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Ascensión Andina-Díaz y José A. García-Martínez

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Departamento de Teoría e Historia Económica
Facultad de Ciencias Económicas y Empresariales
Universidad de Málaga
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Media silence, feedback power and reputation*

Ascensión Andina-Díaz[†]and José A. García-Martínez [‡]

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Abstract

This paper proposes a theory of media silence. The argument is that news organizations have the power to raise public concern and so affect the probability that there is ex-post verification of the true state of the world. Built on the literature of career concerns, we consider a newspaper that seeks to maximize its reputation for high quality. Our results predict more media silence, the higher the prior expectations on the quality of the firm, the greater the probability of ex-post verification, and the higher the power of the newspaper to activate the verification.

Keywords: Feedback power; reputation; quality; competition; media silence

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1 Introduction

Much is known about the great power of the media to set the political agenda, create opinion, or convert the simplest event into a newsworthy story. Such a prevalent role in our society

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[†]Dpto. Teoría e Historia Económica, Universidad de Málaga, 29071 Málaga, Spain. E-mail: aandina@uma.es

[‡]Dpto. Estudios Económicos y Financieros, Universidad Miguel Hernández, Elche, Alicante, Spain. E-mail: jose.garciam@umh.es

should require of committed journalists, non-manipulable newspapers and institutions that guarantee the freedom of the press. However, facts show this not to be the case. Evidence of media bias is extensive, along with studies documenting the pernicious effects of media misconduct.[1]

Temptations are out there and there are many sources that can lead to media bias. It can be government manipulation or some other more subtle form of persuasion exerted by interest groups or advertisers.

> "Les Brown reports that NBC stood up to Coca-Cola in 1970 when Coke forcefully pressured NBC to change a documentary, "Migrant", which showed Coke as one of the perpetrators of offensive treatment of laborers in the Florida citrus industry. After NBC broadcast the show uncensored [...] NBC lost all its network billings from Coke, amounting to several million dollars. When Brown's story was reprinted eight years later, the introduction observed a third result: "NBC ha[d] not ... produced a documentary on a controversial domestic issue involving an important advertiser since.""

Baker (1995)

It can also be the consequence of lack of patience and investment.

> "Great journalism requires time. Woodward and Bernstein were given it. Harry Evans had a team of Sunday Times reporters working for eight months before exposing the establishment cover-up of Kim Philby's spy ring. Few editors today who would allow anyone eight months on a story. Too much space to fill, less time, fewer people."

Alastair Campbell (In a lecture at Cambridge University, transcribed in *The Guardian*, 14 November 2013.)

Or the opportunistic behavior of journalists and editors, who may fail to report news accurately when they have all the information needed to do so.

[1] See Besley and Burgess (2002), Adserá et al. (2003), Strömberg (2004), Groseclose and Milyo (2005), DellaVigna and Kaplan (2007), Snyder and Strömberg (2010) or Larcinese et al. (2011).

> "Consumers cannot tell if a report has been confirmed with multiple sources, evaluate the reliability of unnamed sources, or know what stories have not been reported."
>
> Logan and Sutter (2004)

This paper identifies a new source of media bias that originates in the opportunistic behavior of a news organization, which may voluntarily choose to distort its information. All in all, our contribution is to present a model in which a career concerned newspaper silences information, and its silence is higher, the higher the (prior) expectation of it being high quality, the greater the probability that there is ex-post verification of the state of the world, and the greater the capacity of the firm to affect this probability.

Following the seminal paper by Gentzkow and Shapiro (2006), we consider a newspaper that seeks to build a reputation for quality. Crucial to our results is the assumption that news organizations will have, in our model, as in real world, the capacity to affect *feedback*, that is, the power to alter the probability that there is ex-post verification of the true state of the world. Indirectly, this means that the newspaper can affect its reputation. The argument is that a news organization that turns the spotlight on, let us say, a possible corruption scandal, may raise public concern about the consequences of the fraud, may eventually induce a citizen or institution to denounce the facts and take the case to court, and may result in the judge passing sentence and thus, indirectly, determining whether the media's story was true or just another example of a "Jimmy's World" fabrication.[2] On the contrary, a country in which news organizations give no room to scoops on their front pages, but rather print news items on the usual events of a society (economy, politics, sports, etc.), silences citizens and precludes learning.

[2]In reference to a false story written by Janet Cooke, that was front-page in the *Washington Post* on September 29, 1980. Cooke, who was even given the Pulitzer Prize for this article, subsequently confessed the story was false. The confession was printed in the *Post* on April 16, 1981. This malpractice obliged the *Washington Post* to offer numerous explanations and apologies, as well as to publicly return the Pulitzer, to make personnel changes in the newspaper and, naturally, to fire Cooke. More recently, *The New York Magazine* printed on the December 15, 2014, the story of Mohammed Islam, who claimed had won $72 million trading on the stock market. This story turned into a major international news item. However, just one day after, *The New York Observer* published an interview with Islam, who admitted he had previously lied. *The New York Magazine* retracted the story and apologized, concluding: "We were duped. Our fact-checking process was obviously inadequate; we take full responsibility and we should have known better. New York apologizes to our readers."

To formalize this idea, we consider a newspaper that receives a source that reports on the existence (or not) of a corruption scandal in the economy. The media firm, whose only concern is to appear competent, can take two actions, each corresponding to the two possible states of the world (that the malpractice does/does not exist). The key assumption is that actions are different in terms of consequences. That is, whereas one action (letting the scandal go in the paper) activates the feedback with positive probability, taking the other action (silencing the uncertain misconduct and printing instead easy-to-cover stories) guarantees the newspaper that the truth will never come out (or, at least, not before consumers assign a reputation to the news organization).[3]

Our model thus partially endogeneizes the existence of feedback.[4] This is interesting, as the media industry is not the only real-world example of a situation in which the existence of feedback is inextricably linked with the action chosen.[5] Another example could be a judge, court, competition team, or any authority with the power to accuse and prosecute somebody for a harmful act. Suppose this authority receives factual (though inconclusive) evidence of a wrongdoing by a powerful personality or firm. In this case, its decision on whether to go further with the inquiry quite closely resembles that of the news organization. Indeed, formally prosecuting means embarking on a process whose details will be argued by citizens beyond the court, thus with a verdict trespassing on public opinion. In contrast, keeping silent on the misconduct will probably preclude citizens' learning about the factual (though inconclusive) evidence of wrongdoing. To this class of situations, our work sheds light on the unexpected perverse effects of transparency.

We start the analysis with a benchmark case consisting of a monopoly newspaper that operates in a world in which two states of the world are equiprobable. Our results show that, in equilibrium, the newspaper does not always act on its information, but it chooses to

[3]This is so in the main body of the paper. In Section 3.4. we relax it and consider that consumers can also learn the state of the world when the newspaper chooses to silence the scandal.

[4]Gentzkow and Shapiro (2006) propose an alternative explanation to endogeneize feedback. They assume that the probability of feedback is positively related to the number of firms in the media industry. However, they do not consider that a firm, on its own, can affect this probability.

[5]The literature on experts and effort choice has also considered situations in which the probability of ex-post verification of the true state may depend on the action chosen by the agent. See Milbourn et al. (2001) or Suurmond et al. (2004). The idea behind these papers is the implementation of a *de novo* project, where success or failure can only be observed if the project is implemented (in which case, ex-post verification of the state always occurs with probability one). The focus of this literature is, however, on the effects of reputational concerns on the incentives of the agent to exert effort.

silence corruption signals and thus, it prints, too often, easy-to-cover stories. Interestingly, we obtain that the greater the (prior) expectations on the type of the newspaper, the more corruption signals it chooses to omit. Similarly, the higher the probability of feedback, the greater the media silence will be. That is, the higher the probability that consumers get to learn the consequences of the newspaper's action, and so, the accuracy of its reports, the higher the probability that a news organization lies. To give an intuition for these results, first note that covering a corruption scandal can result in feedback, in which case the state of the world will be realized and citizens will count on hard evidence to build the newspaper's reputation. In this sense, printing the story of a malpractice means taking into account the possibility of making an error and being proven wrong. In contrast, remaining silent and instead printing easy-to-cover events ensures for the newspaper that consumers will never know about the omitted story. Because in this case the state will never be realized, the newspaper knows that errors will never be exposed. This difference in consequences results in a risk neutral news organization finding it optimal to print easy-to-cover stories, which ensures no error and so no type revelation. The result is media silence. Now, either an increase in the expected type of the firm or in the probability of feedback yields an increasing in the asymmetry of the consequences associated with the two actions. Thus, greater expectations and greater transparency (on consequences) produce less accurate information.

Our second main result is that we can relax the assumption that the two states of the world are equiprobable and be certain that previous conclusions still hold. There is only one exception: when the prior distribution that the state is corrupt is too strong. The reason is that in this case, consumers are so biased in their prior beliefs that they rate any newspaper that contradicts their priors as low quality. This is the classical "herding on the prior" effect. An argument that, because of the counterbalanced forced that the endogenous feedback introduces in our model, is here only strong enough to drive media behavior when priors are sufficiently high.

Finally, we analyze the effects of the introduction of an exogenous probability of feedback, that the newspaper cannot affect, on its printing strategy. Note that this will be the result of the introduction of competition. Our results show that this form of competition disciplines news organizations with higher quality signals, but not those with lower quality, that even in the presence of more media firms, find it optimal to silence signals of corruption. Note also that in the presence of this exogenous probability of feedback, we can analyze the effect of a change in the marginal impact of a newspaper on the probability that consumers learn the state of the world. We refer to this as the *feedback power* of a firm. To this respect, our model predicts more revelation of information by newspapers that, because of the competition, see their feedback power reduced. In contrast, we show that an increase in the political and social influence of a newspaper that results in an increase in its feedback power, enhances the capacity of the firm to affect ex-post verification, and thus, increases its silence.

The closest paper to ours is Gentzkow and Shapiro (2006). They propose a model in which a newspaper seeks to build a reputation for quality and the consumers' prior expectations are in favor of one state of the world. This drives media bias which, in their model, originates in the incentive of the newspaper to slant its reports towards the consumers' popular beliefs. They also consider the effects of an increase in competition, which they assume generates an increase in the probability of feedback, and show that competition reduces media bias. Formally, our paper is also related to Prat (2005), who first showed that an increase in the transparency (on actions) can have detrimental effects. In his model, however, increasing the transparency of consequences (the kind of transparency we talk about in our paper) can only be beneficial. The present work challenges this view. Also related is the work by Fox and Weelden (2012), who obtain that when the prior on the state is too unbalanced, transparency of consequences increases the incentive for the expert to stick more often to the prior. Interestingly, if costs of mistakes are asymmetric, this can decrease the principal's expected welfare.[6]

Topically, our paper belongs to the blooming literature on media economics, and more particularly, it contributes to the analysis of the origins of media bias. Much has been said in this respect. The numerous explanations to date have been grouped into two categories. On the one hand, the supply-side arguments, that account for reasons such as media ownership (Bovitz et al. (2002) and Djankov et al. (2003)), advertisers and interest groups (Corneo (2006) and Ellman and Germano (2009)), career concerns of journalists (Baron (2006)) or government capture (Besley and Prat (2006) and Egorov et al. (2009)). On the other hand, there is the demand driven forces, that consider reasons that originate in the consumers' preferences for certain stories (Mullainathan and Shleifer (2005)) or their prior beliefs (Gentzkow and Shapiro (2006)). The present paper contributes to the latter class of

[6]That reputation can have perverse effects has also been shown in other contexts. See Levy (1997), Morris (2001), Ottaviani and Sorensen (2001) or Hörner (2002).

literature, by pointing out that, without the need for any outside interference, the media's ability to determine what consumers get to know can also result in media bias and, more precisely, in media silence.

The rest of the paper is organized as follows. Section 2 describes the model, Section 3 presents our results and Section 4 concludes. All the proofs are relegated to the Appendix.

2 Model

We consider an economy with one newspaper and a mass of consumers. The state of the world is $w \in \{N, C\}$, where C corresponds to a situation in which there is a *corruption scandal* in the economy and N to one in which *no corruption scandal exists.* Each state occurs with equal probability.[7]

The newspaper receives a signal $s \in \{n, c\}$ on the state of the world, whose distribution depends on the newspaper's quality. With probability α, the newspaper is high quality and has a signal that perfectly reveals the state of the world. With probability $1-\alpha$, the newspaper is normal and receives an imperfect but informative signal, with $P(n/N) = P(c/C) = \gamma > \frac{1}{2}$.

Upon receiving the signal, the newspaper publishes a report $r \in \{\hat{n}, \hat{c}\}$. We denote by $\sigma_s(r) \in [0, 1]$ the probability that, conditioned on its signal s, a newspaper takes action r. We assume that the high type media firm always reports its signal honestly.[8] As for the normal type, we consider it has discretion to report either $\hat{n}$ or $\hat{c}$. This freedom to lie captures two types of media bias: A newspaper that having observed factual (though inconclusive) evidence of a corruption scandal chooses to silence it, i.e., $\sigma_c(\hat{n}) > 0$; and a news organization that without any evidence chooses to let the corruption scandal go in the paper, i.e., $\sigma_n(\hat{c}) > 0$. We refer to the former class of bias as media silence.

We assume that a newspaper that reports $\hat{c}$ activates the feedback with probability $\mu \in [0, 1]$, in which case the state of the world will be revealed to consumers. In contrast,

[7]The assumption that both states are equiprobable means that media firms have no incentives to go for the consumers' prior beliefs. This differentiates our analysis from Gentzkow and Shapiro (2006) and ensures that herding effects play no role in generating our conclusions. This will become clearer in Section 3.3, where we relax this assumption and consider the more general case of $P(w = C) = \theta \in (0, 1)$.

[8]This assumption is for expositional purposes. However, as we show in Section A.3 in the Appendix, playing truthfully is an equilibrium strategy for the high type.

publishing $\hat{n}$ ensures the media firm that consumers will never know the true state (or, at least, not before they assign a reputation to the newspaper). Note that this assumption partially endogeneizes the existence of feedback, giving the media firm the power to determine, with its report, whether or not consumers will learn if there is truly a corruption scandal in the economy.[9] This is a quite natural assumption in the media industry. Nonetheless, the power of the media to ignite cascades of accusations and responses and to stimulate coverage by other social spheres may lead to depuration of responsibilities, and thus learning. At the same time, it is difficult to think of a situation in which consumers manage to learn the truth of a story that never received the attention of the media industry, possibly because in this case consumers even ignore that such a story could have ever occurred. We denote by $X \in \{N, C, 0\}$ the feedback received, with $X = 0$ indicating that there is no feedback.

The consumers observe the newspaper's report r and feedback X and, based on this information, update their belief on the newspaper's type. Let $\lambda(r, X)$ denote the consumers' posterior probability that the newspaper is high quality, given $r \in \{\hat{n}, \hat{c}\}$ and $X \in \{N, C, 0\}$.

The newspaper is career-concerned and seeks to maximize reputation. As most papers in the literature, we assume that reputation is captured by the probability that consumers place on the media firm being of high expertise $\lambda(r, X)$.[10] This assumption should be taken as a reduced form of a more complex game, in which the newspaper seeks to appear high quality because future circulation (and thus profits) is increasing in reputation.[11]

Consumers are assumed to value information. To make this point, we can think of our consumers as citizens who, upon observing the report of the newspaper and before the state may be realized, take a decision on a private investment that yields a positive payoff π when the newspaper correctly informs on the state of the world, and zero otherwise. Because the newspaper's signal is informative, $\gamma > 1/2$, the expected payoff to a consumer from the

[9] In the paper we use the terms *feedback* (Gentzkow and Shapiro (2006)) and *transparency of consequences* (Prat (2005)) indistinctively, with $\mu = 1$ meaning feedback occurring with probability one, and so there is full transparency of consequences.

[10] See Ottaviani and Sorensen (2001), Prat (2005), Gentzkow and Shapiro (2006) and Fox and Weelden (2012).

[11] This is in line with empirical evidence. Logan and Sutter (2004), using a cross-section of US newspapers, find that papers that have recently won Pulitzer Prizes have higher circulations, and Kovach and Rosenstiel (2001) observe that media firms with high standards have higher audiences. Also related, Anderson (2004) obtains that market forces penalize media firms whose quality of journalism falls.

investment,

$$\frac{1}{2}\left(\alpha+(1-\alpha)(\gamma\sigma_n(\hat{n})+(1-\gamma)\sigma_c(\hat{n}))\right)\pi+\frac{1}{2}\left(\alpha+(1-\alpha)(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))\right)\pi,$$

is increasing in the accuracy of news and maximized when the news organization follows its signal, $\sigma_n(\hat{n})=\sigma_c(\hat{c})=1$. Thus, if we define media bias as any deviation of the information the newspaper transmits from the signal it receives, the conclusion is straightforward: Media bias has detrimental effects for consumers.

We begin the analysis by considering the belief that the consumers place on the newspaper being the high type $\lambda(r,X)$.

$$\begin{aligned}
\lambda(\hat{n},0) &= \frac{\alpha}{\alpha+(1-\alpha)(\sigma_c(\hat{n})+\sigma_n(\hat{n}))} && (1)\\
\lambda(\hat{c},N) &= 0 && (2)\\
\lambda(\hat{c},C) &= \frac{\alpha}{\alpha+(1-\alpha)(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))} && (3)\\
\lambda(\hat{c},0) &= \frac{\alpha}{\alpha+(1-\alpha)(\sigma_c(\hat{c})+\sigma_n(\hat{c}))}. && (4)
\end{aligned}$$

Note that a media firm that chooses to print easy-to-cover events, $\hat{n}$, cannot activate the feedback. As a result, only $\lambda(\hat{n},0)$ follows a report of $\hat{n}$. This introduces an asymmetry in the consequences of reports, as $\hat{n}$ ensures a certain payoff of $\lambda(\hat{n},0)$, whereas printing $\hat{c}$ means playing a lottery with outcomes $\lambda(\hat{c},0)$, $\lambda(\hat{c},N)$ and $\lambda(\hat{c},C)$.

Let $E\{\lambda(r,X)/s\}$ denote the expected payoff to the (normal) newspaper when it observes signal $s\in\{n,c\}$ and publishes $r\in\{\hat{n},\hat{c}\}$.[12]

$$\begin{aligned}
E\{\lambda(\hat{n},X)/s\} &= \lambda(\hat{n},0)\\
E\{\lambda(\hat{c},X)/n\} &= (1-\mu)\lambda(\hat{c},0)+\mu[\gamma\lambda(\hat{c},N)+(1-\gamma)\lambda(\hat{c},C)]\\
E\{\lambda(\hat{c},X)/c\} &= (1-\mu)\lambda(\hat{c},0)+\mu[\gamma\lambda(\hat{c},C)+(1-\gamma)\lambda(\hat{c},N)]
\end{aligned}$$

where, given $\lambda(\hat{c},N)=0$, the last two expressions reduce to:

$$\begin{aligned}
E\{\lambda(\hat{c},X)/n\} &= (1-\mu)\lambda(\hat{c},0)+\mu(1-\gamma)\lambda(\hat{c},C)\\
E\{\lambda(\hat{c},X)/c\} &= (1-\mu)\lambda(\hat{c},0)+\mu\gamma\lambda(\hat{c},C)
\end{aligned}$$

[12] Note we consider a risk-neutral media firm. Assuming risk aversion would magnify the media bias that our results predict.

Now, we can define the expected gain to reporting $\hat{n}$ rather than $\hat{c}$, after observing signal s, as:

$$\Delta_s = E\{\lambda(\hat{n}, X)/s\} - E\{\lambda(\hat{c}, X)/s\}.$$

Substituting, we obtain:

$$\Delta_n = \lambda(\hat{n}, 0) - ((1-\mu)\lambda(\hat{c}, 0) + \mu(1-\gamma)\lambda(\hat{c}, C)) \tag{5}$$

$$\Delta_c = \lambda(\hat{n}, 0) - ((1-\mu)\lambda(\hat{c}, 0) + \mu\gamma\lambda(\hat{c}, C)) \tag{6}$$

In the following, we will say that $(\sigma_n(\hat{n})^*, \sigma_c(\hat{c})^*)$ is an *equilibrium strategy* if $\sigma_n(\hat{n})^*$ maximizes the expected payoff to the newspaper after observing signal n, and $\sigma_c(\hat{c})^*$ does it after signal c.

Remark 1. *If* $\Delta_n(\sigma_n(\hat{n})^*, \sigma_c(\hat{c})^*) = \Delta_c(\sigma_n(\hat{n})^*, \sigma_c(\hat{c})^*) = 0$*, then* $(\sigma_n(\hat{n})^*, \sigma_c(\hat{c})^*)$ *is an equilibrium strategy. Additionally, if* $\Delta_n > 0$ (< 0) *for all* $\sigma_n(\hat{n})$*, then* $\sigma_n(\hat{n})^* = 1$ (0)*. On the other hand, if* $\Delta_c > 0$ (< 0) *for all* $\sigma_c(\hat{c})$*, then* $\sigma_c(\hat{c})^* = 0$ (1)*.*

3 Results

3.1 No feedback

Let us start the analysis briefly discussing the case of no feedback, $\mu = 0$. Here, when the consumers have to assign a reputation to the newspaper, they have not yet learnt the state of the world. Thus, they form beliefs on the quality of the news organization with the sole information of the newspaper's report, i.e., $\lambda(r, 0)$. An example is a media firm with short-term career prospects, thus mainly concerned for its reputation (and thus profits) in the immediate future (before consumers can process and learn the truth); or a country with slow institutions or an inefficient judicial system, where processes drag on in time, hence postponing learning.

The analysis of this case yields a clear cut prediction. In the equilibrium without feedback, thus no fear of being proven wrong, the (normal) newspaper simply replicates the frequency of reports of the high type news organization. In a world where each state occurs with equal probability, this means sending $\hat{n}$ and $\hat{c}$ with probability 1/2 each. Next proposition shows this result.

Proposition 1. *Suppose* $\mu = 0$*. Any* $(\sigma_n(\hat{n})^*, \sigma_c(\hat{c})^*) \in [0,1]^2$ *such that* $\sigma_c(\hat{n})^* = \sigma_n(\hat{c})^*$ *constitute an equilibrium.*

Proof. In the Appendix. □

3.2 Feedback

> "Controversy? I don't think you can be a great reporter and avoid controversy very often, because one of the roles a good journalist plays is to tell the tough truths as well as the easy truths. And the tough truths will lead you to controversy, and even a search for the tough truths will cost you something. Please don't make this play or read as any complaint, it's trying to explain this goes with the territory if you're a journalist of integrity. That if you start out a journalist or if you reach a point in journalism where you say, "Listen, I'm just not going not touch anything that could possibly be controversial," then you ought to get out."

Dan Rather

Let us now consider the more interesting scenario in which consumers can learn the state of the world before assessing a belief. In this case, building a reputation for quality means taking into account the possibility of making an error and being proven wrong. Note, however, that this risk is exclusive to action $\hat{c}$, as reporting $\hat{n}$ guarantees the newspaper that consumers will never learn the truth. This asymmetry proves crucial to our conclusions, as observed in the next result.

Theorem 1. *Suppose* $\mu > 0$*. Then, in equilibrium,* $\sigma_n(\hat{n})^* = 1$ *and* $\sigma_c(\hat{n})^* > 0$*.*

Proof. In the Appendix. □

Theorem 1 shows that a newspaper that receives signal n always chooses the conservative action and reports $\hat{n}$. The reason is straightforward. Why should a newspaper without any scoop risk its reputation by reporting on uncertain events? The fear of opening up further investigations and being proven wrong, disciplines the media firm and ensures it sticks to the evidence. The interesting scenario is however when following a signal of c. Here, it turns out that the news organization does not always follow its signal, but it sometimes chooses to silence evidence on corruption and devote instead that space to reporting easy-to-cover stories. A sole media firm, with the only concern of maximizing reputation, can thus generate media bias (in the form of media silence).[13]

Note, additionally, that the result in Theorem 1 is independent of the value of parameters α, γ and μ.[14] This is rather surprising, as although we may expect newspapers with low quality signals to misreport facts, it was not so clear a priori that firms with reliable signals would also find it profitable to silence corruption scandals.[15] The fear of being proven wrong and the power of the media to preclude learning is again key to the result.

More interesting is the comparative static analysis with respect to parameters α and μ. Regarding α, we obtain that the higher the prior probability that the news organization is high type, the more the corruption scandals the firm will silence. In other words, great expectations on the quality of a newspaper generates media silence.

Corollary 1. *Media silence is increasing in α, $\frac{\partial \sigma_c(\hat{n})^*}{\partial \alpha} > 0$.*

Proof. In the Appendix. □

To gain an intuition for this result, first note that the reputation of a news organization that takes action $\hat{n}$ is increasing in α and, in the limit as α tends to 1, reputation $\lambda(\hat{n}, 0)$ approaches 1. On the other hand, playing the lottery associated with report $\hat{c}$ ensures the media firm a positive probability of making an error and being proven wrong, thus receiving the worst payoff ever, 0.[16] When the average quality of the media industry in a country is excellent, a consumer without information on the type of a particular newspaper will (most likely) perceive this firm as being of high type too. In this scenario, why should a newspaper that merely by omitting a scandal can secure the good payoff of $\lambda(\hat{n}, 0)$ play a lottery that,

[13]We want to highlight the fact that our results are obtained in a set-up in which the news organization is only concerned about reputation. That is, it is not the fact that printing corruption scandals is audience rewarding (see Andina-Díaz (2009)) or that libels can be punished (see Garoupa (1999*a*,*b*) and Stanig (2014)), that drive our results. In our model, the self-censorship that the newspaper practices exclusively originates in the media's power to preclude citizens learning, thus indirectly affecting the firm's reputation.

[14]Though the magnitude of the media bias does depend on these values. Substituting for different cases shows that the bias is important and, sometimes, even extreme, making the newspaper's report completely uninformative. For example, when $\alpha = 0.75$, $\gamma = 0.6$ and $\mu = 1$, we have $\sigma_c(\hat{n}) = 1$.

[15]Here, the static comparative analysis reveals $\frac{\partial \sigma_c(\hat{n})^*}{\partial \gamma} < 0$, as shown in Lemma 4 in the Appendix. This is as expected, that is, the lower the quality of a newspaper, the higher the incentive to be silent.

[16]The idea is that printing $\hat{c}$ can activate the feedback, in which case the newspaper's type will be revealed. Note, additionally, that the probability of receiving payoff 0 does not depend on α.

with certain probability, will reveal its type and drive the firm into the nightmare of a zero payoff? No reason for this, which explains why great expectations on the quality of a news organization drives the firm's silence. A silence that can be complete for α sufficiently high.[17] On the contrary, when α is low, consumers without information on the type of a newspaper will (most likely) perceive this firm as low type too. Here, making an error does not imply such a large relative loss as before, whereas being proven right has more beneficial effects (than before). The consequence of all this are firms which, because of their mediocre environment, are forced to follow their signals and play the lottery more often, hoping to run a big story that brings people down. Unexpectedly, this reduces media bias.

Last, we perform the comparative static analysis with respect to parameter μ. Interestingly, we obtain that the incentive of a media firm to stick with action $\hat{n}$ out of fear of being proven wrong increases with μ. That is, increasing transparency has detrimental effects because it induces the news organization to silence more scandals.

Corollary 2. *Media silence is increasing in μ, $\frac{\partial \sigma_c(\hat{n})^*}{\partial \mu} > 0$.*

Proof. In the Appendix. □

The intuition for this result is as follows. Because increasing the probability of feedback increases the likelihood of being proven wrong and so the difference in payoffs associated with actions $\hat{n}$ and $\hat{c}$, the newspaper reacts to an increase in μ taking the conservative action $\hat{n}$ more often and so, silencing even more corruption scandals. Once more, the argument hinges upon the endogeneity of feedback, which is crucial to explain why, in our model, and in the terminology of Prat (2005), *transparency of consequences* has detrimental effects. This is in contrast to previous contributions in the career concern literature, where increasing transparency of consequences (learning the state) always induces the (low type) expert to send the report that is most likely to match the state of the world. If signals are informative, as in Prat (2005) or Gentzkow and Shapiro (2006), this leads to truthful reporting. If, however, the prior on the state is sufficiently strong,[18] as in Fox and Weelden (2012), this same argument explains why increasing transparency makes the expert more reticent to act on his private information.

[17] Lemma 3 in the Appendix shows that there exists $\bar{\alpha} \in (0, 1)$ such that $\forall \alpha > \bar{\alpha}$, $\sigma_c(\hat{n})^* = 1$.

[18] Namely, the prior is higher than the quality of the signal of the low type expert.

3.3 Unbalanced prior

> "When a significant segment of the public is interested in - or, better, outraged at - a politician's misbehavior, it heightens journalist' incentives to cover the matter."
>
> Robert M. Entman.

We next relax the assumption that the two states of the world are equiprobable. Let $P(w = C) = \theta$ denote the prior probability that the state is *corrupted*, with $\theta \in (0,1)$. In this case, after report $r \in \{\hat{n}, \hat{c}\}$ and feedback $X \in \{N, C, 0\}$, the posterior probability $\lambda(r, X)$ that the consumers assign to the news organization as being of high type is:

$$\lambda(\hat{n}, 0) = \frac{\alpha(1-\theta)}{\alpha(1-\theta) + (1-\alpha)((1-\theta)(\gamma\sigma_n(\hat{n}) + (1-\gamma)\sigma_c(\hat{n})) + \theta(\gamma\sigma_c(\hat{n}) + (1-\gamma)\sigma_n(\hat{n})))} \tag{7}$$

$$\lambda(\hat{c}, N) = 0 \tag{8}$$

$$\lambda(\hat{c}, C) = \frac{\alpha}{\alpha + (1-\alpha)(\gamma\sigma_c(\hat{c}) + (1-\gamma)\sigma_n(\hat{c}))} \tag{9}$$

$$\lambda(\hat{c}, 0) = \frac{\alpha\theta}{\alpha\theta + (1-\alpha)(\theta(\gamma\sigma_c(\hat{c}) + (1-\gamma)\sigma_n(\hat{c})) + (1-\theta)(\gamma\sigma_n(\hat{c}) + (1-\gamma)\sigma_c(\hat{c})))}. \tag{10}$$

It is interesting to distinguish two cases here: $\theta < \frac{1}{2}$ and $\theta > \frac{1}{2}$. To see the reason for this, note that with an unbalanced prior there are two important force on stage. On the one hand, the endogenous feedback, that drives the media firm towards silencing corruption scandals. On the other hand, the "herding on the prior" effect, that induces the newspaper to send the report that is most likely to confirm the prior belief.[19] When $\theta < \frac{1}{2}$, it is clear that the two effects go in the same direction, whereas when $\theta > 1/2$ they push towards different actions.

Let us first comment the case $\theta < \frac{1}{2}$.[20] Here, there are clear reasons to print easy-to-cover stories. Based on this, we should expect the newspaper to omit signals of corruption. Our results show this to be the case. Thus, in line with Theorem 1, we obtain $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{n})^* > 0$. Additionally, and also as expected, we observe that the higher the prior probability that the state is N (the lower θ), the higher the media silence. That is, a stronger prior (towards N) drives a greater bias. Last, we obtain that there exists $\bar{\alpha} \in (0,1)$ such

[19] See Gentzkow and Shapiro (2006) for an explanation of the "herding on the prior" argument and its consequences in terms of media bias. See also Heidhues and Lagerlöf (2003) and Cummins and Nyman (2005) for models of herding applied to other contexts.

[20] The analysis and results that follow are relegated to Section A.2 in the Appendix.

that $\forall\alpha > \bar{\alpha}$, $\sigma_c(\hat{n})^* = 1$. Or, to say it differently, if α is sufficiently high, media silence is complete.[21] This result, which we also derived in the previous section, highlights the perverse effects that great expectations on the quality of the media can have on the number of corruption scandals reported by a news organization. Indeed, it raises a concern about the silent role of the media in countries with high standards of the press (high α) and low levels of perceived corruption (low θ). To these cases, our result suggests that media silence might be more the consequence of a career concerned industry than the real image of the country's level of corruption.

Let us now consider $\theta > \frac{1}{2}$. Here, the two aforementioned driving forces push towards opposite directions. This creates a richer and more complex scenario. We next present the result.

Theorem 2. *Let $\theta \in (1/2, 1)$. There exist $\bar{\theta}_1$, $\bar{\theta}_2$ and $\bar{\theta}_3$, with $\frac{1}{2} < \bar{\theta}_1 < \bar{\theta}_2 < \bar{\theta}_3 < 1$, such that:*

1. *If $\theta \in (1/2, \bar{\theta}_1)$, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{n})^* > 0$.*
2. *If $\theta \in (\bar{\theta}_1, \bar{\theta}_2)$, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{c})^* = 1$.*
3. *If $\theta \in (\bar{\theta}_2, \bar{\theta}_3)$, $\sigma_n(\hat{c})^* > 0$ and $\sigma_c(\hat{c})^* = 1$.*
4. *If $\theta \in (\bar{\theta}_3, 1)$, $\sigma_n(\hat{c})^* = 1$ and $\sigma_c(\hat{c})^* = 1$.*

Theorem 2 illustrates how the equilibrium strategy of the media firm changes as θ increases. Thus, we first observe that when $1/2 < \theta < \bar{\theta}_1$, the "herding on the prior" effect is not strong enough to completely offset the incentive of the newspaper to take the conservative action. The conclusion is that even if consumers believe that the *corrupted* state is the most likely, if this prior is not too strong, we can have news organizations silencing evidence of corruption.[22] Additionally, we also obtain that for α sufficiently high, media silence can here be complete.[23]

Next, when $\theta \in (\bar{\theta}_1, \bar{\theta}_2)$, the two aforementioned arguments cancel out and we obtain that the newspaper truthfully follows its signals. Now, pushing θ beyond $\bar{\theta}_2$ represents a

[21] This is an extreme result that nonetheless does not require of a too strong parameter configuration. For example, if $\theta = 0.2$, $\gamma = 0.4$ and $\mu = 0.6$, we obtain $\bar{\alpha} = 0.68$.

[22] This is the same result than in cases $\theta < \frac{1}{2}$ and $\theta = \frac{1}{2}$ (Theorem 1). It thus proves the robustness of this conclusion.

[23] See Lemma 13 in the Appendix.

situation in which the prior on the state is sufficiently strong to offset any counterbalancing force which, for $\theta > \bar{\theta}_3$, results in the newspaper always reporting $\hat{c}$, independently of its signal. This creates a different class of media bias, that talks about newspapers printing too many stories on corruption, in the hope for catering to the people and possibly, bringing them down.

3.4 Feedback power and competition

> "You go all over America and you see small papers that do really good jobs in their communities of reporting. The modern New York Times, the modern Washington Post, the modern Wall Street Journal are better papers than they were at the time of Watergate in most respects. But if you look at the rest of the field, ... real news based on the best obtainable version of the truth was becoming less and less a commodity, less and less a real part of our journalistic institutions."

Carl Bernstein.

In the previous sections we have assumed that the newspaper is the only institution with the power to activate feedback. We next relax this assumption and consider that even when the news organization chooses to silence a corruption scandal, there is a positive probability that consumers learn the state of the world. This is a natural assumption when there are more media firms in the industry, or when certain institutions, such as the judicial system or the police, are free from external influence and perform well. In these cases, silencing a scandal does no longer guarantee the newspaper that citizens will never learn the truth, as it may well be the case that some other news organization, or another institution in the economy, covers the scandal.

In the analysis that follows we take the following approach. We continue focusing on one newspaper, but we now assume that even when this news organization chooses to silence the scandal, there is a positive probability that the true state is revealed to consumers. Let μ_0 denote this probability. Additionally, let μ_1 denote the probability that feedback occurs when the media firm reports the scandal, and assume $0 < \mu_0 \leq \mu_1 < 1$. Then, we can define $\mu_1 - \mu_0$ as the marginal impact of the firm on the probability that consumers learn the state of the world. We refer to this marginal impact as the feedback power of the firm. Note that when $\mu_0 = 0$ we are in the monopoly scenario, and that as μ_0 increases, $\mu_1 - \mu_0$ decreases, which represents a reduction in the feedback power of the firm. This can be interpreted as an increase in the level of competition in the media industry.[24] For expositional purposes, this is the argument we will use.

To clarify the concept of feedback power in the context of the media industry, consider the following exercise. Suppose a competitive media industry, in which all the newspapers are small enough as to affect the probability of feedback. This means news organizations take, in this case, the probability of feedback as something exogenous (they are feedback-takers), something they cannot affect. Note that this is the case when $\mu_1 - \mu_0$ is small enough and, in the limit, equal to zero. Indeed, when $\mu_1 - \mu_0 = 0$, it happens that there is only one probability of feedback, which does not depend on the action taken by the firm.[25] Suppose now the other extreme scenario, in which there is a powerful newspaper, with a large influence on the society. Because a corruption scandal printed in this newspaper will surely have a great social and judicial impact on the society, $\mu_1 - \mu_0$ cannot be zero for this firm. Moreover, the greater the power of the news organization we consider, the higher this difference should be.

Let us now proceed with the analysis, which is done assuming $\theta = 1/2$. Given a report $r \in \{\hat{n}, \hat{c}\}$ and feedback $X \in \{N, C, 0\}$, the posterior probability $\lambda(r, X)$ that consumers assign to the newspaper as being of high type is:

$$\lambda(\hat{n}, N) = \frac{\alpha}{\alpha + (1-\alpha)(\gamma\sigma_n(\hat{n}) + (1-\gamma)\sigma_c(\hat{n}))} \tag{11}$$

$$\lambda(\hat{n}, C) = 0 \tag{12}$$

$$\lambda(\hat{n}, 0) = \frac{\alpha}{\alpha + (1-\alpha)(\sigma_c(\hat{n}) + \sigma_n(\hat{n}))} \tag{13}$$

$$\lambda(\hat{c}, N) = 0 \tag{14}$$

$$\lambda(\hat{c}, C) = \frac{\alpha}{\alpha + (1-\alpha)(\gamma\sigma_c(\hat{c}) + (1-\gamma)\sigma_n(\hat{c}))} \tag{15}$$

$$\lambda(\hat{c}, 0) = \frac{\alpha}{\alpha + (1-\alpha)(\sigma_c(\hat{c}) + \sigma_n(\hat{c}))}. \tag{16}$$

Proceeding as previously, we can obtain the expected payoff to the (normal) newspaper

[24] Gentzkow and Shapiro (2006) present an alternative mechanism to explain how an increase in the number of media firms can increase the feedback probability in their model.

[25] This is the standard assumption in the literature.

when it observes signal $s \in \{n, c\}$ and publishes $r \in \{\hat{n}, \hat{c}\}$:

$$\begin{aligned}
E\{\lambda(\hat{n}, X)/n\} &= (1-\mu_0)\lambda(\hat{n}, 0) + \mu_0\gamma\lambda(\hat{n}, N) \\
E\{\lambda(\hat{n}, X)/c\} &= (1-\mu_0)\lambda(\hat{n}, 0) + \mu_0(1-\gamma)\lambda(\hat{n}, N) \\
E\{\lambda(\hat{c}, X)/n\} &= (1-\mu_1)\lambda(\hat{c}, 0) + \mu_1(1-\gamma)\lambda(\hat{c}, C) \\
E\{\lambda(\hat{c}, X)/c\} &= (1-\mu_1)\lambda(\hat{c}, 0) + \mu_1\gamma\lambda(\hat{c}, C),
\end{aligned}$$

and the expected gain to reporting $\hat{n}$ rather than $\hat{c}$, after observing signal n and c, respectively:

$$\Delta_n = (1-\mu_0)\lambda(\hat{n}, 0) + \mu_0\gamma\lambda(\hat{n}, N) - ((1-\mu_1)\lambda(\hat{c}, 0) + \mu_1(1-\gamma)\lambda(\hat{c}, C)) \quad (17)$$

$$\Delta_c = (1-\mu_0)\lambda(\hat{n}, 0) + \mu_0(1-\gamma)\lambda(\hat{n}, N) - ((1-\mu_1)\lambda(\hat{c}, 0) + \mu_1\gamma\lambda(\hat{c}, C)). \quad (18)$$

We next present the result:

Theorem 3. *Suppose* $0 < \mu_0 < \mu_1 < 1$. *Then, in equilibrium,*

1. *If* $\gamma < \hat{\gamma} \in (0, 1)$, $\sigma_n(\hat{n})^* = 1$ *and* $\sigma_c(\hat{n})^* > 0$,
2. *If* $\gamma > \hat{\gamma} \in (0, 1)$, $\sigma_n(\hat{n})^* = 1$ *and* $\sigma_c(\hat{c})^* = 1$,

with $\hat{\gamma} = \frac{\mu_0 + \alpha(\mu_1 - \mu_0)}{2\mu_0 + \alpha(\mu_1 - \mu_0)} \in (0, 1)$.

Proof. In the Appendix. □

From Theorem 3, we observe that introducing competition in the media industry, in the form of an exogenous feedback probability, ensures that newspapers with higher quality sources ($\gamma > \hat{\gamma}$) stick to their signals and thus, reduce their bias. However, this watchdog role is not at work on newspapers of lower quality, which continue silencing evidence of corruption. The fear of revealing their type and being proven wrong again prevents news organizations with lower quality signals to reveal their information.

The comparative static analysis also yields interesting insights. First, that an increase in the probability that the media is perceived as high type (α) strengthens the requirement on the quality of a firm to ensure revelation.[26] Thus, in line with the result in Corollary

[26] Note that when $\alpha \longrightarrow 0$, then $\hat{\gamma} \longrightarrow 1/2$. Thus, for any $\gamma \in (0, 1)$, in equilibrium, a newspaper always follows its signal. Since, $\frac{d\hat{\gamma}}{d\alpha} > 0$, the result follows.

1, we obtain that also with this form of competition, great expectations on the type of a newspaper drives media silence.

Second, that an increase in μ_0 reduces media bias, whereas an increase in μ_1 has the opposite effect and magnifies the bias. This is formally stated next.

Corollary 3. *Media silence is decreasing in* μ_0 *and increasing in* μ_1*,* $\frac{d\sigma_c(\hat{n})^*}{d\mu_0} < 0$ *and* $\frac{d\sigma_c(\hat{n})^*}{d\mu_1} > 0$.

Proof. In the Appendix. □

It is useful to interpret this result in terms of feedback power. To this, let us consider the following exercise. For a given μ_1, the smaller μ_0, thus the greater the feedback power of the firm $(\mu_1 - \mu_0)$, the higher the incentives of the news organization to silence evidence of corruption. Indeed, from Theorem 3, we observe that in the limit, when μ_0 tends to zero, $\hat{\gamma} \longrightarrow 1$. That is, media silence will occur in this case for any newspaper's quality, as in the monopoly scenario. On the contrary, the higher μ_0, thus the smaller the influence of the firm, the more likely it will stick to its signal. This insight is also observed in Theorem 3, when $\mu_0 \longrightarrow \mu_1$. Here, in the limit, we obtain $\hat{\gamma} = 1/2$. In other words, tough competition will serve to discipline all news organizations, independently of their quality. A similar exercise can be done for a fixed μ_0. Thus, given μ_0, the higher the political influence and market power of the firm, as measured by μ_1, the more often it omits a scandal; and the lower its feedback power, the higher its incentives to reveal its information. Our model thus predicts more media silence in powerful and influential news organization, and more disclosure of information in newspapers that operates in competitive environments, that is, media firms with a very limited capacity to influence the political, economic or social spheres.[27]

[27]Though this result may seen paradoxical at first sight, it is not such when we understand the logic underneath. To this, think of a country and its most influential newspapers. For example, *The New York Times* or *The Washington Post* in the US, *The Guardian* in the UK, or *El País* in Spain. Because of their power to activate ex-post verification and the secure payoff associated with action $\hat{n}$, many of these firms may try to avoid incurring in an error and being proven wrong. The result is that large news organizations very carefully examine and double-check the accuracy of any scoop before letting it go in the paper. In contrast, smaller newspapers, lacking this power to influence public opinion, are free from such great pressure and close scrutiny. This ensures more revelation of information by these smaller papers.

4 Conclusion

People receive much of the information from the media. Even in the area of new technologies, a recent study conducted by *Gallup*,[28] shows that 70% of Americans rate traditional media (tv, print newspapers and radio) as *"the main source of news about current events in the US and around the world"*. Internet and social media (Facebook, Twitter, etc) is mentioned by 21% of the population, and only a small 5% talk about other sources such as word of mouth. A tendency that the *American Press Institute* confirms to hold across generations.[29] These numbers reflect the importance of the media industry as to set what citizens get to know, to learn, and how much we lose from a silent media.

Based on these facts we build a model in which a news organization, through its printing strategy, has the power to determine how much citizens can ever learn about an issue. In other words, we endogeneize the feedback.

Our results show that because of the power of the media to determine how much citizens can learn, and thus to affect a firm's reputation, a news organization will choose the secure action of silencing corruption scandals more often than it should. Thus, a sole media firm with the only concern of reputation, can generate media bias (in the form of media silence). Interestingly, we obtain that greater expectations on the quality of a newspaper increases its silence and that similarly, an increase in the probability of feedback has as well detrimental effects. We next relax the basic framework in two directions. We obtain that media silence persist the introduction of an unbalanced prior, except when consumers' priors are strongly biased towards the corrupted state. In this case, as expected, a new source of media bias emerges, that talks about newspapers publishing stories of malpractices too often. Finally, we discuss the effects of a change in the feedback power of a firm due to a change in competition. We obtain that competition has the desired watchdog effect on newspapers with higher quality signals, but not on those with lower quality. We also show that an increase in competition disciplines the newspapers that lose feedback power. In contrast, increasing the market power or political influence of a news organization results in more media silence, hence more media bias.

Beyond the media industry, where our assumption that actions affect feedback may seem quite natural, we consider that there are other real-world situations that can also fit into our

[28] "TV Is Americans' Main Source of News", *Politics*, July 8, 2013.

[29] "The Personal News Cycle: How Americans choose to get their news", March 17, 2014.

model. Think for example in a judge accusing against a personality, a competition authority opening an inspection in an important firm, or a doctor prescribing a new treatment or medicine. The essence to all these examples is clear, and is to do with a really simple question: Do all my actions provoke feedback with the same probability? Or they are instead different in terms of attracting public attention? As the answer is simple as well. If actions differ in their influence magnitude, then we can presume we have another example of endogenous feedback. To these situations, the model in this paper presents new insights into the unexpected effects of quality and transparency.

A Appendix

The appendix is divided into four subsections: A.1) Monopoly; A.2) Unbalanced prior; A.3) Strategic high type; and A.4) Feedback power.

Prior to the analysis, note that the functions Δ_n and Δ_c depend on two variables, $\sigma_c(\hat{c})^*$ and $\sigma_n(\hat{n})^*$, and three parameters, α, γ and μ. In the case of an unbalanced prior, there will be a fourth parameter, θ. We use notation $\Delta_s[\cdot]$, with $s \in \{n, c\}$, when we need to make explicit this dependence.

A.1 Monopoly

Proof of Proposition 1

First, note that

$\lambda(\hat{n}, 0) = \frac{\alpha}{\alpha+(1-\alpha)(\sigma_c(\hat{n})+\sigma_n(\hat{n}))} > \lambda(\hat{c}, 0) = \frac{\alpha}{\alpha+(1-\alpha)(\sigma_c(\hat{c})+\sigma_n(\hat{c}))} \iff$

$\sigma_c(\hat{c}) + \sigma_n(\hat{c}) > \sigma_c(\hat{n}) + \sigma_n(\hat{n}) \iff 1 - \sigma_c(\hat{n}) + \sigma_n(\hat{c}) > \sigma_c(\hat{n}) + 1 - \sigma_n(\hat{c}) \iff$

$\sigma_n(\hat{c}) > \sigma_c(\hat{n})$.

Now, suppose $\mu = 0$. Clearly, $\Delta_n = \Delta_c = \lambda(\hat{n}, 0) - \lambda(\hat{c}, 0)$.

Then, in equilibrium, only $\sigma_c(\hat{n})^* = \sigma_n(\hat{c})^*$ can occur. Let us argue by contradiction:

$\sigma_n(\hat{c})^* > \sigma_c(\hat{n})^* \iff \lambda^*(\hat{n}, 0) > \lambda^*(\hat{c}, 0) \iff \Delta_c = \Delta_n > 0 \iff \sigma_n(\hat{c})^* = 0$ and $\sigma_c(\hat{n})^* = 1$, a contradiction.

$\sigma_n(\hat{c})^* < \sigma_c(\hat{n})^* \iff \lambda^*(\hat{n}, 0) < \lambda^*(\hat{c}, 0) \iff \Delta_c = \Delta_n < 0 \iff \sigma_n(\hat{c})^* = 1$ and $\sigma_c(\hat{n})^* = 0$, a contradiction.

Then, since $\sigma_c(\hat{n})^* = \sigma_n(\hat{c})^*$, it follows that $\lambda^*(\hat{n}, 0) = \lambda^*(\hat{c}, 0)$ and $\Delta_n = \Delta_c = 0$. This completes the proof. ■

Proof of Theorem 1

To prove this Theorem we first need the following two Lemmas.

Lemma 1. *If* $\mu > 0$*, then* $\Delta_n > \Delta_c$*.*

Proof. $\Delta_n > \Delta_c$

$\Longleftrightarrow$

$\lambda(\hat{n}, 0) - ((1-\mu)\lambda(\hat{c}, 0) + \mu\,(1-\gamma)\lambda(\hat{c}, C)) > \lambda(\hat{n}, 0) - ((1-\mu)\lambda(\hat{c}, 0) + \mu\,\gamma\lambda(\hat{c}, C))$

$\Longleftrightarrow$

$-\mu(1-\gamma)\lambda(\hat{c}, C) > -\mu\gamma\lambda(\hat{c}, C)$

$\Longleftrightarrow$

$(1-\gamma) < \gamma.$

Since $\gamma > \frac{1}{2}$, the proof follows. ♦

Lemma 2. *If* $\mu > 0$ *and* $\sigma_c(\hat{c}) = 1$*, then* $\Delta_n > 0$

Proof.

$\Delta_n = \lambda(\hat{n}, 0) - ((1-\mu)\lambda(\hat{c}, 0) + \mu\,(1-\gamma)\lambda(\hat{c}, C)) =$
$= \frac{\alpha}{\alpha+(1-\alpha)(\sigma_c(\hat{n})+\sigma_n(\hat{n}))} - \left(\frac{(1-\mu)\alpha}{\alpha+(1-\alpha)(\sigma_c(\hat{c})+\sigma_n(\hat{c}))} + \frac{\mu(1-\gamma)\alpha}{\alpha+(1-\alpha)(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))}\right).$

Now, $\Delta_n[\sigma_c(\hat{c}) = 1] =$
$= \frac{\alpha}{\alpha+(1-\alpha)\sigma_n(\hat{n})} - \left(\frac{(1-\mu)\alpha}{1+(1-\alpha)\sigma_n(\hat{c})} + \frac{\mu(1-\gamma)\alpha}{\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c}))}\right) > 0$

$\Longleftrightarrow$

$(1+(1-\alpha)\sigma_n(\hat{c}))(\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c})))$

$-(1-\mu)((\alpha+(1-\alpha)\sigma_n(\hat{n}))(\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c})))$

$-\mu(1-\gamma)((\alpha+(1-\alpha)\sigma_n(\hat{n}))(1+(1-\alpha)\sigma_n(\hat{c})) > 0$

$\Longleftrightarrow$

$(\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c})))(1+(1-\alpha)\sigma_n(\hat{c}) - \alpha - (1-\alpha)\sigma_n(\hat{n}))$

$+\mu\gamma(\alpha+(1-\alpha)\sigma_n(\hat{n}))(1+(1-\alpha)\sigma_n(\hat{c}))$

$+\mu(\alpha+(1-\alpha)\sigma_n(\hat{n}))(\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c})) - 1 - (1-\alpha)\sigma_n(\hat{c})) > 0$

$\Longleftrightarrow$

$(\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c})))(1-\alpha)2\sigma_n(\hat{c})$

$+\mu(\alpha+(1-\alpha)\sigma_n(\hat{n}))(\gamma+\gamma(1-\alpha)\sigma_n(\hat{c})+\alpha+\gamma-\alpha\gamma+(1-\alpha)(1-\gamma)\sigma_n(\hat{c}))-1-(1-\alpha)\sigma_n(\hat{c})) > 0$

$\Longleftrightarrow$

$(\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c})))(1-\alpha)2\sigma_n(\hat{c})+\mu(\alpha+(1-\alpha)\sigma_n(\hat{n}))(2\gamma-1+\alpha(1-\gamma)) > 0$

$\Longleftrightarrow$

$(2\gamma-1+\alpha(1-\gamma)) > 0$ which, since $\frac{1}{2} < \gamma < 1$, always holds. ♦

Now, we can prove that if $\mu > 0$, then $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{n})^* > 0$.
There are nine equilibrium configuration to analyze.

1.	$\sigma_c(\hat{c})^* = 1$	$\sigma_n(\hat{n})^* = 1$	$\Longleftrightarrow$	$\Delta_c \leq 0$	$\Delta_n \geq 0$.
2.	$0 < \sigma_c(\hat{c})^* < 1$	$\sigma_n(\hat{n})^* = 1$	$\Longleftrightarrow$	$\Delta_c = 0$	$\Delta_n \geq 0$.
3.	$\sigma_c(\hat{c})^* = 0$	$\sigma_n(\hat{n})^* = 1$	$\Longleftrightarrow$	$\Delta_c \geq 0$	$\Delta_n \geq 0$.
4.	$\sigma_c(\hat{c})^* = 1$	$\sigma_n(\hat{n})^* = 0$	$\Longleftrightarrow$	$\Delta_c \leq 0$	$\Delta_n \leq 0$.
5.	$0 < \sigma_c(\hat{c})^* < 1$	$\sigma_n(\hat{n})^* = 0$	$\Longleftrightarrow$	$\Delta_c = 0$	$\Delta_n \leq 0$.
6.	$\sigma_c(\hat{c})^* = 0$	$\sigma_n(\hat{n})^* = 0$	$\Longleftrightarrow$	$\Delta_c \geq 0$	$\Delta_n \leq 0$.
7.	$\sigma_c(\hat{c})^* = 1$	$0 < \sigma_n(\hat{n})^* < 1$	$\Longleftrightarrow$	$\Delta_c \leq 0$	$\Delta_n = 0$.
8.	$0 < \sigma_c(\hat{c})^* < 1$	$0 < \sigma_n(\hat{n})^* < 1$	$\Longleftrightarrow$	$\Delta_c = 0$	$\Delta_n = 0$.
9.	$\sigma_c(\hat{c})^* = 0$	$0 < \sigma_n(\hat{n})^* < 1$	$\Longleftrightarrow$	$\Delta_c \geq 0$	$\Delta_n = 0$.

Note that from Lemma 1, configurations 5, 6, 8 and 9 cannot be. Similarly, from Lemma 2, configurations 4 and 7 can neither be. Consequently, $\sigma_n(\hat{n})^* = 1$. This means only configurations 1-3 are left which, taking into account Lemmas 1 and 2, can be rewritten as:

1.	$\sigma_c(\hat{c})^* = 1$	$\sigma_n(\hat{n})^* = 1$	$\Longleftrightarrow$	$\Delta_c \leq 0$	$\Delta_n \geq 0$.
2.	$0 < \sigma_c(\hat{c})^* < 1$	$\sigma_n(\hat{n})^* = 1$	$\Longleftrightarrow$	$\Delta_c = 0$	$\Delta_n > 0$.
3.	$\sigma_c(\hat{c})^* = 0$	$\sigma_n(\hat{n})^* = 1$	$\Longleftrightarrow$	$\Delta_c \geq 0$	$\Delta_n > 0$.

Let us now consider $\sigma_n(\hat{n})^* = 1$ and analyze how the normal newspaper proceeds when it observes signal c.

$$\Delta_c\left[\sigma_n(\hat{n})^* = 1\right] = \frac{\alpha}{\alpha+(1-\alpha)(1+\sigma_c(\hat{n}))} - \left(\frac{(1-\mu)\alpha}{\alpha+(1-\alpha)\sigma_c(\hat{c})} + \frac{\mu\gamma\alpha}{\alpha+\gamma(1-\alpha)\sigma_c(\hat{c})}\right). \tag{19}$$

Now, let us suppose $\sigma_c(\hat{n})^* = 0$. In this case,

$\Delta_c\left[\sigma_n(\hat{n})^* = 1, \sigma_c(\hat{n})^* = 0\right] = \alpha - \left((1-\mu)\alpha + \frac{\mu\gamma\alpha}{\alpha+\gamma(1-\alpha)}\right) = \frac{\mu\alpha^2(1-\gamma)}{\alpha+\gamma(1-\alpha)} > 0$. Hence, in equilibrium, $\sigma_c(\hat{n})^* > 0$. ■

Proof of Corollary 1

From (19),

$\Delta_c\left[\sigma_n(\hat{n})=1\right]=\alpha\left(\frac{1}{\alpha+(1-\alpha)(1+\sigma_c(\hat{n}))}-\left(\frac{(1-\mu)}{\alpha+(1-\alpha)(1-\sigma_c(\hat{n}))}+\frac{\mu\gamma}{\alpha+\gamma(1-\alpha)(1-\sigma_c(\hat{n}))}\right)\right).$

Let us denote

$$F(\sigma_c(\hat{n}),\alpha)=\frac{1}{\alpha+(1-\alpha)(1+\sigma_c(\hat{n}))}-\left(\frac{(1-\mu)}{\alpha+(1-\alpha)(1-\sigma_c(\hat{n}))}+\frac{\mu\gamma}{\alpha+\gamma(1-\alpha)(1-\sigma_c(\hat{n}))}\right). \qquad (20)$$

In equilibrium, $\Delta_c\left[\sigma_n(\hat{n})^*=1,\sigma_c(\hat{n})^*\right]=0 \iff F(\sigma_c(\hat{n})^*,\alpha)=0.$

Now, by the implicit function theorem,

$$\frac{\partial\sigma_c(\hat{n})^*}{\partial\alpha}=-\frac{\frac{\partial F(\sigma_c(\hat{n})^*,\alpha)}{\partial\alpha}}{\frac{\partial F(\sigma_c(\hat{n})^*,\alpha)}{\partial\sigma_c(\hat{n})^*}},$$

where,

$\frac{\partial F(\sigma_c(\hat{n})^*,\alpha)}{\partial\alpha}=\frac{\sigma_c(\hat{n})^*}{(\alpha+(1-\alpha)(1+\sigma_c(\hat{n})^*))^2}+(1-\mu)\frac{\sigma_c(\hat{n})^*}{(\alpha+(1-\alpha)(1-\sigma_c(\hat{n})^*))^2}+\gamma\mu\frac{\gamma\sigma_c(\hat{n})^*+1-\gamma}{(\alpha+\gamma(1-\alpha)(1-\sigma_c(\hat{n})^*))^2}>0,$

$\frac{\partial F(\sigma_c(\hat{n})^*,\alpha)}{\partial\sigma_c(\hat{n})^*}=-\frac{1-\alpha}{(\alpha+(1-\alpha)(1+\sigma_c(\hat{n})^*))^2}-\left((1-\alpha)\frac{1-\mu}{(\alpha+(1-\alpha)(1-\sigma_c(\hat{n})^*))^2}+\gamma^2\mu\frac{1-\alpha}{(\alpha+\gamma(1-\alpha)(1-\sigma_c(\hat{n})^*))^2}\right)<0.$

Consequently,

$\frac{\partial\sigma_c(\hat{n})^*}{\partial\alpha}>0.$ ■

Proof of Corollary 2

Let us now denote by $F(\sigma_c(\hat{n})^*,\mu)$ the right hand side of equation (20). By the implicit function theorem,

$\frac{\partial\sigma_c(\hat{n})^*}{\partial\mu}=-\frac{\frac{\partial F(\sigma_c(\hat{n})^*,\mu)}{\partial\mu}}{\frac{\partial F(\sigma_c(\hat{n})^*,\mu)}{\partial\sigma_c(\hat{n})^*}},$

where,

$\frac{\partial F(\sigma_c(\hat{n})^*,\mu)}{\partial\mu}=\frac{\alpha(1-\gamma)}{(\alpha+(1-\alpha)(1-\sigma_c(\hat{n})^*))(\alpha+\gamma(1-\alpha)(1-\sigma_c(\hat{n})^*))}>0,$

$\frac{\partial F(\sigma_c(\hat{n})^*,\mu)}{\partial\sigma_c(\hat{n})^*}<0$ (shown in Corollary 1).

Consequently,

$\frac{\partial\sigma_c(\hat{n})^*}{\partial\mu}>0.$ ■

<u>Additional results</u>

Lemma 3. *There exists $\bar{\alpha}\in(0,1)$ such that for all $\alpha>\bar{\alpha}$, $\sigma_c(\hat{n})^*=1$.*

Proof.

First, Corollary 1 shows that $\sigma_c(\hat{n})^*$ is increasing in α. Second, from the proof of Corollary 1, it follows that $\Delta_c[\sigma_n(\hat{n}) = 1] > 0 \iff F(\sigma_c(\hat{n}), \alpha) > 0$.

Now, since

$F(\sigma_c(\hat{n}), \alpha = 0) = -\frac{2\sigma_c(\hat{n})}{(1-\sigma_c(\hat{n}))(1+\sigma_c(\hat{n}))} < 0$, and

$F(\sigma_c(\hat{n}), \alpha = 1) = 1 - ((1-\mu) + \mu\gamma) = \mu(1-\gamma) > 0$,

we have $\Delta_c[\sigma_n(\hat{n}) = 1, \alpha = 1] > 0$, and thus $\sigma_c(\hat{n})^* = 1$ for $\alpha = 1$. From here, the proof follows. ■

Lemma 4. $\frac{\partial \sigma_c(\hat{n})^*}{\partial \gamma} < 0$

Proof.

Let us now denote by $F(\sigma_c(\hat{n})^*, \gamma)$ the right hand side of equation (20). By the implicit function theorem,

$\frac{\partial \sigma_c(\hat{n})^*}{\partial \gamma} = -\frac{\frac{\partial F(\sigma_c(\hat{n})^*, \gamma)}{\partial \gamma}}{\frac{\partial F(\sigma_c(\hat{n})^*, \gamma)}{\partial \sigma_c(\hat{n})^*}}$,

where,

$\frac{\partial F(\sigma_c(\hat{n})^*, \gamma)}{\partial \gamma} = -\frac{\mu\alpha}{(\alpha+\gamma(1-\alpha)(1-\sigma_c(\hat{n})^*))^2} < 0$,

$\frac{\partial F(\sigma_c(\hat{n})^*, \gamma)}{\partial \sigma_c(\hat{n})^*} < 0$ (shown in Corollary 1).

Consequently,

$\frac{\partial \sigma_c(\hat{n})^*}{\partial \gamma} < 0$. ■

A.2 Unbalanced prior

In the main body of the paper, we differentiate two cases: $\theta < \frac{1}{2}$ and $\theta > \frac{1}{2}$. This was done for expositional purposes. However, in the Appendix, there is no need for such a differentiation. Thus, next result (Proposition 2) considers the two cases together, and so holds for any $\theta \in (0, 1)$. It then proves Theorem 2.

Before going into this proof, note that the only difference with respect to the monopoly scenario is that instead of considering beliefs (1)-(4), we now have to consider beliefs (7)-(10). As for the functions Δ_n and Δ_c, they are those in (5) and (6).

Proposition 2. *Let $\theta \in (0, 1)$. There exist $\bar{\theta}_1$, $\bar{\theta}_2$ and $\bar{\theta}_3$, with $\frac{1}{2} < \bar{\theta}_1 < \bar{\theta}_2 < \bar{\theta}_3 < 1$, such that:*

1. If $\theta \in (0, \bar{\theta}_1)$, $\sigma_n(\hat{n})^* = 1$ *and* $\sigma_c(\hat{n})^* > 0$.

2. If $\theta \in (\bar{\theta}_1, \bar{\theta}_2)$, $\sigma_n(\hat{n})^* = 1$ *and* $\sigma_c(\hat{c})^* = 1$.

3. If $\theta \in (\bar{\theta}_2, \bar{\theta}_3)$, $\sigma_n(\hat{c})^* > 0$ *and* $\sigma_c(\hat{c})^* = 1$.

4. If $\theta \in (\bar{\theta}_3, 1)$, $\sigma_n(\hat{c})^* = 1$ *and* $\sigma_c(\hat{c})^* = 1$.

Proof

The Proposition is proven through a Remark and seven Lemmas.

Remark 2. *Since* $\gamma > 1/2$, Δ_n *is strictly greater than* Δ_c.

Lemma 5. *The functions* Δ_n *and* Δ_c *are decreasing in* θ.

Proof. From (5), (6) and (7)-(10), we obtain that, as $\frac{\partial\lambda(\hat{c},C)}{\partial\theta} = 0$, then $\frac{\partial\Delta_n}{\partial\theta} = \frac{\partial\Delta_c}{\partial\theta} = \frac{\partial\lambda(\hat{n},0)}{\partial\theta} - (1-\mu)\frac{\partial\lambda(\hat{c},0)}{\partial\theta}$,

with,

$\frac{\partial\lambda(\hat{n},0)}{\partial\theta} = \frac{-\alpha(1-\alpha)(\gamma\sigma_c(\hat{n})+(1-\gamma)\sigma_n(\hat{n}))}{(\alpha(1-\theta)+(1-\alpha)((1-\theta)(\gamma\sigma_n(\hat{n})+(1-\gamma)\sigma_c(\hat{n}))+\theta(\gamma\sigma_c(\hat{n})+(1-\gamma)\sigma_n(\hat{n}))))^2} < 0,$

$\frac{\partial\lambda(\hat{c},0)}{\partial\theta} = \frac{\alpha(1-\alpha)(\gamma\sigma_n(\hat{c})+(1-\gamma)\sigma_c(\hat{c}))}{(\alpha\theta+(1-\alpha)(\theta(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))+(1-\theta)(\gamma\sigma_n(\hat{c})+(1-\gamma)\sigma_c(\hat{c}))))^2} > 0.$

Consequently,

$\frac{\partial\Delta_n}{\partial\theta} = \frac{\partial\Delta_c}{\partial\theta} < 0.$ ♦

Lemma 6. $\Delta_n[\theta = 1] < 0$ *and* $\Delta_c[\theta = 1] < 0$.

Proof. Note that $\Delta_n = \lambda(\hat{n},0) - ((1-\mu)\lambda(\hat{c},0) + \mu(1-\gamma)\lambda(\hat{c},C))$. Thus, $\Delta_n[\theta = 1] = 0 - ((1-\mu)\lambda(\hat{c},0) + \mu(1-\gamma)\lambda(\hat{c},C)) < 0$, since $\lambda(\hat{c},0) > 0$ and $\lambda(\hat{c},C) > 0$ for $\theta = 1$.

Analogously, we show $\Delta_c[\theta = 1] = -((1-\mu)\lambda(\hat{c},0) + \mu\gamma\lambda(\hat{c},C)) < 0$. ♦

Lemma 7. *The function* Δ_n *is decreasing in* $\sigma_n(\hat{n})$.

Proof. Note that $\frac{\partial\Delta_n}{\partial\sigma_n(\hat{n})} = \frac{\partial\lambda(\hat{n},0)}{\partial\sigma_n(\hat{n})} - ((1-\mu)\frac{\partial\lambda(\hat{c},0)}{\partial\sigma_n(\hat{n})} + \mu(1-\gamma)\frac{\partial\lambda(\hat{c},C)}{\partial\sigma_n(\hat{n})})$, with

$\frac{\partial\lambda(\hat{n},0)}{\partial\sigma_n(\hat{n})} = \frac{-\alpha(1-\theta)(1-\alpha)(\gamma(1-\theta)+(1-\gamma)\theta)}{(\alpha(1-\theta)+(1-\alpha)((1-\theta)(\gamma\sigma_n(\hat{n})+(1-\gamma)\sigma_c(\hat{n}))+\theta(\gamma\sigma_c(\hat{n})+(1-\gamma)\sigma_n(\hat{n}))))^2} < 0,$

$\frac{\partial\lambda(\hat{c},0)}{\partial\sigma_n(\hat{n})} = \frac{\alpha\theta(1-\alpha)(\gamma(1-\theta)+(1-\gamma)\theta)}{(\alpha\theta+(1-\alpha)(\theta(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))+(1-\theta)(\gamma\sigma_n(\hat{c})+(1-\gamma)\sigma_c(\hat{c}))))^2} > 0,$

$\frac{\partial\lambda(\hat{c},C)}{\partial\sigma_n(\hat{n})} = \frac{\alpha(1-\alpha)(1-\gamma)}{(\alpha+(1-\alpha)(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c})))^2} > 0.$

Consequently, $\frac{\partial\Delta_n}{\partial\sigma_n(\hat{n})} < 0.$ ♦

Lemma 8. *The function* Δ_c *is increasing in* $\sigma_c(\hat{c})$.

Proof. Note that $\frac{\partial \Delta_c}{\partial \sigma_c(\hat{c})} = \frac{\partial \lambda(\hat{n},0)}{\partial \sigma_c(\hat{c})} - ((1-\mu)\frac{\partial \lambda(\hat{c},0)}{\partial \sigma_c(\hat{c})} + \mu\gamma\frac{\partial \lambda(\hat{c},C)}{\partial \sigma_c(\hat{c})})$, with

$\frac{\partial \lambda(\hat{n},0)}{\partial \sigma_c(\hat{c})} = \frac{\alpha(1-\theta)(1-\alpha)((1-\gamma)(1-\theta)+\gamma\theta)}{(\alpha(1-\theta)+(1-\alpha)((1-\theta)(\gamma\sigma_n(\hat{n})+(1-\gamma)\sigma_c(\hat{n}))+\theta(\gamma\sigma_c(\hat{n})+(1-\gamma)\sigma_n(\hat{n}))))^2} > 0$,

$\frac{\partial \lambda(\hat{c},0)}{\partial \sigma_c(\hat{c})} = \frac{-\alpha\theta(1-\alpha)((1-\gamma)(1-\theta)+\gamma\theta)}{(\alpha\theta+(1-\alpha)(\theta(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))+(1-\theta)(\gamma\sigma_n(\hat{c})+(1-\gamma)\sigma_c(\hat{c}))))^2} < 0$,

$\frac{\partial \lambda(\hat{c},C)}{\partial \sigma_c(\hat{c})} = \frac{-\alpha(1-\alpha)\gamma}{(\alpha+(1-\alpha)(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c})))^2} < 0$.

Consequently, $\frac{\partial \Delta_c}{\partial \sigma_c(\hat{c})} > 0$. ♦

Lemma 9. *Let $\bar{\theta}_1$, $\bar{\theta}_2$, and $\bar{\theta}_3$ be thresholds such that*

$\Delta_c\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 1; \theta = \bar{\theta}_1\right] = 0$,

$\Delta_n\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 1; \theta = \bar{\theta}_2\right] = 0$, *and*

$\Delta_n\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 0; \theta = \bar{\theta}_3\right] = 0$.

Then, $\frac{1}{2} < \bar{\theta}_1 < \bar{\theta}_2 < \bar{\theta}_3 < 1$.

Proof. First, it is shown that $\bar{\theta}_1 > \frac{1}{2}$. If $\theta = \frac{1}{2}$, then $\Delta_c\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 1; \theta = \frac{1}{2}\right] = \frac{\mu\alpha^2(1-\gamma)}{\alpha+\gamma(1-\alpha)} > 0$. Now, from Lemma 5, we know $\frac{\partial \Delta_c}{\partial \theta} < 0$. Then, $\bar{\theta}_1$ must be greater than $\frac{1}{2}$.

The inequality $\bar{\theta}_1 < \bar{\theta}_2$ follows, as $\Delta_n > \Delta_c$ and $\frac{\partial \Delta_n}{\partial \theta} = \frac{\partial \Delta_c}{\partial \theta} < 0$ (by Remark 2 and Lemma 5).

Now, from Lemmas 5 and 7, we have $\bar{\theta}_2 < \bar{\theta}_3$.

Last, since $\Delta_n[\theta = 1] < 0$ (by Lemma 6) and $\frac{\partial \Delta_n}{\partial \theta} < 0$ (by Lemma 5), threshold $\bar{\theta}_3$ must be strictly smaller than 1. ♦

Lemma 10. *Suppose $\sigma_c(\hat{c}) = 1$. Then:*

1) If $\theta \in (0, \bar{\theta}_2)$, $\Delta_n > 0$.

2) If $\theta \in (\bar{\theta}_2, \bar{\theta}_3)$, Δ_n only has one inner root.

3) If $\theta \in (\bar{\theta}_3, 1)$, $\Delta_n < 0$.

Proof. Consider first $\theta \in (0, \bar{\theta}_2)$. As $\Delta_n\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 1; \theta = \bar{\theta}_2\right] = 0$, $\frac{\partial \Delta_n}{\partial \theta} < 0$ and $\frac{\partial \Delta_n}{\partial \sigma_n(\hat{n})} < 0$ (see Lemmas 9, 5 and 7), we have $\Delta_n > 0$.

Consider now $\theta \in (\bar{\theta}_2, \bar{\theta}_3)$. As $\Delta_n\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 1; \theta = \bar{\theta}_2\right] = 0$, $\Delta_n\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 0; \theta = \bar{\theta}_3\right] = 0$, $\frac{\partial \Delta_n}{\partial \theta} < 0$ and $\frac{\partial \Delta_n}{\partial \sigma_n(\hat{n})} < 0$ (see Lemmas 9, 5 and 7), we have that the function Δ_n has only one inner root (in $\sigma_n(\hat{n})$).

Last, consider $\theta \in (\bar{\theta}_3, 1)$. As $\Delta_n\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 0; \theta = \bar{\theta}_3\right] = 0$, $\frac{\partial \Delta_n}{\partial \theta} < 0$, $\frac{\partial \Delta_n}{\partial \sigma_n(\hat{n})} < 0$ and $\Delta_n[\theta = 1] < 0$ (see Lemmas 9, 5, 7 and 6), we have $\Delta_n < 0$. ♦

Lemma 11. *Suppose $\sigma_n(\hat{n}) = 1$. Then, if $\theta \in (\bar{\theta}_1, 1)$, $\Delta_c < 0$.*

Proof. Consider $\theta \in (\bar{\theta}_1, 1)$. As $\Delta_c\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 1; \theta = \bar{\theta}_1\right] = 0$, $\frac{\partial \Delta_c}{\partial \theta} < 0$, $\frac{\partial \Delta_c}{\partial \sigma_c(\hat{c})} > 0$ and $\Delta_c\left[\theta = 1\right] < 0$ (see Lemmas 9, 5, 8 and 6), we have $\Delta_c < 0$. ♦

Now, there are nine possible equilibrium configurations to analyze.

1.	$\sigma_c(\hat{c})^* = 1$	$\sigma_n(\hat{n})^* = 1$	$\Longleftrightarrow$	$\Delta_c \leq 0$	$\Delta_n \geq 0$
2.	$0 < \sigma_c(\hat{c})^* < 1$	$\sigma_n(\hat{n})^* = 1$	$\Longleftrightarrow$	$\Delta_c = 0$	$\Delta_n \geq 0$
3.	$\sigma_c(\hat{c})^* = 0$	$\sigma_n(\hat{n})^* = 1$	$\Longleftrightarrow$	$\Delta_c \geq 0$	$\Delta_n \geq 0$
4.	$\sigma_c(\hat{c})^* = 1$	$\sigma_n(\hat{n})^* = 0$	$\Longleftrightarrow$	$\Delta_c \leq 0$	$\Delta_n \leq 0$
5.	$0 < \sigma_c(\hat{c})^* < 1$	$\sigma_n(\hat{n})^* = 0$	$\Longleftrightarrow$	$\Delta_c = 0$	$\Delta_n \leq 0$
6.	$\sigma_c(\hat{c})^* = 0$	$\sigma_n(\hat{n})^* = 0$	$\Longleftrightarrow$	$\Delta_c \geq 0$	$\Delta_n \leq 0$
7.	$\sigma_c(\hat{c})^* = 1$	$0 < \sigma_n(\hat{n})^* < 1$	$\Longleftrightarrow$	$\Delta_c \leq 0$	$\Delta_n = 0$
8.	$0 < \sigma_c(\hat{c})^* < 1$	$0 < \sigma_n(\hat{n})^* < 1$	$\Longleftrightarrow$	$\Delta_c = 0$	$\Delta_n = 0$
9.	$\sigma_c(\hat{c})^* = 0$	$0 < \sigma_n(\hat{n})^* < 1$	$\Longleftrightarrow$	$\Delta_c \geq 0$	$\Delta_n = 0$

Note that from Remark 2, configurations 5, 6, 8, and 9 cannot be. Then, we next analyze the remaining equilibrium configurations (for each of the intervals of θ considered in Proposition 2). We do it taking into account the restriction $\Delta_n > \Delta_c$ imposed by Remark 2.

a) Interval $\theta \in (0, \bar{\theta}_1)$. By Lemma 10, in this interval we have $\Delta_n[\sigma_c(\hat{c}) = 1] > 0$. Then, $\sigma_n(\hat{n})^* = 1$, and thus configurations 4 and 7 cannot be. Hence, only configurations 1, 2 and 3 are left. However, configuration 1 is neither possible. The reason is that if $\sigma_n(\hat{n})^* = 1$, then $\sigma_c(\hat{c})^* < 1$ (since $\Delta_c\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 1; \theta = \bar{\theta}_1\right] = 0$ and $\frac{\partial \Delta_c}{\partial \theta} < 0$, which implies $\Delta_c\left[\sigma_c(\hat{c}) = 1; \sigma_n(\hat{n}) = 1; \theta < \bar{\theta}_1\right] > 0$, and thus $\sigma_c(\hat{c})^* < 1$). Therefore, only configurations 2 and 3 are possible, and thus $\sigma_n(\hat{n})^* = 1$ and $0 \leq \sigma_c(\hat{c})^* < 1$. Additionally, as $\frac{\partial \Delta_c}{\partial \sigma_c(\hat{c})} > 0$ (see Lemma 8), there is only one equilibrium.

b) Interval $\theta \in (\bar{\theta}_1, \bar{\theta}_2)$. The same argument above shows that configurations 4 and 7 can neither be here. Thus, in equilibrium, $\sigma_n(\hat{n})^* = 1$. In this case, if $\sigma_n(\hat{n})^* = 1$, then $\sigma_c(\hat{c})^* = 1$ (because by Lemma 11, if $\sigma_n(\hat{n})^* = 1$, then $\Delta_c < 0$, and consequently $\sigma_c(\hat{c})^* = 1$).

c) Interval $\theta \in (\bar{\theta}_2, \bar{\theta}_3)$. Analogously to the previous point, by Lemma 11, if $\sigma_n(\hat{n})^* = 1$, then $\Delta_c < 0$, and consequently $\sigma_c(\hat{c})^* = 1$. Thus, configurations 2 and 3 cannot be. The only possible configurations that are left are 1, 4 and 7, which implies that in equilibrium $\sigma_c(\hat{c})^* = 1$. However, configurations 1 and 4 cannot be either. The reason is that by lemma 10, in this interval, if $\sigma_c(\hat{c}) = 1$, then Δ_n has only one inner root. Thus, in equilibrium,

$0 < \sigma_n(\hat{n})^* < 1$.

d) Interval $\theta \in (\bar{\theta}_3, 1)$. Again, from Lemma 11, if $\sigma_n(\hat{n})^* = 1$, then $\sigma_c(\hat{c})^* = 1$. Thus, only 1, 4 or 7 can be. However, from lemma 10, neither 1 nor 7 can hold. The reason is that in this interval, if $\sigma_c(\hat{c}) = 1$, then $\Delta_n < 0$, and thus $\sigma_n(\hat{n})^* = 0$. Consequently, in equilibrium, $\sigma_c(\hat{c})^* = 1$ and $\sigma_n(\hat{n})^* = 0$. ■

Additional results

Lemma 12. $\frac{\partial \sigma_c(\hat{n})^*}{\partial \theta} < 0$.

Proof.

Since $\frac{\partial \sigma_c(\hat{n})^*}{\partial \theta} = -\frac{\frac{\partial \Delta_c}{\partial \theta}}{\frac{\partial \Delta_c}{\partial \sigma_c(\hat{n})^*}}$, from Lemmas 5 and 8, the proof follows. ■

Lemma 13. *For any $\theta \in (0, \bar{\theta}_1)$, there exists $\bar{\alpha} \in (0,1)$ such that for all $\alpha > \bar{\alpha}$, $\sigma_c(\hat{n})^* = 1$*

Proof.

First note that from Proposition 2, if $\theta < \bar{\theta}_1$, then $\sigma_n(\hat{n})^* = 1$.

Now, we show that $\Delta_c [\sigma_c(\hat{c}) = 0; \sigma_n(\hat{n}) = 1; \alpha]$ is increasing in α. To this, note that $\Delta_c [\sigma_c(\hat{c}) = 0; \sigma_n(\hat{n}) = 1] = \lambda(\hat{n}, 0) - ((1-\mu)\lambda(\hat{c}, 0) + \mu\gamma\lambda(\hat{c}, C)) = (1-\gamma)\,\mu - \frac{(1-\alpha)}{(1-\alpha\theta)}$, and $\frac{d\left((1-\gamma)\mu - \frac{(1-\alpha)}{(1-\alpha\theta)}\right)}{d\alpha} = \frac{1-\theta}{(\theta\alpha-1)^2} > 0$.

Finally, note that $\Delta_c [\sigma_c(\hat{c}) = 0; \sigma_n(\hat{n}) = 1; \alpha = 0] = (1-\gamma)\,\mu - 1 < 0$, which implies that if α is small enough, then $\sigma_c(\hat{n})^* < 1$. Additionally, by Proposition 2, $\sigma_c(\hat{n})^* > 0$. Finally, $\Delta_c [\sigma_c(\hat{c}) = 0; \sigma_n(\hat{n}) = 1; \alpha = 1] = (1-\gamma)\,\mu > 0$, which implies that if α is high enough, then $\sigma_c(\hat{n})^* = 1$. From here, the proof follows. ■

A.3 High type plays strategically

In this section, we show that if the high type is strategic, then it is an equilibrium strategy for the high type to always report its signal.

We denote by $\sigma_{hs}(r) \in [0,1]$ the probability that, conditioned on its signal s, a high type newspaper takes action r. In addition, $\sigma_s(r)$ will continue denoting this probability for the normal type.

Proposition 3. *Let $\theta \in (0,1)$. There exist $\bar{\theta}_1$, $\bar{\theta}_2$ and $\bar{\theta}_3$, with $\frac{1}{2} < \bar{\theta}_1 < \bar{\theta}_2 < \bar{\theta}_3 < 1$, such that:*

- *If $\theta \in (0, \bar{\theta}_1)$, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{n})^* > 0$.*

- *If* $\theta \in (\bar{\theta}_1, \bar{\theta}_2)$, $\sigma_n(\hat{n})^{*}= 1$ *and* $\sigma_c(\hat{c})^{*}= 1$.

- *If* $\theta \in (\bar{\theta}_2, \bar{\theta}_3)$, $\sigma_n(\hat{c})^{*}> 0$ *and* $\sigma_c(\hat{c})^{*}= 1$.

- *If* $\theta \in (\bar{\theta}_3, 1)$, $\sigma_n(\hat{c})^{*}= 1$ *and* $\sigma_c(\hat{c})^{*}= 1$,

In addition, if the high type plays strategically, the truthful strategy $(\sigma_{hc}(\hat{c})^{*} = 1$ *and* $\sigma_{hn}(\hat{n})^{*} = 1)$ *is an equilibrium strategy for the high type.*

Proof.

Proposition 2 shows that if the high type plays the truthful strategy ($\sigma_{hc}(\hat{c})^{*} = 1$ and $\sigma_{hn}(\hat{n})^{*} = 1$), the normal type's strategy described above is an equilibrium strategy. Therefore, we only have to show that if the normal type plays such a strategy, the truthful strategy is an equilibrium strategy for the high type. To this, we will assume that the high type plays the truthful strategy, ($\sigma_{hc}(\hat{c})^{*} = 1$ and $\sigma_{hn}(\hat{n})^{*} = 1$), and then show that this is indeed an equilibrium strategy.

First, we derive the payoff functions for the high type. As for the normal type, they are defined in equations (5) and (6).

Let $E_h\{\lambda(r, X)/s\}$ denote the expected payoff to the high type newspaper when it observes signal $s \in \{n, c\}$ and publishes $r \in \{\hat{n}, \hat{c}\}$.

$E_h\{\lambda(\hat{n}, X)/s\} = \lambda(\hat{n}, 0)$

$E_h\{\lambda(\hat{c}, X)/n\} = (1-\mu)\lambda(\hat{c}, 0) + \mu[\lambda(\hat{c}, N)] = (1-\mu)\lambda(\hat{c}, 0)$

$E_h\{\lambda(\hat{c}, X)/c\} = (1-\mu)\lambda(\hat{c}, 0) + \mu[\lambda(\hat{c}, C)]$

Now, we define the expected gain to reporting $\hat{n}$ rather than $\hat{c}$, after observing signal s, as $\Delta_s^h = E_h\{\lambda(\hat{n}, X)/s\} - E_h\{\lambda(\hat{c}, X)/s\}$.

Substituting, we obtain:

$$\Delta_n^h = \lambda(\hat{n}, 0) - (1-\mu)\lambda(\hat{c}, 0)$$
$$\Delta_c^h = \lambda(\hat{n}, 0) - ((1-\mu)\lambda(\hat{c}, 0) + \mu\lambda(\hat{c}, C))$$

Claim 1. $\Delta_n^h > \Delta_n > \Delta_c > \Delta_c^h$.

Proof.

First, note that from Remark 2, $\Delta_n > \Delta_c$.

Additionally,

$\Delta_n^h = \lambda(\hat{n}, 0) - (1-\mu)\lambda(\hat{c}, 0) > \Delta_n = \lambda(\hat{n}, 0) - ((1-\mu)\lambda(\hat{c}, 0) + \mu(1-\gamma)\lambda(\hat{c}, C))$, and

$\Delta_c^h = \lambda(\hat{n},0) - ((1-\mu)\lambda(\hat{c},0) + \mu\lambda(\hat{c},C)) < \Delta_c = \lambda(\hat{n},0) - ((1-\mu)\lambda(\hat{c},0) + \mu\gamma\lambda(\hat{c},C))$.

Consequently, $\Delta_n^h > \Delta_n > \Delta_c > \Delta_c^h$. ♦

Next, we go into the analysis of the nine possible equilibrium configurations for the normal type, enumerated in the proof of Proposition 2. There, we showed that configurations 5, 6, 8 and 9 could not be in equilibrium (as $\Delta_n > \Delta_c$). This is also the case now. Then, we next analyze the equilibrium configurations that are left: 1, 2, 3, 4 and 7; and show that for none of them, the high type has an incentive to deviate from the truthful strategy.

Configuration 1: In this case, $\Delta_c \leq 0$. Then, from Claim 1, $\Delta_c^h < 0$, and thus $\sigma_{hc}(\hat{c})^* = 1$. In addition, $\Delta_n \geq 0$, consequently, $\Delta_n^h > 0$, and thus $\sigma_{hn}(\hat{n})^* = 1$.

Configuration 2: This case is analogous to the previous one.

Configuration 3: Since $\Delta_n \geq 0$, then $\Delta_n^h > 0$ and thus $\sigma_{hn}(\hat{n})^* = 1$. Because under this configuration, the normal type never sends $\hat{c}$, if $\hat{c}$ were to be reported, the newspaper would assigned a probability one of being the high type. Consequently, $\Delta_c^h = \lambda(\hat{n},0) - ((1-\mu)\lambda(\hat{c},0) + \mu\lambda(\hat{c},C)) = \lambda(\hat{n},0) - 1 < 0$, which implies $\sigma_{hc}(\hat{c})^* = 1$.

Configuration 4: Since $\Delta_c \leq 0$, then $\Delta_c^h < 0$, and thus $\sigma_{hc}(\hat{c})^* = 1$. Because under this configuration, the normal type never sends $\hat{n}$, if $\hat{n}$ were to be reported, the newspaper would assign a probability one of being the high type. Consequently, $\Delta_n^h = \lambda(\hat{n},0) - (1-\mu)\lambda(\hat{c},0) = 1 - (1-\mu)\lambda(\hat{c},0) > 0$, which implies $\sigma_{hn}(\hat{n})^* = 1$.

Configuration 7: This case is analogous to Configuration 1.

Then, the true strategy is an equilibrium strategy. ■

The next result shows that the equilibrium above is unique. To this, we make the following assumption: In equilibrium, the high type matches the state of the world more often than the normal type.[30] Formally, it implies $\frac{P(\hat{c}|\aleph,C)}{P(\hat{c}|H,C)} < \frac{P(\hat{c}|\aleph,N)}{P(\hat{c}|H,N)}$, where $P(\hat{c} \mid \aleph, C)$ is the probability that a normal type ($\aleph$) reports $\hat{c}$ when the state of the world is C. Analogously, $P(\hat{c} \mid H, C)$ is the probability that a high type (H) reports $\hat{c}$ when the state of the world is C and so on, so forth. It is straightforward to prove that if $\frac{P(\hat{c}|\aleph,C)}{P(\hat{c}|H,C)} < \frac{P(\hat{c}|\aleph,N)}{P(\hat{c}|H,N)}$, then $\lambda(\hat{c},C) > \lambda(\hat{c},N)$.

[30] Note that this is a quite mild assumption. Nonetheless, if it were not the case, it would not make sense for a consumer to assign a reputational reward to a high type.

Corollary 4. *If* $\frac{P(\hat{c}|\aleph,C)}{P(\hat{c}|H,C)} < \frac{P(\hat{c}|\aleph,N)}{P(\hat{c}|H,N)}$*, then the equilibrium described in Proposition 3 is unique.*

Proof.

First, note that from the proof of Proposition 2, we know that if the high type plays the true strategy, then the equilibrium strategy of the normal type is unique.

Then, we just have to show that the true strategy is the only equilibrium strategy for the high type. To this, we first rewrite the functions Δ_n, Δ_c, Δ_n^h and Δ_c^h, to take into account the fact that the high type can now lie and report $\hat{c}$ when its signal indicates n (in which case, the real state is N). They are:

$\Delta_n = \lambda(\hat{n},0) - ((1-\mu)\lambda(\hat{c},0) + \mu((1-\gamma)\lambda(\hat{c},C) + \gamma\lambda(\hat{c},N)))$,

$\Delta_c = \lambda(\hat{n},0) - ((1-\mu)\lambda(\hat{c},0) + \mu(\gamma\lambda(\hat{c},C) + (1-\gamma)\lambda(\hat{c},N)))$,

$\Delta_n^h = \lambda(\hat{n},0) - ((1-\mu)\lambda(\hat{c},0) + \mu\lambda(\hat{c},N))$, and

$\Delta_c^h = \lambda(\hat{n},0) - ((1-\mu)\lambda(\hat{c},0) + \mu\lambda(\hat{c},C))$.

As $\frac{P(\hat{c}|\aleph,C)}{P(\hat{c}|H,C)} < \frac{P(\hat{c}|\aleph,N)}{P(\hat{c}|H,N)}$, then $\lambda(\hat{c},C) > \lambda(\hat{c},N)$, which implies

$\lambda(\hat{c},C) > \gamma\lambda(\hat{c},C) + (1-\gamma)\lambda(\hat{c},N) > (1-\gamma)\lambda(\hat{c},C) + \gamma\lambda(\hat{c},N) > \lambda(\hat{c},N)$.

Consequently, $\Delta_n^h > \Delta_n > \Delta_c > \Delta_c^h$. The rest of the proof is analogous to the proof of Proposition 3. ■

A.4 Feedback power

In this section we consider the beliefs in (11)-(16) and the functions Δ_n and Δ_c defined in (17) and (18).

Proof of Theorem 3

The Theorem is proven through three Lemmas.

Lemma 14. *If* $0 < \mu_0 < \mu_1 < 1$*, then* $\Delta_n > \Delta_c$*.*

Proof. $\Delta_n > \Delta_c$

$\iff$

$(1-\mu_0)\lambda(\hat{n},0) + \mu_0\gamma\lambda(\hat{n},N) - ((1-\mu_1)\lambda(\hat{c},0) + \mu_1(1-\gamma)\lambda(\hat{c},C)) >$

$(1-\mu_0)\lambda(\hat{n},0) + \mu_0(1-\gamma)\lambda(\hat{n},N) - ((1-\mu_1)\lambda(\hat{c},0) + \mu_1\gamma\lambda(\hat{c},C))$

$\iff$

$\mu_0\lambda(\hat{n},N)(2\gamma-1) > \mu_1\lambda(\hat{c},C)(1-2\gamma)$.

Since $\gamma > 1/2$, the proof follows. ♦

Lemma 15. *If* $0 < \mu_0 < \mu_1 < 1$ *and* $\sigma_c(\hat{c}) = 1$*, then* $\Delta_n > 0$.

Proof.

$\Delta_n\left[\sigma_c(\hat{c}) = 1\right] =$
$= \frac{(1-\mu_0)\alpha}{\alpha+(1-\alpha)\sigma_n(\hat{n})} + \frac{\mu_0\gamma\alpha}{\alpha+(1-\alpha)\gamma\sigma_n(\hat{n})} - (\frac{(1-\mu_1)\alpha}{\alpha+(1-\alpha)(1+\sigma_n(\hat{c}))} + \frac{\mu_1(1-\gamma)\alpha}{\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c}))})$.

First, note that if $\mu_0 = 0$, Lemma 2 implies $\Delta_n\left[\sigma_c(\hat{c}) = 1, \mu_0 = 0\right] > 0$.

Now, we define $T = \frac{(1-\mu_0)\alpha}{\alpha+(1-\alpha)\sigma_n(\hat{n})} + \frac{\mu_0\gamma\alpha}{\alpha+(1-\alpha)\gamma\sigma_n(\hat{n})}$. Note that if $\frac{\partial T}{\partial\mu_0} < 0$, then $\frac{\partial\Delta_n[\sigma_c(\hat{c})=1]}{\partial\mu_0} < 0$. Consequently, as $\mu_0 \in (0,\mu_1)$, to show that $\Delta_n\left[\sigma_c(\hat{c}) = 1\right] > 0$, it is sufficient to prove that $\Delta_n\left[\sigma_c(\hat{c}) = 1; \mu_0 = \mu_1\right] > 0$, where

$\Delta_n\left[\sigma_c(\hat{c}) = 1; \mu_0 = \mu_1\right] = \frac{(1-\mu_1)\alpha}{\alpha+(1-\alpha)\sigma_n(\hat{n})} + \frac{\mu_1\gamma\alpha}{\alpha+(1-\alpha)\gamma\sigma_n(\hat{n})} - (\frac{(1-\mu_1)\alpha}{\alpha+(1-\alpha)(1+\sigma_n(\hat{c}))} + \frac{\mu_1(1-\gamma)\alpha}{\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c}))})$.

Now, since $\gamma > \frac{1}{2}$ and $\sigma_n(\hat{n}) \in [0,1]$, with $\sigma_n(\hat{c}) = 1-\sigma_n(\hat{n})$, we obtain $\frac{(1-\mu_1)\alpha}{\alpha+(1-\alpha)\sigma_n(\hat{n})} > \frac{(1-\mu_1)\alpha}{\alpha+(1-\alpha)(1+\sigma_n(\hat{c}))}$ and $\frac{\mu_1\gamma\alpha}{\alpha+(1-\alpha)\gamma\sigma_n(\hat{n})} > \frac{\mu_1(1-\gamma)\alpha}{\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_n(\hat{c}))}$. This completes the proof. ♦

Now, there are nine equilibrium configuration to analyze.

1. $\sigma_c(\hat{c})^* = 1 \quad \sigma_n(\hat{n})^* = 1 \iff \Delta_c \leq 0 \quad \Delta_n \geq 0.$
2. $\sigma_c(\hat{c})^* < 1 \quad \sigma_n(\hat{n})^* = 1 \iff \Delta_c = 0 \quad \Delta_n \geq 0.$
3. $\sigma_c(\hat{c})^* = 0 \quad \sigma_n(\hat{n})^* = 1 \iff \Delta_c \geq 0 \quad \Delta_n \geq 0.$
4. $\sigma_c(\hat{c})^* = 1 \quad \sigma_n(\hat{n})^* = 0 \iff \Delta_c \leq 0 \quad \Delta_n \leq 0.$
5. $\sigma_c(\hat{c})^* < 1 \quad \sigma_n(\hat{n})^* = 0 \iff \Delta_c = 0 \quad \Delta_n \leq 0.$
6. $\sigma_c(\hat{c})^* = 0 \quad \sigma_n(\hat{n})^* = 0 \iff \Delta_c \geq 0 \quad \Delta_n \leq 0.$
7. $\sigma_c(\hat{c})^* = 1 \quad \sigma_n(\hat{n})^* < 1 \iff \Delta_c \leq 0 \quad \Delta_n = 0.$
8. $\sigma_c(\hat{c})^* < 1 \quad \sigma_n(\hat{n})^* < 1 \iff \Delta_c = 0 \quad \Delta_n = 0.$
9. $\sigma_c(\hat{c})^* = 0 \quad \sigma_n(\hat{n})^* < 1 \iff \Delta_c \geq 0 \quad \Delta_n = 0.$

Note that from Lemma 14, configurations 5, 6, 8 and 9 cannot be. Similarly, from Lemma 15, configurations 4 and 7 can neither be. Consequently, $\sigma_n(\hat{n})^* = 1$. Then, taking into account the restriction imposed by Lemma 14, the resulting possible configurations are:

1. $\sigma_c(\hat{c})^* = 1 \quad \sigma_n(\hat{n})^* = 1 \iff \Delta_c \leq 0 \quad \Delta_n \geq 0.$
2. $\sigma_c(\hat{c})^* < 1 \quad \sigma_n(\hat{n})^* = 1 \iff \Delta_c = 0 \quad \Delta_n > 0.$
3. $\sigma_c(\hat{c})^* = 0 \quad \sigma_n(\hat{n})^* = 1 \iff \Delta_c \geq 0 \quad \Delta_n > 0.$

Let us now consider $\sigma_n(\hat{n})^* = 1$ and analyze how the normal newspaper proceeds when it observes signal c.

$$\Delta_c = (1-\mu_0)\lambda(\hat{n},0) + \mu_0(1-\gamma)\lambda(\hat{n},N) - ((1-\mu_1)\lambda(\hat{c},0) + \mu_1\gamma\lambda(\hat{c},C))$$
$$= \frac{(1-\mu_0)\alpha}{\alpha+(1-\alpha)(\sigma_c(\hat{n})+\sigma_n(\hat{n}))} + \frac{\mu_0(1-\gamma)\alpha}{\alpha+(1-\alpha)(\gamma\sigma_n(\hat{n})+(1-\gamma)\sigma_c(\hat{n}))} - (\frac{(1-\mu_1)\alpha}{\alpha+(1-\alpha)(\sigma_c(\hat{c})+\sigma_n(\hat{c}))} + \frac{\mu_1\gamma\alpha}{\alpha+(1-\alpha)(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))}).$$

$$\Delta_c[\sigma_n(\hat{n})^* = 1] =$$
$$= \frac{(1-\mu_0)\alpha}{\alpha+(1-\alpha)(\sigma_c(\hat{n})+1)} + \frac{\mu_0(1-\gamma)\alpha}{\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_c(\hat{n}))} - (\frac{(1-\mu_1)\alpha}{\alpha+(1-\alpha)\sigma_c(\hat{c})} + \frac{\mu_1\gamma\alpha}{\alpha+(1-\alpha)\gamma\sigma_c(\hat{c})}).$$

Now, let us suppose $\sigma_c(\hat{n})^* = 0$. In this case,

$$\Delta_c[\sigma_n(\hat{n})^* = 1, \sigma_c(\hat{n})^* = 0] = (1-\mu_0)\alpha + \frac{\mu_0(1-\gamma)\alpha}{\alpha+(1-\alpha)\gamma} - ((1-\mu_1)\alpha + \frac{\mu_1\gamma\alpha}{\alpha+(1-\alpha)\gamma})$$
$$= \frac{(1-\mu_0)\alpha(\alpha+(1-\alpha)\gamma)+\mu_0(1-\gamma)\alpha-(1-\mu_1)\alpha(\alpha+(1-\alpha)\gamma)-\mu_1\gamma\alpha}{\alpha+(1-\alpha)\gamma}$$
$$= \frac{\alpha^2(\mu_1-\mu_0)+\alpha(1-\alpha)\gamma(\mu_1-\mu_0)+\alpha(\mu_0(1-\gamma)-\mu_1\gamma)}{\alpha+(1-\alpha)\gamma}$$
$$= \alpha(\mu_1-\mu_0) + \frac{\alpha(\mu_0(1-\gamma)-\mu_1\gamma)}{\alpha+(1-\alpha)\gamma} > 0 \Leftrightarrow \gamma < \frac{\mu_0+\alpha(\mu_1-\mu_0)}{2\mu_0+\alpha(\mu_1-\mu_0)}.$$

Let $\hat{\gamma} = \frac{\mu_0+\alpha(\mu_1-\mu_0)}{2\mu_0+\alpha(\mu_1-\mu_0)}$, with $\hat{\gamma} \in (0,1)$. Hence, in equilibrium, $\sigma_c(\hat{n})^* > 0$ for $\gamma < \hat{\gamma} \in (0,1)$, and $\sigma_c(\hat{c})^* = 1$ for $\gamma > \hat{\gamma}$. ■

Proof of Corollary 3

Note that $\frac{d\sigma_c(\hat{n})^*}{d\mu_0} = -\frac{\frac{\partial\Delta_c[\sigma_n(\hat{n})^*=1]}{\partial\mu_0}}{\frac{\partial\Delta_c[\sigma_n(\hat{n})^*=1]}{\partial\sigma_c(\hat{n})^*}}$ and $\frac{d\sigma_c(\hat{n})^*}{d\mu_1} = -\frac{\frac{\partial\Delta_c[\sigma_n(\hat{n})^*=1]}{\partial\mu_1}}{\frac{\partial\Delta_c[\sigma_n(\hat{n})^*=1]}{\partial\sigma_c(\hat{n})^*}}$, with

$$\frac{\partial\Delta_c[\sigma_n(\hat{n})^*=1]}{\partial\mu_0} = \frac{-\gamma\alpha^2+\alpha(1-\alpha)(1-2\gamma)}{(\alpha+(1-\alpha)(\sigma_c(\hat{n})+1))(\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_c(\hat{n})))} < 0,$$
$$\frac{\partial\Delta_c[\sigma_n(\hat{n})^*=1]}{\partial\mu_1} = \frac{\alpha^2(1-\gamma)}{(\alpha+(1-\alpha)\sigma_c(\hat{c}))(\alpha+(1-\alpha)\gamma\sigma_c(\hat{c}))} > 0,$$
$$\frac{\partial\Delta_c[\sigma_n(\hat{n})^*=1]}{\partial\sigma_c(\hat{n})} = -\frac{\alpha(1-\alpha)(1-\mu_0)}{(\alpha+(1-\alpha)(\sigma_c(\hat{n})+1))^2} - \frac{\alpha\mu_0(1-\alpha)(1-\gamma)^2}{(\alpha+(1-\alpha)(\gamma+(1-\gamma)\sigma_c(\hat{n})))^2} - \frac{\alpha(1-\alpha)(1-\mu_0)}{(\alpha+(1-\alpha)(1-\sigma_c(\hat{n})))^2} - \frac{\alpha\gamma^2\mu_1(1-\alpha)}{(\alpha+(1-\alpha)\gamma(1-\sigma_c(\hat{n})))^2} < 0.$$

Consequently, $\frac{d\sigma_c(\hat{n})^*}{d\mu_0} < 0$ and $\frac{d\sigma_c(\hat{n})^*}{d\mu_1} > 0$. ■

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