Reputation and news suppression in the media industry*

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Abstract

This paper proposes a new argument to explain why media firms silence information that may be relevant to consumers and why this behavior may vary across firms and market structures. We build on the literature of career concerns and consider firms that seek to maximize their reputation for high quality. Crucial to our results is the idea that media firms' reporting strategies affect the probability that consumers learn the state of the world. We show that reputational concerns introduce an incentive for firms to withhold scoops and that this incentive is higher in media firms with high levels of initial reputation and/or great social influence. We also show that the incentive to withhold information may persist when we consider competition. In particular, we show that sequential competition is not a powerful force towards accuracy; however, simultaneous competition can be. These results suggest that market competition matters for how much information is revealed by firms. Finally, we draw predictions on a firm's optimal choice of an editorial standard, the persistence of news suppression when consumers believe one state to be more likely than the other, and the possibility that silence may be socially beneficial.

Keywords: Reputation; endogenous feedback; market competition; news suppression
JEL: C72; D82; D83

1 Introduction

In the last decades, scholars have greatly focused on the issue of media bias.[1] However, the question of media silence has received less attention. Even though it is more difficult to measure than other types of media bias, anecdotal evidence suggests that whereas some media firms are extremely careful about printing scoops, others do not hesitate a second and run almost every piece of news reaching their newsrooms. The Lewinsky scandal and the story of bin Laden's death are two good examples of those differences in media behavior.

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[1] The term media bias is used in the literature to refer to situations where media firms either selectively omit part of their information or frame their information with an ideological context. The latter case is also referred to as media slant. See the surveys by Andina-Díaz (2011), Gentzkow et al. (2016) and Puglisi and Snyder (2015).

The first story goes back to January 1998, when Mark Whitaker, the *Newsweek*'s editor at the time, decided not to run the Lewinsky Story that his reporter, Michael Isikoff, had been pursuing for nearly a year.[2] When asked about why he had not published the story, Mark Whitaker admitted in an interview to *CNN* in November 2011: "*We didn't feel that we were on firm enough ground to report a story that would be about accusing the president [...]. If we had gotten that wrong it could have been [...] a mortal blow to Newsweek's reputation.*" The story that belonged to *Newsweek* was finally published on the Internet by *Drudge Report*, a far less influential outlet than the prestigious magazine *Newsweek.* Despite it, the news report hit Internet newsgroups and the *Drudge Report* web-site had thousands of visits. Three days later, *The Washington Post* broke the story.[3]

The second story is about the investigative reporter Seymour M. Hersh and his article "The Killing of Osama bin Laden". Hersh, who in the seventies won the Pulitzer Prize for exposing the My Lai Massacre during the Vietnam War and has written several other influential articles, started to investigate the official story of bin Landen's death just a couple of months after the US operation in May 2011. Over three years later, he sent a draft of his report to *The New Yorker.*[4] Despite Hersh's strong ties to the magazine, where he is a regular contributor, David Remnick, the editor of the *The New Yorker*, told Hersh that he did not think he had "*the story nailed down*" and suggested he continued his investigation. Instead, Hersh gave the story to *The London Review of Books*, where it was published in May 2015. According to Jonathan Mahler: "*The bin Laden report wasn't the first one by Hersh that Remnick rejected because he considered the sourcing too thin [...] In 2013 and 2014, he passed on two Hersh articles [...] Those articles also landed in The London Review of Books.*"[5]

This paper studies why media firms withhold information that may be relevant to consumers and why this behavior varies from firm to firm. It also studies whether this behavior may vary with the market structure. Our contribution is twofold. On the one hand, we show that media silence can be explained by reputational concerns. This is new in the literature, as previous research explains media silence by means of institutional features. Two arguments have so far been used to explain the decision of a media firm to withhold information: Media capture, either by the government or by advertisers (see the works by Vaidya (2005), Besley and Prat (2006), Ellman and Germano (2009), Gehlbacha and Sonin (2014), Shadmehr and Bernhardt (2015), You et al. (2018), Qin and Strömberg (2018), Gitmez and Molavi (2018), or Trombetta (2018)); and the existence of defamation lawsuits and/or physical threats to journalists (see Garoupa (1999), Stanig (2015), and Gratton (2015)). Beyond these arguments, whose importance is entirely justified, we propose a new reason to explain media silence. The novelty of our approach is that we argue at the firm level and this allows us to explain variations in media silence between firms competing under the same rules. In this sense, we talk of media *self-silence.*

On the other hand, we show that the incentives of media firms to self-silence information may also vary with the market structure. This is important because one could expect this sort of media self-silence to disappear in the presence of competition. Our results suggest that this is not necessarily the case and that, indeed, when the media market has leaders and followers, we should observe some news to be published

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[2] The Lewinski Story refers to the political sex scandal that involved President Bill Clinton and White House intern Monica Lewinsky. The sexual relationship took place between 1995 and 1997 and led to President Clinton's impeachment by the House of Representatives, being accused of lying under oath and obstructing justice. The Senate finished the impeachment trial, acquitting Clinton on all charges.

[3] See "Scandalous scoop breaks online", *BBC News* January 30, 1998; and "Former Newsweek Editor on Why He didn't Run Lewinsky Story: 'We Didn't Feel We Were on Firm Enough Ground' ", *NewsBuster*, November 6, 2011.

[4] In his article, Hersh accused the Obama administration of lying about the death of Osama bin Laden. In his words: "*The killing was the high point of Obama's first term, and a major factor in his re-election. The White House still maintains that the mission was an all-American affair, and that the senior generals of Pakistan's army and Inter-Services Intelligence agency (ISI) were not told of the raid in advance. This is false, as are many other elements of the Obama administration's account.*"

[5] See "What Do We Really Know About Osama bin Laden's Death?", written by Jonathan Mahler, in *The New York Times*, October 18, 2015.

only by the less reputable firms. This result speaks directly to the described anecdotes, suggesting an argument to explain the observed behavior. It further speaks to recent literature on market structure and the type of news released by media firms: soft versus hard news (see Cagé (2019)), or the persuasion content of news (see Prat (2018) and Levy et al. (2019)). Beyond these ideas, our results suggest that market structure may also affect news' content not only per se, but also for career concerns reasons.

At the core of our model is the idea that media firms have the power to raise public concern and so affect the probability that there is ex-post verification of the state of the world. That means that media firms will have in our model, as in the real world, the capacity to affect the *probability of feedback*, i.e., the power to influence the probability that consumers learn the state of the world. The argument is that when media firms turn the spotlight on, let us say, a possible corruption scandal, they 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, which may result in the judge passing sentence and thus, indirectly determining whether the firms' stories were true or just another example of a "Jimmy's World" fabrication.[6] On the contrary, a country in which media firms give no room to scoops on their front pages, but rather exclusively print news items on the usual events of a society (economy, politics, sports, etc.), silences citizens and precludes learning. These arguments underpin the incentive of a firm to withhold information. Of course, with competition, this is not the whole story, as a highly respected firm withholding information may expect consumers to react to the firm's silence, especially if the story is later published by a smaller firm and shown to be correct. Even in that case, our results show that career concerns may be relevant enough to induce highly respected firms to withhold scoops.

Our results help explain why both *Newsweek* and *The New Yorker* decided to hold the Lewinsky and the bin Laden's death stories, respectively, whereas *Drudge Report* and *The London Review of Books* ran them. More generally, it provides a logic to explain why highly respected media firms such as *The New York Times*, *The Washington Post* or *The Guardian*, have stringent editorial standards; whereas smaller firms, lacking the power to influence public opinion, are less strict with the quality of their sources, which makes them more prone to print scandals.[7]

The model is as follows. We consider a media industry with either one or two risk-neutral media firms that seek to build a reputation for high quality. Media firms make decisions regarding the report to publish. Prior to making a decision, each firm receives an informative signal as to whether (or not) a corruption scandal exists in the economy and takes on one of two actions: either to publish that there is a scandal or to publish any other news item that we refer to as easy-to-cover stories (e.g. political or economic news, sports, entertainment and such). We assume that consumers value information and want a media firm to publish a scandal only when the signal supports it. Otherwise, they would like a firm to print easy-to-cover stories. The key assumption is that actions are different in terms of consequences. In particular, we consider that to print a scandal activates the probability of feedback and that this probability depends on the number of firms covering the scandal and on the identity of these firms. Additionally, we consider that if all the firms chose to print easy-to-cover stories, then consumers would never receive ex-post verification of the state.[8] Thus, the capacity of consumers to monitor the quality of a media firm is endogenous in our

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[6] In reference to a false story written by Janet Cooke, which 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 media firm and, naturally, to fire Cooke. More recently, *The New York Magazine* printed on the December 15, 2014, the story of Mohammed Islam, who claimed he had made $72 million trading on the stock market. This story became a major international news item. However, just one day later, *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."

[7] Note that even a highly respected media firm with a stringent editorial process may end up publishing a wrong piece of news, as the stories in the previous footnote suggest. However, this cannot occur with a high probability.

[8] The idea behind this modelling approach is to capture the power of the media to ignite cascades of accusations and

model, as whether consumers receive information on the state depends on the firms' reports.

We start by considering the case of a monopoly. Our results for this scenario show that with endogenous feedback, reputational concerns induce the media firm to withhold scoops and to print too often easy-to-cover stories. We obtain that the higher the initial reputation of the firm and/or the probability of feedback, the greater the incentive of the firm to silence a scoop. This effect is so strong that it can even induce a monopoly with a high quality private signal to silence the story, i.e., silence can be complete even if stories are strongly sourced.

We then move to the case with competition. Here we consider two approaches. The first approach is inspired by the motivation stories previously described and considers a sequential game between a leader and a follower, where a scoop that is withheld by the leader can be eventually received and published by the follower. The second approach considers a simultaneous game between two firms that receive signals and make decisions simultaneously. The purpose of these two approaches is to study the effect that market structure has on the firms' behavior and to investigate whether the predictions of the monopoly game are robust to the consideration of competition. Our results show that the incentive to withhold a scoop may persist when considering competition and that market structure matters for how much information is revealed by firms. Our first main result in this respect is that when the media market has leaders and followers, in equilibrium some news will just be published by the less reputable firms. Noteworthy, this result is in line with the Lewinsky and bin Laden motivation stories, suggesting that the differences in the treatment given by the media firms to the same scoop can be explained by a career concerns argument. Our second main result is that when there are no leaders and followers but rather firms that choose simultaneously, there is an equilibrium where all firms publish their scoops; something that cannot occur when there is sequential competition. We also show that complete silence is an equilibrium with sequential competition, however it is not with simultaneous competition. In this sense, our results suggest that market structure matters for how much information is revealed by firms and that simultaneous competition is a more powerful force towards accuracy than sequential competition.

Finally, we consider extensions of our model to give predictions on four relevant questions: i) The capacity of a firm to affect the probability of feedback and its incentive to withhold a scoop, ii) a firm's optimal choice of an editorial standard, iii) the persistence of news suppression when consumers believe one state of the world to be more likely than the other (with corruption just occurring in one of the states) and iv) the possibility that silence may be socially beneficial. On question i), our model shows that the incentive to withhold a scoop increases in the capacity of the firm to affect the probability of feedback, which we refer to as the *feedback power* of the firm. We also show that in the absence of feedback power, there is no media self-silence. On question ii), our model shows that reputational concerns help explain why firms with higher feedback power and/or higher initial reputation set higher editorial standards and so are more stringent in the vetting process of their stories. On question iii), our model shows that news suppression persists when we consider an unbalanced prior belief, except for the case in which the prior probability that there is a corruption scandal in the economy is too strong. In this case, the classical herding effect explains the result, driving media firms towards the fabrication of scandals. On question iv), our model shows that whether news suppression is detrimental or beneficial to consumers depends on how costly the mistakes of the media are to consumers. Thus, when the cost function is symmetric, media silence is always detrimental to consumers. However, when publishing a false story is more costly than

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responses and to stimulate coverage by other social spheres, which may lead to depuration of responsibilities and thus learning. An example can be found in the investigation of Cristiano Ronaldo, José Mourinho, Karim Benzema or Neymar, among others, initiated by the Spanish Tax Office in December 2016, after the documents released by Football Leaks and featured in the Spanish influential newspaper *El Mundo* alleging that some important football players and managers had diverted income to offshore tax havens. At the same time, it illustrates how hard it is for consumers to learn the truth of a story that never received the attention of the media industry, possibly because in that case consumers did not even know that such a story had ever occurred.

silencing a true one, media silence can be socially beneficial.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 presents the general model. In Section 4 we present the results for the monopoly case and in Section 5 the results for the cases with competition. Here we study two approaches. One in which the firms compete in a sequential order, and another one in which they compete simultaneously. Section 6 discusses a number of extensions and Section 7 concludes. All the proofs are relegated to the Appendix.

2 Related literature

The closest paper to ours is Gentzkow and Shapiro (2006). They propose a model in which a media firm seeks to build a reputation for high quality and the consumers' prior beliefs consider one state to be more likely than the other. This drives media bias which, in their model, originates in the incentive of the media firm to slant its reports towards the consumers' prior beliefs. In contrast to Gentzkow and Shapiro (2006), the type of media bias that we identify in this work does not require one state to be more likely than the other and so persists when they are equiprobable. In fact, the class of media bias that we characterize originates in the power of the media industry to set what consumers get to know, which indirectly gives firms in this industry the capacity to affect the consumers' monitoring ability of media firms. This is a more subtle effect that has not been studied so far.

Formally, our paper is related to Levy (2005), Leaver (2009), and Camara and Dupuis (2015), who consider models of career-concerns with endogenous feedback.[9] While these papers share some features with ours, there are important differences. The most relevant one is that none of these papers consider competition between experts. This is an important aspect, as to the best of our knowledge, our work is the first one to jointly analyze the strategic effects derived from the endogenous feedback with the strategic effects derived from the competition between experts. Additionally, our model differs from the existing ones in that we consider the probability of feedback as a continuous random variable, whereas Levy (2005), Leaver (2009), and Camara and Dupuis (2015) consider it a binary variable.

An important question in our paper is the effect of consumers receiving ex-post verification of the state on the incentives of media firms to disclose their private information. In this sense, our work is related to Prat (2005), who first showed that an increase in the transparency on actions can have detrimental effects to the principal. In his model, however, increasing the transparency on consequences (the kind of transparency we talk about in our paper) can only be beneficial, as it is also the case in Gentzkow and Shapiro (2006). The present work challenges this view, showing that an increase in the probability that consumers learn the state, unambiguously drives less accurate media reports. In a different context, Andina-Díaz and García-Martínez (2020) show that when an agent is concerned both about reputation and bias, there are conditions under which transparency on consequences can also be detrimental to the principal. Fox and Van Weelden (2012) also identify conditions for this kind of transparency to be detrimental. The key idea in this work is that the costs for the principal of the agent's mistakes can be different across the states. Lastly, our paper also relates to the papers by Levy (2007), Morris (2001), Ottaviani and Sørensen (2001), or Hörner (2002) among others who, in different contexts, show that reputation can have perverse effects.

Topically, our paper belongs to the blooming literature on media economics, and more particularly, it contributes to the understanding of two main research questions within this literature. First, the analysis of the sources of media bias.[10] Much has been said in this respect. The numerous explanations to date have

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[9] The literature on experts and effort choice has also considered situations in which the probability of ex-post verification of the state of the world may depend on the action chosen by the agent. See Hirshleifer and Thakor (1992), Holmström (1999), Milbourn et al. (2001) and 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).

[10] The phenomenon of media bias has been empirically documented by Groseclose and Milyo (2005), Egorov et al. (2009),

been grouped into two categories. On the one hand, the supply-side arguments, which account for reasons such as media ownership (Bovitz et al. (2002), Djankov et al. (2003), Anderson and McLaren (2012)), cost structure (Strömberg (2004*a*)), advertisers and interest groups (Corneo (2006), Ellman and Germano (2009), Petrova (2008, 2012) and Sobbrio (2011)), journalists and editors (Baron (2006), Sobbrio (2014)) or government capture (Besley and Prat (2006)). On the other hand, there are demand driven forces, which consider reasons that originate in the consumers' preferences for certain stories (Mullainathan and Shleifer (2005)), the consumers' prior beliefs (Gentzkow and Shapiro (2006)) or the existence of consumers exhibiting the "bias blind spot" (Stone (2011)). The present paper contributes to this literature by pointing out that the media's capacity to determine what consumers get to know can also result in media bias and, more precisely, in media silence, which is different from distortion of news and other types of bias already analyzed in the literature. Second, the effect of market structure on news' content and the amount of information revealed by firms. See Mullainathan and Shleifer (2005), Gentzkow and Shapiro (2006), George (2007), Andina-Díaz (2009, 2015), Fan (2013), Prat (2018), Cagé (2019), and Levy et al. (2019). To this literature, this paper contributes by proposing a new argument through which market structure may affect news' content: via career concerns, which may yield media self-silence.

3 The model

We consider a model with K risk-neutral media firms with careers concerns and a mass of consumers. Section 4 analyzes the case of $K = 1$ and Section 5 the case of $K = 2$. There is a binary state of the world $\omega \in \{N, C\}$, where C stands for a situation in which there is a *corruption scandal* in the economy and N stands for a situation in which there is *no corruption scandal*. Let θ denote the prior probability that consumers and firms have on the state of the world being C. We consider that the two states are equally likely.[11]

Media firms make decisions on the report to publish. Let $r_i \in \{\hat{n}, \hat{c}\}$ be the report of firm $i \in \{1, 2\}$. We denote by $\hat{c}$ the action of publishing a scandal and by $\hat{n}$ the action of publishing any other piece of news, i.e. economic and political news, entertainment, sports and such, which we refer to as easy-to-cover stories. Prior to making a decision, firm i receives a private signal $s_i \in \{n, c\}$ on the state of the world. When $s_i = c$, firm i receives information on the scandal, in which case we say that firm i receives a *scoop*. When $s_i = n$, the firm does not receive a scoop. We denote by γ the quality of a signal, with $P(n \mid N) = P(c \mid C) = \gamma$, and assume that the quality of the signal depends on the type of the firm, which can be either high type or normal type. We assume that a high type firm receives a signal that perfectly reveals the state of the world (it has quality 1); whereas a normal type firm receives an imperfect but informative signal of quality $\gamma \in (\frac{1}{2}, 1)$, this value being common knowledge. Types of firms are i.i.d. and signals are i.i.d. conditional on the state. Note that γ can be arbitrarily close to 1, i.e., normal type firms can receive signals of arbitrarily excellent quality. Each media firm knows its type, but neither consumers nor the other firms know it. They attach a prior probability $\alpha_0^i \in (0, 1)$ to firm i being high type (consequently $1 - \alpha_0^i$ is the probability that firm i is normal type). We refer to this probability as the firm's initial reputation.

For expositional purposes, we assume that high type media firms always publish their signals honestly,

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Larcinese et al. (2011), Tella and Franceschelli (2011), Durante and Knight (2012), and Latham (2015), among others. Another important branch of the literature of media economics focuses on the effects of the media on voting and policies. See Besley and Burgess (2001), Strömberg (2004*b*), Chan and Suen (2008), Gerber et al. (2009), Ashworth and Shotts (2010), Chiang and Knight (2011), Duggan and Martinelli (2011), Drago et al. (2014), Piolatto and Schuett (2015), Schroeder and Stone (2015), and Casas et al. (2016).

[11] The assumption that both states are equiprobable means that media firms have no incentive 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. Section 6.3 explores the effect of relaxing this assumption and analyze the game with $\theta \in (0, 1)$, for the case of a monopoly.

i.e., they fully disclose their private information. This assumption is relaxed in Section A.2 of the Appendix, where for the case of a monopoly we show that revealing the firm's signal is the unique equilibrium strategy of a high type firm. Thus, the analysis of the paper focuses on the behavior of the normal type firms, hereafter simply referred to as the firms. We consider that a (normal type) firm can publish either $\hat{n}$ or $\hat{c}$, and denote by $\sigma^i_{s_i}(r_i) \in [0,1]$ the probability that, conditioned on its signal s_i, firm i takes action r_i. This freedom to publish any report captures two types of media bias that we want to explore: A firm that having observed factual (though inconclusive) evidence of a corruption scandal chooses to silence it, i.e., $\sigma^i_c(\hat{n}) > 0$; and a firm that having received no evidence of a scandal chooses to fabricate it, i.e., $\sigma^i_n(\hat{c}) > 0$. Our results show that it is the former class of bias that occurs in our context. We will refer to this class of bias as media self-silence.

Media firms have career concerns and choose a report to publish seeking to maximize their reputation for high quality. This means that normal type firms seek to be perceived as high type firms, as high type firms receive signals of perfect quality. Hence, as most papers in the literature, we assume that reputation is captured by the probability that the consumers place on the media firm being a high type.[12] This assumption should be taken as a reduced form of a more complex game in which media firms seek to appear high type because circulation and profits are increasing in reputation.[13]

Let $\mu \in [0,1]$ denote the probability that before forming a belief about the type of the media firms, consumers receive ex-post verification of the state of the world. We refer to μ as the *probability of feedback*. A key ingredient in this model is to consider that the probability of feedback depends on the reports of the media firms in the following way. We consider that when all the firms publish $\hat{n}$, consumers will never learn the state of the world (or, at least, not at the time they assign a reputation to the firms). In contrast, when some of the firms publish $\hat{c}$, there is a positive probability that the consumers learn the state. This probability will depend on the number of firms taking action $\hat{c}$ and on the identity of these firms. Given that these aspects may vary from one scenario to another, a more detailed exposition of the functioning of the probability of feedback is provided in each of the market structures that we consider. We denote by $X \in \{N, C, 0\}$ the feedback received by the consumers, with $X = 0$ indicating that there is no feedback and $X = N$ indicating that consumers learn that the state is N (analogously for $X = C$).

Consumers observe the media firms' reports and feedback X and, based on this information, update their beliefs about each of the media firm's type. In the case $K = 2$, let $\alpha^i_1(r_1, r_2, X)$ denote the consumers' posterior probability that media firm i is high type, given the vector of reports (r_1, r_2), with $r_i \in \{\hat{n}, \hat{c}\}$ for $i \in \{1, 2\}$, and $X \in \{N, C, 0\}$. In the case $K = 1$, we skip the super/subscript i and write the posterior probability as $\alpha_1(r, X)$.

Before moving into the analysis of the different market structures, let us derive the efficient strategy of a media firm that seeks to maximize the consumers' welfare. This analysis will serve us as a reference point to evaluate the results that we obtain in this paper. To this purpose, let us consider that consumers receive a payoff $\pi > 0$ when the firm correctly informs on the state of the world, and they suffer a cost $\varphi > 0$ when the firm publishes a false report. This assumption is made for simplicity and will be relaxed in Section 6.4, where we explore the efficient strategy of a media firm when consumers have a more general utility function that allows for different costs of errors. For now, note that when costs are symmetric, and since a firm's signal is always informative, the expected payoff to a consumer is maximized when the firm publishes its signal (see Proposition 8). Thus, from the point of view of the consumers, the efficient

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[12] See Ottaviani and Sørensen (2001), Prat (2005), Gentzkow and Shapiro (2006) and Fox and Van Weelden (2012).

[13] Formally, this speaks to the literature of reputation building in repeated games (see the survey by Mailath and Samuelson (2015)). Models of reputation building depends on how "commitment types" are specified. To this respect, note that the model in this paper considers only one commitment type, the high type of the firm, with this assumption being relaxed in Appendix A.2. On a different issue, the assumption that circulation and profits are increasing in reputation is in line with empirical evidence. Logan and Sutter (2004), using a cross-section of US media firms, find that newspapers that have recently won Pulitzer Prizes have higher circulations. Kovach and Rosenstiel (2001) observe that media firms with higher standards have higher audiences, and Anderson (2004) finds that market forces penalize media firms whose quality of journalism falls.

strategy of a media firm is to always publish the signal's content, i.e., $\sigma_n^i(\hat{n}) = \sigma_c^i(\hat{c}) = 1$ for all $i \in \{1,2\}$. Based on this, if we define media bias as any situation in which a firm misreports its signal, the conclusion is straightforward: Media bias, then media silence, has detrimental effects on consumers' welfare.

We then move on to analyze of the game. Our equilibrium concept is perfect Bayesian equilibrium. In the following we will say that $\{(\sigma_n^i(\hat{n})^*, \sigma_c^i(\hat{c})^*)\}_{i\in\{1,2\}}$ is an *equilibrium strategy* if given the equilibrium strategy of the other firm and the consistent beliefs, $\sigma_n^i(\hat{n})^*$ maximizes the expected payoff to firm i after observing signal n, and $\sigma_c^i(\hat{c})^*$ does it after signal c.

4 Monopoly

Let us start by considering the case of a monopoly media industry. Here $K = 1$ so we skip the super/subscript of the firm. Note that in this case, if the media firm publishes $\hat{n}$, consumers will never know the state of the world; whereas if it publishes $\hat{c}$, they may learn the state. Remember that we denote by $\alpha_1(r, X)$ the consumers' consistent beliefs about the firm being high type, with $r \in \{\hat{n}, \hat{c}\}$ and $X = \{N, C, 0\}$. These beliefs are derived in Appendix A.1. Then, in the monopoly case, the situation is such that a firm that reports $\hat{n}$ gets $\alpha_1(\hat{n}, 0)$ for sure; whereas publishing $\hat{c}$ means playing a lottery with three possible outcomes: $\alpha_1(\hat{c}, 0)$, $\alpha_1(\hat{c}, N)$ and $\alpha_1(\hat{c}, C)$. Nonetheless, remember that we consider risk-neutral firms.

The next proposition characterizes the unique equilibrium of the monopoly game. The expressions of all the thresholds and the equilibrium probability x_0 are defined in the proof.[14]

Proposition 1. *There exist* $\hat{\gamma} < 1$ *and* $\hat{\alpha}_0 \in (0,1)$ *such that in the unique equilibrium of the game,* $\sigma_n(\hat{n})^* = 1$ *and:*

1. *If* $\gamma > \hat{\gamma}$*, then* $\sigma_c(\hat{n})^* = x_0 \in (0,1)$*.*
2. *If* $\gamma < \hat{\gamma}$*, then:*
    - *(a) If* $\alpha_0 < \hat{\alpha}_0$*, then* $\sigma_c(\hat{n})^* = x_0 \in (0,1)$*,*
    - *(b) If* $\alpha_0 > \hat{\alpha}_0$*, then* $\sigma_c(\hat{n})^* = 1$*.*

The results in Proposition 1 show that a monopoly firm that receives signal n always publishes $\hat{n}$. To have an intuition for this result, note that in the model publishing $\hat{n}$ is safe, while publishing $\hat{c}$ always carries the risk of ruining the firms' reputation, i.e., getting outcome $\alpha_1(\hat{c}, N) = 0$. Since the signal of the firm is informative ($\gamma > \frac{1}{2}$), choosing $\hat{c}$ after signal n is very likely to yield a zero payoff, as the most likely state after signal n is N. Hence, $\sigma_n(\hat{n})^* = 1$. Additionally, Proposition 1 also shows that a monopoly that receives signal c silences the scoop with positive probability, independently of α_0, γ and μ. In order to see this, let us conjecture $\sigma_n(\hat{n}) = \sigma_c(\hat{c}) = 1$, in which case both the high type and the normal type media firm use the same strategy profile. This means that if there is no feedback, the consumers' posterior belief on the type of the firm will always be the prior, α_0. Thus, publishing $\hat{n}$ yields a safe payoff of α_0, whereas publishing $\hat{c}$ conveys a probability $\mu(1-\gamma)$ of ruining the firm's reputation.[15] This significantly reduces the expected payoff associated with action $\hat{c}$, and yields the result. Last, note that the incentive

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[14] In the proof of this proposition, in Appendix A.1., we give the explicit expression of the equilibrium probability for the cases in which the firm withholds a scoop with probability strictly between 0 and 1. This probability (x_0) is a function of the parameters in the model γ, α_0, and μ, and it satisfies $\Delta_c[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{n}) = x_0] = 0$, with Δ_c being defined by (6). In the proof of this result we also derive the explicit expressions of thresholds $\hat{\gamma}$ and $\hat{\alpha}_0$, with $\hat{\gamma}$ being a function of parameters μ and α_0; and $\hat{\alpha}_0$ being a function of μ.

[15] It also conveys a probability $(1-\mu)$ of getting payoff α_0 and a probability $\mu\gamma$ of receiving $\alpha_1(\hat{c}, C)$, with $\alpha_1(\hat{c}, C) = \frac{\alpha_0}{\alpha_0 + (1-\alpha_0)\gamma} > \alpha_0$. However, the expected payoff of report $\hat{c}$, which is $(1-\mu)\alpha_0 + \mu\gamma\frac{\alpha_0}{\alpha_0+(1-\alpha_0)\gamma}$, is lower than α_0, as $\gamma\frac{\alpha_0}{\alpha_0+(1-\alpha_0)\gamma} < \alpha_0$. Hence, $\sigma_c(\hat{c}) = 1$ cannot be in equilibrium.

to withhold a scoop can be large enough to induce the monopoly firm to silence all its scoops, i.e., media silence can be complete. This occurs when the firm has high initial reputation and its signal is of low quality. Our next result presents the comparative static analysis with respect to parameters γ, α_0 and μ.

Corollary 1. *The probability that a monopoly firm withholds a scoop is decreasing in the firm's signal quality, i.e.* $\frac{\partial \sigma_c(\hat{n})^*}{\partial \gamma} < 0$, *and increasing in both the initial reputation of the firm and the probability of feedback, i.e.,* $\frac{\partial \sigma_c(\hat{n})^*}{\partial \alpha_0} > 0$ *and* $\frac{\partial \sigma_c(\hat{n})^*}{\partial \mu} > 0$.

This result states that the probability that a monopoly silences a scoop is decreasing in the firm's signal quality, an increasing in both how much the monopoly has to lose (the firm's initial reputation α_0), and the probability that it can lose it conditional on publishing the scandal (the probability of feedback μ). The intuition for this result is straightforward: The higher the quality of the scoop, the smaller the risk of publishing the scandal; whereas the higher the firm's initial reputation and/or the probability of feedback, the higher the expected cost of reporting the scandal. Taking these arguments to the limit, we expect media self-silence to disappear when either $\gamma \to 1$, $\alpha_0 \to 0$ and/or $\mu \to 0$. These intuitions are confirmed by our results (see the proof of Corollary 1, in Appendix A.1.)[16] For additional insights on these results, see the discussion at the end of Section 6.1.

5 Competition

In this section we introduce competition. In particular, we consider a media industry with two firms and take two approaches to the study of competition. The first approach considers a sequential game between a leader and a follower, where the leader first receives a signal and chooses a report, and the follower plays only in the case that the leader does not break a scandal. The second approach considers a simultaneous game between two firms, both receiving a signal and choosing a report to publish at the same time. The purpose of this section is to study the effect of market structure on the firms' behavior and to investigate whether the predictions of the monopoly game, and in particular the predictions on the equilibrium with complete silence and the impossibility of an equilibrium with full disclosure, are robust to the consideration of competition. The results in this section show that, in our context, it is not competition per se that breaks the predictions of the monopoly, but we require simultaneous competition, i.e., a more balanced sort of competition.

5.1 A model of sequential competition

Inspired by the stories described in the Introduction, in this section we consider a sequential game between two strategic firms. For expositional purposes we will refer to the firms as the marker leader (L) and the follower (F). We assume that both firms are endowed with an initial reputation, α_0^L and α_0^F, with $0 < \alpha_0^F \leq \alpha_0^L < 1$. This means that firms can be either high type or normal type, with the leader being high type with a higher probability than the follower. Types are private information, i.i.d. and, as described in Section 3, they determine the quality of the signal that the firm receives.

Following the sequence of events described in the motivation stories, we consider that firm L first receives a signal $s_L \in \{n, c\}$ of quality γ on the state of the world (with the signal being perfect if the leader is high type and $\gamma < 1$ if it is normal type), upon which it publishes a report $r_L \in \{\hat{n}, \hat{c}\}$. For the sake of simplicity, we consider that if the leader publishes a scandal, the follower does not make any choice, i.e, after report $r_L = \hat{c}$ the follower takes no action.[17] In contrast, if the leader publishes $r_L = \hat{n}$,

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[16] Additionally, when $\mu \to 1$, the limit of $\sigma_c(\hat{n})^*$ is $\frac{1}{2}\frac{\alpha_0(1-\gamma)}{\gamma(1-\alpha_0)} > 0$, with $\frac{1}{2}\frac{\alpha_0(1-\gamma)}{\gamma(1-\alpha_0)} > 1 \Leftrightarrow \gamma < \frac{\alpha_0}{2-\alpha_0}$ and $\alpha_0 > \frac{2\gamma}{1+\gamma}$. This means that when μ tends to one, silence can be complete provided that γ is sufficiently small and α_0 sufficiently high.

[17] This is a simplifying assumption. In our view, it is also a natural one, as it is analogous to considering a situation in which when a scandal is published and scrutinized, it only affects the reputation of the first publishing media firm. We think that this is often the case in the real world.

we consider that the game moves to a second stage in which the follower receives a signal $s_F \in \{n, c\}$ of quality γ (with the signal being perfect if the follower is high type and $\gamma < 1$ if it is normal type), upon which it chooses a report $r_F \in \{\hat{n}, \hat{c}\}$ to publish. Signals are i.i.d. conditional on the state. This means that a leader that receives a scoop and chooses to withhold it knows that with a probability higher than 1/2 the follower will receive the same scoop, i.e., the same signal content c, and eventually may choose to publish it.[18] There is however a probability (though smaller than 1/2) that the follower does not receive the scoop, i.e., the follower observes signal n instead of c.

Note that in a leader-follower game, we may expect the probability that consumers learn the state of the world to depend on the identity of the firm that publishes the scoop. Then, given the description of the game, there are three situations to consider. In the first, the leader publishes the scoop. We denote by μ_L the probability that consumers learn the state in this case. In the second, the leader publishes $r_L = \hat{n}$ and the follower publishes $r_F = \hat{c}$. We denote by μ_F be the probability that consumers learn the state in this case and assume $0 < \mu_F \leq \mu_L < 1$. The last case corresponds to a situation in which no firm publishes a scandal, i.e., $(r_L, r_F) = (\hat{n}, \hat{n})$. Here, we assume that consumers never learn the state of the world.

Before presenting the results, let us comment on the consumers' posterior beliefs about firm $i \in \{L, F\}$ being a high type firm, $\alpha_1^i(r_i, r_j, X)$. Two ideas are worth noting. First, when $r_L = \hat{c}$, we just need to obtain the consumers' beliefs about the type of the leader; however, when $r_L = \hat{n}$, the analysis requires the consumers to form beliefs about both the types of the leader and the follower. Second, when there is feedback, X is sufficient; hence, $\alpha_1^i(r_i, r_j, X)$ does not depend on r_j in this case and it can be written as $\alpha_1^i(r_i, X)$. In contrast, when there is no feedback, firm j's report reveals information not only on firm j's type but on the opponent's type, i.e., firm i. The beliefs of this section are derived in Appendix A.3.

We next present the results of this section. The first proposition states that full disclosure of the firms' private information is not an equilibrium of the leader-follower game. This is an important result, as it suggests that when we introduce competition in the form of a leader-follower game, there is no possibility of having an equilibrium in which the two firms disclose all the scoops that reach their newsrooms. In this sense, our model suggests that having competition in the media industry is not enough to guarantee the disclosure of all the firms' private information.

Proposition 2. *(Full disclosure) The strategy profile* $\left(\sigma_n^L(\hat{n}), \sigma_c^L(\hat{c}); \sigma_n^F(\hat{n}), \sigma_c^F(\hat{c})\right) = (1, 1; 1, 1)$ *is never an equilibrium strategy profile.*

In order to see the intuition for this result, note that once the leader chooses $\hat{n}$ and gives the follower the opportunity to play, the latter faces a situation that is very similar to the monopoly game. Thus, the incentive to withhold a scoop that explains the result in Section 4, also explains the result in this case.[19]

The next result explores the idea of complete silence. We do this in Proposition 3 below, where we characterize the range of parameter values for which there is an equilibrium of this kind (the expressions of all the thresholds are defined in the proof of this result). It is worth noting that in line with the result of the monopoly, the equilibrium with complete silence requires the leader to have high initial reputation, the signal to be of low quality, and the two firms to have enough influence to affect the probability of feedback.

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[18] The probability that the follower receives the scoop in this case is $P(C \mid c_L)\left(\alpha_0^F + (1-\alpha_0^F)\gamma\right) + P(N \mid c_L)(1-\alpha_0^F)(1-\gamma) > \frac{1}{2}$, as $P(C \mid c_L) > P(N \mid c_L)$. An alternative approach (to considering that signals are i.i.d. conditional on the state) might be to consider that signals are positively, even perfectly, correlated. This alternative presents some flaws. First, it would introduce an additional parameter in the analysis (to measure the signals' correlation). Second, in the limit, if correlation were very high, the model would impose that any signal that is disregarded by a leader always reaches the follower. Though we consider this is sometimes the case, we think that generalizing and considering it to always be the case is very restrictive.

[19] Nevertheless, note that the analysis of the present game is more complex than the analysis of the monopoly game in Section 4, as beliefs now incorporate information on the action of the leader, which conveys information on the most likely state; hence, on the reputation of the follower.

Proposition 3. *(Complete silence) There exist $\bar{\mu}_L < 1$, $\bar{\alpha}_L < 1$, $\bar{\mu}_F < 1$, $0 < \underline{\alpha}_F < \overline{\alpha}_F < 1$, and $\bar{\gamma} > \frac{1}{2}$, such that if $\mu_L > \bar{\mu}_L$, $\alpha_0^L > \bar{\alpha}_L$, $\mu_F > \bar{\mu}_F$, $\alpha_0^F \in (\underline{\alpha}_F, \overline{\alpha}_F)$, and $\gamma < \bar{\gamma}$, then the strategy profile $\left(\sigma_n^L(\hat{n}), \sigma_c^L(\hat{c}); \sigma_n^F(\hat{n}), \sigma_c^F(\hat{c})\right) = (1,0;1,0)$ is an equilibrium strategy profile.*

The result in Proposition 3 poses two interesting comments. The first one is that the equilibrium with complete silence requires the follower to have neither a high initial reputation nor a low initial reputation. The idea is the following. On the one hand, a high α_0^F induces the leader to disclose its signal more often, as a high α_0^F means a high probability that the follower receives a perfectly informative signal and publishes it. On the other hand, a low α_0^F induces the follower to disclose its signal more often, as a low α_0^F means a small cost of losing the firm's reputation. Hence, complete silence requires $\alpha_0^F \in (\underline{\alpha}_F, \overline{\alpha}_F)$.[20] The second one is that the equilibrium with complete silence is more likely to hold in societies with an influential media industry and an effective judicial system than in societies with less influential firms and a less effective judicial system. The intuition is quite simple: the higher the capacity of media firms to activate the judicial process and the more responsive the judicial system is, the higher the probability that the consumers will learn the state of the world; hence, the higher the probability that a firm that publishes a scoop will lose its reputation.

The last result of this section explores the possibility of having an equilibrium in which the follower publishes a scoop that the leader has previously withhold. In this regard, Proposition 4 below states that there is no equilibrium in which the leader always stays silent and the follower publishes all the scoops. However, there is an equilibrium in which the leader always withholds a scoop and the follower publishes it with positive probability. Note that this result supports the evidence reported in the motivation examples in the Introduction, where both the Lewinsky and the bin Laden stories were broken by smaller media firms after more respected firms chose to withhold them.

Proposition 4. *(Partial disclosure)*

1. *The strategy profile $\left(\sigma_n^L(\hat{n}), \sigma_c^L(\hat{c}); \sigma_n^F(\hat{n}), \sigma_c^F(\hat{c})\right) = (1,0;1,1)$ is never an equilibrium strategy profile.*
2. *There exist $\hat{\mu}_L < 1$, $\hat{\alpha}_L < 1$, $\hat{\mu}_F > 0$, and $\hat{\alpha}_F > 0$, such that if $\mu_L > \hat{\mu}_L$, $\alpha_0^L > \hat{\alpha}_L$, $\mu_F < \hat{\mu}_F$, and $\alpha_0^F < \hat{\alpha}_F$, then the strategy profile $\left(\sigma_n^L(\hat{n}), \sigma_c^L(\hat{c}); \sigma_n^F(\hat{n}), \sigma_c^F(\hat{c})\right) = (1,0;1,x)$, with $x > 0$, is an equilibrium strategy profile.*

To conclude, note that the equilibrium in point *2.* of Proposition 4 requires μ_L and α_0^L to be high enough and μ_F and α_0^F to be low enough (the equilibrium probability x and the thresholds are defined in the proof of the proposition).[21] The first two conditions, together with the condition on μ_F, guarantee that the leader finds it optimal to withhold a scoop. The last two conditions guarantee that the follower finds it optimal to publish it (with positive probability). With a focus on parameters μ_L and μ_F, these conditions say that the higher the capacity of the leader to affect the probability of feedback and the smaller the capacity of the follower, the more likely it is to have an equilibrium in which a scoop is withheld by the leader and published by the follower. In this sense, this result suggests that the higher the asymmetry in the media industry is, i.e., the more different firms are in their social influence, the more likely it is to observe situations such as the ones described in the Introduction.[22]

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[20] More precisely, $\sigma_c^L(\hat{c}) = 0$ requires high values of μ_L and α_0^L, and low values of α_0^F and γ; and $\sigma_c^F(\hat{c}) = 0$ requires high values of μ_F, α_0^F, and α_0^L, and low values of γ.

[21] In the proof of this proposition, in Appendix A.3., we characterize the equilibrium probability x, it being a function of the parameters in the model $\gamma, \alpha_0^F, \alpha_0^L$, and μ_F, and it satisfying $\Delta_{c_F}\left[\sigma_n^L(\hat{n}) = 1, \sigma_c^L(\hat{c}) = 0, \sigma_n^F(\hat{n}) = 1, \sigma_c^F(\hat{c})\right]$, with Δ_{c_F} being defined by (25).

[22] In this regard, Entman (2012) presents extensive evidence supporting the idea that firms differ in their social influence. In his paper, he classifies *New York Times* and *Washington Post* as highly influential; *Time* and *Newsweek* as influential; *Boston Globe*, *Chicago Tribune* and other major regional papers as occasionally influential, and so on.

5.2 A model of simultaneous competition

In the light of these results, we next consider that the two firms compete simultaneously. The purpose of this section is to study whether the predictions of the leader-follower game analyzed in the previous section hold when the two firms receive signals and make decisions simultaneously. More precisely, we are especially interested in the predictions concerning full disclosure and complete silence.

To this aim, in this section we consider two strategic firms, 1 and 2, each receiving a signal $s_i \in \{n, c\}$ of quality γ on the state (with the signal being perfect if the firm is high type and $\gamma < 1$ if it is normal type), upon which each firm chooses a report $r_i \in \{\hat{n}, \hat{c}\}$ to publish, with $i \in \{1, 2\}$. To keep the analysis as simple as possible, we consider that the two firms are identical in terms of both initial reputation and their capacity to affect the probability of feedback.

Note that in this section, a firm makes a decision on the report to publish without knowing whether or not the competitor has received a scoop and whether or not it plans to publish it (in Section 5.1, the leader faces a similar situation). This is important for a firm, say firm i, because the report sent by the competitor will affect the consumers' belief about firm i both directly, through the report of firm j, and indirectly, through the probability of feedback. Elaborating on this last idea, note that when a scoop can be published by more than one firm, we should expect the probability that the consumers learn the state to depend on the number of firms that publish the scoop. In this regard, and given the assumption that firms are identical in their capacity to affect the probability of feedback, there are three situations to consider. In the first, the two firms publish the scandal, i.e., the profile of reports observed by the consumers is $(r_1, r_2) = (\hat{c}, \hat{c})$. Let us denote by μ_J the probability that consumers learn the state in this case. In the second, there is only one firm that publishes the scandal, i.e., the profile of reports that the consumers observe is either $(r_1, r_2) = (\hat{n}, \hat{c})$ or $(r_1, r_2) = (\hat{c}, \hat{n})$. We denote by μ_I the probability of feedback in this case and assume $0 < \mu_I \leq \mu_J < 1$. Note that μ_I (alternatively, μ_J) measures the individual capacity of a firm (alternatively, the joint capacity of the industry) to affect the probability of feedback. The last case corresponds to a situation in which no firm publishes a scandal, i.e., $(r_1, r_2) = (\hat{n}, \hat{n})$. Here, we assume that the consumers never learn the state of the world.

In line with previous analysis, the beliefs of this section are derived in Appendix A.4.

We next present the results of this section. Proposition 5 states our two main results. The first one is that there are parameter configurations for which full disclosure is an equilibrium. In particular, point *1.* of Proposition 5 shows the existence of threshold $\tilde{\gamma}$ such that full disclosure of private information is an equilibrium provided that the quality of the signal is sufficiently high, with $\tilde{\gamma}$ being defined in the proof of Proposition 5, in the Appendix.[23] The second result of Proposition 5 shows that there is no equilibrium in which a scoop is always silenced.

Proposition 5. *Suppose* $0 < \mu_I \leq \mu_J < 1$.

1. *(Full disclosure) There exist* $\tilde{\gamma} \in (\frac{1}{2}, 1)$ *such that* $(\sigma_n^1(\hat{n})^*, \sigma_c^1(\hat{c})^*; \sigma_n^2(\hat{n})^*, \sigma_c^2(\hat{c})^*) = (1, 1; 1, 1)$ *is an equilibrium strategy profile if and only if* $\gamma > \tilde{\gamma}$.
2. *(Complete silence) The strategy profile* $(\sigma_n^1(\hat{n})^*, \sigma_c^1(\hat{c})^*; \sigma_n^2(\hat{n})^*, \sigma_c^2(\hat{c})^*) = (1, 0; 1, 0)$ *is never an equilibrium strategy profile.*

The reader can observe that the results of this section are in sharp contrast to the results in the previous sections. In fact, full disclosure of private information was neither an equilibrium in the monopoly game nor in the leader-follower game; however, it can now be an equilibrium. Additionally, complete silence was an equilibrium both in the monopoly game and in the leader-follower game; however, it is not an equilibrium

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[23] The value of $\tilde{\gamma}$ corresponds to the unique real root of polynomial (30) defined in the proof of Proposition 5, and it makes $\Delta_{c_i}[\sigma_n^1(\hat{n}) = 1, \sigma_c^1(\hat{c}) = 1, \sigma_n^2(\hat{n}) = 1, \sigma_c^2(\hat{c}) = 1] = 0$, with Δ_{c_i} defined by (29). This value ($\tilde{\gamma}$) is a function of the parameters in the model α, μ_I, and μ_J.

in the present case. In this sense, simultaneous competition (and not competition per se) proves as an effective mechanism to discipline media firms, in the sense of preventing them from withholding their scoops.

The next two results focus on the equilibrium with full disclosure described in point *1.* of Proposition 5, which requires $\gamma > \tilde{\gamma}$, and analyze the effect of parameters μ_I and μ_J on the equilibrium behavior. The idea is to understand how these parameters and the relationship between them affect the incentive of a firm to publish a scoop.

Corollary 2. *Let* σ^* *denote the strategy profile* $(\sigma_n^1(\hat{n})^*, \sigma_c^1(\hat{c})^*; \sigma_n^2(\hat{n})^*, \sigma_c^2(\hat{c})^*) = (1, 1; 1, 1)$.

1. *The set of parameters for which the profile* σ^* *is an equilibrium strategy profile increases in* μ_I *and decreases in* μ_J*, i.e.,* $\frac{\partial \tilde{\gamma}}{\partial \mu_I} < 0$ *and* $\frac{\partial \tilde{\gamma}}{\partial \mu_J} > 0$.
2. *The maximum value of* $\tilde{\gamma}$ *is* $\tilde{\gamma}^{Max} = \tilde{\gamma} \mid_{\mu_I = 0, \mu_J = 1} < 1$*, and the minimum value of* $\tilde{\gamma}$ *is* $\tilde{\gamma}^{Min} = \frac{1}{2}$*, which can be obtained when* $\mu_I = \mu_J = 0$*. In the latter case, the profile* σ^* *is always an equilibrium strategy profile.*

Corollary 2 shows that the region where full disclosure is an equilibrium increases in μ_I and decreases in μ_J. A first implication of this result is that the smaller the joint capacity of the industry to affect the probability of feedback, μ_J, the higher the probability that the equilibrium with full disclosure exists. Thus, when $\mu_I = \mu_J = 0$, the profile σ^* is always an equilibrium strategy profile, as point *2.* of the corollary states. A second implication of Corollary 2 is that for a given μ_I (alternatively, for a given μ_J), the closer μ_I and μ_J are, the more likely it is to have the equilibrium with full disclosure. Corollary 3 below elaborates on this idea. It also shows that if μ_I and μ_J are very different, the profile $(\sigma_n^1(\hat{n})^*, \sigma_c^1(\hat{c})^*; \sigma_n^2(\hat{n})^*, \sigma_c^2(\hat{c})^*) = (1, 1; 1, 1)$ is never an equilibrium strategy profile.

Corollary 3. *For any* $\gamma < \tilde{\gamma}^{Max}$ *there exists* $0 < \hat{\mu}_I < \hat{\mu}_J < 1$ *such that:*

1. *If* $\mu_I < \hat{\mu}_I < \hat{\mu}_J < \mu_J$*, then the strategy profile* $(\sigma_n^1(\hat{n})^*, \sigma_c^1(\hat{c})^*; \sigma_n^2(\hat{n})^*, \sigma_c^2(\hat{c})^*) = (1, 1; 1, 1)$ *is never an equilibrium strategy profile.*
2. *If* $\hat{\mu}_I < \mu_I \leq \mu_J < \hat{\mu}_J$*, then the strategy profile* $(\sigma_n^1(\hat{n})^*, \sigma_c^1(\hat{c})^*; \sigma_n^2(\hat{n})^*, \sigma_c^2(\hat{c})^*) = (1, 1; 1, 1)$ *is an equilibrium strategy profile.*

In order to gain some intuition for this result, note that in the case of competition, publishing $\hat{n}$ is no longer a safe action, as there is now a probability that the opponent chooses $\hat{c}$, in which case the consumers will learn the state with probability μ_I. However, publishing $\hat{c}$ is still riskier than publishing $\hat{n}$, as in the former case the probability of feedback may be $\mu_J \geq \mu_I$. The point is that the extra risk of taking action $\hat{c}$ over $\hat{n}$ increases in the distance $\mu_J - \mu_I$. This is due to the fact that publishing $\hat{n}$ never yields a probability of feedback μ_J, whereas publishing $\hat{c}$ can yield it; hence, μ_J is exclusively associated with action $\hat{c}$. This means that the more similar μ_I and μ_J are, the smaller the extra risk of action $\hat{c}$ over $\hat{n}$. In contrast, the more different they are, the riskier action $\hat{c}$ over $\hat{n}$ is. Thus, higher $\mu_J - \mu_I$ reduces the incentive to publish a scoop, which makes more difficult that the equilibrium with full disclosure holds.

6 Extensions

This section considers extensions on the monopoly game considered in Section 4. Our aim is to make predictions on four relevant questions: i) The capacity of a firm to affect the probability of feedback and its incentive to withhold a scoop, ii) a firm's optimal choice of an editorial standard, iii) the persistence of news suppression when consumers believe one state to be more likely than the other and iv) the possibility that silence may be socially beneficial.

6.1 Feedback power

The results of previous sections show a relationship between the probability of feedback and the incentive of a firm to withhold a scoop. Note that in this paper the probability of feedback depends on the profile of actions taken by the media firms, i.e., it is endogenous. This means that, in this work, firms have the capacity to affect the probability of feedback (by publishing $\hat{c}$ instead of $\hat{n}$). In this section we focus on the *capacity of a firm* to increase the probability of feedback *on its own*, and on the effects of this capacity on the incentive of the firm to withhold a scoop. Hereafter, we refer to this capacity of the firm as the *firm's feedback power*, and we define it as a measure of the social influence of the firm.

A first idea we would like to stress is that it is not straightforward to measure the feedback power of a firm when there is competition. In order to see this, consider the leader-follower game and let us obtain the feedback power of the leader. Note that if the leader publishes $r_L = \hat{c}$, the probability of feedback is μ_L; whereas if it publishes $r_L = \hat{n}$, the probability of feedback depends on the follower's action and it is either 0 (if the follower takes action $r_F = \hat{n}$), or μ_F (if the follower takes action $r_F = \hat{c}$). This simple exercise shows that with competition, the feedback power of the leader is either $(\mu_L - 0)$ or $(\mu_L - \mu_F)$, depending on the action of the follower. This dependence makes it not straightforward to find a simple measure of the feedback power of a firm, with the complexity increasing in the number of firms that compete in the market.[24]

Nonetheless, note that the idea behind the feedback power of a firm is to measure the capacity of the firm to increase the probability of feedback on its own, by publishing $\hat{c}$ instead of $\hat{n}$. To gain some intuition for this question, in this section we propose a simple model in which a unique firm faces different probabilities of feedback, depending on the action it takes. In particular, we consider that if the firm takes action $\hat{c}$, the probability of feedback is μ^e_M; and that if it takes action $\hat{n}$, the probability of feedback is μ^e, with $0 < \mu^e \leq \mu^e_M < 1$. Note that in this case, $\mu^e_M - \mu^e$ is the feedback power of the firm. Note also that this model can be seen as an extension of the monopoly game. Alternatively, it can be interpreted as a model of competition between a scoop-firm and a large number of competitors (Gentzkow and Shapiro (2006)).[25] We next present the results of this game. The expressions of all the thresholds are defined in the proof of the proposition.[26]

Proposition 6. *There exist $\overline{\gamma}^e \in (\frac{1}{2}, 1)$ and $\overline{\alpha}_0 \in (0,1)$, such that in the unique equilibrium of this game, $\sigma_n(\hat{n})^* = 1$ and:*

1. *If $\gamma > \overline{\gamma}^e$, then $\sigma_c(\hat{c})^* = 1$.*
2. *If $\gamma < \overline{\gamma}^e$, then we have the following situations:*
   - *(a) If $\alpha_0 < \overline{\alpha}_0$, $\sigma_c(\hat{n})^* = x_3 \in (0,1)$.*
   - *(b) If $\alpha_0 > \overline{\alpha}_0$, there exist $\underline{\gamma} \in (\frac{1}{2}, \overline{\gamma}^e)$ such that if $\gamma < \underline{\gamma}$, then $\sigma_c(\hat{n})^* = 1$; and if $\underline{\gamma} < \gamma < \overline{\gamma}^e$, then $\sigma_c(\hat{n})^* = x_3 \in (0,1)$.*

Two results are worth mentioning. The first result is that full disclosure can now be an equilibrium, provided that the quality of the signal is sufficiently high (in particular, higher than $\overline{\gamma}^e = \frac{\mu^e + \alpha_0(\mu^e_M - \mu^e)}{2\mu^e + \alpha_0(\mu^e_M - \mu^e)}$). Note that full disclosure was neither an equilibrium in the monopoly game nor in the leader-follower game.

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[24] In the monopoly game, the feedback power of the firm is simply the probability of feedback.

[25] This interpretation considers K firms, one of them being the "scoop-firm", i.e., the firm that receives a signal and chooses the action first. The other $K-1$ firms play later enough to know the state of the world and, in equilibrium, they always publish their signals honestly. See the working paper version of this work (Andina-Díaz and García-Martínez (2018)), for a detailed interpretation of the model along these lines.

[26] Proposition 6 uses beliefs (1)-(4) and (11)-(12), without the super/subscript L. Additionally, in the proof of this proposition, in Appendix A.5., we describe x_3, it being a function of the parameters in the model γ, α_0, μ^e, and μ^e_M; and satisfying $\Delta_c[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{n}) = x_3] = 0$, with Δ_c being defined by (32). In the proof of this result we also derive the expressions of thresholds $\overline{\gamma}^e$ and $\overline{\alpha}_0$, with $\overline{\gamma}^e$ being a function of parameters α_0, μ^e, and μ^e_M; and $\overline{\alpha}_0$ being a function of μ^e, and μ^e_M.

Thus, a first observation is that having a probability of feedback after action $\hat{n}$ reduces the incentive of the firm to withhold a scoop. The second result is that complete silence can still be an equilibrium, provided that the signal is of low quality and the firm has high initial reputation. This result is in line with those in the monopoly and the leader-follower game. Corollary 4 below formally states these ideas. It also shows the effect of parameters μ^e and μ^e_M on the equilibrium behavior of the firm. The discussion after the corollary focuses on these effects.

Corollary 4. *The probability that the firm silences a scoop is increasing in* μ^e_M *and* α_0 *and decreasing in* μ^e *and* γ*, i.e.* $\frac{\partial \sigma_c(\hat{n})^*}{\partial \mu^e_M} > 0$, $\frac{\partial \sigma_c(\hat{n})^*}{\partial \alpha_0} > 0$, $\frac{\partial \sigma_c(\hat{n})^*}{\partial \mu^e} < 0$ *and* $\frac{\partial \sigma_c(\hat{n})^*}{\partial \gamma} < 0$.

Note that as the feedback power of the firm, $\mu^e_M - \mu^e$, increases in μ^e_M and decreases in μ^e, a result of Corollary 4 is that media self-silence is increasing in the firm's feedback power. The analysis of the limit cases provides more insights in this line (see the proof of Proposition 6, in Appendix A.5). Note that when $\mu^e \to 0$, then $\overline{\gamma}^e \to 1$. This result shows that when the firm is the only institution in the society with the capacity to affect the probability of feedback, the media firm will always withhold a scoop with positive probability, even if the scoop is of very high quality. We also observe that when $\mu^e_M \to \mu^e$, then $\overline{\gamma}^e \to \frac{1}{2}$. This result shows that when the feedback power of the firm becomes insignificant and in the limit it vanishes, the media firm will publish all the scoops that reach its newsroom, even if they are poorly sourced and the firm has a high initial reputation.

This last idea reveals an important point that we would like to stress: The capacity of a firm to affect the probability of feedback is key to explain both the incentive of the firm to withhold a scoop and why this incentive increases in the initial reputation of the firm. Indeed, note that if firms had no feedback power, we should expect all firms to disclose all their scoops, including highly respected firms with high levels of initial reputation.

6.2 Choosing an editorial standard

The analysis in previous sections shows that media self-silence is a feature of firms with either high initial reputation and/or high feedback power. In this section we analyze the relationship between this result and the firm's optimal decision on its editorial standard. By editorial standard we mean the minimum quality (or amount of evidence) that a firm requires in a scoop to be willing to publish it. For simplicity, we perform the analysis for the monopoly game.

The result in Proposition 1 in the monopoly game shows that for any α_0, there always exists threshold $\hat{\gamma} = 1 - \frac{2}{\mu}\frac{1-\alpha_0}{2-\alpha_0} < 1$ such that all scoops of quality higher than this threshold are published with positive probability and may be silenced otherwise. From here, the result in Corollary 5 follows.

Corollary 5. *The editorial standard of a monopoly firm is increasing in both the initial reputation of the firm and the probability of feedback, i.e.,* $\frac{\partial \hat{\gamma}}{\partial \alpha_0} > 0$ *and* $\frac{\partial \hat{\gamma}}{\partial \mu} > 0$.

The result states that the higher the initial reputation of a firm and/or the higher the probability of feedback (which, according to the analysis of the previous section, it coincides with the firm's feedback power in this case), the higher the editorial standard of the firm. This means that the higher α_0 and/or μ, the stricter the firm will be in the vetting process of its stories. This result puts forth an argument to explain why more respected and/or more influential media firms are more selective with the stories they publish and why they choose to silence scoops that other firms will never suppress.

6.3 Unbalanced prior

This section considers a situation in which the two states of the world are not necessarily equiprobable. In particular, we now consider $\theta \in (0,1)$, with θ being the probability that the state is C. We perform the analysis for the monopoly game.

Let us first consider $\theta < \frac{1}{2}$. Note that, in this case, the firm has a stronger incentive to silence a scoop as the unbalanced prior belief introduces a new force (the classical *herding on the prior* effect) towards action $\hat{n}$.[27] In this regard, the results for this case are clear and show that, in equilibrium, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{n})^* > 0$ (see Proposition 10 in Appendix A.6). Our results also show that the lower θ, the higher the media self-silence will be. Lastly, we obtain that there exist $\hat{\alpha}_0 \in (0,1)$ such that $\forall \alpha_0 > \hat{\alpha}_0$, $\sigma_c(\hat{n})^* = 1$. Or, to say it differently, if α_0 is sufficiently high, a monopoly firm withholds all the scoops. This result raises a concern about the silent role of the media in countries with low levels of perceived corruption (low θ) and high press standards (high α_0).

We next analyze the case $\theta > \frac{1}{2}$, where the two effects that are now at play push towards opposite directions. We obtain the following result, with the thresholds being defined in the proof.[28]

Proposition 7. *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 in the unique equilibrium of the game:*

1. *If $\theta \in (1/2, \bar{\theta}_1)$, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{n})^* = min\{1, x_1\} > 0$,*
2. *If $\theta \in (\bar{\theta}_1, \bar{\theta}_2)$, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{c})^* = 1$,*
3. *If $\theta \in (\bar{\theta}_2, \bar{\theta}_3)$, $\sigma_n(\hat{c})^* = x_2 > 0$ and $\sigma_c(\hat{c})^* = 1$,*
4. *If $\theta \in (\bar{\theta}_3, 1)$, $\sigma_n(\hat{c})^* = 1$ and $\sigma_c(\hat{c})^* = 1$.*

This result shows that an increase in the probability that the state is C increases the incentive of a firm to go for the prior belief. Eventually, this incentive can compensate the incentive to silence a scoop and so produce an equilibrium in which the media firm discloses its signal. It occurs when $\theta \in (\bar{\theta}_1, \bar{\theta}_2)$. Proposition 7 also shows that increasing probability θ beyond a certain point can drive to an equilibrium in which the media firm always takes action $\hat{c}$, irrespectively of its signal. It results in a different class of media bias that talks about media firms printing too many scandals, in the hope of catering to the people and possibly bringing them down.

6.4 Is silence always bad?

In this section we relax the assumption that the consumers' payoff is π when $r = \omega$ and $-\varphi$ otherwise. In particular, we now consider that the consumers' utility from a media report r is:

$$u(r,\omega) = \begin{cases} \pi \text{ if } r = \omega, \\ -\varphi_{\hat{c}} \text{ if } r = \hat{c}, \omega = N, \\ -\varphi_{\hat{n}} \text{ if } r = \hat{n}, \omega = C, \end{cases}$$

where $\varphi_{\hat{c}}$ is the cost to the consumers when the state of the world is N and the media firm publishes $\hat{c}$, and $\varphi_{\hat{n}}$ is the cost to the consumers when the state is C and the firm publishes $\hat{n}$. Hence, the present section allows for errors to have different associated costs.

In this case, the consumers' expected welfare is:

$$\frac{1}{2}\left(\alpha_0\pi + (1-\alpha_0)((\gamma\sigma_n(\hat{n}) + (1-\gamma)\left(1-\sigma_c(\hat{c})\right))\pi - \left(\gamma\left(1-\sigma_n(\hat{n})\right) + (1-\gamma)\sigma_c(\hat{c})\right)\varphi_{\hat{c}}\right) +$$
$$\frac{1}{2}\left(\alpha_0\pi + (1-\alpha_0)\left((\gamma\sigma_c(\hat{c}) + (1-\gamma)\left(1-\sigma_n(\hat{n})\right))\pi - \left(\gamma\left(1-\sigma_c(\hat{c})\right) + (1-\gamma)\sigma_n(\hat{n})\right)\varphi_{\hat{n}}\right)\right).$$

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[27] 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.

[28] Equilibrium probabilities x_1 and x_2 are such that $\Delta_c\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{n}) = x_1; \theta\right] = 0$ and $\Delta_n\left[\sigma_n(\hat{c}) = x_2, \sigma_c(\hat{c}) = 1; \theta\right] = 0$, respectively; with Δ_n and Δ_c being defined by equations (39) and (40) in Appendix A.6.

Note that under this more general setting, the previous result that any class of media bias is detrimental to the consumers is no longer true.[29] We now find that there is a threshold for the quality of the signal such that depending on whether $\varphi_{\hat{c}}$ or $\varphi_{\hat{n}}$ is greater, consumers may prefer either full disclosure of scoops or complete silence. More precisely, the result states:

Proposition 8. *Let $\hat{\sigma}_n(\hat{n})$ and $\hat{\sigma}_c(\hat{c})$ be the strategy that maximizes the consumers' expected utility.*

1. *If $\varphi_{\hat{n}} > \varphi_{\hat{c}}$, then $\hat{\sigma}_c(\hat{c}) = 1$. Additionally, there exits $\frac{1}{2} < \tilde{\gamma}_1 < 1$ such that if $\gamma < \tilde{\gamma}_1$, $\hat{\sigma}_n(\hat{c}) = 1$, and if $\gamma > \tilde{\gamma}_1$, $\hat{\sigma}_n(\hat{n}) = 1$.*
2. *If $\varphi_{\hat{n}} < \varphi_{\hat{c}}$, then $\hat{\sigma}_n(\hat{n}) = 1$. Additionally, there exits $\frac{1}{2} < \tilde{\gamma}_2 < 1$ such that if $\gamma < \tilde{\gamma}_2$, $\hat{\sigma}_c(\hat{n}) = 1$, and if $\gamma > \tilde{\gamma}_2$, $\hat{\sigma}_c(\hat{c}) = 1$.*
3. *If $\varphi_{\hat{n}} = \varphi_{\hat{c}}$, then $\hat{\sigma}_n(\hat{n}) = 1$ and $\hat{\sigma}_c(\hat{c}) = 1$.*

Intuitively, the result shows that in the case $\varphi_{\hat{n}} > \varphi_{\hat{c}}$, a media firm that seeks to maximize consumers' welfare should never silence a scoop and even more, should publish $\hat{c}$ after signal n when the quality of the signal is low enough. Note that our model of career concerned media firms never predict this to occur in equilibrium, except for the case $\theta > 1/2$.

The more natural scenario possibly corresponds to $\varphi_{\hat{n}} < \varphi_{\hat{c}}$. To this case, Proposition 8 shows that a media firm that seeks to maximize consumers' welfare should never create a scandal and more so, should withhold a scandal whenever the scoop is not of sufficiently high quality. The optimal behavior in this case is consistent with the equilibrium behavior that we found for the different market structures that we analyze in the paper. Thus, this result suggests that in the presence of this class of asymmetric costs, having media firms with reputational concerns may help obtain a more efficient outcome.

7 Conclusion

We propose a model in which media firms, through their reporting strategies, have the power to affect how much citizens can ever learn about an issue. Our results put forth an important reputational incentive for media firms to withhold scoops, showing that media self-silence increases in the initial reputation of the firm, the probability of feedback and the firm's feedback power. We also show that most of these results are strong enough to persist when considering competition; in particular, sequential competition in the form of a leader-follower game. However, we also find that when firms compete in more equalitarian terms, as it is the case when competition is simultaneous, competition can be a powerful force towards accuracy.

The results in our model are much in line with empirical observation. On the one hand, they help explain why neither *Newsweek* nor *The New Yorker* chose to run the Lewinsky and the bin Laden's death stories, respectively, whereas *Drudge Report* and *The London Review of Books* deemed it appropriate to print them and break the news. On the other hand, they suggest an argument to explain why more respected media firms have stricter vetting processes for stories and fact-checkers in their staff; whereas smaller firms, lacking the power to influence public opinion, have less thorough review processes. Lastly, and despite the apparent contradiction, they can accommodate and explain the empirical observation that media firms such as *The New York Times* or *The Washington Post* are far ahead of the rest of firms in terms of number of *Pulitzer Prizes*.[30] We consider that extensions of our model in either of the two following directions would help explain this empirical observation. A first direction would be to consider that highly respected media firms have access to better sources, i.e., they receive signals of better quality.

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[29] Remember we define media bias as any deviation of a firm's report from the firm's signal.

[30] Since 1918, *The New York Times* has been awarded 117 *Pulitzer Prizes*, more than any other media firm. *The Washington Post* has won 47. Because many of these honors are in the categories of Breaking News Reporting and Investigative Reporting, it presents clear evidence that media firms with high social influence do also cover scandals.

A second direction would be to consider that highly respected media firms receive a larger number of scoops, for example because their name and/or influence makes them more attractive to whistle-blowers. In both cases, our prediction is that our model could easily accommodate and explain why more respected media firms can end up publishing more scoops than smaller ones.

Continuing with the contribution of the paper, we would like to stress that the kind of media silence that we identify in this paper does not depend on the existence of defamation lawsuits or physical threats to journalists (see Garoupa (1999), Stanig (2015), and Gratton (2015)), which we agree are real phenomena and important sources of media silence. It is neither explained by media capture, either by the government or by advertisers (see Vaidya (2005), Besley and Prat (2006), Ellman and Germano (2009), Gehlbacha and Sonin (2014), Shadmehr and Bernhardt (2015), You et al. (2018), Qin and Strömberg (2018), Gitmez and Molavi (2018), Trombetta (2018), and Levy et al. (2019)). Introducing these considerations in our model, where only negative news produces feedback, would just reinforce our results. Another important consideration is that we consider risk-neutral firms. Extending the analysis to account for risk-averse media firms, or risk-averse journalists, would just magnify our results. In this regard, our contribution is to point out to a more subtle source of media silence that simply originates in the power of the media to raise public concern and so affect the probability that there is ex-post verification of the state of the world.

Beyond these comments, there are still open questions that the present work cannot fully answer. An interesting one would be to investigate whether the predictions of this model hold when we consider a dynamic game. In such a game, the reputation of a firm at every period should be based on the updating process of consumers' beliefs over previous reports, with the reputation of a firm possibly affecting the capacity of the firm to receive a scoop the next period. In this sense, we could think of a model in which after a report, consumers might receive valuable information to assess the accuracy of the story, which would enable them to reward/punish a media firm according to its behavior and the consumers' preferences. We may expect the reward/punishment to have a positive/negative impact on a firm's reputation, with the reputation of a firm possibly affecting the capacity of the firm to receive a scoop the next period. This setup might help us show how a firm's incentive to silence a scoop and, more generally, how firms' reputations, change over time. These ideas speak directly to the question of how to build a good reputation.[31] Our prediction is that the incentive to withhold a scoop that we identify in the present work would still apply in this new dynamic approach. However, only a detailed analysis will give a precise answer. This kind of questions have been partially addressed in our recent paper, Andina-Díaz et al. (2019), where we consider a dynamic game where behavioral media firms compete for the publication of scoops, and both the publication of scoops and their veracity determine a firm's future audience. Although that paper makes a first attempt to understand these questions in a dynamic setup, there is still much to do to have a thorough understanding of the effects of reputational concerns and endogenous feedback on the behavior of media firms and, in particular, on their incentives to withhold information. We consider that these questions merit future research.

A Appendix

The Appendix is divided into six subsections: A.1) Monopoly; A.2) Monopoly with a strategic high type; A.3) Competition: A model of sequential competition; A.4) Competition: A model of simultaneous competition; A.5) Extension: Feedback power; A.6) Extension: Unbalanced prior; and A.7) Extension: Is silence always bad?

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[31] For repeated games of reputation building, see e.g. Kreps et al. (1982), Fudenberg and Levine (1989, 1992), Ely and Välimäki (2003), and the survey by Mailath and Samuelson (2015). An important point in this literature is the specification of "commitment types", i.e, players who are constrained to follow a particular plan.

A.1 Monopoly

We start obtaining the consumers' beliefs. From Bayes' rule, the consumers' consistent beliefs about the monopoly firm being high type $\alpha_1(r, X)$, with $r \in \{\hat{n}, \hat{c}\}$ and $X = \{N, C, 0\}$, are:

$$\alpha_1(\hat{n}, 0) = \frac{\alpha_0}{\alpha_0 + (1-\alpha_0)(\sigma_c(\hat{n}) + \sigma_n(\hat{n}))}, \tag{1}$$

$$\alpha_1(\hat{c}, N) = 0, \tag{2}$$

$$\alpha_1(\hat{c}, C) = \frac{\alpha_0}{\alpha_0 + (1-\alpha_0)(\gamma\sigma_c(\hat{c}) + (1-\gamma)\sigma_n(\hat{c}))}, \tag{3}$$

$$\alpha_1(\hat{c}, 0) = \frac{\alpha_0}{\alpha_0 + (1-\alpha_0)(\sigma_c(\hat{c}) + \sigma_n(\hat{c}))}, \tag{4}$$

with $\alpha_1(\hat{c}, C) > \alpha_1(\hat{c}, 0) > \alpha_1(\hat{c}, N)$.

Next, we define some important concepts. Let $E\{\alpha_1(r, X) \mid s\}$ denote the expected payoff to the normal type monopoly firm when it observes signal $s \in \{n, c\}$ and publishes $r \in \{\hat{n}, \hat{c}\}$, over the possible realizations of $X \in \{N, C, 0\}$.

$$\begin{aligned} E\{\alpha_1(\hat{n}, X) \mid s\} &= \alpha_1(\hat{n}, 0)\ \forall s \in \{n, c\}, \\ E\{\alpha_1(\hat{c}, X) \mid n\} &= (1-\mu)\alpha_1(\hat{c}, 0) + \mu[P(N \mid n)\alpha_1(\hat{c}, N) + P(C \mid n)\alpha_1(\hat{c}, C)], \\ E\{\alpha_1(\hat{c}, X) \mid c\} &= (1-\mu)\alpha_1(\hat{c}, 0) + \mu[P(C \mid c)\alpha_1(\hat{c}, C) + P(N \mid c)\alpha_1(\hat{c}, N)], \end{aligned}$$

where, given $\alpha_1(\hat{c}, N) = 0$ and $\theta = 1/2$, the last two expressions reduce to:

$$\begin{aligned} E\{\alpha_1(\hat{c}, X) \mid n\} &= (1-\mu)\alpha_1(\hat{c}, 0) + \mu(1-\gamma)\alpha_1(\hat{c}, C), \\ E\{\alpha_1(\hat{c}, X) \mid c\} &= (1-\mu)\alpha_1(\hat{c}, 0) + \mu\gamma\alpha_1(\hat{c}, C). \end{aligned}$$

Additionally, let Δ_s be the expected gain to the monopoly firm from reporting $\hat{n}$ rather than $\hat{c}$, after observing signal $s \in \{n, c\}$:

$$\Delta_n = E\{\alpha_1(\hat{n}, X) \mid n\} - E\{\alpha_1(\hat{c}, X) \mid n\} = \alpha_1(\hat{n}, 0) - ((1-\mu)\alpha_1(\hat{c}, 0) + \mu(1-\gamma)\alpha_1(\hat{c}, C)), \tag{5}$$

$$\Delta_c = E\{\alpha_1(\hat{n}, X) \mid c\} - E\{\alpha_1(\hat{c}, X) \mid c\} = \alpha_1(\hat{n}, 0) - ((1-\mu)\alpha_1(\hat{c}, 0) + \mu\gamma\alpha_1(\hat{c}, C)). \tag{6}$$

We are now in position to prove the two results of this Section.

Proof of Proposition 1

It is a limit case of Proposition 6, with $\mu^e = 0$ and $\mu^e_M = \mu$. From the proof of Proposition 6, we have:
$\lim_{\mu^e \to 0} \overline{\alpha}_0 = \frac{2(2-\mu^e_M)}{4-\mu^e_M} = \frac{2(2-\mu)}{4-\mu} = \hat{\alpha}_0$,
$\lim_{\mu^e \to 0} \underline{\gamma} = 1 - \frac{2}{\mu^e_M}\frac{1-\alpha_0}{2-\alpha_0} = 1 - \frac{2}{\mu}\frac{1-\alpha_0}{2-\alpha_0} = \hat{\gamma}$, and
$\lim_{\mu^e \to 0} \overline{\gamma}^e = 1$.
In addition, when $\mu^e = 0$ and $\mu^e_M = \mu$, expression (33) simplifies to:
$\Delta_c[\sigma_n(\hat{n})^* = 1] = \frac{\alpha_0}{\alpha_0+(1-\alpha_0)(\sigma_c(\hat{n})+1)} - (\frac{(1-\mu)\alpha_0}{\alpha_0+(1-\alpha_0)\sigma_c(\hat{c})} + \frac{\mu\gamma\alpha_0}{\alpha_0+(1-\alpha_0)\gamma\sigma_c(\hat{c})})$,
where $\Delta_c[\sigma_n(\hat{n})^* = 1, \sigma^*_c(\hat{n}) = x_0] = 0$ for

$$x_0(\gamma, \alpha_0, \mu) = \frac{2\gamma+\alpha_0(1-\alpha_0)(2-\mu)-\sqrt{(2\gamma+\alpha_0(1-\gamma)(2-\mu))^2-8\alpha_0(1-\gamma)\gamma\mu}}{4(1-\alpha_0)\gamma}. \ \blacksquare \tag{7}$$

Proof of Corollary 1

It is the limit case of Corollary 4, with $\mu^e = 0$ and $\mu^e_M = \mu$.

From Proposition 1 and expression (7), it is straightforward to show that:

$$\lim_{\gamma\to 1}\sigma_c^*(\hat{n}) = 0 \qquad \lim_{\gamma\to \frac{1}{2}}\sigma_c^*(\hat{n}) = \min\{1, x_0|_{\gamma=\frac{1}{2}}\},$$

$$\lim_{\alpha_0\to 0}\sigma_c^*(\hat{n}) = 0 \qquad \lim_{\alpha_0\to 1}\sigma_c^*(\hat{n}) = 1,$$

$$\lim_{\mu\to 0}\sigma_c^*(\hat{n}) = 0 \qquad \lim_{\mu\to 1}\sigma_c^*(\hat{n}) = \min\{1, \frac{\alpha_0(1-\gamma)}{2\gamma(1-\alpha_0)}\}. \quad \blacksquare$$

A.2 Monopoly with an strategic high type

In this section, we show that in the case of a monopoly there is always an equilibrium in which the high type firm discloses all its information. Let H denote the high type and L denote the normal type (remember that N denotes one of the states of the world). We consider $\theta \in (0,1)$. The proof is done in two steps. First, Proposition 9 below shows that there is an equilibrium in which the normal type firm and the high type firm behave as described in the proposition. Second, Corollary 6 shows that under assumption $\frac{P(\hat{c}|L,C)}{P(\hat{c}|H,C)} < \frac{P(\hat{c}|L,N)}{P(\hat{c}|H,N)}$, i.e., the high type H matches the state of the world more often than the normal type L, the equilibrium described in Proposition 9 is unique.

We denote by $\sigma_s^H(r) \in [0,1]$ the probability that, conditioned on its signal s, a high type firm takes action r. In addition, $\sigma_s(r)$ denotes this probability for the normal type.

Proposition 9. *Let $\theta \in (0,1)$. There exist $\bar{\theta}_1$, $\bar{\theta}_2$ and $\bar{\theta}_3$, with $0 < \bar{\theta}_1 < \bar{\theta}_2 < \bar{\theta}_3 < 1$. For each $\theta \in (0,1)$ there is a unique equilibrium for the normal type firm. In the equilibrium:*

1. *If $\theta \in (0, \bar{\theta}_1)$, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{n})^* = min\{1, x_1\} > 0$,*
2. *If $\theta \in (\bar{\theta}_1, \bar{\theta}_2)$, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{c})^* = 1$,*
3. *If $\theta \in (\bar{\theta}_2, \bar{\theta}_3)$, $\sigma_n(\hat{c})^* = x_2 > 0$ and $\sigma_c(\hat{c})^* = 1$,*
4. *If $\theta \in (\bar{\theta}_3, 1)$, $\sigma_n(\hat{c})^* = 1$ and $\sigma_c(\hat{c})^* = 1$,*

with x_1 satisfying $\Delta_c[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 1 - x_1] = 0$ and x_2 satisfying $\Delta_n[\sigma_n(\hat{n}) = 1 - x_2, \sigma_c(\hat{c}) = 1] = 0$.

In addition, if the high type H plays strategically, the strategy $\left(\sigma_c^H(\hat{c})^*, \sigma_n^H(\hat{n})^*\right) = (1,1)$ is an equilibrium strategy for the high type firm.

Proof.

Proposition 10 (see Appendix A.6) shows that if the high type firm plays the truthful strategy, $\left(\sigma_c^H(\hat{c})^*, \sigma_n^H(\hat{n})^*\right) = (1,1)$, 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 aim, we assume that the high type plays the truthful strategy, $\left(\sigma_c^H(\hat{c})^*, \sigma_n^H(\hat{n})^*\right) = (1,1)$, and show that this is indeed an equilibrium strategy.

First, we derive the payoff functions for the high type (equations (39)-(40) describe the payoffs of the normal type). Let $E^H\{\alpha_1(r,X) \mid s\}$ denote the expected payoff to the high type media firm when it observes signal $s \in \{n, c\}$ and publishes $r \in \{\hat{n}, \hat{c}\}$.

$$E^H\{\alpha_1(\hat{n},X) \mid s\} = \alpha_1(\hat{n},0),$$
$$E^H\{\alpha_1(\hat{c},X) \mid n\} = (1-\mu)\alpha_1(\hat{c},0) + \mu[\alpha_1(\hat{c},N)] = (1-\mu)\alpha_1(\hat{c},0),$$
$$E^H\{\alpha_1(\hat{c},X) \mid c\} = (1-\mu)\alpha_1(\hat{c},0) + \mu[\alpha_1(\hat{c},C)].$$

Now, let Δ_s^H be the expected gain to the high type firm from reporting $\hat{n}$ rather than $\hat{c}$, after observing signal s. From $\Delta_s^H = E^H\{\alpha_1(\hat{n},X) \mid s\} - E^H\{\alpha_1(\hat{c},X) \mid s\}$, substituting, we obtain:

$$\Delta_n^H = \alpha_1(\hat{n},0) - (1-\mu)\alpha_1(\hat{c},0),$$
$$\Delta_c^H = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu\alpha_1(\hat{c},C)).$$

The following Claim 1 is required to prove Proposition 9.

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

Proof.

First, note that from Lemma 6, $\Delta_n > \Delta_c$.

Additionally,

$$\Delta_n^H = \alpha_1(\hat{n},0) - (1-\mu)\alpha_1(\hat{c},0) > \Delta_n = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu P(C \mid n)\alpha_1(\hat{c},C)),$$
$$\Delta_c^H = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu\alpha_1(\hat{c},C)) < \Delta_c = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu P(C \mid c)\alpha_1(\hat{c},C)).$$

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 10. 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 $\sigma_n^H(\hat{n})^* = 1$.

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

Configuration 3: Since $\Delta_n \geq 0$, then $\Delta_n^H > 0$ and thus $\sigma_n^H(\hat{n})^* = 1$. Because under this configuration, the normal type never sends $\hat{c}$, if $\hat{c}$ were to be reported, the media firm would assigned a probability one of being the high type. Consequently, $\Delta_c^H = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu\alpha_1(\hat{c},C)) = \alpha_1(\hat{n},0) - 1 < 0$, which implies $\sigma_c^H(\hat{c})^* = 1$.

Configuration 4: Since $\Delta_c \leq 0$, then $\Delta_c^H < 0$, and thus $\sigma_c^H(\hat{c})^* = 1$. Because under this configuration, the normal type never sends $\hat{n}$, if $\hat{n}$ were to be reported, the media firm would assign a probability one of being the high type. Consequently, $\Delta_n^H = \alpha_1(\hat{n},0) - (1-\mu)\alpha_1(\hat{c},0) = 1 - (1-\mu)\alpha_1(\hat{c},0) > 0$, which implies $\sigma_n^H(\hat{n})^* = 1$.

Configuration 7: This case is analogous to Configuration 1.

Then, the truthful strategy is an equilibrium strategy for the high type. ■

Next, we show that the equilibrium above is unique. To this aim, we make the following assumption: In equilibrium, the high type matches the state of the world more often than the normal type.[32] Formally, it implies $\frac{P(\hat{c}|L,C)}{P(\hat{c}|H,C)} < \frac{P(\hat{c}|L,N)}{P(\hat{c}|H,N)}$, where $P(\hat{c} \mid L, C)$ is the probability that a normal type (L) publishes $\hat{c}$ when the state of the world is C. Analogously, $P(\hat{c} \mid H, C)$ is the probability that a high type (H) publishes $\hat{c}$ when the state of the world is C and so on, so forth. It is straightforward to prove that if $\frac{P(\hat{c}|L,C)}{P(\hat{c}|H,C)} < \frac{P(\hat{c}|L,N)}{P(\hat{c}|H,N)}$, then $\alpha_1(\hat{c},C) > \alpha_1(\hat{c},N)$.

Corollary 6. *If* $\frac{P(\hat{c}|L,C)}{P(\hat{c}|H,C)} < \frac{P(\hat{c}|L,N)}{P(\hat{c}|H,N)}$*, then the equilibrium described in Proposition 9 is unique.*

Proof.

First, note that from the proof of Proposition 10 we know that if the high type plays the truthful strategy, then the equilibrium strategy of the normal type is unique.

Then, we just have to show that the truthful strategy is the only equilibrium strategy for the high type. To this aim, we first rewrite the functions Δ_n, Δ_c, Δ_n^H and Δ_c^H, to take into account the fact that

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[32] 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.

the high type can now lie and publish $\hat{c}$ when its signal indicates n (in which case, the real state is N). They are:

$$\begin{aligned}
\Delta_n &= \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu\left(P(C \mid n)\alpha_1(\hat{c},C) + P(N \mid n)\alpha_1(\hat{c},N)\right)),\\
\Delta_c &= \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu\left(P(C \mid c)\alpha_1(\hat{c},C) + P(N \mid c)\alpha_1(\hat{c},N)\right)),\\
\Delta_n^H &= \alpha_1(\hat{n},0) - \left((1-\mu)\alpha_1(\hat{c},0) + \mu\alpha_1(\hat{c},N)\right),\\
\Delta_c^H &= \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu\alpha_1(\hat{c},C)).
\end{aligned}$$

It is straightforward to show that $P(C \mid c) > P(C \mid n)$, with $P(N \mid c) = 1 - P(C \mid c)$ and $P(N \mid n) = 1 - P(C \mid n)$. As $\frac{P(\hat{c}|L,C)}{P(\hat{c}|H,C)} < \frac{P(\hat{c}|L,N)}{P(\hat{c}|H,N)}$, then $\alpha_1(\hat{c},C) > \alpha_1(\hat{c},N)$, which implies:

$$\alpha_1(\hat{c},N) < P(C \mid n)\alpha_1(\hat{c},C) + P(N \mid n)\alpha_1(\hat{c},N) < P(C \mid c)\alpha_1(\hat{c},C) + P(N \mid c)\alpha_1(\hat{c},N) < \alpha_1(\hat{c},C).$$

Consequently, $\Delta_n^H > \Delta_n > \Delta_c > \Delta_c^H$.

The rest of the proof is analogous to the proof of Proposition 9. ■

A.3 Competition: A model of sequential competition

We first obtain the posterior probability $\alpha_1^i(r_i, r_j, X)$ that the consumers place on media firm i being a high type firm, given report $r_i \in \{\hat{n}_i, \hat{c}_i\}$ and feedback $X \in \{N, C, 0\}$, with $i, j \in \{L, F\}$ and $i \neq j$. Let us denote by H a high type firm and by L a normal type firm. Thus, H_L (respectively H_F) stands for a high type leader (respectively, a high type follower), and L_L (respectively L_F) stands for a normal type leader (respectively, a normal type follower).

We first analyze the *beliefs about the leader's type.* It is straightforward to show that:

$$\begin{aligned}
\alpha_1^L(\hat{c}_L, 0) &= \tfrac{\alpha_0^L}{\alpha_0^L + (1-\alpha_0^L)(\sigma_c^L(\hat{c}) + \sigma_n^L(\hat{c}))}, &(8)\\
\alpha_1^L(\hat{c}_L, N) &= 0, &(9)\\
\alpha_1^L(\hat{c}_L, C) &= \tfrac{\alpha_0^L}{\alpha_0^L + (1-\alpha_0^L)(\gamma\sigma_c^L(\hat{c}) + (1-\gamma)\sigma_n^L(\hat{c}))}, &(10)\\
\alpha_1^L(\hat{n}_L, \hat{c}_F, N) &= P(H_L \mid \hat{n}_L, \hat{c}_F, N) = P(H_L \mid \hat{n}_L, N)\\
&= \tfrac{\alpha_0^L}{\alpha_0^L + (1-\alpha_0^L)(\gamma\sigma_n^L(\hat{n}) + (1-\gamma)\sigma_c^L(\hat{n}))}, &(11)\\
\alpha_1^L(\hat{n}_L, \hat{c}_F, C) &= P(H_L \mid \hat{n}_L, \hat{c}_F, C) = P(H_L \mid \hat{n}_L, C)\\
&= 0, &(12)
\end{aligned}$$

where beliefs (8)-(10) coincide with beliefs (1)-(3) in the monopoly, without superscript L. Next, we obtain beliefs $\alpha_1^L(\hat{n}_L, r_F, 0)$, with $r_F \in \{\hat{n}_F, \hat{c}_F\}$. Note that:

$$\begin{aligned}
\alpha_1^L(\hat{n}_L, r_F, 0) = P(H_L \mid \hat{n}_L, r_F) &= \tfrac{P(r_F|\hat{n}_L,H_L)P(\hat{n}_L|H_L)P(H_L)}{P(r_F|\hat{n}_L,H_L)P(\hat{n}_L|H_L)P(H_L) + P(r_F|\hat{n}_L,L_L)P(\hat{n}_L|L_L)P(L_L)}\\
&= \tfrac{P(H_L)}{P(H_L) + P(L_L)\frac{P(r_F|\hat{n}_L,L_L)P(\hat{n}_L|L_L)}{P(r_F|\hat{n}_L,H_L)P(\hat{n}_L|H_L)}},
\end{aligned}$$

where,

$$\begin{aligned}
P(r_F \mid \hat{n}_L, L_L) &= P(r_F \mid \hat{n}_L, L_L, C)P(C \mid \hat{n}_L, L_L) + P(r_F \mid \hat{n}_L, L_L, N)P(N \mid \hat{n}_L, L_L),\\
P(r_F \mid \hat{n}_L, H_L) &= P(r_F \mid \hat{n}_L, H_L, C)P(C \mid \hat{n}_L, H_L) + P(r_F \mid \hat{n}_L, H_L, N)P(N \mid \hat{n}_L, H_L)\\
&= P(r_F \mid \hat{n}_L, H_L, N)\\
&= P(r_F \mid \hat{n}_L, N).
\end{aligned}$$

Since, for $\omega \in \{N, C\}$,

$$P(\omega \mid \hat{n}_L, L_L) = \tfrac{P(\hat{n}_L|L_L,\omega)P(L_L|\omega)P(\omega)}{P(\hat{n}_L|L_L,C)P(L_L|C)P(C) + P(\hat{n}_L|L_L,N)P(L_L|N)P(N)} = \tfrac{P(\hat{n}_L|L_L,\omega)}{P(\hat{n}_L|L_L,C) + P(\hat{n}_L|L_L,N)},$$

we have,

$$\begin{aligned}P(r_F \mid \hat{n}_L, L_L) &= \tfrac{P(r_F|\hat{n}_L,L_L,C)P(\hat{n}_L|L_L,C)+P(r_F|\hat{n}_L,L_L,N)P(\hat{n}_L|L_L,N)}{P(\hat{n}_L|L_L,C)+P(\hat{n}_L|L_L,N)} \\ &= \tfrac{P(r_F|\hat{n}_L,C)P(\hat{n}_L|L_L,C)+P(r_F|\hat{n}_L,N)P(\hat{n}_L|L_L,N)}{2P(\hat{n}_L|L_L)},\end{aligned}$$

as

$$P(\hat{n}_L \mid L_L) = P(\hat{n}_L \mid L_L, C)P(C) + P(\hat{n}_L \mid L_L, N)P(N) = \frac{1}{2}\left(P(\hat{n}_L \mid L_L, C) + P(\hat{n}_L \mid L_L, N)\right).$$

Then:

$$\begin{aligned}\alpha_1^L(\hat{n}_L, r_F, 0) &= \frac{P(H_L)}{P(H_L)+P(L_L)\frac{\frac{P(r_F|\hat{n}_L,C)P(\hat{n}_L|L_L,C)+P(r_F|\hat{n}_L,N)P(\hat{n}_L|L_L,N)}{2P(\hat{n}_L|L_L)}P(\hat{n}_L|L_L)}{P(r_F|\hat{n}_L,N)P(\hat{n}_L|H_L)}} \\ &= \frac{P(H_L)}{P(H_L)+P(L_L)\frac{P(r_F|\hat{n}_L,C)P(\hat{n}_L|L_L,C)+P(r_F|\hat{n}_L,N)P(\hat{n}_L|L_L,N)}{2P(r_F|\hat{n}_L,N)P(\hat{n}_L|H_L)}} \\ &= \frac{P(H_L)}{P(H_L)+P(L_L)\frac{P(r_F|\hat{n}_L,C)P(\hat{n}_L|L_L,C)+P(r_F|\hat{n}_L,N)P(\hat{n}_L|L_L,N)}{P(r_F|\hat{n}_L,N)}} \\ &= \frac{P(H_L)}{P(H_L)+P(L_L)\left(P(\hat{n}_L|L_L,N)+P(\hat{n}_L|L_L,C)\frac{P(r_F|\hat{n}_L,C)}{P(r_F|\hat{n}_L,N)}\right)},\end{aligned}$$

as

$$\begin{aligned}P(\hat{n}_L \mid H_L) &= P(\hat{n}_L \mid H_L, C)P(C) + P(\hat{n}_L \mid H_L, N)P(N) \\ &= P(N) = \frac{1}{2}.\end{aligned}$$

Now, substituting, we get the following beliefs:

$$\alpha_1^L(\hat{n}_L, \hat{n}_F, 0) = \frac{\alpha_0^L}{\alpha_0^L+(1-\alpha_0^L)\left(\gamma\sigma_n^L(\hat{n})+(1-\gamma)\sigma_c^L(\hat{n})+(\gamma\sigma_c^L(\hat{n})+(1-\gamma)\sigma_n^L(\hat{n}))\frac{(1-\alpha_0^F)(\gamma\sigma_c^F(\hat{n})+(1-\gamma)\sigma_n^F(\hat{n}))}{\alpha_0^F+(1-\alpha_0^F)(\gamma\sigma_n^F(\hat{n})+(1-\gamma)\sigma_c^F(\hat{n}))}\right)}, \tag{13}$$

$$\alpha_1^L(\hat{n}_L, \hat{c}_F, 0) = \frac{\alpha_0^L}{\alpha_0^L+(1-\alpha_0^L)\left(\gamma\sigma_n^L(\hat{n})+(1-\gamma)\sigma_c^L(\hat{n})+(\gamma\sigma_c^L(\hat{n})+(1-\gamma)\sigma_n^L(\hat{n}))\frac{\alpha_0^F+(1-\alpha_0^F)(\gamma\sigma_c^F(\hat{c})+(1-\gamma)\sigma_n^F(\hat{c}))}{(1-\alpha_0^F)(\gamma\sigma_n^F(\hat{c})+(1-\gamma)\sigma_c^F(\hat{c}))}\right)}, \tag{14}$$

with $\alpha_1^L(\hat{c}_L, C) > \alpha_1^L(\hat{c}_L, 0) > \alpha_1^L(\hat{c}_L, N)$ and $\alpha_1^L(\hat{n}_L, N) > \alpha_1^L(\hat{n}_L, r_F, 0) > \alpha_1^L(\hat{n}_L, C)$, with $r_F \in \{\hat{n}_F, \hat{c}_F\}$.

Next, we derive the *beliefs about the follower's type*. It is easy to show that:

$$\begin{aligned}\alpha_1^F(\hat{n}_L, \hat{c}_F, N) &= P(H_F \mid \hat{n}_L, \hat{c}_F, N) = P(H_F \mid \hat{c}_F, N) \\ &= 0, \qquad (15) \\ \alpha_1^F(\hat{n}_L, \hat{c}_F, C) &= P(H_F \mid \hat{n}_L, \hat{c}_F, C) = P(H_F \mid \hat{c}_F, C) \\ &= \tfrac{\alpha_0^F}{\alpha_0^F+(1-\alpha_0^F)(\gamma\sigma_c^F(\hat{c})+(1-\gamma)\sigma_n^F(\hat{c}))}. \qquad (16)\end{aligned}$$

where beliefs (15)-(16) coincide with beliefs (2)-(3) in the monopoly, without superscript F. To derive beliefs $\alpha_1^F(\hat{n}_L, r_F, 0)$, for $r_F \in \{\hat{c}_F, \hat{n}_F\}$, note that:

$$\begin{aligned}\alpha_1^F(\hat{n}_L, r_F, 0) = P(H_F \mid \hat{n}_L, r_F) &= \tfrac{P(r_F|\hat{n}_L,H_F)P(\hat{n}_L|H_F)P(H_F)}{P(r_F|\hat{n}_L,H_F)P(\hat{n}_L|H_F)P(H_F)+P(r_F|\hat{n}_L,L_F)P(\hat{n}_L|L_F)P(L_F)} \\ &= \tfrac{P(H_F)}{P(H_F)+P(L_F)\frac{P(r_F|\hat{n}_L,L_F)P(\hat{n}_L|L_F)}{P(r_F|\hat{n}_L,H_F)P(\hat{n}_L|H_F)}}, \\ &= \tfrac{P(H_F)}{P(H_F)+P(L_F)\frac{P(r_F|\hat{n}_L,L_F)}{P(r_F|\hat{n}_L,H_F)}},\end{aligned}$$

where,

$$\begin{aligned}
P(r_F \mid \hat{n}_L, L_F) &= P(r_F \mid \hat{n}_L, L_F, N)P(N \mid \hat{n}_L, L_F) + P(r_F \mid \hat{n}_L, L_F, C)P(C \mid \hat{n}_L, L_F) \\
&= P(r_F \mid \hat{n}_L, L_F, N)P(N \mid \hat{n}_L) + P(r_F \mid \hat{n}_L, L_F, C)P(C \mid \hat{n}_L), \\
P(\hat{n}_F \mid \hat{n}_L, H_F) &= P(\hat{n}_F \mid \hat{n}_L, H_F, N)P(N \mid \hat{n}_L, H_F) + P(\hat{n}_F \mid \hat{n}_L, H_F, C)P(C \mid \hat{n}_L, H_F) \\
&= P(N \mid \hat{n}_L, H_F) = P(N \mid \hat{n}_L), \\
P(\hat{c}_F \mid \hat{n}_L, H_F) &= P(\hat{c}_F \mid \hat{n}_L, H_F, N)P(N \mid \hat{n}_L, H_F) + P(\hat{c}_F \mid \hat{n}_L, H_F, C)P(C \mid \hat{n}_L, H_F) \\
&= P(C \mid \hat{n}_L, H_F) = P(C \mid \hat{n}_L).
\end{aligned}$$

Since, for $\omega \in \{N, C\}$,

$$P(\omega \mid \hat{n}_L) = \tfrac{P(\hat{n}_L|\omega)P(\omega)}{P(\hat{n}_L|N)P(N)+P(\hat{n}_L|C)P(C)} = \tfrac{P(\hat{n}_L|\omega)}{P(\hat{n}_L|N)+P(\hat{n}_L|C)},$$

we have,

$$P(r_F \mid \hat{n}_L, L_F) = \tfrac{P(r_F|\hat{n}_L,L_F,N)P(\hat{n}_L|N)+P(r_F|\hat{n}_L,L_F,C)P(\hat{n}_L|C)}{P(\hat{n}_L|N)+P(\hat{n}_L|C)},$$

and then:

$$\begin{aligned}
\alpha_1^F(\hat{n}_L, \hat{n}_F, 0) &= \frac{P(H_F)}{P(H_F)+P(L_F)\frac{\frac{P(\hat{n}_F|\hat{n}_L,L_F,N)P(\hat{n}_L|N)+P(\hat{n}_F|\hat{n}_L,L_F,C)P(\hat{n}_L|C)}{P(\hat{n}_L|N)+P(\hat{n}_L|C)}}{\frac{P(\hat{n}_L|\ N)}{P(\hat{n}_L|N)+P(\hat{n}_L|C)}}} \\
&= \frac{P(H_F)}{P(H_F)+P(L_F)\left(P(\hat{n}_F|\hat{n}_L,L_F,N)+P(\hat{n}_F|\hat{n}_L,L_F,C)\frac{P(\hat{n}_L|C)}{P(\hat{n}_L|N)}\right)}, \\
\alpha_1^F(\hat{n}_L, \hat{c}_F, 0) &= \frac{P(H_F)}{P(H_F)+P(L_F)\frac{\frac{P(\hat{c}_F|\hat{n}_L,L_F,N)P(\hat{n}_L|N)+P(\hat{c}_F|\hat{n}_L,L_F,C)P(\hat{n}_L|C)}{P(\hat{n}_L|N)+P(\hat{n}_L|C)}}{\frac{P(\hat{n}_L|\ C)}{P(\hat{n}_L|N)+P(\hat{n}_L|C)}}} \\
&= \frac{P(H_F)}{P(H_F)+P(L_F)\left(P(\hat{c}_F|\hat{n}_L,L_F,C)+P(\hat{c}_F|\hat{n}_L,L_F,N)\frac{P(\hat{n}_L|N)}{P(\hat{n}_L|C)}\right)}.
\end{aligned}$$

Now, substituting, we obtain the following beliefs:

$$\alpha_1^F(\hat{n}_L, \hat{n}_F, 0) = \frac{\alpha_0^F}{\alpha_0^F+(1-\alpha_0^F)\left(\gamma\sigma_n^F(\hat{n})+(1-\gamma)\sigma_c^F(\hat{n})+(\gamma\sigma_c^F(\hat{n})+(1-\gamma)\sigma_n^F(\hat{n}))\frac{(1-\alpha_0^L)(\gamma\sigma_c^L(\hat{n})+(1-\gamma)\sigma_n^L(\hat{n}))}{\alpha_0^L+(1-\alpha_0^L)(\gamma\sigma_n^L(\hat{n})+(1-\gamma)\sigma_c^L(\hat{n}))}\right)}, \tag{17}$$

$$\alpha_1^F(\hat{n}_L, \hat{c}_F, 0) = \frac{\alpha_0^F}{\alpha_0^F+(1-\alpha_0^F)\left(\gamma\sigma_c^F(\hat{c})+(1-\gamma)\sigma_n^F(\hat{c})+(\gamma\sigma_n^F(\hat{c})+(1-\gamma)\sigma_c^F(\hat{c}))\frac{\alpha_0^L+(1-\alpha_0^L)(\gamma\sigma_n^L(\hat{n})+(1-\gamma)\sigma_c^L(\hat{n}))}{(1-\alpha_0^L)(\gamma\sigma_c^L(\hat{n})+(1-\gamma)\sigma_n^L(\hat{n}))}\right)}, \tag{18}$$

with $\alpha_1^F(\hat{c}_F, C) > \alpha_1^F(\hat{n}_L, \hat{c}_F, 0) > \alpha_1^F(\hat{c}_F, N)$.

At this point, we can obtain the expected gain to the (normal type) follower from reporting $\hat{n}$ rather than $\hat{c}$, after observing the leader's report $\hat{n}_L$ and signal $s_F \in \{n_F, c_F\}$:

$$\Delta_{n_F} \;=\; \alpha_1^F(\hat{n}_L, \hat{n}_F, 0) - \left((1-\mu_F)\alpha_1^F(\hat{n}_L, \hat{c}_F, 0) + \mu_F P(C \mid n_F, \hat{n}_L)\alpha_1^F(\hat{n}_L, \hat{c}_F, C)\right), \tag{19}$$

$$\Delta_{c_F} \;=\; \alpha_1^F(\hat{n}_L, \hat{n}_F, 0) - \left((1-\mu_F)\alpha_1^F(\hat{n}_L, \hat{c}_F, 0) + \mu_F P(C \mid c_F, \hat{n}_L)\alpha_1^F(\hat{n}_L, \hat{c}_F, C)\right), \tag{20}$$

where, for $s_F \in \{n_F, c_F\}$,

$$\begin{aligned}
P(C \mid s_F, \hat{n}_L) \;&=\; \tfrac{P(s_F|\hat{n}_L,C)P(\hat{n}_L|C)P(C)}{P(s_F|\hat{n}_L,C)P(\hat{n}_L|C)P(C)+P(s_F|\hat{n}_L,N)P(\hat{n}_L|N)P(N)} = \frac{P(s_F|\hat{n}_L,C)}{P(s_F|\hat{n}_L,C)+P(s_F|\hat{n}_L,N)\frac{P(\hat{n}_L|N)}{P(\hat{n}_L|C)}} \\
&=\; \frac{P(s_F|\hat{n}_L,C)}{P(s_F|\hat{n}_L,C)+P(s_F|\hat{n}_L,N)\frac{\alpha_0^L+(1-\alpha_0^L)(\gamma\sigma_n^L(\hat{n})+(1-\gamma)\sigma_c^L(\hat{n}))}{(1-\alpha_0^L)(\gamma\sigma_c^L(\hat{n})+(1-\gamma)\sigma_n^L(\hat{n}))}},
\end{aligned} \tag{21}$$

with

$$\begin{aligned}
P(c_F \mid \hat{n}_L, C) = P(n_F \mid \hat{n}_L, N) = \gamma, \\
P(n_F \mid \hat{n}_L, C) = P(c_F \mid \hat{n}_L, N) = 1-\gamma.
\end{aligned}$$

Similarly, the expected gain to the (normal type) leader from reporting $\hat{n}$ rather than $\hat{c}$, after observing signal $s_L \in \{n_L, c_L\}$:

$$\begin{aligned}
\Delta_{n_L} &= P(\hat{n}_F \mid n_L, \hat{n}_L)\alpha_1^L(\hat{n}_L, \hat{n}_F, 0) + P(\hat{c}_F \mid n_L, \hat{n}_L)\left((1-\mu_F)\alpha_1^L(\hat{n}_L, \hat{c}_F, 0) + \mu_F P(N \mid \hat{n}_L, n_L, \hat{c}_F)\alpha_1^L(\hat{n}_L, \hat{c}_F, N)\right) \\
&\quad - \left((1-\mu_L)\alpha_1^L(\hat{c}_L, 0) + \mu_L P(C \mid n_L)\alpha_1^L(\hat{c}_L, C)\right), \qquad (22) \\
\Delta_{c_L} &= P(\hat{n}_F \mid c_L, \hat{n}_L)\alpha_1^L(\hat{n}_L, \hat{n}_F, 0) + P(\hat{c}_F \mid c_L, \hat{n}_L)\left((1-\mu_F)\alpha_1^L(\hat{n}_L, \hat{c}_F, 0) + \mu_F P(N \mid \hat{n}_L, c_L, \hat{c}_F)\alpha_1^L(\hat{n}_L, \hat{c}_F, N)\right) \\
&\quad - \left((1-\mu_L)\alpha_1^L(\hat{c}_L, 0) + \mu_L P(C \mid c_L)\alpha_1^L(\hat{c}_L, C)\right), \qquad (23)
\end{aligned}$$

where, for $s_L \in \{n_L, c_L\}$,

$$\begin{aligned}
P(\hat{n}_F \mid s_L, \hat{n}_L) &= P(\hat{n}_F \mid s_L, \hat{n}_L, N)P(N \mid s_L) + P(\hat{n}_F \mid s_L, \hat{n}_L, C)P(C \mid s_L) \\
&= \left(\alpha_0^F + (1-\alpha_0^F)\left(\gamma\sigma_n^F(\hat{n}) + (1-\gamma)\sigma_c^F(\hat{n})\right)\right)P(N \mid s_L) \\
&+ (1-\alpha_0^F)\left(\gamma\sigma_c^F(\hat{n}) + (1-\gamma)\sigma_n^F(\hat{n})\right)P(C \mid s_L), \\
P(\hat{c}_F \mid s_L, \hat{n}_L) &= 1 - P(\hat{n}_F \mid s_L, \hat{n}_L) \\
P(N \mid \hat{n}_L, s_L, \hat{c}_F) &= \tfrac{P(\hat{c}_F|\hat{n}_L,s_L,N)P(\hat{n}_L|s_L,N)P(s_L|N)P(N)}{P(\hat{c}_F|\hat{n}_L,s_L,N)P(\hat{n}_L|s_L,N)P(s_L|N)P(N)+P(\hat{c}_F|\hat{n}_L,s_L,C)P(\hat{n}_L|s_L,C)P(s_L|C)P(C)} \\
&= \tfrac{P(s_L|N)}{P(s_L|N)+P(s_L|C)\frac{P(\hat{c}_F|\hat{n}_L,C)}{P(\hat{c}_F|\hat{n}_L,N)}} \\
&= \tfrac{P(s_L|N)}{P(s_L|N)+P(s_L|C)\frac{\alpha_0^F+(1-\alpha_0^F)\left(\gamma\sigma_c^F(\hat{c})+(1-\gamma)\sigma_n^F(\hat{c})\right)}{(1-\alpha_0^F)\left(\gamma\sigma_n^F(\hat{c})+(1-\gamma)\sigma_c^F(\hat{c})\right)}}, \\
P(C \mid c_L) &= P(N \mid n_L) = \gamma, \\
P(C \mid n_L) &= P(N \mid c_L) = 1 - \gamma.
\end{aligned}$$

We are now in position to prove the results of this section. Lemma 1 below is a preliminary result.

Lemma 1. $\Delta_{n_F} > \Delta_{c_F}$ *always holds.*

Proof.

From (19)-(20), it follows that $\Delta_{n_F} > \Delta_{c_F} \iff P(C \mid n_F, \hat{n}_L) < P(C \mid c_F, \hat{n}_L)$.

From (21), it follows that $P(C \mid n_F, \hat{n}_L) < P(C \mid c_F, \hat{n}_L) \iff$

$$\frac{(1-\gamma)}{(1-\gamma)+\gamma\frac{\alpha_0^L+(1-\alpha_0^L)(\gamma\sigma_n^L(\hat{n})+(1-\gamma)\sigma_c^L(\hat{n}))}{(1-\alpha_0^L)(\gamma\sigma_c^L(\hat{n})+(1-\gamma)\sigma_n^L(\hat{n}))}} < \frac{\gamma}{\gamma+(1-\gamma)\frac{\alpha_0^L+(1-\alpha_0^L)(\gamma\sigma_n^L(\hat{n})+(1-\gamma)\sigma_c^L(\hat{n}))}{(1-\alpha_0^L)(\gamma\sigma_c^L(\hat{n})+(1-\gamma)\sigma_n^L(\hat{n}))}} \qquad (24)$$

Let $A = \frac{\alpha_0^L+(1-\alpha_0^L)(\gamma\sigma_n^L(\hat{n})+(1-\gamma)\sigma_c^L(\hat{n}))}{(1-\alpha_0^L)(\gamma\sigma_c^L(\hat{n})+(1-\gamma)\sigma_n^L(\hat{n}))}$. Clearly, $A > 0$. Then (24) can be rewritten as $\frac{(1-\gamma)}{(1-\gamma)+\gamma A} < \frac{\gamma}{\gamma+(1-\gamma)A}$ which always holds for any $A > 0$ because $\gamma > \frac{1}{2}$. ■

Proof of Proposition 2

To prove Proposition 2, it is enough to prove $\Delta_{c_F}\left[\sigma_n^L(\hat{n}) = 1, \sigma_c^L(\hat{c}) = 1, \sigma_n^F(\hat{n}) = 1, \sigma_c^F(\hat{c}) = 1\right] > 0$, which implies that $\sigma_c^F(\hat{c}) = 1$ cannot be part of any equilibrium in which $\sigma_n^L(\hat{n}) = 1$, $\sigma_c^L(\hat{c}) = 1$, and $\sigma_n^F(\hat{n}) = 1$.

From (23) and after some algebra, we obtain:

$$\Delta_{c_F}\left[\sigma_n^L(\hat{n}) = 1, \sigma_c^L(\hat{c}) = 1, \sigma_n^F(\hat{n}) = 1, \sigma_c^F(\hat{c}) = 1\right]$$

$$= \frac{\alpha_0^F}{(1-\alpha_0^F)\left(\frac{(1-\alpha_0^L)(1-\gamma)^2}{(1-\alpha_0^L)\gamma+\alpha_0^L}+\gamma\right)+\alpha_0^F} - \left(\frac{\alpha_0^F\gamma}{((1-\alpha_0^F)\gamma+\alpha_0^F)\left(\frac{(1-\alpha_0^L)\gamma+\alpha_0^L}{1-\alpha_0^L}+\gamma\right)}\mu_F + \frac{\alpha_0^F}{(1-\alpha_0^F)\left(\frac{(1-\alpha_0^L)\gamma+\alpha_0^L}{1-\alpha_0^L}+\gamma\right)+\alpha_0^F}(1-\mu_F)\right).$$

First, we show that:

$$\frac{\alpha_0^F}{(1-\alpha_0^F)\left(\frac{(1-\alpha_0^L)(1-\gamma)^2}{(1-\alpha_0^L)\gamma+\alpha_0^L}+\gamma\right)+\alpha_0^F} > \frac{\alpha_0^F}{(1-\alpha_0^F)\left(\frac{(1-\alpha_0^L)\gamma+\alpha_0^L}{1-\alpha_0^L}+\gamma\right)+\alpha_0^F} \iff \frac{(1-\alpha_0^L)(1-\gamma)^2}{(1-\alpha_0^L)\gamma+\alpha_0^L} < \frac{(1-\alpha_0^L)\gamma+\alpha_0^L}{1-\alpha_0^L}$$

$$\iff \frac{(1-\gamma)^2}{\gamma+\frac{\alpha_0^L}{(1-\alpha_0^L)}} < \gamma + \frac{\alpha_0^L}{(1-\alpha_0^L)} \iff (1-\gamma)^2 < \left(\gamma + \frac{\alpha_0^L}{(1-\alpha_0^L)}\right)^2,$$

which always holds, as $\gamma > \frac{1}{2}$.

Second, we show that:

$$\begin{aligned} & \frac{\alpha_0^F}{(1-\alpha_0^F)\left(\frac{(1-\alpha_0^L)(1-\gamma)^2}{(1-\alpha_0^L)\gamma+\alpha_0^L}+\gamma\right)+\alpha_0^F} > \frac{\alpha_0^F\gamma}{((1-\alpha_0^F)\gamma+\alpha_0^F)\left(\frac{(1-\alpha_0^L)\gamma+\alpha_0^L}{1-\alpha_0^L}+\gamma\right)} \\ \iff \quad & \frac{1}{\gamma\left((1-\alpha_0^F)\left(\frac{(1-\alpha_0^L)(1-\gamma)^2}{(1-\alpha_0^L)\gamma+\alpha_0^L}+\gamma\right)+\alpha_0^F\right)} > \frac{1}{((1-\alpha_0^F)\gamma+\alpha_0^F)\left(\frac{(1-\alpha_0^L)\gamma+\alpha_0^L}{1-\alpha_0^L}+\gamma\right)} \\ \iff \quad & \frac{1}{\gamma(1-\alpha_0^F)\left(\frac{(1-\alpha_0^L)(1-\gamma)^2}{(1-\alpha_0^L)\gamma+\alpha_0^L}+\gamma\right)+\gamma\alpha_0^F} > \frac{1}{((1-\alpha_0^F)\gamma\left(\frac{(1-\alpha_0^L)\gamma+\alpha_0^L}{1-\alpha_0^L}+\gamma\right)+\left(\frac{(1-\alpha_0^L)\gamma+\alpha_0^L}{1-\alpha_0^L}+\gamma\right)\alpha_0^F)}, \end{aligned}$$

which always holds, since $\frac{(1-\alpha_0^L)(1-\gamma)^2}{(1-\alpha_0^L)\gamma+\alpha_0^L} < \frac{(1-\alpha_0^L)\gamma+\alpha_0^L}{1-\alpha_0^L}$, as proved above.

Then, $\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=1,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})=1\right] > 0$. ■

Proof of Proposition 3

To prove Proposition 3, we show that if we conjecture $(\sigma_n^L(\hat{n}),\sigma_c^L(\hat{c});\sigma_n^F(\hat{n}),\sigma_c^F(\hat{c})) = (1,0;1,0)$ then, for the parameter values specified in the statement of the proposition, we have $\Delta_{n_L} > 0$, $\Delta_{c_L} > 0$, $\Delta_{n_F} > 0$ and $\Delta_{c_F} > 0$. This means that for that range of parameters, the conjectured strategy profile is an equilibrium strategy profile.

First, we show that $\Delta_{n_L} > \Delta_{c_L}$ and $\Delta_{c_L} > 0$. From (22)-(23) and after some algebra, we obtain:

$$\begin{aligned} \Delta_{n_L}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})=0\right] &= \frac{\alpha_0^L(\gamma+(1-\alpha_0^F)(1-\gamma))}{(2-\alpha_0^F)(1-\alpha_0^L)+\alpha_0^L} - (1-\gamma)\mu_L + \mu_L - 1, \\ \Delta_{c_L}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})=0\right] &= \frac{\alpha_0^L((1-\alpha_0^F)\gamma+(1-\gamma))}{(2-\alpha_0^F)(1-\alpha_0^L)+\alpha_0^L} - \gamma\mu_L + \mu_L - 1, \end{aligned}$$

where, clearly, $\Delta_{n_L} > \Delta_{c_L}$.

To show $\Delta_{c_L} > 0$, note that:

1. $\Delta_{c_L} = \frac{\alpha_0^L((1-\alpha_0^F)\gamma+(1-\gamma))}{(2-\alpha_0^F)(1-\alpha_0^L)+\alpha_0^L} - \gamma\mu_L + \mu_L - 1 > 0 \iff \mu_L > \frac{\alpha_0^F-\alpha_0^F\alpha_0^L-2+2\alpha_0^L-\alpha_0^F\alpha_0^L\gamma}{\left(\alpha_0^F+\alpha_0^L-\alpha_0^F\alpha_0^L-2\right)(1-\gamma)} = \bar{\mu}_L$,
2. $\bar{\mu}_L = \frac{\alpha_0^F-\alpha_0^F\alpha_0^L-2+2\alpha_0^L-\alpha_0^F\alpha_0^L\gamma}{\left(\alpha_0^F+\alpha_0^L-\alpha_0^F\alpha_0^L-2\right)(1-\gamma)} < 1 \iff \gamma < \frac{\alpha_0^L}{2\alpha_0^F\alpha_0^L-\alpha_0^F-\alpha_0^L+2} = \bar{\gamma}'$,
3. $\bar{\gamma}' = \frac{\alpha_0^L}{2\alpha_0^F\alpha_0^L-\alpha_0^F-\alpha_0^L+2} > \frac{1}{2} \iff \alpha_0^F < \frac{3\alpha_0^L-2}{2\alpha_0^L-1} = \bar{\alpha}_F$ and $\alpha_0^L > \frac{2}{3} = \bar{\alpha}'_L$. In addition, in this case, $\bar{\alpha}_F < \alpha_0^L$ always.

Consequently, $\Delta_{c_L} = \frac{\alpha_0^L((1-\alpha_0^F)\gamma+(1-\gamma))}{(2-\alpha_0^F)(1-\alpha_0^L)+\alpha_0^L} - \gamma\mu_L + \mu_L - 1 > 0$ if and only if $\alpha_0^L > \frac{2}{3}$, $\alpha_0^F < \bar{\alpha}_F$, $\gamma < \bar{\gamma}'$, and $\mu_L > \bar{\mu}_L$.

Second, we note that by Lemma 1, $\Delta_{n_F} > \Delta_{c_F}$. Then, we just have to show that $\Delta_{c_F} > 0$. We do this in Lemma 2 below.

Lemma 2. *There exist* $\bar{\mu}_F < 1$, $\bar{\gamma}'' < \frac{1}{2}$, $\underline{\alpha}_F < \alpha_0^L$, *and* $\bar{\alpha}''_L < 1$ *such that*

$\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})=0\right] > 0$ *if and only if* $\alpha_0^L > \bar{\alpha}''_L$, $\alpha_0^F > \underline{\alpha}_F$, $\gamma < \bar{\gamma}''$, *and* $\mu_F > \bar{\mu}_F$.

Proof.

From (20) and after some algebra, we obtain:

$$\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})=0\right] = \frac{\alpha_0^F}{(1-\alpha_0^F)(2-\alpha_0^L)+\alpha_0^F} + \frac{(1-\gamma)}{1-\alpha_0^L\gamma}\mu_F - 1.$$

It is straightforward to show that

1. $\Delta_{c_F} = \frac{\alpha_0^F}{(1-\alpha_0^F)(2-\alpha_0^L)+\alpha_0^F} + \frac{(1-\gamma)}{1-\alpha_0^L\gamma}\mu_F - 1 > 0 \iff \mu_F > \frac{\left(\alpha_0^F-1\right)\left(\alpha_0^L-2\right)\left(\gamma\alpha_0^L-1\right)}{(1-\gamma)\left(\alpha_0^F+\alpha_0^L-\alpha_0^F\alpha_0^L-2\right)} = \bar{\mu}_F$,
2. $\bar{\mu}_F = \frac{\left(\alpha_0^F-1\right)\left(\alpha_0^L-2\right)\left(\gamma\alpha_0^L-1\right)}{(1-\gamma)\left(\alpha_0^F+\alpha_0^L-\alpha_0^F\alpha_0^L-2\right)} < 1 \iff \gamma < \frac{\alpha_0^F}{2-\alpha_0^F\left(\alpha_0^L\right)^2+3\alpha_0^F\alpha_0^L-\alpha_0^F+\left(\alpha_0^L\right)^2-3\alpha_0^L} = \bar{\gamma}''$,

3. $\bar{\gamma}'' = \frac{\alpha_0^F}{2-\alpha_0^F\left(\alpha_0^L\right)^2+3\alpha_0^F\alpha_0^L-\alpha_0^F+\left(\alpha_0^L\right)^2-3\alpha_0^L} > \frac{1}{2} \iff \alpha_0^F > \frac{\left(\alpha_0^L\right)^2-3\alpha_0^L+2}{\left(\alpha_0^L\right)^2-3\alpha_0^L+3} = \underline{\alpha}_F$,

4. $\bar{\alpha}_F = \frac{\left(\alpha_0^L\right)^2-3\alpha_0^L+2}{\left(\alpha_0^L\right)^2-3\alpha_0^L+3} < \alpha_0^L \iff \alpha_0^L > \bar{\alpha}_L''$,

where $\bar{\alpha}_L'' \simeq 0.67$ is the unique real root of polynomial $\left(\alpha_0^L\right)^3 - 4\left(\alpha_0^L\right)^2 + 6\alpha_0^L - 2$.

Consequently, $\Delta_{cF} = \frac{\alpha_0^F}{(1-\alpha_0^F)(2-\alpha_0^L)+\alpha_0^F} + \frac{(1-\gamma)}{1-\alpha_0^L\gamma}\mu_F - 1 > 0$ if and only if $\alpha_0^L > \bar{\alpha}_L''$, $\alpha_0^F > \underline{\alpha}_F$,$\gamma < \bar{\gamma}''$, and $\mu_F > \bar{\mu}_F$. ♦

To conclude the proof of Proposition 3, we need to show that $\underline{\alpha}_F < \bar{\alpha}_F$. We obtain that:

$$\underline{\alpha}_F < \bar{\alpha}_F \iff \frac{\left(\alpha_0^L\right)^2-3\alpha_0^L+2}{\left(\alpha_0^L\right)^2-3\alpha_0^L+3} < \frac{3\alpha_0^L-2}{2\alpha_0^L-1} \iff \frac{4-\left(\alpha_0^L\right)^3+4\left(\alpha_0^L\right)^2-8\alpha_0^L}{\left(2\alpha_0^L-1\right)\left(3-3\alpha_0^L+\left(\alpha_0^L\right)^2\right)} < 0.$$

This expression holds if either $\alpha_0^L < \frac{1}{2}$ or $\alpha_0^L > \bar{\alpha}_L''' \simeq 0.7$, which is the unique real root of polynomial $4 - \left(\alpha_0^L\right)^3 + 4\left(\alpha_0^L\right)^2 - 8\alpha_0^L$.

Therefore, both $\Delta_{c_L} > 0$ and $\Delta_{cF} > 0$ hold if simultaneously $\alpha_0^L > Max\{\bar{\alpha}_L', \bar{\alpha}_L'', \bar{\alpha}_L'''\} = \bar{\alpha}_L$, $\alpha_0^F \in (\underline{\alpha}_F, \bar{\alpha}_F)$, $\gamma < Min\{\bar{\gamma}', \bar{\gamma}''\} = \bar{\gamma}$, $\mu_L > \bar{\mu}_L$, and $\mu_F > \bar{\mu}_F$. ■

Proof of Proposition 4

We first prove point *1.* of Proposition 4.

To this aim, it is enough to show that $\Delta_{c_F}\left[\sigma_n^L(\hat{n}) = 1, \sigma_c^L(\hat{c}) = 0, \sigma_n^F(\hat{n}) = 1, \sigma_c^F(\hat{c}) = 1\right] > 0$, which implies that $\sigma_c^F(\hat{c}) = 1$ cannot be part of any equilibrium in which $\sigma_n^L(\hat{n}) = 1$, $\sigma_c^L(\hat{c}) = 0$, and $\sigma_n^F(\hat{n}) = 1$.

From (23) and after some algebra, we obtain:

$$\begin{aligned}&\Delta_{c_F}\left[\sigma_n^L(\hat{n}) = 1, \sigma_c^L(\hat{c}) = 0, \sigma_n^F(\hat{n}) = 1, \sigma_c^F(\hat{c}) = 1\right] \\ &= \alpha_0^F\left(\frac{1}{\alpha_0^L(\alpha_0^F(1-\gamma)+\gamma-1)+1} - \frac{(\alpha_0^L-1)\gamma\mu_F}{(\alpha_0^F(1-\gamma)+\gamma)(\alpha_0^L\gamma-1)} + \frac{\alpha_0^L-\alpha_0^L\mu_F+\mu_F-1}{\alpha_0^F\alpha_0^L(\gamma-1)-\alpha_0^L\gamma+1}\right),\end{aligned} \tag{25}$$

which is greater than zero if and only if expression (26) below does:

$$\frac{1}{\alpha_0^L(\alpha_0^F(1-\gamma)+\gamma-1)+1} - \frac{(\alpha_0^L-1)\gamma\mu_F}{(\alpha_0^F(1-\gamma)+\gamma)(\alpha_0^L\gamma-1)} + \frac{\alpha_0^L-\alpha_0^L\mu_F+\mu_F-1}{\alpha_0^F\alpha_0^L(\gamma-1)-\alpha_0^L\gamma+1}. \tag{26}$$

Next, we show that that expression (26) is a linear and increasing function in μ_F, and that it takes a positive value at $\mu_F = 0$. This implies that expression (26) is positive for all μ_F.

First, note that the derivative of (26) with respect to μ_F is

$$\frac{1-\alpha_0^L}{\alpha_0^F\alpha_0^L(\gamma-1)-\alpha_0^L\gamma+1} - \frac{(\alpha_0^L-1)\gamma}{(\alpha_0^F(1-\gamma)+\gamma)(\alpha_0^L\gamma-1)} = \frac{\alpha_0^F(1-\alpha_0^L)(1-\gamma)}{(\alpha_0^F(\gamma-1)-\gamma)(\alpha_0^L\gamma-1)(1-\alpha_0^L\left(\gamma+\alpha_0^F(1-\gamma)\right))} > 0.$$

Second, note that, at $\mu_F = 0$, expression (26) is equal to:

$$\frac{1}{\alpha_0^L(\alpha_0^F(1-\gamma)+\gamma-1)+1} + \frac{1-\alpha_0^L}{\left(\alpha_0^F(1-\gamma)+\gamma\right)\alpha_0^L-1} \tag{27}$$

It is straightforward to show that (27) is decreasing in α_0^F. Thus, if (27) is greater or equal than zero at $\alpha_0^F = 1$, then (27) will be greater than zero for all $\alpha_0^F \in (0,1)$. Note that when $\alpha_0^F = 1$, expression (27) is $\frac{1}{\alpha_0^L((1-\gamma)+\gamma-1)+1} + \frac{1-\alpha_0^L}{((1-\gamma)+\gamma)\alpha_0^L-1} = 1 - 1 = 0$. Therefore, if $\mu_F = 0$, expression (26) is greater than zero, which implies $\Delta_{c_F}\left[\sigma_n^L(\hat{n}) = 1, \sigma_c^L(\hat{c}) = 0, \sigma_n^F(\hat{n}) = 1, \sigma_c^F(\hat{c}) = 1\right] > 0$.

Next, we prove point *2.* of Proposition 4.

First, we focus on the follower' strategy. Lemma 3 below shows that if either $\alpha_0^L < \bar{\alpha}_L''$, $\alpha_0^F < \underline{\alpha}_F$, $\gamma > \bar{\gamma}''$, or $\mu_F < \bar{\mu}_F$, then there exists a unique $0 < \tilde{\sigma}_c^F(\hat{c}) < 1$ such that $\Delta_{c_F}\left[\sigma_n^L(\hat{n}) = 1, \sigma_c^L(\hat{c}) = 0, \sigma_n^F(\hat{n}) = 1, \tilde{\sigma}_c^F(\hat{c})\right] = 0$. In addition, by Lemma 1, $\Delta_{n_F} > \Delta_{c_F}$. The combination of these results say that, necessarily,

$\Delta_{n_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\tilde{\sigma}_c^F(\hat{c})\right] > 0$. Therefore, the follower' strategy $\left(\sigma_n^F(\hat{n}),\sigma_c^F(\hat{c})\right) = (1,\tilde{\sigma}_c^F(\hat{c}))$ can be an equilibrium strategy when the leader's strategy is $\left(\sigma_n^L(\hat{n}),\sigma_c^L(\hat{c})\right)=(1,0)$.

Second, we focus on the leader's strategy. Here we show that there exist $\tilde{\mu}_L<1$, $\tilde{\alpha}_L<1$, $\tilde{\mu}_F>0$, and $\tilde{\alpha}_F>0$, such that, if $\mu_L>\tilde{\mu}_L$, $\alpha_0^L>\tilde{\alpha}_L$, $\mu_F<\tilde{\mu}_F$, and $\alpha_0^F<\tilde{\alpha}_F$, the leader finds it optimal to always take action $\hat{n}$ when the follower's strategy is $\left(\sigma_n^F(\hat{n}),\sigma_c^F(\hat{c}\right)=(1,\tilde{\sigma}_c^F(\hat{c}))$. To show this, it is sufficient to prove that both $\Delta_{n_L}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})\right]$ and $\Delta_{c_L}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\tilde{\sigma}_c^F(\hat{c})\right]$ are greater than zero when $\alpha_0^L=1$, $\alpha_0^F=0$, $\mu_L=1$ and $\mu_F=0$ (because of the continuity of the functions). The following expressions, which come from (22)-(23), prove this statement:

$$\begin{aligned}&\Delta_{n_L}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})\right]|_{\alpha_0^L=1,\alpha_0^F=0\mu_L=1,\mu_F=0}\\&\qquad=(1-\gamma)(\gamma+(1-\gamma)(1-\sigma_c^F(\hat{c})))+\gamma(1-\gamma+\gamma(1-\sigma_c^F(\hat{c}))>0,\\&\Delta_{c_L}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\tilde{\sigma}_c^F(\hat{c})\right]|_{\alpha_0^L=1,\alpha_0^F=0\mu_L=1,\mu_F=0}\\&\qquad=\gamma>0.\end{aligned}$$

Third, consider the strategy profile $\left(\sigma_n^L(\hat{n}),\sigma_c^L(\hat{c});\sigma_n^F(\hat{n}),\sigma_c^F(\hat{c}\right)=(1,0;1,\tilde{\sigma}_c^F(\hat{c}))$. As proved above, if $\mu_L>\tilde{\mu}_L$, $\alpha_0^L>\tilde{\alpha}_L$, $\mu_F<\tilde{\mu}_F$, and $\alpha_0^F<\tilde{\alpha}_F$, the leader does not gain by deviating. Additionally, if either $\alpha_0^L<\bar{\alpha}_L''$, $\alpha_0^F<\underline{\alpha}_F$, $\gamma>\bar{\gamma}''$, or $\mu_F<\bar{\mu}_F$, the follower does neither gain by deviating. Consequently, this strategy profile is an equilibrium strategy profile if $\mu_L>\tilde{\mu}_L$, $\alpha_0^L>\tilde{\alpha}_L$, $\mu_F<Min\{\tilde{\mu}_F,\bar{\mu}_F\}$, and $\alpha_0^F<Min\{\tilde{\alpha}_F,\underline{\alpha}_F\}$, where we denote $\hat{\mu}_L=\tilde{\mu}_L$, $\hat{\alpha}_L=\tilde{\alpha}$, $\hat{\alpha}_F=Min\{\hat{\alpha}_F,\underline{\alpha}_F\}$ and $\hat{\mu}_F=Min\{\hat{\mu}_F,\bar{\mu}_F\}$.

Finally, we prove Lemma 3, which consider thresholds $\bar{\alpha}_L''$, $\underline{\alpha}_F$, $\bar{\gamma}''$, and $\bar{\mu}_F$, from Lemma 2.

Lemma 3. *If either $\alpha_0^L<\bar{\alpha}_L''$, $\alpha_0^F<\underline{\alpha}_F$, $\gamma>\bar{\gamma}''$, or $\mu_F<\bar{\mu}_F$, then there exists a unique $0<\tilde{\sigma}_c^F(\hat{c})<1$ such that $\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\tilde{\sigma}_c^F(\hat{c})\right]=0$.*

Proof.

First, we show that $\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})\right]$ is increasing in $\sigma_c^F(\hat{c})$. From (20) and after some algebra, we obtain:

$$\begin{aligned}&\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})\right]\\&=\alpha_0^F\left(\tfrac{(\alpha_0^L-1)\gamma\mu_F}{(\alpha_0^L\gamma-1)((\alpha_0^F-1)\gamma\sigma_c^F(\hat{c})-\alpha_0^F)}+\tfrac{\alpha_0^L(1-\mu_F)+\mu_F-1}{(\alpha_0^F-1)\sigma_c^F(\hat{c})(\alpha_0^L\gamma-1)-\alpha_0^F\alpha_0^L+\alpha_0^F}-\tfrac{1}{(\alpha_0^F-1)\sigma_c^F(\hat{c})(\alpha_0^L\gamma-1)-\alpha_0^F\alpha_0^L+\alpha_0^F+\alpha_0^L-2}\right),\end{aligned}$$

with

$$\begin{aligned}&\tfrac{\partial\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})\right]}{\partial\sigma_c^F(\hat{c})}\\&=\tfrac{(1-\alpha_0^F)(1-\alpha_0^L)\gamma^2\mu_F}{(1-\alpha_0^L\gamma)((\alpha_0^F-1)\gamma\sigma_c^F(\hat{c})-\alpha_0^F)^2}+\tfrac{(1-\alpha_0^F)(1-\alpha_0^L\gamma)(1-\alpha_0^L(1-\mu_F)-\mu_F)}{((\alpha_0^F-1)\sigma_c^F(\hat{c})(\alpha_0^L\gamma-1)-\alpha_0^F\alpha_0^L+\alpha_0^F)^2}+\tfrac{(1-\alpha_0^F)(1-\alpha_0^L\gamma)}{((\alpha_0^F-1)\sigma_c^F(\hat{c})(\alpha_0^L\gamma-1)-\alpha_0^F\alpha_0^L+\alpha_0^F+\alpha_0^L-2)^2}>0.\end{aligned}$$

Second, as point *1.* of Proposition 4 shows, $\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})=1\right]>0$.

Finally, from Lemma 2, it follows that $\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})=0\right]<0$ if and only if either $\alpha_0^L<\bar{\alpha}_L''$, $\alpha_0^F<\underline{\alpha}_F$, $\gamma>\bar{\gamma}''$, or $\mu_F<\bar{\mu}_F$. Consequently, if one of these conditions hold, then $\Delta_{c_F}\left[\sigma_n^L(\hat{n})=1,\sigma_c^L(\hat{c})=0,\sigma_n^F(\hat{n})=1,\sigma_c^F(\hat{c})\right]$ has an only root in the interval $(0,1)$. ♦

Let $\tilde{\sigma}_c^F(\hat{c})=x$. This completes the proof of Proposition 4. ■

A.4 Competition: A model of simultaneous competition

First, we describe how we obtain the posterior probability $\alpha_1^i(r_i,r_j,X)$ that the consumers place on media firm i being a high type, given report $r_i\in\{\hat{n}_i,\hat{c}_i\}$ when $X=0$, with $i,j\in\{1,2\}$ and $i\neq j$. Remember that we denote by H a high type firm and by L a normal type firm.

We start noting that in the case there is feedback, X is sufficient. Thus, expressions (9)-(10) define beliefs $\alpha_1^i(\hat{c}_i,N)$ and $\alpha_1^i(\hat{c}_i,C)$, respectively; and expressions (11) and (12) define beliefs $\alpha_1^i(\hat{n}_i,N)$ and $\alpha_1^i(\hat{n}_i,C)$, respectively; all with the corresponding super/subscript.

For the case without feedback, note that when competition is simultaneous, firms make decisions without knowing what report the competitor will publish. This is also the case when competition is sequential and we focus on the decision of the leader of publishing $r_L = \hat{n}$. In this case, the leader, when making a decision, neither knows what report the follower will publish. This means that, from the point of view of the consumers, the derivation of the beliefs about the types of the firms in the present case is analogous to the derivation of the beliefs about the type of the leader when the latter reports $r_L = \hat{n}$. Hence, the analysis in Appendix A.3. for the leader firm, gives us the general expressions:

$$\begin{aligned}
\alpha_1^i(\hat{n}_i, r_j, 0) &= \frac{P(H_i)}{P(H_i)+P(L_i)\left(P(\hat{n}_i|L_i,N)+P(\hat{n}_i|L_i,C)\frac{P(r_j|C)}{P(r_j|N)}\right)},\\
\alpha_1^i(\hat{c}_i, r_j, 0) &= \frac{P(H_i)}{P(H_i)+P(L_i)\left(P(\hat{c}_i|L_i,C)+P(\hat{c}_i|L_i,N)\frac{P(r_j|N)}{P(r_j|C)}\right)}.
\end{aligned}$$

from where, substituting, we get the following beliefs:[33]

$$\begin{aligned}
\alpha_1^i(\hat{c}_i, \hat{c}_j, 0) &= \frac{\alpha_0}{\alpha_0+(1-\alpha_0)\left(\gamma\sigma_c^i(\hat{c})+(1-\gamma)\sigma_n^i(\hat{c})+(\gamma\sigma_n^i(\hat{c})+(1-\gamma)\sigma_c^i(\hat{c}))\frac{(1-\alpha_0)(\gamma\sigma_n^j(\hat{c})+(1-\gamma)\sigma_c^j(\hat{c}))}{\alpha_0+(1-\alpha_0)(\gamma\sigma_c^j(\hat{c})+(1-\gamma)\sigma_n^j(\hat{c}))}\right)},\\
\alpha_1^i(\hat{c}_i, \hat{n}_j, 0) &= \frac{\alpha_0}{\alpha_0+(1-\alpha_0)\left(\gamma\sigma_c^i(\hat{c})+(1-\gamma)\sigma_n^i(\hat{c})+(\gamma\sigma_n^i(\hat{c})+(1-\gamma)\sigma_c^i(\hat{c}))\frac{\alpha_0+(1-\alpha_0)(\gamma\sigma_n^j(\hat{n})+(1-\gamma)\sigma_c^j(\hat{n}))}{(1-\alpha_0)(\gamma\sigma_c^j(\hat{n})+(1-\gamma)\sigma_n^j(\hat{n}))}\right)},\\
\alpha_1^i(\hat{n}_i, \hat{n}_j, 0) &= \frac{\alpha_0}{\alpha_0+(1-\alpha_0)\left(\gamma\sigma_n^i(\hat{n})+(1-\gamma)\sigma_c^i(\hat{n})+(\gamma\sigma_c^i(\hat{n})+(1-\gamma)\sigma_n^i(\hat{n}))\frac{(1-\alpha_0)(\gamma\sigma_c^j(\hat{n})+(1-\gamma)\sigma_n^j(\hat{n}))}{\alpha_0+(1-\alpha_0)(\gamma\sigma_n^j(\hat{n})+(1-\gamma)\sigma_c^j(\hat{n}))}\right)},\\
\alpha_1^i(\hat{n}_i, \hat{c}_j, 0) &= \frac{\alpha_0}{\alpha_0+(1-\alpha_0)\left(\gamma\sigma_n^i(\hat{n})+(1-\gamma)\sigma_c^i(\hat{n})+(\gamma\sigma_c^i(\hat{n})+(1-\gamma)\sigma_n^i(\hat{n}))\frac{\alpha_0+(1-\alpha_0)(\gamma\sigma_c^j(\hat{c})+(1-\gamma)\sigma_n^j(\hat{c}))}{(1-\alpha_0)(\gamma\sigma_n^j(\hat{c})+(1-\gamma)\sigma_c^j(\hat{c}))}\right)},
\end{aligned}$$

where beliefs $\alpha_1^i(\hat{n}_i, \hat{n}_j, 0)$, $\alpha_1^i(\hat{n}_i, \hat{c}_j, 0)$ and $\alpha_1^i(\hat{c}_i, \hat{n}_j, 0)$ above coincide with beliefs (13)-(14) and (18), respectively, with $L = i$ and $F = j$ in expressions (13)-(14) and $F = i$ and $L = j$ in expression (18). Note also that $\alpha_1^i(\hat{c}_i, C) > \alpha_1^i(\hat{c}_i, r_j, 0) > \alpha_1^i(\hat{c}_i, N)$ and $\alpha_1^i(\hat{n}_i, N) > \alpha_1^i(\hat{n}_i, r_j, 0) > \alpha_1^i(\hat{n}_i, C)$, with $r_j \in \{\hat{n}_j, \hat{c}_j\}$.

Next, we obtain the expected gain to a (normal type) firm $i \in \{1, 2\}$ from reporting $\hat{n}$ rather than $\hat{c}$, after observing signal $s_i \in \{n_i, c_i\}$:

$$\begin{aligned}
\Delta_{n_i} &= P(\hat{n}_j \mid n_i)(\alpha_1^i(\hat{n}_i, \hat{n}_j, 0) - ((1-\mu_I)\alpha_1^i(\hat{c}_i, \hat{n}_j, 0) + \mu_I P(C \mid n_i, \hat{n}_j)\alpha_1^i(\hat{c}_i, \hat{n}_j, C)))\\
&+ P(\hat{c}_j \mid n_i)((1-\mu_I)\alpha_1^i(\hat{n}_i, \hat{c}_j, 0) + \mu_I P(N \mid n_i, \hat{c}_j)\alpha_1^i(\hat{n}_i, \hat{c}_j, N))\\
&- P(\hat{c}_j \mid n_i)((1-\mu_J)\alpha_1^i(\hat{c}_i, \hat{c}_j, 0) + \mu_J P(C \mid n_i, \hat{c}_j)\alpha_1^i(\hat{c}_i, \hat{c}_j, C)), \qquad (28)\\
\Delta_{c_i} &= P(\hat{n}_j \mid c_i)(\alpha_1^i(\hat{n}_i, \hat{n}_j, 0) - ((1-\mu_I)\alpha_1^i(\hat{c}_i, \hat{n}_j, 0) + \mu_I P(C \mid c_i, \hat{n}_j)\alpha_1^i(\hat{c}_i, \hat{n}_j, C)))\\
&+ P(\hat{c}_j \mid c_i)((1-\mu_I)\alpha_1^i(\hat{n}_i, \hat{c}_j, 0) + \mu_I P(N \mid c_i, \hat{c}_j)\alpha_1^i(\hat{n}_i, \hat{c}_j, N))\\
&- P(\hat{c}_j \mid c_i)((1-\mu_J)\alpha_1^i(\hat{c}_i, \hat{c}_j, 0) + \mu_J P(C \mid c_i, \hat{c}_j)\alpha_1^i(\hat{c}_i, \hat{c}_j, C)). \qquad (29)
\end{aligned}$$

with

$$\begin{aligned}
&P(\hat{n}_j \mid n_i) = (1-\alpha_0)(\gamma\sigma_c^j(\hat{n}) + (1-\gamma)\sigma_n^j(\hat{n}))(1-\gamma) + (\alpha_0 + (1-\alpha_0)(\gamma\sigma_n^j(\hat{n}) + (1-\gamma)\sigma_c^j(\hat{n})))\gamma,\\
&P(\hat{n}_j \mid c_i) = (1-\alpha_0)(\gamma\sigma_c^j(\hat{n}) + (1-\gamma)\sigma_n^j(\hat{n}))\gamma + (\alpha_0 + (1-\alpha_0)(\gamma\sigma_n^j(\hat{n}) + (1-\gamma)\sigma_c^j(\hat{n})))(1-\gamma),\\
&P(\hat{c}_j \mid n_i) = 1 - P(\hat{n}_j \mid n_i),\\
&P(\hat{c}_j \mid c_i) = 1 - P(\hat{n}_j \mid c_i),
\end{aligned}$$

and, for $s_i \in \{n_i, c_i\}$,

$$\begin{aligned}
P(C \mid s_i, \hat{n}_j) &= \frac{P(s_i|C)}{P(s_i|C)+P(s_i|N)\frac{\alpha_0+(1-\alpha_0)(\gamma\sigma_n^j(\hat{n})+(1-\gamma)\sigma_c^j(\hat{n}))}{(1-\alpha_0)(\gamma\sigma_c^j(\hat{n})+(1-\gamma)\sigma_n^j(\hat{n}))}},\\
P(N \mid s_i, \hat{c}_j) &= \frac{P(s_i|N)}{P(s_i|N)+P(s_i|C)\frac{\alpha_0+(1-\alpha_0)(\gamma\sigma_c^j(\hat{c})+(1-\gamma)\sigma_n^j(\hat{c}))}{(1-\alpha_0)(\gamma\sigma_n^j(\hat{c})+(1-\gamma)\sigma_c^j(\hat{c}))}},\\
P(C \mid s_i, \hat{c}_j) &= \frac{P(s_i|C)}{P(s_i|C)+P(s_i|N)\frac{(1-\alpha_0)(\gamma\sigma_n^j(\hat{c})+(1-\gamma)\sigma_c^j(\hat{c}))}{\alpha_0+(1-\alpha_0)(\gamma\sigma_c^j(\hat{c})+(1-\gamma)\sigma_n^j(\hat{c}))}}.
\end{aligned}$$

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[33] The reader interested in a more detailed derivation of the beliefs can consult the working paper version of this work (Andina-Díaz and García-Martínez (2018)).

We are now in position to prove the results of this section.

***Proof of Proposition* 5**

First, we prove point *1.* of Proposition 5.

From (28),

$$\begin{aligned}
&\Delta_{n_i}[\sigma_n^1(\hat{n})=1,\sigma_c^1(\hat{c})=1,\sigma_n^2(\hat{n})=1,\sigma_c^2(\hat{c})=1]\\
&=\tfrac{\alpha\left(2\alpha^3(\gamma-1)^3\mu_J+2\alpha^2(2\gamma-1)(\gamma-1)^2(\mu_I-2\mu_J+2)-2\alpha(\gamma-1)((\gamma-1)\gamma(4\mu_I-5\mu_J+8)+\mu_I-\mu_J+2)+(2\gamma-1)(2(\gamma-1)\gamma(\mu_I-\mu_J+2)+\mu_I+1)\right)}{2(\gamma-\alpha(1-\gamma))(2\alpha^2(\gamma-1)^2+\alpha(6\gamma-4\gamma^2-2)+1+2\gamma(\gamma-1))}\\
&=\tfrac{\alpha N_n(\gamma,\mu_I,\mu_J,\alpha)}{D(\gamma,\alpha)},
\end{aligned}$$

with $D(\gamma,\alpha)>0$.

Thus, $\Delta_{n_i}[\sigma_n^1(\hat{n})=1,\sigma_c^1(\hat{c})=1,\sigma_n^2(\hat{n})=1,\sigma_c^2(\hat{c})=1]>0 \iff N_n(\gamma,\mu_I,\mu_J,\alpha)>0$.

After some algebra it can be shown that $\frac{\partial N_n(\gamma,\mu_I,\mu_J,\alpha)}{\partial\gamma}>0$. Consequently, $N_n(\gamma,\mu_I,\mu_J,\alpha)>0 \iff N_n(\gamma=\frac{1}{2},\mu_I,\mu_J,\alpha)>0$. Since $N_n(\gamma=\frac{1}{2},\mu_I,\mu_J,\alpha)=\frac{1}{4}\alpha\mu_J\left(1-\alpha^2\right)>0$, then $\Delta_{n_i}[\sigma_n^1(\hat{n})=1,\sigma_c^1(\hat{c})=1,\sigma_n^2(\hat{n})=1,\sigma_c^2(\hat{c})=1]>0$.

Now from (29),

$$\begin{aligned}
&\Delta_{c_i}[\sigma_n^1(\hat{n})=1,\sigma_c^1(\hat{c})=1,\sigma_n^2(\hat{n})=1,\sigma_c^2(\hat{c})=1]\\
&=\tfrac{\alpha\left(2\alpha^3(\gamma-1)^3\mu_J-2\alpha^2(2\gamma-1)(\gamma-1)^2(\mu_I+\mu_J+2)+2\alpha(\gamma-1)((\gamma-1)\gamma(4\mu_I+\mu_J+8)+\mu_I+2)-(2\gamma-1)(2(\gamma-1)\gamma(\mu_I+2)+\mu_I+1)\right)}{2(\gamma-\alpha(1-\gamma))(2\alpha^2(\gamma-1)^2+\alpha(6\gamma-4\gamma^2-2)+1+2\gamma(\gamma-1))}\\
&=\tfrac{\alpha N_c(\gamma,\mu_I,\mu_J,\alpha)}{D(\gamma,\alpha)},
\end{aligned}$$

with $D(\gamma,\alpha)>0$.

Thus $\Delta_{c_i}[\sigma_n^1(\hat{n})=1,\sigma_c^1(\hat{c})=1,\sigma_n^2(\hat{n})=1,\sigma_c^2(\hat{c})=1]<0 \iff N_c(\gamma,\mu_I,\mu_J,\alpha)<0$.

Now, if we write $N_c(\gamma,\mu_I,\mu_J,\alpha)$ in terms of γ, we get the next polynomial:

$$\begin{aligned}
&\gamma^3\left(2(\alpha-1)^2(\alpha\mu_J-2\mu_I-4)\right)+\gamma^2(2(\alpha-1)((5\alpha-3)(\mu_I+2)+\alpha(2-3\alpha)\mu_J))\\
&+\gamma\left(2\left(\alpha\left(3\alpha^2\mu_J-4\alpha(\mu_I+\mu_J+2)+5\mu_I+\mu_J+10\right)-2\mu_I-3\right)\right)\\
&-2(\alpha-1)\alpha(\alpha\mu_J-\mu_I-2)+\mu_I+1.
\end{aligned}\tag{30}$$

After some algebra, it can be shown that $\frac{\partial N_c(\gamma,\mu_I,\mu_J,\alpha)}{\partial\gamma}<0$.

In addition, $N_c(\gamma=\frac{1}{2},\mu_I,\mu_J,\alpha)=\frac{1}{4}\alpha\mu_J\left(1-\alpha^2\right)>0$ and $N_c(\gamma=1,\mu_I,\mu_J,\alpha)=-1-\mu_2<0$. Thus, there exists $\frac{1}{2}<\tilde{\gamma}<1$ such that if $\gamma<\tilde{\gamma}$, then $\Delta_{c_i}[\sigma_n^1(\hat{n})=1,\sigma_c^1(\hat{c})=1,\sigma_n^2(\hat{n})=1,\sigma_c^2(\hat{c})=1]>0$, and if $\gamma>\tilde{\gamma}$, then $\Delta_{c_i}[\sigma_n^1(\hat{n})=1,\sigma_c^1(\hat{c})=1,\sigma_n^2(\hat{n})=1,\sigma_c^2(\hat{c})=1]<0$, where $\tilde{\gamma}$ is the unique real root of expression (30).

Next, we prove point *2.* of Proposition 5.

Note that, from (29),

$$\Delta_{c_i}[\sigma_n^1(\hat{n})=1,\sigma_c^1(\hat{c})=0,\sigma_n^2(\hat{n})=1,\sigma_c^2(\hat{c})=0]=-\tfrac{2+\alpha((1+\gamma)\alpha-3)}{2+(\alpha-2)\alpha}-\gamma\mu_I+\mu_I<0.$$

Consequently, reporting $\hat{n}$ after signal c cannot be part of an equilibrium. ■

***Proof of Corollary* 2**

First, we prove point *1.* of Corollary 2.

From the proof of Proposition 5, the unique real root of $N_c(\gamma,\mu_I,\mu_I,\alpha)$ in γ is $\tilde{\gamma}$. Also, from this proof, $\frac{\partial N_c(\gamma,\mu_I,\mu_J,\alpha)}{\partial\gamma}<0$. Additionally, we can show that:

$$\tfrac{\partial N_c(\gamma,\mu_I,\mu_J,\alpha)}{\partial\mu_I}=-2\alpha^2(2\gamma-1)(\gamma-1)^2+2\alpha(1-2\gamma)^2(\gamma-1)-2\gamma(\gamma(2\gamma-3)+2)+1<0.$$

Then, by the Implicit Function Theorem, $\frac{\partial\tilde{\gamma}}{\partial\mu_I}=-\frac{\frac{\partial N_c(\gamma,\mu_I,\mu_J,\alpha)}{\partial\mu_I}}{\frac{\partial N_c(\gamma,\mu_I,\mu_J,\alpha)}{\partial\gamma}}<0$.

Analogously, $\frac{\partial N_c(\gamma,\mu_I,\mu_I,\alpha)}{\partial \mu_J} = 2(\alpha-1)\alpha(\gamma-1)^2(\alpha(\gamma-1)-\gamma) > 0$. Thus $\frac{\partial \tilde{\gamma}}{\partial \mu_J} = -\frac{\frac{\partial N_c(\gamma,\mu_I,\mu_J,\alpha)}{\partial \mu_J}}{\frac{\partial N_c(\gamma,\mu_I,\mu_J,\alpha)}{\partial \gamma}} > 0$.

Second, we prove point *2.* of Corollary 2.

From the proof of Proposition 5 we know that:

1. $\Delta_{n_i}[\sigma_n^1(\hat{n}) = 1, \sigma_c^1(\hat{c}) = 1, \sigma_n^2(\hat{n}) = 1, \sigma_c^2(\hat{c}) = 1] > 0$,
2. $\Delta_{c_i}[\sigma_n^1(\hat{n}) = 1, \sigma_c^1(\hat{c}) = 1, \sigma_n^2(\hat{n}) = 1, \sigma_c^2(\hat{c}) = 1] < 0 \iff N_c(\gamma, \mu_I, \mu_J, \alpha) < 0$,
3. $\frac{\partial N_c(\gamma,\mu_I,\mu_J,\alpha)}{\partial \gamma} < 0$, and $N_c(\gamma = \frac{1}{2}, \mu_I, \mu_J, \alpha) = \frac{1}{4}\alpha\mu_J\left(1-\alpha^2\right)$.

Consequently, $N_c(\gamma = \frac{1}{2}, \mu_I = 0, \mu_J = 0, \alpha) = 0$, which implies that if $\mu_J = 0$, then $N_c(\gamma, \mu_I = 0, \mu_J = 0, \alpha) < 0$ for any $\gamma > \frac{1}{2}$. Therefore $\sigma_c^i(\hat{c})^* = \sigma_n^i(\hat{n})^* = 1$ for $i \in \{1,2\}$ is always an equilibrium strategy when $\mu_J = 0$. ■

***Proof of Corollary* 3**

By Proposition 5, for any $0 < \mu_I < \mu_J < 1$, there exists $\frac{1}{2} < \tilde{\gamma}(\alpha, \mu_I, \mu_J) < 1$, such that, $\sigma_c^i(\hat{c})^* = \sigma_n^i(\hat{n})^* = 1$ for $i \in \{1,2\}$ is equilibrium strategy if and only if $\gamma > \tilde{\gamma}(\alpha, \mu_I, \mu_J)$.

For any $\gamma' < \tilde{\gamma}^{Max}$, there exists a $0 < \hat{\mu}_I < \hat{\mu}_J < 1$ such that $\tilde{\gamma}(\alpha, \hat{\mu}_I, \hat{\mu}_I) = \gamma'$. As $\frac{\partial \tilde{\gamma}}{\partial \mu_I} < 0$ and $\frac{\partial \tilde{\gamma}}{\partial \mu_J} > 0$, if $\mu_I < \hat{\mu}_I$ and $\mu_J > \hat{\mu}_J$, then $\gamma' < \tilde{\gamma}(\alpha, \mu_I, \mu_I)$, which implies that $\sigma_c^i(\hat{c})^* = \sigma_n^i(\hat{n})^* = 1$ for $i \in \{1,2\}$ is not an equilibrium strategy. In addition, if $\mu_I > \hat{\mu}_I$ and $\mu_J < \hat{\mu}_J$, then $\gamma' > \tilde{\gamma}(\alpha, \mu_I, \mu_I)$, which implies that $\sigma_c^i(\hat{c})^* = \sigma_n^i(\hat{n})^* = 1$ for $i \in \{1,2\}$ is an equilibrium strategy. ■

A.5 Extension: Feedback power

In this section, the expected gain to a monopoly for reporting $\hat{n}$ rather than $\hat{c}$ after signal $s \in \{n, c\}$:

$$\Delta_n = (1-\mu^e)\alpha_1(\hat{n},0) + \mu^e\gamma\alpha_1(\hat{n},N) - ((1-\mu_M^e)\alpha_1(\hat{c},0) + \mu_M^e(1-\gamma)\alpha_1(\hat{c},C)), \tag{31}$$

$$\Delta_c = (1-\mu^e)\alpha_1(\hat{n},0) + \mu^e(1-\gamma)\alpha_1(\hat{n},N) - ((1-\mu_M^e)\alpha_1(\hat{c},0) + \mu_M^e\gamma\alpha_1(\hat{c},C)), \tag{32}$$

with beliefs given by (1)-(4) and (11)-(12), without the super/subscript L.

Proof of Proposition 6

The Proposition is proven through three Lemmas.

Lemma 4. *If* $0 < \mu^e < \mu_M^e < 1$*, then* $\Delta_n > \Delta_c$.

Proof.

$\Delta_n > \Delta_c \iff (1-\mu^e)\alpha_1(\hat{n},0) + \mu^e\gamma\alpha_1(\hat{n},N) - ((1-\mu_M^e)\alpha_1(\hat{c},0) + \mu_M^e(1-\gamma)\alpha_1(\hat{c},C)) >$
$(1-\mu^e)\alpha_1(\hat{n},0) + \mu^e(1-\gamma)\alpha_1(\hat{n},N) - ((1-\mu_M^e)\alpha_1(\hat{c},0) + \mu_M^e\gamma\alpha_1(\hat{c},C))$
$\iff \mu^e\alpha_1(\hat{n},N)(2\gamma-1) > \mu_M^e\alpha_1(\hat{c},C)(1-2\gamma)$.

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

Lemma 5. *If* $0 < \mu^e < \mu_M^e < 1$ *and* $\sigma_c(\hat{c}) = 1$*, then* $\Delta_n > 0$.

Proof.

$\Delta_n\left[\sigma_c(\hat{c}) = 1\right] = \frac{(1-\mu^e)\alpha_0}{\alpha_0+(1-\alpha_0)\sigma_n(\hat{n})} + \frac{\mu^e\gamma\alpha_0}{\alpha_0+(1-\alpha_0)\gamma\sigma_n(\hat{n})} - (\frac{(1-\mu_M^e)\alpha_0}{\alpha_0+(1-\alpha_0)(1+\sigma_n(\hat{c}))} + \frac{\mu_M^e(1-\gamma)\alpha_0}{\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_n(\hat{c}))})$.

Now, we define $T = \frac{(1-\mu^e)\alpha_0}{\alpha_0+(1-\alpha_0)\sigma_n(\hat{n})} + \frac{\mu^e\gamma\alpha_0}{\alpha_0+(1-\alpha_0)\gamma\sigma_n(\hat{n})}$. Note that, as $\frac{\partial T}{\partial \mu^e} < 0$, then $\frac{\partial \Delta_n[\sigma_c(\hat{c})=1]}{\partial \mu^e} < 0$. Consequently, as $\mu^e \in (0, \mu_M^e)$, to show that $\Delta_n\left[\sigma_c(\hat{c}) = 1\right] > 0$, it is sufficient to prove that $\Delta_n\left[\sigma_c(\hat{c}) = 1; \mu^e = \mu_M^e\right] > 0$, where

$\Delta_n\left[\sigma_c(\hat{c}) = 1; \mu^e = \mu_M^e\right] = \frac{(1-\mu_M^e)\alpha_0}{\alpha_0+(1-\alpha_0)\sigma_n(\hat{n})} + \frac{\mu_M^e\gamma\alpha_0}{\alpha_0+(1-\alpha_0)\gamma\sigma_n(\hat{n})} - (\frac{(1-\mu_M^e)\alpha_0}{\alpha_0+(1-\alpha_0)(1+\sigma_n(\hat{c}))} + \frac{\mu_M^e(1-\gamma)\alpha_0}{\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_n(\hat{c}))})$.

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 $\frac{(1-\mu^e_M)\alpha_0}{\alpha_0+(1-\alpha_0)\sigma_n(\hat{n})} > \frac{(1-\mu^e_M)\alpha_0}{\alpha_0+(1-\alpha_0)(1+\sigma_n(\hat{c}))}$ and $\frac{\mu^e_M\gamma\alpha_0}{\alpha_0+(1-\alpha_0)\gamma\sigma_n(\hat{n})} > \frac{\mu^e_M(1-\gamma)\alpha_0}{\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_n(\hat{c}))}$. 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 4, configurations 5, 6, 8 and 9 cannot be. Similarly, from Lemma 5, configurations 4 and 7 can neither be. Consequently, $\sigma_n(\hat{n})^* = 1$. Then, taking into account the restriction imposed by Lemma 4, 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 type firm proceeds when it observes signal c. The function Δ_c defined in (32) with $\sigma_n(\hat{n})^* = 1$ is

$$\Delta_c[\sigma_n(\hat{n})^* = 1] = \frac{(1-\mu^e)\alpha_0}{\alpha_0+(1-\alpha_0)(\sigma_c(\hat{n})+1)} + \frac{\mu^e(1-\gamma)\alpha_0}{\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_c(\hat{n}))} - \left(\frac{(1-\mu^e_M)\alpha_0}{\alpha_0+(1-\alpha_0)\sigma_c(\hat{c})} + \frac{\mu^e_M\gamma\alpha_0}{\alpha_0+(1-\alpha_0)\gamma\sigma_c(\hat{c})}\right). \tag{33}$$

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

$$\begin{aligned}
&\Delta_c[\sigma_n(\hat{n})^* = 1, \sigma_c(\hat{n})^* = 0] = (1-\mu^e)\alpha_0 + \frac{\mu^e(1-\gamma)\alpha_0}{\alpha_0+(1-\alpha_0)\gamma} - \left((1-\mu^e_M)\alpha_0 + \frac{\mu^e_M\gamma\alpha_0}{\alpha_0+(1-\alpha_0)\gamma}\right)\\
&= \frac{(1-\mu^e)\alpha_0(\alpha_0+(1-\alpha_0)\gamma)+\mu^e(1-\gamma)\alpha_0-(1-\mu^e_M)\alpha_0(\alpha_0+(1-\alpha_0)\gamma)-\mu^e_M\gamma\alpha_0}{\alpha_0+(1-\alpha_0)\gamma}\\
&= \frac{\alpha_0^2(\mu^e_M-\mu^e)+\alpha_0(1-\alpha_0)\gamma(\mu^e_M-\mu^e)+\alpha_0(\mu^e(1-\gamma)-\mu^e_M\gamma)}{\alpha_0+(1-\alpha_0)\gamma}\\
&= \alpha_0(\mu^e_M-\mu^e) + \frac{\alpha_0(\mu^e(1-\gamma)-\mu^e_M\gamma)}{\alpha_0+(1-\alpha_0)\gamma} > 0 \Leftrightarrow \gamma < \frac{\mu^e+\alpha_0(\mu^e_M-\mu^e)}{2\mu^e+\alpha_0(\mu^e_M-\mu^e)}.
\end{aligned}$$

Let $\overline{\gamma}^e = \frac{\mu^e+\alpha_0(\mu^e_M-\mu^e)}{2\mu^e+\alpha_0(\mu^e_M-\mu^e)}$, where it is straightforward to show that $\overline{\gamma}^e \in (0,1)$. Hence, in equilibrium, $\sigma_c(\hat{n})^* > 0$ for $\gamma < \overline{\gamma}^e \in (0,1)$, and $\sigma_c(\hat{c})^* = 1$ for $\gamma > \overline{\gamma}^e$.

Now, we obtain the threshold for complete silence, i.e., $\sigma_c(\hat{n})^* = 1$.

To this aim $\Delta_c[\sigma_n(\hat{n})^* = 1, \sigma_c(\hat{n})^* = 1] = \frac{(1-\mu^e)\alpha_0}{\alpha_0+(1-\alpha_0)2} + \frac{\mu^e(1-\gamma)\alpha_0}{\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma))} - ((1-\mu^e_M)+\mu^e_M\gamma) > 0$,

$\iff \gamma < \frac{\alpha_0\mu^e+\mu^e_M+\frac{\alpha_0(1-\mu^e)}{2-\alpha_0}-1}{\alpha_0\mu^e+\mu^e_M}$

Let $\underline{\gamma} = \frac{\alpha_0\mu^e+\mu^e_M+\frac{\alpha_0(1-\mu^e)}{2-\alpha_0}-1}{\alpha_0\mu^e+\mu^e_M}$, where it is straightforward to show that:

1. $\underline{\gamma} < \overline{\gamma}^e < 1$,
2. $\frac{1}{2} > \underline{\gamma} \iff \alpha_0 > \frac{4-\mu^e_M-\sqrt{\left(\mu^e_M-4\right)^2+8\left(\mu^e_M-2\right)\mu^e}}{2\mu^e}$,

Let $\overline{\alpha}_0 = \frac{4-\mu^e_M-\sqrt{\left(\mu^e_M-4\right)^2+8\left(\mu^e_M-2\right)\mu^e}}{2\mu^e}$.

To conclude, note that function $\Delta_c[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c})]$ is strictly increasing in $\sigma_c(\hat{c})$,

$$\frac{\partial\Delta_c[\sigma_c(\hat{c}),\sigma_n(\hat{n})=1]}{\partial\sigma_c(\hat{c})} = \frac{\alpha_0(1-\alpha_0)(1-\mu^e)}{(\alpha_0+(1-\alpha_0)\sigma_c(\hat{c})-2)^2} + \frac{\alpha_0\mu^e(1-\alpha_0)(1-\gamma)^2}{((\gamma+(1-\gamma)\alpha_0-1)\sigma_c(\hat{c})+1)^2} + \frac{\alpha_0(1-\mu^e_M)(1-\alpha_0)}{(\alpha_0+(1-\alpha_0)\sigma_c(\hat{c}))^2} + \frac{\alpha_0\gamma^2(1-\alpha_0)\mu^e_M}{(\alpha_0+(1-\alpha_0)\gamma\sigma_c(\hat{c}))^2} > 0. \tag{34}$$

Then, there is only one equilibrium. Now, if $\gamma \geq \overline{\gamma}^e$, there is only one equilibrium in which $\sigma_c(\hat{c})^* = 1$. On the other hand, if $\gamma < \overline{\gamma}^e$, in the unique equilibrium $\sigma_c(\hat{c})^*$ is either 0 or the root of equation $\Delta_c\left[\sigma_c(\hat{c}), \sigma_n(\hat{n}) = 1\right] = 0$ in the interval (0,1). Let $\tilde{x}_3$ be that root. Then, we have the following situations. First, if $\alpha_0 \leq \overline{\alpha}_0$, then $\underline{\gamma} \leq \frac{1}{2}$; consequently, γ is always greater than $\underline{\gamma}$, which implies that $\sigma_c^*(\hat{c}) = \tilde{x}_3$ when $\gamma < \overline{\gamma}^e$. Second, if $\alpha_0 > \hat{\alpha}_0$, then $\frac{1}{2} < \underline{\gamma}$; therefore, when $\gamma \leq \underline{\gamma}$, $\sigma_c^*(\hat{n}) = 1$. However, when $\gamma \in \left(\underline{\gamma}, \overline{\gamma}^e\right)$, in equilibrium $\sigma_c^*(\hat{c}) = \tilde{x}_3$. Let $x_3 = 1 - \tilde{x}_3$. Thus, if $\sigma_c^*(\hat{c}) = \tilde{x}_3$, then $\sigma_c^*(\hat{n}) = x_3$.

Finally, from $\overline{\gamma}^e = \frac{\mu^e + \alpha_0(\mu_M^e - \mu^e)}{2\mu^e + \alpha_0(\mu_M^e - \mu^e)}$, it is straightforward to show that $\lim_{\mu^e \to 0} \overline{\gamma}^e \to 1$ and $\lim_{\mu_M^e \to \mu^e} \overline{\gamma}^e \to \frac{1}{2}$. ■

Proof of Corollary 4

From (33),

$$\Delta_c[\sigma_n(\hat{n})^* = 1] = \frac{(1-\mu^e)\alpha_0}{\alpha_0+(1-\alpha_0)(\sigma_c(\hat{n})+1)} + \frac{\mu^e(1-\gamma)\alpha_0}{\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_c(\hat{n}))} - \left(\frac{(1-\mu_M^e)\alpha_0}{\alpha_0+(1-\alpha_0)\sigma_c(\hat{c})} + \frac{\mu_M^e\gamma\alpha_0}{\alpha_0+(1-\alpha_0)\gamma\sigma_c(\hat{c})}\right).$$

Let us denote

$$F(\sigma_c(\hat{n}), \gamma, \alpha_0, \mu) = \frac{(1-\mu^e)}{\alpha_0+(1-\alpha_0)(\sigma_c(\hat{n})+1)} + \frac{\mu^e(1-\gamma)}{\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_c(\hat{n}))} - \left(\frac{(1-\mu_M^e)}{\alpha_0+(1-\alpha_0)\sigma_c(\hat{c})} + \frac{\mu_M^e\gamma}{\alpha_0+(1-\alpha_0)\gamma\sigma_c(\hat{c})}\right).$$

In equilibrium, $\Delta_c\left[\sigma_n(\hat{n})^* = 1, \sigma_c(\hat{n})^*\right] = 0 \iff F(\sigma_c(\hat{n})^*, \gamma, \alpha_0, \mu^e, \mu_M^e) = 0$.

Now, by the Implicit Function Theorem,

$$\frac{\partial\sigma_c(\hat{n})^*}{\partial\gamma} = -\frac{\frac{\partial F(\sigma_c(\hat{n})^*,\gamma,\alpha_0,\mu)}{\partial\gamma}}{\frac{\partial F(\sigma_c(\hat{n})^*,\gamma,\alpha_0,\mu)}{\partial\sigma_c(\hat{n})^*}},\ \frac{\partial\sigma_c(\hat{n})^*}{\partial\alpha_0} = -\frac{\frac{\partial F(\sigma_c(\hat{n})^*,\gamma,\alpha_0,\mu)}{\partial\alpha_0}}{\frac{\partial F(\sigma_c(\hat{n})^*,\gamma,\alpha_0,\mu)}{\partial\sigma_c(\hat{n})^*}},\ \frac{\partial\sigma_c(\hat{n})^*}{\partial\mu} = -\frac{\frac{\partial F(\sigma_c(\hat{n})^*,\gamma,\alpha_0,\mu)}{\partial\mu}}{\frac{\partial F(\sigma_c(\hat{n})^*,\gamma,\alpha_0,\mu)}{\partial\sigma_c(\hat{n})^*}},$$

where, $\frac{\partial F(\cdot)}{\partial\sigma_c(\hat{n})^*} < 0$ since, as shown in equation (34), $\frac{\partial\Delta_c[\sigma_n(\hat{n})=1]}{\partial\sigma_c(\hat{c})} > 0$ which implies $\frac{\partial\Delta_c[\sigma_n(\hat{n})^*=1]}{\partial\sigma_c(\hat{n})^*} < 0$ and $\frac{\partial F(\cdot)}{\partial\sigma_c(\hat{n})^*} < 0$.

Additionally,

$$\begin{aligned}
\frac{\partial F(\cdot)}{\partial\gamma} &= -\frac{\mu^e}{(\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_c(\hat{n})))^2} - \frac{\alpha_0\mu_M^e}{(\alpha_0+(1-\alpha_0)\gamma\sigma_c(\hat{c}))^2} < 0,\\
\frac{\partial F(\cdot)}{\partial\mu^e} &= -\frac{1}{\alpha_0+(1-\alpha_0)(\sigma_c(\hat{n})+1)} - \frac{\mu^e}{(\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_c(\hat{n})))^2} < 0,\\
\frac{\partial F(\cdot)}{\partial\mu_M^e} &= \frac{1}{\alpha_0+(1-\alpha_0)\sigma_c(\hat{c})} > 0,\\
\frac{\partial F(\cdot)}{\partial\alpha_0} &= \frac{(1-\mu^e)\sigma_c(\hat{n})}{(\alpha_0+(1-\alpha_0)(\sigma_c(\hat{n})+1))^2} - \frac{\mu^e(1-\gamma)^2(1-\sigma_c(\hat{n}))}{(\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_c(\hat{n})))^2} + \frac{(1-\mu_M^e)^2(1-\sigma_c(\hat{c}))}{(\alpha_0+(1-\alpha_0)\sigma_c(\hat{c}))^2} + \frac{\mu_M^e\gamma(1-\gamma\sigma_c(\hat{c}))}{(\alpha_0+(1-\alpha_0)\gamma\sigma_c(\hat{c}))^2} > 0,
\end{aligned}$$

as $\frac{\mu^e(1-\gamma)^2(1-\sigma_c(\hat{n}))}{(\alpha_0+(1-\alpha_0)(\gamma+(1-\gamma)\sigma_c(\hat{n})))^2} < \frac{\mu_M^e\gamma(1-\gamma\sigma_c(\hat{c}))}{(\alpha_0+(1-\alpha_0)\gamma\sigma_c(\hat{c}))^2}$ in the last derivative; since $\gamma + (1-\gamma)\sigma_c(\hat{n}) > \gamma\sigma_c(\hat{c})$, $\mu^e < \mu_M^e$ and $(1-\gamma)^2(1-\sigma_c(\hat{n})) < \gamma\,(1-\gamma\sigma_c(\hat{c}))$, as $\gamma \in (\frac{1}{2}, 1)$.

Consequently,

$$\frac{\partial\sigma_c(\hat{n})^*}{\partial\gamma} < 0, \frac{\partial\sigma_c(\hat{n})^*}{\partial\alpha_0} > 0, \frac{\partial\sigma_c(\hat{n})^*}{\partial\mu^e} < 0, \frac{\partial\sigma_c(\hat{n})^*}{\partial\mu_M^e} > 0. \ \blacksquare$$

A.6 Extension: Unbalanced prior

Here we consider $\theta \in (0,1)$, with $P(\omega = C) = \theta$.

First, we obtain the posterior probability $\alpha_1(r, X)$ that consumers assign to the media firm being a high type, given report $r \in \{\hat{n}, \hat{c}\}$ and feedback $X \in \{N, C, 0\}$:

$$\alpha_1(\hat{n}, 0) = \frac{\alpha_0(1-\theta)}{\alpha_0(1-\theta)+(1-\alpha_0)((1-\theta)(\gamma\sigma_n(\hat{n})+(1-\gamma)\sigma_c(\hat{n}))+\theta(\gamma\sigma_c(\hat{n})+(1-\gamma)\sigma_n(\hat{n})))}, \tag{35}$$

$$\alpha_1(\hat{c}, N) = 0, \tag{36}$$

$$\alpha_1(\hat{c}, C) = \frac{\alpha_0}{\alpha_0+(1-\alpha_0)(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))}, \tag{37}$$

$$\alpha_1(\hat{c}, 0) = \frac{\alpha_0\theta}{\alpha_0\theta+(1-\alpha_0)(\theta(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))+(1-\theta)(\gamma\sigma_n(\hat{c})+(1-\gamma)\sigma_c(\hat{c})))}. \tag{38}$$

In the main body of the paper, we differentiate two cases: $\theta < \frac{1}{2}$ and $\theta > \frac{1}{2}$. Next result (Proposition 10) considers the two cases together, and so holds for any $\theta \in (0,1)$. It then proves Proposition 7.

Before going into this proof, note that function Δ_n and Δ_c are now:

$$\Delta_n = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu\tfrac{\theta(1-\gamma)}{\theta(1-\gamma)+(1-\theta)\gamma}\alpha_1(\hat{c},C)), \tag{39}$$

$$\Delta_c = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu\tfrac{\theta\gamma}{\theta\gamma+(1-\theta)(1-\gamma)}\alpha_1(\hat{c},C)). \tag{40}$$

We are now in position to prove the result of this section.

Proposition 10. *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, in the unique equilibrium of the game:*

1. *If $\theta \in (0,\bar{\theta}_1)$, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{n})^* = min\{1, x_1\} > 0$,*
2. *If $\theta \in (\bar{\theta}_1,\bar{\theta}_2)$, $\sigma_n(\hat{n})^* = 1$ and $\sigma_c(\hat{c})^* = 1$,*
3. *If $\theta \in (\bar{\theta}_2,\bar{\theta}_3)$, $\sigma_n(\hat{c})^* = x_2 > 0$ and $\sigma_c(\hat{c})^* = 1$,*
4. *If $\theta \in (\bar{\theta}_3,1)$, $\sigma_n(\hat{c})^* = 1$ and $\sigma_c(\hat{c})^* = 1$*

with $x_1(\gamma,\alpha_0,\mu,\theta)$ satisfying $\Delta_c\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 1 - x_1; \theta\right] = 0$, and $x_2(\gamma,\alpha_0,\mu,\theta)$ satisfying $\Delta_n\left[\sigma_n(\hat{n}) = 1 - x_2, \sigma_c(\hat{c}) = 1; \theta\right] = 0$.

Proof.

The Proposition is proven through eight Lemmas.

Lemma 6. *The function Δ_n is strictly greater than Δ_c.*

Proof.

$\Delta_n = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu P(C \mid n)\alpha_1(\hat{c},C)) > \Delta_c = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu P(C \mid c)\alpha_1(\hat{c},C))$

$\iff P(C \mid n) < P(C \mid c) \iff \frac{\theta(1-\gamma)}{\theta(1-\gamma)+(1-\theta)\gamma} < \frac{\theta\gamma}{\theta\gamma+(1-\theta)(1-\gamma)} \iff \gamma > \frac{1}{2}$. ♦

Lemma 7. *The functions Δ_n and Δ_c are decreasing in θ.*

Proof.

From (35)-(38) and (39)-(40), and since $\frac{\partial\alpha_1(\hat{c},C)}{\partial\theta} = 0$, then
$\frac{\partial\Delta_n}{\partial\theta} = \frac{\partial\alpha_1(\hat{n},0)}{\partial\theta} - \Big((1-\mu)\frac{\partial\alpha_1(\hat{c},0)}{\partial\theta} + \mu\frac{\partial P(C|n)}{\partial\theta}\alpha_1(\hat{c},C)\Big)$ and $\frac{\partial\Delta_c}{\partial\theta} = \frac{\partial\alpha_1(\hat{n},0)}{\partial\theta} - \Big((1-\mu)\frac{\partial\alpha_1(\hat{c},0)}{\partial\theta} + \mu\frac{\partial P(C|c)}{\partial\theta}\alpha_1(\hat{c},C)\Big)$, with,

$$\begin{aligned}
\tfrac{\partial\alpha_1(\hat{n},0)}{\partial\theta} &= \tfrac{-\alpha_0(1-\alpha_0)(\gamma\sigma_c(\hat{n})+(1-\gamma)\sigma_n(\hat{n}))}{(\alpha_0(1-\theta)+(1-\alpha_0)((1-\theta)(\gamma\sigma_n(\hat{n})+(1-\gamma)\sigma_c(\hat{n}))+\theta(\gamma\sigma_c(\hat{n})+(1-\gamma)\sigma_n(\hat{n}))))^2} < 0,\\
\tfrac{\partial\alpha_1(\hat{c},0)}{\partial\theta} &= \tfrac{\alpha_0(1-\alpha_0)(\gamma\sigma_n(\hat{c})+(1-\gamma)\sigma_c(\hat{c}))}{(\alpha_0\theta+(1-\alpha_0)(\theta(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))+(1-\theta)(\gamma\sigma_n(\hat{c})+(1-\gamma)\sigma_c(\hat{c}))))^2} > 0,\\
\tfrac{\partial P(C|n)}{\partial\theta} &= \tfrac{(1-\gamma)\gamma}{(\theta+\gamma-2\theta\gamma)^2} > 0,\\
\tfrac{\partial P(C|c)}{\partial\theta} &= \tfrac{(1-\gamma)\gamma}{(\theta+\gamma-2\theta\gamma-1)^2} > 0.
\end{aligned}$$

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

Lemma 8. $\Delta_n\left[\theta = 1\right] < 0$ *and* $\Delta_c\left[\theta = 1\right] < 0$.

Proof.

Note that $\Delta_n = \alpha_1(\hat{n},0) - ((1-\mu)\alpha_1(\hat{c},0) + \mu P(C \mid n)\alpha_1(\hat{c},C))$. Thus, $\Delta_n\left[\theta = 1\right] = 0 - ((1-\mu)\alpha_1(\hat{c},0) + \mu\alpha_1(\hat{c},C)) < 0$, since $\alpha_1(\hat{c},0) > 0$, $\alpha_1(\hat{c},C) > 0$ and $P(C \mid n) = 1$ for $\theta = 1$.

Analogously, we show $\Delta_c\left[\theta = 1\right] = -((1-\mu)\alpha_1(\hat{c},0) + \mu\alpha_1(\hat{c},C)) < 0$. ♦

Lemma 9. *The function Δ_n is strictly decreasing in $\sigma_n(\hat{n})$.*

Proof.

Note that $\frac{\partial \Delta_n}{\partial \sigma_n(\hat{n})} = \frac{\partial \alpha_1(\hat{n},0)}{\partial \sigma_n(\hat{n})} - ((1-\mu)\frac{\partial \alpha_1(\hat{c},0)}{\partial \sigma_n(\hat{n})} + \mu P(C \mid n)\frac{\partial \alpha_1(\hat{c},C)}{\partial \sigma_n(\hat{n})})$, with

$$\frac{\partial \alpha_1(\hat{n},0)}{\partial \sigma_n(\hat{n})} = \frac{-\alpha_0(1-\theta)(1-\alpha_0)(\gamma(1-\theta)+(1-\gamma)\theta)}{(\alpha_0(1-\theta)+(1-\alpha_0)((1-\theta)(\gamma\sigma_n(\hat{n})+(1-\gamma)\sigma_c(\hat{n}))+\theta(\gamma\sigma_c(\hat{n})+(1-\gamma)\sigma_n(\hat{n}))))^2} < 0,$$
$$\frac{\partial \alpha_1(\hat{c},0)}{\partial \sigma_n(\hat{n})} = \frac{\alpha_0\theta(1-\alpha_0)(\gamma(1-\theta)+(1-\gamma)\theta)}{(\alpha_0\theta+(1-\alpha_0)(\theta(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))+(1-\theta)(\gamma\sigma_n(\hat{c})+(1-\gamma)\sigma_c(\hat{c}))))^2} > 0,$$
$$\frac{\partial \alpha_1(\hat{c},C)}{\partial \sigma_n(\hat{n})} = \frac{\alpha_0(1-\alpha_0)(1-\gamma)}{(\alpha_0+(1-\alpha_0)(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c})))^2} > 0.$$

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

Lemma 10. *The function Δ_c is strictly increasing in $\sigma_c(\hat{c})$.*

Proof.

Note that $\frac{\partial \Delta_c}{\partial \sigma_c(\hat{c})} = \frac{\partial \alpha_1(\hat{n},0)}{\partial \sigma_c(\hat{c})} - ((1-\mu)\frac{\partial \alpha_1(\hat{c},0)}{\partial \sigma_c(\hat{c})} + \mu P(C \mid c)\frac{\partial \alpha_1(\hat{c},C)}{\partial \sigma_c(\hat{c})})$, with

$$\frac{\partial \alpha_1(\hat{n},0)}{\partial \sigma_c(\hat{c})} = \frac{\alpha_0(1-\theta)(1-\alpha_0)((1-\gamma)(1-\theta)+\gamma\theta)}{(\alpha_0(1-\theta)+(1-\alpha_0)((1-\theta)(\gamma\sigma_n(\hat{n})+(1-\gamma)\sigma_c(\hat{n}))+\theta(\gamma\sigma_c(\hat{n})+(1-\gamma)\sigma_n(\hat{n}))))^2} > 0,$$
$$\frac{\partial \alpha_1(\hat{c},0)}{\partial \sigma_c(\hat{c})} = \frac{-\alpha_0\theta(1-\alpha_0)((1-\gamma)(1-\theta)+\gamma\theta)}{(\alpha_0\theta+(1-\alpha_0)(\theta(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c}))+(1-\theta)(\gamma\sigma_n(\hat{c})+(1-\gamma)\sigma_c(\hat{c}))))^2} < 0,$$
$$\frac{\partial \alpha_1(\hat{c},C)}{\partial \sigma_c(\hat{c})} = \frac{-\alpha_0(1-\alpha_0)\gamma}{(\alpha_0+(1-\alpha_0)(\gamma\sigma_c(\hat{c})+(1-\gamma)\sigma_n(\hat{c})))^2} < 0.$$

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

Lemma 11. *The equilibrium is unique.*

Proof.

This result is a consequence of Lemmas 9 and 10.

Lemma 12. *Let $\bar{\theta}_1$, $\bar{\theta}_2$, and $\bar{\theta}_3$ be thresholds such that*
$\Delta_c\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 1; \theta = \bar{\theta}_1\right] = 0$,
$\Delta_n\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 1; \theta = \bar{\theta}_2\right] = 0$, *and*
$\Delta_n\left[\sigma_n(\hat{n}) = 0, \sigma_c(\hat{c}) = 1; \theta = \bar{\theta}_3\right] = 0$.
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 $\Delta_c\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 1; \theta = \frac{1}{2}\right] = \frac{\mu\alpha_0^2(1-\gamma)}{\alpha_0+\gamma(1-\alpha_0)} > 0$. Now, from Lemma 7, 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 $\Delta_n > \Delta_c$, $\frac{\partial \Delta_n}{\partial \theta} < 0$ and $\frac{\partial \Delta_c}{\partial \theta} < 0$ (by Lemma 6 and Lemma 7).

Now, from Lemmas 7 and 9, we have $\bar{\theta}_2 < \bar{\theta}_3$.

Last, since $\Delta_n[\theta = 1] < 0$ (by Lemma 8) and $\frac{\partial \Delta_n}{\partial \theta} < 0$ (by Lemma 7), threshold $\bar{\theta}_3$ must be strictly smaller than 1. ♦

Lemma 13. *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 $\Delta_n\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 1; \theta = \bar{\theta}_2\right] = 0$, $\frac{\partial \Delta_n}{\partial \theta} < 0$ and $\frac{\partial \Delta_n}{\partial \sigma_n(\hat{n})} < 0$ (see Lemmas 12, 7 and 9), we have $\Delta_n > 0$.

Consider now $\theta \in (\bar{\theta}_2, \bar{\theta}_3)$. As $\Delta_n\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 1; \theta = \bar{\theta}_2\right] = 0$, $\Delta_n\left[\sigma_n(\hat{n}) = 0, \sigma_c(\hat{c}) = 1; \theta = \bar{\theta}_3\right] = 0$, $\frac{\partial \Delta_n}{\partial \theta} < 0$ and $\frac{\partial \Delta_n}{\partial \sigma_n(\hat{n})} < 0$ (see Lemmas 12, 7 and 9), 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 $\Delta_n\left[\sigma_n(\hat{n}) = 0, \sigma_c(\hat{c}) = 1; \theta = \bar{\theta}_3\right] = 0$, $\frac{\partial \Delta_n}{\partial \theta} < 0$, $\frac{\partial \Delta_n}{\partial \sigma_n(\hat{n})} < 0$ and $\Delta_n[\theta = 1] < 0$ (see Lemmas 12, 7, 9 and 8), we have $\Delta_n < 0$. ♦

Lemma 14. *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 $\Delta_c \left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 1; \theta = \bar{\theta}_1\right] = 0$, $\frac{\partial \Delta_c}{\partial \theta} < 0$, $\frac{\partial \Delta_c}{\partial \sigma_c(\hat{c})} > 0$ and $\Delta_c \left[\theta = 1\right] < 0$ (see Lemmas 12, 7, 10 and 8), we have $\Delta_c < 0$. ♦

Now, there are nine possible equilibrium configurations to analyze, where Δ_c and Δ_n are evaluated in the corresponding equilibrium configurations.

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

Note that from Lemma 6, 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 10). We do it taking into account the restriction $\Delta_n > \Delta_c$ imposed by Lemma 6.

a) Interval $\theta \in (0, \bar{\theta}_1)$. By Lemma 13, 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 10), there is only one equilibrium. Therefore, $\sigma_c(\hat{c})^*$ has to be either 0 or the root of equation $\Delta_c \left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}); \theta < \bar{\theta}_1\right] = 0$ in the interval (0,1). Let $\tilde{x}_1$ be that root. Then $\sigma_c(\hat{c})^* = \max\{0, \tilde{x}_1\}$ and consequently $\sigma_c(\hat{n})^* = \min\{1, x_1\}$, with $\tilde{x}_1 = 1 - x_1$.

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 14, 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 14, 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 13, in this interval, if $\sigma_c(\hat{c}) = 1$, then Δ_n has only one inner root. Let $\tilde{x}_2$ be that root. Thus, in equilibrium, $0 < \sigma_n(\hat{n})^* = \tilde{x}_2 < 1$ and consequently $0 < \sigma_n(\hat{c})^* = x_2 < 1$, with $x_2 = 1 - \tilde{x}_2$.

d) Interval $\theta \in (\bar{\theta}_3, 1)$. Again, from Lemma 14, if $\sigma_n(\hat{n})^* = 1$, then $\sigma_c(\hat{c})^* = 1$. Thus, only 1, 4 or 7 can be. However, from lemma 13, 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 15. $\frac{\partial \sigma_c(\hat{n})^*}{\partial \theta} < 0$.

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 7 and 10, the proof follows. ■

Lemma 16. *For any $\theta \in (0, \bar{\theta}_1)$, there exists $\bar{\alpha_0} \in (0, 1)$ such that for all $\alpha_0 > \bar{\alpha_0}$, $\sigma_c(\hat{n})^* = 1$.*

Proof.

First note that from Proposition 10, if $\theta < \bar{\theta}_1$, then $\sigma_n(\hat{n})^* = 1$.

Now, we show that $\Delta_c\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 0; \alpha_0\right]$ is increasing in α_0. To this aim, note that:

$$\Delta_c\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 0\right] = \alpha_1(\hat{n}, 0) - ((1-\mu)\alpha_1(\hat{c}, 0) + \mu + P(C \mid c)\alpha_1(\hat{c}, C)) = \tfrac{\alpha_0(1-\theta)}{1-\alpha_0\theta} + \mu + \tfrac{\gamma\theta\mu}{\gamma-1+\theta-2\gamma\theta} - 1,$$

$$\tfrac{\partial \Delta_c[\sigma_n(\hat{n})=1, \sigma_c(\hat{c})=0]}{\partial \alpha_0} = \frac{1-\theta}{(\theta\alpha_0 - 1)^2} > 0.$$

Finally, note that $\Delta_c\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 0; \alpha_0 = 0\right] = \mu + \frac{\gamma\theta\mu}{\gamma-1+\theta-2\gamma\theta} - 1 < 0$, which implies that if α_0 is small enough, then $\sigma_c(\hat{n})^* < 1$. Additionally, by Proposition 10, $\sigma_c(\hat{n})^* > 0$. Finally, $\Delta_c\left[\sigma_n(\hat{n}) = 1, \sigma_c(\hat{c}) = 0; \alpha_0 = 1\right] = \mu + \frac{\gamma\theta\mu}{\gamma-1+\theta-2\gamma\theta} > 0$, which implies that if α_0 is high enough, then $\sigma_c(\hat{n})^* = 1$. From here, the proof follows.■

A.7 Extension: Is silence always bad?

Proof of Proposition 8

Let $EU\left(\sigma_n(\hat{n}), \sigma_c(\hat{c})\right)$ denote the consumers' expected utility. It is:

$$\begin{aligned}
&\frac{1}{2}\left(\alpha_0\pi + (1-\alpha_0)((\gamma\sigma_n(\hat{n}) + (1-\gamma)\left(1-\sigma_c(\hat{c})\right))\pi - \left(\gamma\left(1-\sigma_n(\hat{n})\right) + (1-\gamma)\sigma_c(\hat{c})\right)\varphi_{\hat{c}})\right) + \\
&\frac{1}{2}\left(\alpha_0\pi + (1-\alpha_0)\left((\gamma\sigma_c(\hat{c}) + (1-\gamma)\left(1-\sigma_n(\hat{n})\right))\pi - \left(\gamma\left(1-\sigma_c(\hat{c})\right) + (1-\gamma)\sigma_n(\hat{n})\right)\varphi_{\hat{n}}\right)\right).
\end{aligned}$$

Note that the function $EU\left(\sigma_n(\hat{n}), \sigma_c(\hat{c})\right)$ is linear in both arguments and have derivatives:

$$\tfrac{d(EU(\sigma_n(\hat{n}), \sigma_c(\hat{c})))}{d\sigma_c(\hat{c})} = \frac{1}{2}\left(1-\alpha_0\right)\left(2\pi\gamma - \varphi_{\hat{c}} - \pi + \gamma\varphi_{\hat{c}} + \gamma\varphi_{\hat{n}}\right), \tag{41}$$

$$\tfrac{d(EU(\sigma_n(\hat{n}), \sigma_c(\hat{c})))}{d\sigma_n(\hat{n})} = \frac{1}{2}\left(1-\alpha_0\right)\left(2\pi\gamma - \varphi_{\hat{n}} - \pi + \gamma\varphi_{\hat{c}} + \gamma\varphi_{\hat{n}}\right), \tag{42}$$

which are increasing in γ. In addition, evaluated at $\gamma = \frac{1}{2}$ and $\gamma = 1$, we have:

$$\left.\tfrac{d(EU(\sigma_n(\hat{n}), \sigma_c(\hat{c})))}{d\sigma_c(\hat{c})}\right|_{\gamma=\frac{1}{2}} = \frac{1}{2}\left(1-\alpha_0\right)\frac{1}{2}\left(\varphi_{\hat{n}} - \varphi_c\right), \tag{43}$$

$$\left.\tfrac{d(EU(\sigma_n(\hat{n}), \sigma_c(\hat{c})))}{d\sigma_c(\hat{c})}\right|_{\gamma=1} = \frac{1}{2}\left(1-\alpha_0\right)\left(\pi + \varphi_{\hat{n}}\right) > 0, \tag{44}$$

$$\left.\tfrac{d(EU(\sigma_n(\hat{n}), \sigma_c(\hat{c})))}{d\sigma_n(\hat{n})}\right|_{\gamma=\frac{1}{2}} = \frac{1}{2}\left(1-\alpha_0\right)\frac{1}{2}\left(\varphi_{\hat{c}} - \varphi_n\right), \tag{45}$$

$$\left.\tfrac{d(EU(\sigma_n(\hat{n}), \sigma_c(\hat{c})))}{d\sigma_n(\hat{n})}\right|_{\gamma=1} = \frac{1}{2}\left(1-\alpha_0\right)\left(\pi + \varphi_{\hat{c}}\right) > 0. \tag{46}$$

Now, suppose $\varphi_{\hat{n}} > \varphi_{\hat{c}}$. In this case, equations (43) and (44) are positive. Then equation (41) is always positive and consequently $\hat{\sigma}_c(\hat{c}) = 1$. Additionally, when $\varphi_{\hat{n}} > \varphi_{\hat{c}}$, equation (45) is negative and (46) is positive. Since equation (42) is increasing in γ, there must be $\tilde{\gamma}_1 \in \left(\frac{1}{2}, 1\right)$ such that if $\gamma < \tilde{\gamma}_1$, equation (42) is negative; and if $\gamma > \tilde{\gamma}_1$, equation (42) is positive. Consequently, if $\gamma < \tilde{\gamma}_1$, $\hat{\sigma}_n(\hat{n}) = 0$, and if $\gamma > \tilde{\gamma}_1$, $\hat{\sigma}_n(\hat{n}) = 1$. The proof for the case $\varphi_{\hat{n}} < \varphi_{\hat{c}}$ is analogous and then omitted.

From (41) and (42), if $\varphi_{\hat{n}} = \varphi_{\hat{c}}$, then $\frac{d(EU(\sigma_n(\hat{n}), \sigma_c(\hat{c})))}{d\sigma_c(\hat{c})} = \frac{d(EU(\sigma_n(\hat{n}), \sigma_c(\hat{c})))}{d\sigma_n(\hat{n})} > 0$. Thus, $\hat{\sigma}_c(\hat{c}) = 1$ and $\hat{\sigma}_n(\hat{n}) = 1$. ■

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