1-\gamma)\epsilon)^{j+1} ((1-\gamma)\epsilon)^{N-j} W(j+1)$$

$$- \sum_{j=0}^{N-1} \binom{N}{j} (1-(1-\gamma)\epsilon)^{j+1} ((1-\gamma)\epsilon)^{N-j} W(j) - (1-(1-\gamma)\epsilon)^{N+1} W(N)$$

$$\geq (1-(1-\gamma)\epsilon)^{N+1} (W(N+1) - W(N)) \geq 0.$$

□

Lemma 6. *When blogs are present, uninformed unbiased firms strictly prefer to report honestly by sending message "Equal".*

Proof. Like when blogs are absent, uninformed unbiased firms strictly prefer message "Equal" to "Both Bad" as message "Equal" provides positive expected surplus while message "Both Bad" provides a payoff of 0 with certainty. Additionally, message "Equal" is also strictly preferred to both messages "A" and "B". To see this, suppose informed unbiased firms send the correct message with probability ϕ when it is a time for a change. As seen in the text, the expected benefit to providing information for an informed unbiased firm is

$$(v_H - v_L)\left[\mu P(\phi,\gamma,N,R(\phi)) + (1-\mu)P(\phi,\gamma,N,W(\phi))\right].$$

However, the expected benefit to an uninformed unbiased firm from sending message "A" or "B" is

$$\frac{1}{4}(v_H - v_L)\left[\mu P(\phi,\gamma,N,R(\phi)) + (1-\mu)P(\phi,\gamma,N,W(\phi))\right]$$

$$-\frac{1}{4}(v_H - v_L)\left[\mu \sum_{j=0}^{\lfloor\frac{N-W(\phi)}{2}\rfloor} \binom{N}{j+W(\phi), j, N-2j-W(\phi)} \left(\frac{1}{2}\gamma\right)^{j+W(\phi)} \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^{j}\right.$$

$$\times\left((1-\gamma)(1-\epsilon)(1-\phi) + (1-\gamma)\epsilon\right)^{N-2j-W(\phi)}$$

$$+(1-\mu)\sum_{j=0}^{\lfloor\frac{N-R(\phi)}{2}\rfloor} \binom{N}{j, j+R(\phi), N-2j-R(\phi)} \left(\frac{1}{2}\gamma\right)^{j} \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi\right)^{j+R(\phi)}$$

$$\left.\times\left((1-\gamma)(1-\epsilon)(1-\phi) + (1-\gamma)\epsilon\right)^{N-2j-R(\phi)}\right]$$

If alternative A is the best option, the benefit to an uninformed unbiased firm from sending message "A" corresponds exactly with that of an informed unbiased firm. However, if alternative B is the best option, by sending message "A" an uninformed unbiased firm will sometimes induce the population to select alternative A when they otherwise would have implemented the correct alternative. If it is not time for a change, the expected benefit to sending message "A" exactly offsets the expected cost. Therefore, the expected benefit to an uninformed firm from sending either message "A" or "B" is strictly less than that of an informed firm. Hence, in any equilibrium in which informed unbiased firms send the correct message with $\phi < 1$, uninformed unbiased firms will strictly prefer to send message "Equal". Additionally, when $\phi = 1$, R(1) = 1 and W(1) = 0, since $u \leq \frac{\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)}{\gamma + (1-\gamma)(1-\epsilon)}$. Therefore, when informed unbiased firms are fully revealing their information, the benefit to an uninformed unbiased firm from sending message "A" or "B" over message "Equal" is

$$\frac{1}{4}(v_H - v_L)\left[\mu \sum_{j=0}^{\lfloor\frac{N-1}{2}\rfloor} \binom{N}{j, j+1, N-2j-1} \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\right)^{j} \left(\frac{1}{2}\gamma\right)^{j+1} \left((1-\gamma)\epsilon\right)^{N-2j-1}\right.$$

$$+ (1-\mu) \sum_{j=0}^{\lfloor \frac{N}{2} \rfloor} \binom{N}{j, j, N-2j} \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\right)^j \left(\frac{1}{2}\gamma\right)^j \left((1-\gamma)\epsilon\right)^{N-2j} \Bigg]$$

$$-\frac{1}{4}(v_H - v_L) \Bigg[\mu \sum_{j=0}^{\lfloor \frac{N}{2} \rfloor} \binom{N}{j, j, N-2j} \left(\frac{1}{2}\gamma\right)^j \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\right)^j \left((1-\gamma)\epsilon\right)^{N-2j}$$

$$+ (1-\mu) \sum_{j=0}^{\lfloor \frac{N-1}{2} \rfloor} \binom{N}{j, j+1, N-2j-1} \left(\frac{1}{2}\gamma\right)^j \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\right)^{j+1} \left((1-\gamma)\epsilon\right)^{N-2j-1} \Bigg]$$

$$= \frac{1}{4}(v_H - v_L) \Bigg[\sum_{j=0}^{\lfloor \frac{N-1}{2} \rfloor} \binom{N}{j, j+1, N-2j-1} \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\right)^j \left(\frac{1}{2}\gamma\right)^j \left((1-\gamma)\epsilon\right)^{N-2j-1}$$

$$\times \left\{ \mu \left(\frac{1}{2}\gamma\right) - \left(1-\mu\right) \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\right) \right\}$$

$$+(1-2\mu) \sum_{j=0}^{\lfloor \frac{N}{2} \rfloor} \binom{N}{j, j, N-2j} \left(\frac{1}{2}\gamma\right)^j \left(\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\right)^j \left((1-\gamma)\epsilon\right)^{N-2j} \Bigg]$$

The first term is negative since $u \leq \frac{\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)}{\gamma + (1-\gamma)(1-\epsilon)}$ and the second term is negative since $\mu > \frac{1}{2}$.

□

Endogenous Reputation Costs

Suppose the reputation cost from any message is the ex-post probability the population assigns to a firm being a biased type after the true state has been realized. Since biased firms send either message "A" or "B" deterministically, should an unbiased firm send message "Equal" or "Both Bad" it will perfectly signal its type. When alternative A is revealed to be optimal ex-post, the population will believe that any firm that has sent message "A" is biased with probability $\frac{\frac{1}{2}\gamma}{\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)\phi}$.[22] Therefore, when reputation costs are endogenous, the indifference condition for informed unbiased types is,

$$\left(\frac{v_H - v_L}{2}\right) P(\phi, \gamma, N) = \frac{\frac{1}{2}\gamma}{\frac{1}{2}\gamma + (1-\gamma)(1-\epsilon)\phi}.$$

Notice for an arbitrary population size there may be multiple equilibria as both benefits and costs are decreasing in ϕ.[23] However, as N gets large, the benefit to an informed unbiased firm from signaling the correct alternative approaches zero, while the cost to doing so is at least $\frac{\frac{1}{2}\gamma}{\frac{1}{2}\gamma+(1-\gamma)(1-\epsilon)}$. Therefore, as the number of competitors gets large, informed unbiased firms will withhold information and the main results in the text will continue to hold.

[22]As seen in the text, no unbiased firm will send message "B" if A is the best option.
[23]For example, when $N = 2$, for some parameter configurations both $\phi = 0$ and $\phi = 1$ constitute equilibria.

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