Fact-Checking, Media Competition and Political Accountability *

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Abstract

We present a media market model in which a set of news outlets receive some information on whether a political scandal took place and compete to break the news. Media outlets can decide whether to break the story immediately or wait and fact-check, considering that if another outlet breaks the news, the profit opportunity disappears. We show that, as competition increases, each outlet becomes more likely to publish unverified news. As a consequence of this, the amount of information provided by the media market, and hence readers' welfare, can be non-monotonic in the degree of competition. What is more, we show that readers following a realistic behavioral heuristic to consult media end up with no information as competition grows large.

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1 Introduction

The news media play a fundamental role in providing political information to citizens and keeping candidates and elected officials accountable to public opinion (Hayes and Lawless, 2015, Strömberg, 2015). To fulfill their role, the news media act as a filter between the information they receive from their sources and the information they transmit to the public. At the heart of this process lies what is often called fact-checking, which means verifying a source's claims before reporting them. By its very nature, fact-checking takes time, and hence it delays publication: in a business crafted around the requirement of breaking news, this poses a significant trade-off. As the former New York Times editor Bill Keller put it: "The major feature of the media landscape today is the acceleration of everything. Probably the most troublesome tension is the one between the need to file immediately, because a thousand other people are filing immediately, and the time it takes to do real reporting."

With these stylized facts in mind, in this paper we develop a simple theoretical framework to investigate how competition shapes the fact-checking behavior of media outlets and the quality of the information they provide. The main trade-off we address is, as mentioned in the Bill Keller quote above, one between speed and accuracy. Since fact-checking takes time, media outlets that decide to fact check run the risk of being preempted: if one of their competitors decides to report immediately, they end up losing the scoop.

A famous case involving the publication of insufficiently fact-checked documents is the so called *Killian Documents Controversy*, which involved a set of memorandums containing sharp ctiticism about President George W. Bush's service in the Texas Air National Guard in 1972-73. On September 8, 2004, CBS anchor Dan Rather presented these documents in his *60 Minutes II* broadcast. This initially sparked a big scandal with potentially serious consequences for the upcoming election, but it soon became clear that CBS had failed to properly verify the documents. What is more, the authenticity of the documents was challenged by several typewriting experts. The controversy was damaging

for CBS and it led to the removal of some key components of the program's production team. Even the anchor Dan Rather ended up leaving CBS in the aftermath. After the incident, CBS established a review panel: in an interview with the Washington Post, panel member Louis Boccardi stated that he believed the misreporting to have happened "primarily because of a rush to air that overwhelmed the proper application of the CBS News Standards".[1]

As the Killian Documents Controversy exemplifies, the trade-off between speed and accuracy is a quintessential problem of journalism. On top of that, the changes in the media landscape that occurred in recent years, primarily due to the growing importance of the internet and the emergence of the so-called 24-hour news cycle, might have exacerbated this type of dynamics to an even greater extent.[2] To make matters worse, the internet has also dramatically decreased the entry barriers into the news media sector, and it has "leveled the playing field", making competition between traditional outlets and a vast fringe of smaller players much more symmetric than before (Zhuravskaya et al., 2020).[3,4]

In light of this, this paper's first contribution is to show how media competition can worsen publishing standards. The stronger media competition, the stronger the pressure for media outlets to choose speed over accuracy, leading to increasingly imprecise news. Interestingly, the driving force behind this result is the increased amount of accurate information that competition makes available, that is, the same force that can make competition beneficial. Consider a media outlet contemplating whether to fact-check a rumor or report it immediately: the larger the number of firms in the market, the greater

[1] The review panel did not "find a basis to accuse those who investigated, produced, vetted or aired the Segment of having a political bias", further supporting the rush to air as the main driving force.

[2] Another factor playing a fundamental role for the "need to file immediately" is what has been called "unbundling of journalism" (Bisceglia, 2021), which allows readers to consume single pieces of news and share them through social media. This increased the premium for being the first to cover a story, as shown for example by Cagé et al. (2020).

[3] As Cagé (2016) shows, the increasing number of media outlets does not only concern the internet.

[4] Setting up a blog or a social media profile does not require significant capital or expertise, and it allows a large number of media entrepreneurs to have access to a vast market of readers with products that sometimes are, at least at first sight, not very different from those of more established players. In a recent paper, Bhuller et al. (2020) study how the internet changed the market for print newspapers.

the probability that at least one has reliable enough information leading it to report immediately. As a result, an outlet with a loose rumor also would report immediately to avoid the risk of losing the scoop.

Having studied how competition affects reporting standards, the second contribution of this paper is to analyze the overall effect of competition on the quality of the information available to citizens, and hence on social welfare. On the one hand, media competition increases the overall amount of information available to the media, and hence it increases citizens' potential chances to be informed of political misbehavior. This is the celebrated *watchdog* role of media and is clearly beneficial to society. On the other hand, as we have seen, competition can also crowd out fact-checking and spark unfounded scandals that end up damaging honest politicians. The combination of these two effects results in a non-monotonic relationship between media competition and the quality of information citizens have access to through the media. In particular, we show that even a citizen capable of extracting all information from the media market can be worse off as competition increases.

Our results emphasize two important issues. The first one is the fact that by increasing information *quantity* at the expense of *quality*, competition entails a load of cognitive costs: facing a larger number of information sources of lower accuracy, a reader needs to consult a larger number of them to attain the same level of information. The second issue is the fact that the decrease in publishing standards caused by competition is especially dangerous for attention-limited readers following a simple heuristic to get information from the media market.[5] Under this behavioral protocol, which entails preferentially consulting outlets reporting of a scandal, readers as just as informed as fully rational agents when media outlets fact-check, but they become less and less informed as media stop fact-checking.

To sum up, our results question the desirability of pluralism and competition in the

[5]A detailed explanation of the heuristic can be found in Section 4.1.

media sector and propose an explanation for the consistent decrease in the level of trust in the accuracy of media observed in the last two decades.[6] In this respect, our results reflect some of the arguments presented by Shleifer (2004) about the "unethical" consequences of competition: whereas his work does not mention the media, in our model competitive pressures crowd-out a form of *ethical* behavior such as fact-checking.

So far we have focused on the possible negative consequences of media competition. However, the preemption mechanism lying at the base of our results in Sections 3 and 4 also contains a silver lining. As we discuss in Section 5, if we allow media outlets that decide to fact-check to have the possibility of "debunking" other media outlets that reported a false rumor, competition can lead to increased rather than decreased reporting standards. Intuitively, the fear of getting debunked from competing outlets provides an incentive to fact-check.

Our paper mainly contributes to the theoretical literature on the effects of media competition.[7] One of the key channels making media competition beneficial for political accountability is presented in Besley and Prat (2006). In their model, an increase in the number of media outlets makes capture more costly: a corrupt politician or interest group would have to pay monopolist profits to each outlet to prevent the publication of a scandal. Our model, instead, shows that if the concern is not capture by interest groups but reporting accuracy, the relationship between competition and political accountability is non-monotonic.[8]

Concerning possible negative effects of media competition, a channel emphasized by the existing literature is that of slant (Mullainathan and Shleifer, 2005, Bernhardt et al.,

[6] Gallup asks Americans for trust in media -such as newspaper, TV and radio- since 1972. Trust ranged between 68% and 72% in the 1970s and it is currently at 40%. http://news.gallup.com/poll/321116/americans-remain-distrustful-mass-media.aspx. Moreover, Park et al. (2020) show that distrust in media effect is associated with an increase in social media use.

[7] Gentzkow and Shapiro (2008) present an excellent overview of the possible effects of media competition on the truthfulness of news, both from the supply and the demand side. However, the pressure to publish unverified news, which lies at the heart of our work, is absent from their discussion.

[8] Another model in which competition reduces the ability of governments to control the media is Gehlbach and Sonin (2014). Similarly, Germano and Meier (2013) show that media outlets are more likely to underreport topics sensitive to their advertisers in a market with high ownership concentration.

2008, Sobbrio, 2014). Similarly, in Perego and Yuksel (2021), media informativeness decreases due to the specialization on ideological instead of valence dimensions of policy. Our paper differs from this strand of the literature since we derive the possibility of competition leading to inaccuracy in the absence of ideological considerations and without resorting to readers' heterogeneity. Moreover, whereas in models such as Mullainathan and Shleifer (2005) and Chen and Suen (2021), competition increases the overall informativeness of the media despite making each outlet less accurate, in our setup, competition can be detrimental even to an agent that had access to the reports of all media.[9]

Despite not addressing media competition, one of the key results in Kranton and McAdams (2020) has an interesting relation to ours. Namely, they show that news veracity is single-peaked in the degree of network density: this is driven by the fact that, in their model, it is readers who filter the news by deciding whether to share it through the network. Similarly, Gratton et al. (2018) model fact-checking as an exogenous process occurring after the report of a scandal. Before fact-checking occurs, receivers update their beliefs on the veracity of the report based on the timing of the report with respect to an electoral deadline. Whereas we are, to the best of our knowledge, the first to have explicitly modeled the speed-accuracy trade-off arising from the competition to break the news, meanwhile a similar trade-off has also been considered by Pant and Trombetta (2019), who focus on the reputation consequences of the timing of publishing, and Oliver (2019), who studies how publication standards change when media outlets can publish at any time rather than at fixed time slots.

Our work also speaks to the existing empirical literature studying the consequences of increasing media pluralism. Gentzkow et al. (2011) use US local newspapers data from 1869-1928 to find that newspaper entry increases turnout. Despite the result not being statistically significant, they also estimate an adverse effect of an additional newspaper on

[9]Readers' heterogeneity is also crucial in the theoretical framework in Cagé (2020), who shows that when readers are sufficiently heterogeneous, a duopoly leads to quality differentiation in order to soften price competition. Another related paper is Li et al. (2021), who study how the presence of alternative media in the news market affects political accountability. We derive the results of our model without considering heterogeneity among readers nor media.

incumbency advantage, which reflects the predictions of our model.[10] Drago et al. (2014) carry out a similar exercise with data on local Italian newspapers and find a positive effect of the number of newspapers on voters' participation in elections and an increase in the reelection probability of mayors who decide to rerun. On the contrary, Cagé (2020) finds that newspaper entry decreased turnout and the number of articles, especially hard-news ones, in France. Finally, Angelucci et al. (2020) investigate the introduction of television in 1950s America and document decreases in turnout and the amount of original reporting.

2 The Model

Consider a media market composed of $N > 1$ media outlets acting across two periods. In the first period, a state of the world $\omega \in \{0, 1\}$ is drawn, with $Pr(\omega = 1) = p$. When the realization of the state is $\omega = 1$, there is a political scandal, whereas if $\omega = 0$ there is no scandal.[11] Once the state of the world is realized, each media outlet $i \in \{1, \ldots, N\}$ receives an independent signal s_i about ω. The signal is private information of each media outlet and can take three different values: when $s_i = f$, the media outlet receives a definitive proof of scandal (a fact), when $s_i = r$ it receives partial evidence (a rumor) and, finally, when $s_i = n$ the media receives no indication of misconduct. Let $\gamma_s^\omega \in [0, 1]$ be the probability of receiving a signal $s \in \{n, r, f\}$ in each state of the world ω. We make the following restrictions on the information structure.

Assumption 1. *The probabilities* γ_s^ω *satisfy* $\gamma_f^0 = 0$, $\gamma_r^0 \leq \gamma_r^1$ *and* $\gamma_n^0 \geq \gamma_n^1$.

As a consequence of Assumption 1, the following properties hold: a fact makes the media outlet certain of the scandal, a rumor is informative of the existence of a scandal, and receiving no information of misbehavior is a signal that no scandal took place.

After observing s_i, each media outlet simultaneously decides whether to publish or

[10] Snyder Jr and Strömberg (2010) find that increased press coverage increases the incumbency advantage, and similarly Prior (2006) finds that television increases incumbency advantage. Ansolabehere et al. (2006), on the other hand, find null effects of television on incumbency advantage.

[11] Analogously, we sometimes use the expression "the incumbent politician misbehaved" for $\omega = 1$ and "behaved honestly" for $\omega = 0$.

fact-check. Fact-checking does not have any direct cost other than the time it takes, which forces the media outlet to delay the potential publication to the second period. If fact-checking takes place, media outlets learn the state of the world ω and all uncertainty is resolved.[12] If a media outlet reports a scandal that did not occur, it bears a cost of $c > 1$. This can be thought of as deriving from libel lawsuits, reputation losses affecting the career prospects of editors or journalists, or even "moral" costs measuring the strength of editorial standards. Notice that since $c > 1$, an outlet would never wrongfully report when knowing the truth: in other words, there is no deliberate fake news in our model.

Media outlets' objective is to maximize profits, and their source of revenue is breaking the news, that is, being the first to report about the possible scandal. We normalize the revenue from breaking the news to 1, and assume that a media outlet accrues such revenue independently of how many other outlets report, as long as the news has not been broken before.[13] Moreover, revenues are independent of whether the scandal took place and whether reporting occurs after a rumor or a definitive proof.[14] The revenue from reporting after other outlets have already broken the news is fixed at zero for simplicity of exposition.[15]

The costs and revenues we just presented naturally lead to a trade-off between immediately publishing a possibly incorrect rumor and running the risk of losing the scoop if other outlets publish first. In order to focus on the behavior of media outlets observing a rumor, we assume that the firms with a fact at hand publish immediately, whereas those that received no information can neither fact-check nor publish. Regarding the first assumption, media outlets with a fact do not face any trade-off since they know that they

[12]Notice that by doing this, we are in effect stacking the deck of the model against our objective by looking at a best-case scenario in which fact-checking guarantees perfect accuracy and has no direct monetary costs, and finding that nonetheless, media do not always have the incentive to fact-check.

[13]We do not allow media outlets to earn a profit by "copying" the scoop from another outlet. This issue is addressed by Hafer et al. (2018), who show that media acquire more information when it is easier to secure the profits from the scoop.

[14]Actually, Vosoughi et al. (2018) show that false news reach more people than the truth, but they claim that the difference may be driven by the greater average novelty of false news.

[15]In Section 5 we enrich the model adding an extra revenue of debunking wrong news in the second period and and extra cost of being debunked.

will not incur a cost by publishing immediately. Thus, fact-checking becomes a (weakly) dominated strategy.[16] Regarding outlets that receive no information, our assumption is motivated by the fact that a story needs to be based on at least a rumor and, similarly, fact-checking requires some starting information to verify.[17]

In the next section, we present the model results using sub-game perfect Nash equilibrium in pure strategies as a solution concept. We only consider symmetric equilibria, in which all outlets with the same information behave in the same way.

3 Results

In the second period, all media outlets that decided to fact-check learn the state of the world. Given $c > 1$, media outlets do not have the incentive to deliberately report fake news, and thus report the scandal if and only if $\omega = 1$.

The heart of the model is the first period. Media outlets that observe a rumor ($s_i = r$) can either publish immediately of fact-check. They are uncertain on whether the scandal occurred or not, assigning probability $\rho = Pr[\omega = 1|r]$ to the scandal existing:

$$\rho = \frac{p\gamma_r^1}{p\gamma_r^1 + (1-p)\gamma_r^0} \tag{1}$$

At this point, it is clear that this game can have two symmetric equilibria in pure strategies, depending on the behavior of media outlets that receive a rumor. We denote as *Fact-Checking Equilibrium* the equilibrium in which the media outlets that observe a rumor fact-check and only report in the second period after learning the truth. We denote instead as *Inaccurate Equilibrium* the equilibrium where media outlets that observe a rumor report the scandal in the first period, and fact-checking does not occur.

[16] Notice that we could relax this assumption without changing the equilibrium behavior by adding a bonus $\beta > 0$ for outlets publishing in the first period: this could be motivated either by impatience or by the risk of the scoop losing relevance over time. Alternatively, a trembling-hand refinement would go in the same direction.

[17] Since receiving no signal is good news about the politician, the assumption that outlets without information do not report a scandal could be micro-founded.

Concerning the assumption that media without information cannot fact-check, this does not affect the equilibrium behavior but simplifies welfare analysis. We make this modeling choice to isolate the effect of fact-checking from that of the arrival of new information.

Let us begin with the Inaccurate Equilibrium. If a media outlet believes that all other outlets will report conditional on seeing at least a rumor, the payoff for waiting until the fact-checking stage is $\rho {\gamma_n^1}^{N-1}$. As a matter of fact, such an outlet can only break the news if the scandal exists and all other firms receive no information. Instead, the payoff from publishing immediately is $1 - c(1-\rho)$. To rule out trivial results, we focus on parameters such that this quantity is positive: this means that either the cost of misreporting is not too high or that rumors are sufficiently informative of a scandal to make reporting them profitable.

Assumption 2. *The expected profits from reporting a non-fact checked rumor are positive, that is* $1 - c(1-\rho) > 0$.

Comparing the payoffs from fact-checking and immediately publishing, we find a threshold on the cost of misreporting below which the Inaccurate Equilibrium exists:

$$c \leq c^I := 1 + \frac{\rho}{1-\rho}\left(1 - {\gamma_n^1}^{N-1}\right) \tag{2}$$

Consider now the Fact-Checking Equilibrium, in which outlets only report conditional on observing definitive proof of a scandal and fact-check otherwise. For this equilibrium to exist, a unilateral deviation by a media outlet that received a rumor must be unprofitable. When observing a rumor, the expected payoff of fact-checking is $\rho(1-\gamma_f^1)^{N-1}$, whereas the expected profit of immediately publishing is $1 - c(1-\rho)$. Comparing these payoffs, we derive the following threshold on c, above which the Fact-Checking Equilibrium exists:

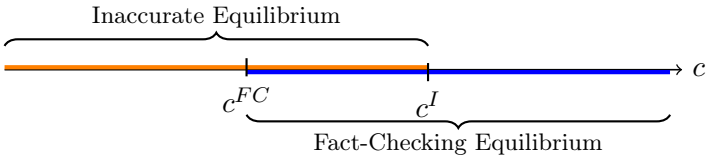
$$c \geq c^{FC} := 1 + \frac{\rho}{1-\rho}\left(1 - (1-\gamma_f^1)^{N-1}\right) \tag{3}$$

The following proposition describes the equilibria of the model:

Proposition 1. *(Existence of the Fact-Checking and Innacurate equilibria)*

1. *The Fact-Checking Equilibrium exists if and only if* $c \geq c^{FC}$.

Figure 1: Existence of the Equilibria



2. *The Inaccurate Equilibrium exists if and only if* $c \leq c^I$.

3. *Since* $c^{FC} < c^I$, *there always exists at least one equilibrium in pure strategies.*

As we have seen, the outcome of the game crucially depends on the value of c: for high values of the cost of misreporting, media outlets do not have the incentive to publish rumors, and the unique equilibrium is the Fact-Checking Equilibrium, whereas for low values of the cost of misreporting, fact-checking is never optimal and the unique equilibrium is the Inaccurate Equilibrium. As it is shown in Figure 1, since $c^{FC} < c^I$, there is a region of intermediate values of c in which both equilibria exist.[18]

Notice that, while the choice of characterizing the existence of the two possible equilibria based on c is intuitive, an alternative characterization is also interesting. Rearranging conditions (2) and (3) we obtain that the Fact-Checking Equilibrium exists for sufficiently low values of the prior probability of a scandal p, whereas the Inaccurate Equilibrium exists for sufficiently large values of p. This has the relevant consequence that in environments where corruption is widespread, media outlets do not have the incentive to fact-check.

3.1 Market Competition and Fact-Checking

In this subsection, we study the comparative statics with respect to the number of active media outlets, which we interpret as a measure of market competitiveness.[19] The number

[18] In addition to the two pure strategy equilibria, in this region, there is also a symmetric mixed strategy equilibrium, which we characterize in section A.1 of the Appendix.

[19] The number of media outlets can, for example, be driven by the size of the barriers to entry. The use of the number of active firms as an index of competitiveness is widespread in the media economics literature.

of media outlets in the market affects the expected profits from fact-checking through the probability of preemption: in both types of equilibrium, the probability that some outlet breaks the news in the first period increases in N. Therefore, the larger is N, the stronger is the pressure to publish in the first period if a media outlet wants to enjoy the revenue from breaking the news. This leads to the following result:

Corollary 1. *There exist thresholds N^{FC} and N^{I} such that the Fact-Checking Equilibrium exists if and only if $N \leq N^{FC}$ and the Inaccurate Equilibrium exists if and only if $N \geq N^{I}$. Moreover $N^{I} < N^{FC}$.*

To summarize, as the number of media first increases, the outcome of the game switches from the Fact-Checking Equilibrium to the Inaccurate Equilibrium, with an intermediate region of values of N where both equilibria exist. The main takeaway is that an increase in competitive pressure driven by a larger number of competitors can be detrimental to publishing standards, leading media to publish unverified news instead of fact-checking. In Section 4 we analyze how this affects citizens' welfare. Another way to interpret the comparative statics on N is to consider how the thresholds c^{FC} and c^{I}, which characterize the existence of the Fact-Checking and the Inaccurate Equilibrium respectively, vary with N: our comparative statics result implies that both thresholds increase in N. Therefore, keeping the cost of misreporting fixed, the equilibrium type can switch from Fact-Checking to Inaccurate as N grows.

4 Welfare

One of the main roles of media is to guide readers' decisions, such as voting choices. To this end, we add a representative citizen to the model, who, after consulting one or more media outlets, has to decide whether to retain or replace the incumbent politician. For the moment, we remain agnostic about how the reader chooses the media outlets she consults.

In particular, consider an environment in which the citizen-reader has to take decision

$d \in \{0, 1\}$ to maximize the following utility function:

$$u(\omega, d) = \begin{cases} 0 \text{ if } d = \omega \\ -e_1 \text{ if } \omega = 0 \text{ and } d = 1 \\ -e_2 \text{ if } \omega = 1 \text{ and } d = 0 \end{cases} \tag{4}$$

Decision $d = 1$ means replacing the politician and $d = 0$ reelecting him. The parameter $e_1 \geq 0$ represents the cost of replacing a politician who behaved honestly (type 1 error), whereas $e_2 \geq 0$ represents the cost of reelecting a politician involved in a scandal (type 2 error).[20,21]

Given this setup, the optimal decision for the representative reader is to replace the politician when the posterior probability of the scandal exceeds a value that we denote by ρ^*, with $\rho^* = \frac{e_1}{e_1+e_2}$, and keep the incumbent otherwise.

In order to evaluate the welfare consequences of competition in the media market, we apply the well known results by Blackwell (1951), who provides an informativeness criterion related to the concept of second order stochastic dominance. Intuitively, the more spread out is the distribution of posteriors after consulting the media, the less likely is the citizen to make mistakes when taking the accountability decision d.[22]

In light of this, our first result is that, fixing the number of outlets consulted by the reader, welfare is higher under the Fact-Checking than under the Inaccurate Equilibrium. Under the former equilibrium type, a media outlet reports the scandal only when they are certain that it occurred, in such a way that a scandal never hits honest incumbents. Therefore, the only possibility of mistake arises when a media outlet receives nothing and thus fails to report an existing scandal, leading the voter to retain a misbehaving incumbent. In the Inaccurate Equilibrium, on the contrary, a media outlet also reports when it receives a rumor, adding another possible source of error (i.e., replacing an honest incumbent) and therefore providing less accurate information compared to fact-checking.[23]

[20] The fact that $u(\omega, \omega) = 0$ for each ω is irrelevant, as long as $u(\omega, \omega) \geq u(\omega, \omega')$, $\forall\ \omega' \neq \omega$.

[21] These parameters can be thought of as reduced form expressions of payoffs deriving from the future behavior of the politician in office, or other environmental factors beyond the scope of our model.

[22] For more details, please refer to Appendix A.3.

[23] Notice that the greater accuracy of the Fact-Checking Equilibrium does not depend on whether the

Tightly related to this observation is the fact that, as a consequence of the eventual switch from the Fact-Checking to the Inaccurate Equilibrium (see Corollary 1), a reader consulting a fixed number of media outlets (randomly drawn from the universe of the N available outlets) is bound to suffer a welfare loss as competition increases.[24]

Corollary 2. *Fixing the number of media outlets consulted, welfare is higher under the Fact-Checking Equilibrium than under the Inaccurate Equilibrium: hence, the welfare of a reader consulting a fixed number of outlets (weakly) decreases as competition increases.*

The negative implications of competition for readers' welfare highlighted in Corollary 2 nevertheless deliver a possibility result: competition can increase a reader's welfare, but only insofar as it leads to consulting a greater number of outlets. Despite the lower quality of each signal, competition allows the reader to benefit from the increased quantity of signals.

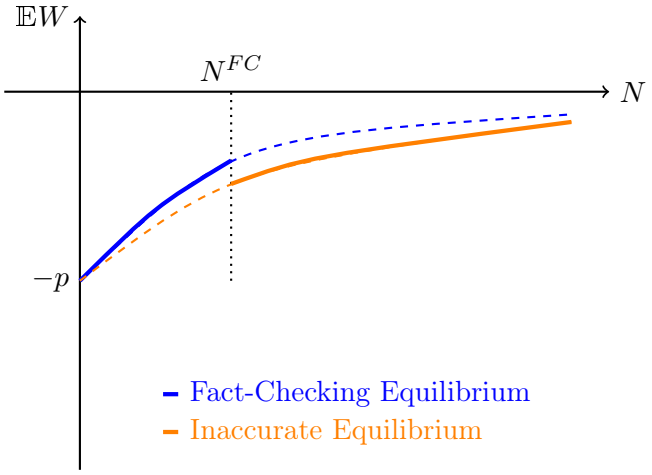
To highlight this quality/quantity trade-off, we consider the scenario in which the reader consults all available outlets. In this environment, the number of media outlets consulted is directly proportional to the degree of competition, leading to the welfare non-monotonicity already highlighted in the introduction. As the equilibrium switches from Fact-Checking to Inaccurate, the welfare of a reader consulting all available outlets initially jumps downwards. Still, it starts increasing again after the jump, eventually making the reader better-off despite every individual outlet being less accurate. This is summarized by Proposition 2 below and depicted in Figure 2.

Proposition 2. *Increasing the number of existing media outlets N may make a reader worse off even if she consults all available media outlets. However, as N grows large, welfare increases to its upper bound of* 0*, that is, the media market becomes fully informative.*

receiver of a media outlet's report can distinguish between fact-based and rumor-based information, and it would also be preserved if fact-checking did not deliver perfect information but only better information than the rumor.

[24] Given the existence of both the Fact-Checking and the Inaccurate equilibrium for some values of N, this argument implicitly assumes that there is only one value of N where the equilibrium switches (that is, equilibrium selection), or that we restrict the view to values of N either sufficiently low or sufficiently large, so that the equilibrium is unique.

Figure 2: Welfare Consulting All Existing Media: $d = 0$ Under Prior Beliefs



This result has two takeaways: the first, more direct one, is that intense competition can make a reader less informed, and thus worse-off, even even if she is capable of extracting all the information available in the market by consulting all outlets. In other words, the total amount of information transmitted by the market may be non-monotonic in the degree of competition.

The second takeaway is that media competition entails a load of cognitive costs. In other words, competition increases the level of attention required from a reader to acquire a given amount of information. This happens primarily because, under the Inaccurate Equilibrium, a reader needs to consult more media outlets to have the same amount of information as in the Fact-Checking Equilibrium. However, an additional and more subtle difference between the two equilibria is that a reader in the Fact-Checking Equilibrium just needs to know whether some outlet reported the scandal, whereas, under the Inaccurate Equilibrium, a reader may have to learn from the number of outlets that reported a scandal, which requires more sophistication.[25]

To shed more light on this idea, in the next section we investigate the consequences of a kind of bounded rationality whereby the reader only knows whether some outlet

[25]This happens either when no media reports a fact or when the reader is not capable of distinguishing between reports based on facts and reports based on rumors.

reported a scandal or no one reported it.

4.1 Scandal-Biased Readers

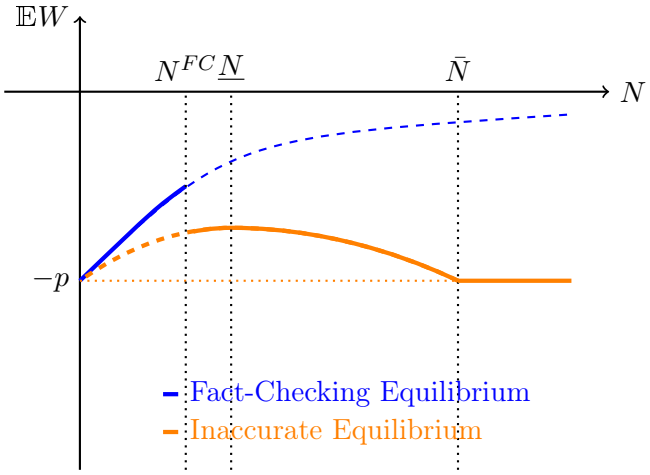
Suppose now that, after consulting the media, the reader only knows whether some outlet reported the scandal – independently of the number of outlets reporting and whether the report contains a fact or a rumor – or none did. We call this type of reader a Scandal-Biased reader. This is a realistic type of behavior for several reasons: for example, it might be due to limited attention (the reader is only willing to consult one outlet) combined with a preference for reading about scandals. It might also be driven by how the reader accesses the news: knowing that the reader is interested in the possibility of a scandal, a social media or news digest algorithm is likely to inform the reader of the scandal as long as at least one of the outlets reports it. Finally, as it will become clear later, a reader naively believing the media is only publishing facts would find it optimal to follow this type of behavior.

In this environment, the effects of the Inaccurate Equilibrium are significantly more detrimental than in our baseline analysis. The reason is that, under the Inaccurate Equilibrium, the reader sees the news of the scandal as long as at least one outlet receives at least a rumor. Intuitively, as the number of outlets grows large, the probability of this happening converges to one independently of the state of the world, i.e., the reader always sees a scandal reported, but this conveys no information.

Interestingly, the opposite happens under the Fact-Checking Equilibrium: as the number of media outlets grows large, a Scandal-Biased reader becomes perfectly informed. What is more, under the Fact-Checking Equilibrium, a Scandal-Biased reader has the same information as a rational reader consulting all media outlets.

In other words, what we call Scandal-Biased behavior does not lead to any bias under the Fact-Checking Equilibrium. On the contrary, it is a useful heuristic to extract all information from the media market. However, such heuristic unravels under the Inaccurate

Figure 3: Welfare with Scandal-Biased Reader: $d = 0$ under Prior Belief



Equilibrium, in the limit depriving the reader of all information.

Proposition 3. *As N grows large, a Scandal-Biased reader becomes fully informed under the Fact-Checking Equilibrium, whereas she ends up with no information under the Inaccurate Equilibrium.*

A corollary of this result is that when readers are affected by this type of bias, the number of media outlets maximizing the welfare function (4) is always finite. In particular, if we assume that the Fact-Checking Equilibrium is played when N is lower than N^{FC} introduced in Corollary 1, the welfare-maximizing degree of competitiveness is $N = N^{FC}$. This is depicted in Figure 3, where we can also see that as the information conveyed by the media market becomes weaker and weaker, there is a point after which media outlets are no longer able to affect the reader's decision to replace the incumbent. If priors are sufficiently in favor of the politician being honest, the reader never replaces the incumbent, and all scandals go unpunished. In other words, there is a breakdown of political accountability.

Finally, another fact worth commenting is that if readers follow this type of behavior because they naively trust media to always fact-check, they might be strictly worse off under a competitive media market than if media did not exist.

5 Debunking Fake News

Thus far, we have assumed that the only possible strategic interaction between different media outlets has to do with whether the news has been broken or not. While this simplification allowed us to isolate the adverse effects of competition on fact-checking through the preemption channel, it also led us to deliberately silence the effects of other potential channels of strategic interaction. This section focuses on a particular feature of competition that can discipline discipline media outlets to fact-check before publishing: this feature is the debunking of wrong information published by another media. To do so, we modify the baseline model such that media outlets receive an extra revenue $b > 0$ for debunking false news published in the first period and suffer an additional cost $d > 0$ when some other media outlet debunks them. The following proposition summarizes the conditions for the existence of the Fact-Checking and the Inaccurate equilibria in this modified model.

Proposition 4. *Existence of the Fact-Checking and Innacurate equilibria with debunking:*

1. *The Fact-Checking Equilibrium exists if and only if* $c \geq c_d^{FC} := c^{FC} - \left(1 - \gamma_n^{0^{N-1}}\right) d$.
2. *The Inaccurate Equilibrium exists if and only if* $c \leq c_d^I := c^I - \left(1 - \gamma_n^{0^{N-1}}\right) b$.

As Proposition 4 shows, adding a cost for being debunked enlarges the set of parameters that guarantees the existence of the Fact-Checking Equilibrium. Intuitively, this happens because the extra cost reduces the expected payoff of publishing immediately: on top of facing the risk of paying the cost for a false publication, the firm faces an additonal cost if some other media outlet fact-checks the information and debunks it. Analogously, the presence of a revenue for the debunking outlet shrinks the set of parameters under which the Inaccurate Equilibrium exists. The reason is that media outlets now have an additional way to profit from fact-checking, which materializes when $\omega = 0$ (i.e., there is no scandal) and some other media outlet reported a false rumor without fact-checking it.

Having presented the existence conditions for pure strategy equilibria in this modified model, we can now study how debunking changes the impact of competition on fact-checking.

Corollary 3. *There exist two thresholds* $\hat{d}, \hat{b} > 0$ *such that:*

(a) c_d^{FC} *is increasing in* N *when* $d \leq \hat{d}$ *and decreasing otherwise.*

(b) c_d^{I} *is increasing in* N *when* $b \leq \hat{b}$ *and decreasing otherwise.*

Corollary 3 shows that the possibility of debunking and being debunked can offset the negative effects that competition has on fact-checking through preemption and that constitued the core of our baseline model results. In the Fact-Checking equilibrium, when competition increases, the expected cost of being debunked when publishing immediately increases as well, because the larger the number of media, the more likely it becomes that at least one of the competing outlets receives a rumor and fact-checks it. When the cost of being debunked is high enough, these additional costs prevail over the decreased revenues from fact-checking due to preemption. Therefore, competition increases the set of parameters for which the Fact-Checking Equilibrium exists. Consider now the Inaccurate Equilibrium: an increase in competition increases the probability of some competing media outlet publishing a wrong scandal in the first period, which, in turn, increases the probability of receiving the revenue b and thus the expected payoff of fact-checking. Therefore, when the benefit of debunking is high enough, the debunking revenue effect is stronger than the preemption effect and competition decreases the set of parameters such that the Inaccurate Equilibrium exists.

6 Conclusion

This paper shows that an increasing competitive pressure can lead media outlets to adopt worse reporting standards and publish non-verified news. The reason why competition crowds out fact-checking is that the time required to verify a rumor or an uncertain piece

of evidence exposes a media outlet to the risk of preemption, that is, the risk that other outlets break the news first.

Our results concerning the behavior of media in a competitive market tell a cautionary tale with regards to the widespread perception that competition and pluralism are beneficial for the amount of information available to citizens: whereas for a given media accuracy, an increase in media competition is socially beneficial, since it increases the probability of exposing political misbehavior, such positive effects can be more than offset by the worsening of reporting standards. In particular, our model delivers the realistic prediction that a highly competitive media sector becomes more scandal-prone, a tendency for which there is evidence in the works of media scholars such as Thompson (2013), who wrote: "*The pressure to run a story before one's competitors acts as an incentive to disclose information that could spark off a scandal, or which could fuel a scandal which is already underway*".[26]

One of the key findings of our model is the possibility of a non-monotonic relationship between competition and the amount of information transmitted by the media market, which works through the incentive to report unverified scandals. Even when the larger number of information sources made available by competition more than offsets the negative effects of the lower accuracy of each individual outlet, our results imply that competition poses a cognitive load on readers, forcing them to consult a large number of sources to attain the same level of information. Moreover, we show that attention-limited readers are likely to suffer the consequences of decreased media accuracy in an amplified manner, to the extent of ending up fully uninformed as competition increases in the limit.

Finally, the paper also discusses how the advantages of competition could be achieved without worsening publication standards. When, on top of competing for breaking the

[26]Similarly, Garrard and Newell (2006) claim that: "*[...] modern scandals are mediated, shaped to varying degrees by the priorities of those reporting them. This has rightly led some commentators to wonder whether the priorities of capitalist (even public-service) media competition have produced behavior dysfunctional for the liberal democracies that modern industrial capitalism tends to produce. [...] Whilst the latter requires the spread of serious information and debate, the competitive priorities of the former, particularly mass-circulation tabloids, point increasingly to sensationalism, titillation, entertainment and trivialisation.*"

news, media outlets also debunk the information published by other media, competition can discipline media outlets and improve publication standards. As long as debunking is more likely to occur when the media who wrongfully reported and the media who debunk do not share economic interests, a policy-relevant implication of our results is that competition can be more beneficial in media environments where media ownership is less concentrated.

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A Additional Results

A.1 Equilibrium in Mixed Strategies

For the symmetric equilibrium in mixed strategies to exist, media outlets need to be indifferent between reporting immediately and fact-checking. Denoting by σ the probability that each media outlet fact-checks conditional on receiving a rumor, the payoff from fact-checking can be written as:

$$\rho \sum_{k=0}^{N-1} \binom{N-1}{k} (\gamma_r^1)^k (\gamma_n^1)^{N-1-k} \sigma^k \tag{5}$$

Equating expression 5 with the payoff from reporting the rumor, which is $1-(1-\rho)c$, yields a polynomial expression the solution of which is the equilibrium σ.

$$1-(1-\rho)c = \rho \sum_{k=0}^{N-1} \binom{N-1}{k} (\gamma_r^1)^k (\gamma_n^1)^{N-1-k} \sigma^k \tag{6}$$

To see that a solution exists, consider first $\sigma = 0$: in that case, the right-hand side of condition (6) becomes $\rho(\gamma_n^1)^{N-1}$, which intuitively is the same payoff for fact-checking in the Inaccurate Equilibrium. Analogously, for $\sigma = 1$ we obtain the payoff from fact-checking in the Fact-Checking equilibrium, i.e. $\rho(1-\gamma_f^1)^{N-1}$. Given that the right-hand side of condition (6) is monotonically increasing in σ, whenever $1-(1-\rho)c < \rho(1-\gamma_f^1)^{N-1}$ and $1-(1-\rho)c > \rho(\gamma_n^1)^{N-1}$, that is when both the Fact-Checking and the Inaccurate Equilibrium exist, there exists a unique σ such that condition (6) is satisfied with equality.

A.2 Revenue Premium for Verified News

Throughout the paper we have assumed that the revenues of breaking the news were independent on whether the information was verified or a rumor. In this section, we amend the model by assuming that when both types of news are published in the first period, media outlets that published verified news receive the revenue of 1, whereas media outlets that published a rumor get a smaller revenue $r < 1$. The reason for this is that keeping the topic (i.e. the potential scandal) fixed, readers could consider verified news

as superior to the rumor, since it involves the same message plus an additional seal of truthfulness.[27]

Therefore, in this modified model, a media outlet publishing a rumor only gets the full revenue when no other outlet has proof of the scandal. Suppose that media outlets play the Fact-Checking Equilibrium. If the scandal exists, then an outlet publishing a rumor obtains a revenue of 1 if none of the other media outlets received (and published) the fact and receives r otherwise. Suppose instead that the scandal does not exist. In that case, Assumption 1 implies that a media outlet publishing the rumor is guaranteed the full revenue of 1: however, this gets more than offset by the cost of misreporting c. As a result, in the modified model, the Fact-Checking Equilibrium exists if the following condition is satisfied:

$$c \geq c_r^{FC} := 1 + r\frac{\rho}{1-\rho}(1-(1-\gamma_f^1)^{N-1}) = c^{FC} - (1-r)\frac{\rho}{1-\rho}(1-(1-\gamma_f^1)^{N-1})) \quad (7)$$

Notice that $c_r^{FC} < c^{FC}$: that is, when readers prefer fact-based news over rumor-based news, the Fact-Checking Equilibrium exists for a broader set of parameters than in the baseline setup with no ability to distinguish the two.[28]

Consider now the Inaccurate Equilibrium. In the modified model, the threshold for its existence (condition (14) in the main body of the paper) becomes the following:

$$c \leq c_r^I := 1+\frac{\rho}{1-\rho}\left(r+(1-r)(1-\gamma_f^1)^{N-1}-(\gamma_n^1)^{N-1}\right) = c^I-(1-r)\frac{\rho}{1-\rho}[1-(1-\gamma_f^1)^{N-1}] \quad (8)$$

Notice that as in the baseline model, $c_r^{FC} < c_r^I$. Moreover, analogously to the Fact-Checking Equilibrium case, $c_r^I < c^I$, meaning that the Inaccurate Equilibrium is less likely to exist in the model with readers capable of telling verified news apart from rumors, and awarding a premium to the former.[29]

[27] Implicitly, we assume that the rumor does not contain elements with higher entertainment value compared to the verified news.

[28] For completeness, notice that in the extreme case where $r = 0$, the threshold c_r^{FC} is equal to 1: in other words, the Fact-Checking Equilibrium always exists.

[29] Taking r to the extreme value of 0, the Inaccurate Equilibrium still exists for $c \leq 1 + \frac{\rho}{1-\rho}[(1 -$

To sum up, we have shown that if readers can distinguish verified news from rumors, the Fact-Checking Equilibrium is the outcome of the game for a more extensive set of parameters. In particular, for a given cost of misreporting c, the equilibrium might switch from Inaccurate to Fact-Checking if voters become able to distinguish facts from rumors. Interestingly, notice from conditions (7) and (8) that the thresholds c^{FC} and c^{I} for the existence of the Fact-Checking and the Inaccurate Equilibrium are shifted to the left by the same amount.

Consider now the second part of our main result: the comparative statics with respect to competition. As far as the Fact-Checking Equilibrium is concerned, analogously to what happens in the baseline model, an increase in N leads to an increase in the threshold c_r^{FC}. The intuition is that as long as $r > 0$, an increase in N always reduces the expected revenues of fact-checking more than those of publishing immediately. However, the same cannot be said for the Inaccurate Equilibrium threshold c_r^{I}: unlike in the baseline model, the effect of an increase in N on c_r^{I} is now ambiguous, meaning that competition can eventually decrease the level of costs above which the Inaccurate Equilibrium stops existing. In particular, this happens when the number of competitors is above the following threshold:

$$N_r = 1 + \frac{\ln\left((1-r)\frac{|\ln(\gamma_r^1+\gamma_n^1)|}{|\ln(\gamma_n^1)|}\right)}{\ln\left(\frac{\gamma_n^1}{\gamma_r^1+\gamma_n^1}\right)} \tag{9}$$

The intuition is that when N is low, the force that dominates following an increase in N is that it is more likely for some media outlet to report, increasing the incentives for a media outlet to publish a rumor. However, when N is large, what becomes dominating following an increase in N is the greater probability that some media outlet reports a fact, forcing the outlet publishing the rumor to the lower revenue of r. This eventually decreases the incentives for the outlet to report the rumor. To summarize, the effects

$\gamma_f^1)^{N-1} - (\gamma_n^1)^{N-1}]$. The intuition is that even if a media outlet can only profit when no other outlet has a fact, there are values of c such that it is profitable to publish a rumor: this is because by fact-checking, the outlet only profits when no outlet has either fact or a rumor, i.e. in a subset of cases with respect to when it is profitable to publish a rumor.

of competition in this modified model are not necessarily the same as in the baseline model. Whereas an increase in competition increases the costs necessary to sustain the Fact-Checking Equilibrium, it can also discourage the Inaccurate Equilibrium's adoption.

Finally, concerning the welfare of the two equilibria, the Fact-Checking Equilibrium's welfare is unchanged. In contrast, the welfare associated with the Inaccurate Equilibrium (weakly) increases with respect to the baseline model, since the voter has perfectly accurate information when some media outlet reports a fact in the first period. Just like in the baseline model, however, welfare is higher in the Fact-Checking Equilibrium, thanks to the fact-checking performed by media outlets that observe a rumor.

The results obtained in this environment – where the ability to distinguish facts from rumors is a condition necessary to mitigate the adverse affects of competition – further hint to the fact that competition increases the cognitive and attention requirements for the good functioning of the media role as watchdogs.

A.3 Informativeness Criterion

In this section we provide additional details on the informativeness criterion used to rank outcomes in Section 4. Denote by ρ_v the citizen's posterior probability of the scandal existing (subscript v stands for voter). The posterior belief depends on what we call "information structure", which represents several factors, as for example the number of media outlets consulted by the reader, the equilibrium followed by said outlets or whether the reader is capable of distinguishing news based on facts from news based on rumors. In terms of realizations, the posterior belief ρ_v can clearly take many different values depending on how many among the consulted outlets report a scandal. To prove most of the results in Section 4, it will be useful to denote the cumulative distribution of the possible values taken by the posterior ρ_v under a given information structure as $F(\cdot)$. Given some value of $x \in [0, 1]$, $F(x)$ represents the probability that the posterior belief of the representative citizen falls below x for the given information structure.

Intuitively, following the welfare function (4), it is clear that the representative citizen is better off the higher is the posterior conditional on it being above ρ_v^* and the lower it is conditional on being below ρ_v^*. Under full information, as a matter of fact, the posterior belief is 0 when $\omega = 0$, that is with probability $1 - p$, and 1 when $\omega = 1$, that is with probability p. Clearly, under any posterior distribution, the expected posterior $\int_0^1 \rho_v dF(\rho_v)$ is equal to p by Bayes' Law. As a consequence of this, we also have that the mean of the posterior distribution $F(\cdot)$ is equal to $1 - p$. In light of this, the comparison of the posterior distribution under different information structures boils down to the comparison of distributions with the same mean, allowing us to use second order stochastic dominance as a criterion to evaluate the expected utility of a decision maker with a non-decreasing concave utility function, since our welfare function (4) clearly belongs to this family. Notice that this is just an adaptation to our setup of the famous result by Blackwell (1951), which constitutes the most widely used criterion to measure informativeness. The following Lemma 1 uses this logic to provide us with an informativeness criterion that we can use to evaluate the welfare consequences of different market configurations.

Lemma 1. *Consider two information structures A and B and the ensuing posterior distributions $F_A(\cdot)$ and $F_B(\cdot)$. If $F_A(\cdot)$ is a mean preserving spread of $F_B(\cdot)$, then the welfare of the representative citizen given by expression (4) is higher under information structure A than under information structure B.*

Proof. In order to prove the result we invoke a well known property, which states that given two distributions $F_A(\cdot)$ and $F_B(\cdot)$, the former is a mean-preserving spread of the latter if and only if the following condition holds:

$$\int_0^x F_A(\rho_v)d\rho_v \geq \int_0^x F_B(\rho_v)d\rho_v \ \forall x \in [0,1], \tag{10}$$

To see how this applies to our setup, given welfare function (4), independently of the information structure, the representative citizen decides to retain the politician as long as $\rho_v > \rho_v^* = \frac{e_1}{e_1+e_2}$. Clearly, $\rho_v^* \in [0,1]$. Take $x = \rho_v^*$ and consider the two information

structures A and B. By condition (10),

$$\int_0^{\rho_v^*} F_A(\rho_v)d\rho_v \geq \int_0^{\rho^*} F_B(\rho_v)d\rho_v$$

Now, in order to evaluate the welfare of the citizen, we need to consider the value of the information conditional on $\rho_v \leq \rho_v^*$ under the two information structures $j \in \{A, B\}$. In particular, the value of information (i.e., the difference in expected utility between taking the two actions) given welfare function (4) is proportional to $(\rho_v^* - \rho_v)$ conditional on $\rho_v \leq \rho_v^*$ and it is proportional to $\rho_v - \rho_v^*$ conditional on $\rho_v > \rho_v^*$. This follows from the linearity of our setup and the fact that, be definition, the value of information is zero at $\rho_v = \rho_v^*$, since at that point the citizen is indifferent between the two actions. Clearly, for $\rho_v < \rho_v^*$, the value of information is decreasing in the posterior ρ_v, whereas for $\rho_v > \rho_v^*$ it is increasing in the posterior. We want to verify that condition (10) implies that:

$$\int_0^{\rho_v^*} (\rho_v^* - \rho_v)dF_A(\rho_v) \geq \int_0^{\rho_v^*} (\rho_v^* - \rho_v)dF_A(\rho_v) \tag{11}$$

Integrating both sides by parts we get the following:

$$(\rho_v^* - \rho_v)F_A(\rho_v)|_0^{\rho_v^*} + \int_0^{\rho_v^*} F_A(\rho_v)d\rho_v \geq (\rho_v^* - \rho_v)F_B(\rho_v)|_0^{\rho_v^*} + \int_0^{\rho_v^*} F_B(\rho_v)d\rho_v \tag{12}$$

and since $(\rho_v^* - \rho_v)F_j(\rho_v)|_0^{\rho_v^*} = 0$ for both $j \in \{A, B\}$, we are left with condition (10). The exact same argument can be used to show that the value of information is greater for $\rho_v > \rho_v^*$ whenever condition (10) holds.

Therefore, whenever condition (10) holds, the welfare of the citizen is higher under information structure A compared to B.

□

B Proofs

Proof of Proposition 1

Proof. The proof follows in large part the discussion already carried out in the main body of the paper. The payoff for publishing a rumor without fact-checking it is $1 - c(1 - \rho)$, which is positive following Assumption 2. Suppose that media outlets follow the Fact-Checking equilibrium strategies. Conditional on seeing a rumour, the payoff if a media outlet fact-checks is $\rho(1 - \gamma_1^f)^{N-1}$. Comparing these two quantities yields the threshold c^{FC}, that is the level of c below which a deviation towards publishing a rumor is profitable.

Suppose instead that media outlets follow the Inaccurate Equilibrium strategies. The payoff from reporting a rumor is still $1 - c(1 - \rho)$, whereas the payoff from fact-checking is $\rho(\gamma_n^1)^{N-1}$. Comparing the payoffs from the two possible actions yields c^I, that is the threshold above which a deviation towards fact-checking is profitable. □

Proof of Corollary 1

Proof. Consider first the Fact-checking Equilibrium: a fact-checking media outlet breaks the news if no other media outlet received a fact, which happens with probability $(1 - \gamma_f^1)^{N-1}$, which is decreasing in N. In the Inaccurate Equilibrium, instead, a fact-checking media outlet breaks the news only if all other media outlets received no information, which happens with probability $(\gamma_n^1)^{N-1}$, which is again decreasing in N. Given also that the profit from publishing in the first period does not depend on N, the incentives to publish in the first period increase as N grows. Consider the Fact-Checking Equilibrium first: everything else equal, there is a maximum value of N such that this equilibrium exists. Rearranging condition (3) yields:

$$N \leq N^{FC} := 1 + \frac{\ln(1 - c(1 - \rho)) - \ln \rho}{\ln(1 - \gamma_f^1)} \tag{13}$$

Conversely, the Inaccurate Equilibrium only exists for sufficiently large values of N, as it

can be easily derived rearranging condition (2):

$$N \geq N^I := 1 + \frac{\ln(1 - c(1-\rho)) - \ln(\rho)}{\ln(\gamma_n^1)} \tag{14}$$

Finally, $N^I < N^{FC}$ follows from $|\ln(\gamma_n^1)| > |\ln(1-\gamma_f^1)| = |\ln(\gamma_n^1 + \gamma_f^1)|$. □

Proof of Corollary 2

Proof. Following Lemma 1, we want to show that condition (10) is satisfied when comparing the Fact-Checking and the Inaccurate equilibrium. Assume that the reader consults a set of k outlets, chosen randomly out of the N available ones. Denote by $F_{\mathcal{FC}}(\cdot)$ the distribution of posteriors in the Fact-Checking Equilibrium and $F_{\mathcal{I}}(\cdot)$ the distribution under the Inaccurate Equilibrium. Since the number of consulted outlets is fixed to k across both equilibria, we do not include k in the notation to distinguish the two information structures. In the Fact-Checking Equilibrium, the posterior is equal to 1 as long as at least one of the outlets consulted by the reader reports of a scandal. On the contrary, the posterior when the reader sees no report is

$$\rho_{\mathcal{FC}}^{\emptyset} = \frac{p(\gamma_n^1)^k}{p(\gamma_n^1)^k + (1-p)} < p$$

In the Inaccurate Equilibrium, instead, the posterior conditional on none of the outlets reporting is:

$$\rho_{\mathcal{I}}^{\emptyset} = \frac{p(\gamma_n^1)^k}{p(\gamma^1 + n)^k + (1-p)(\gamma_n^0)^k}$$

Notice that $\rho_{\mathcal{I}}^{\emptyset} > \rho_{\mathcal{FC}}^{\emptyset}$ and hence that $F_{\mathcal{FC}}(\rho_{\mathcal{FC}}^{\emptyset}) > F_{\mathcal{I}}(\rho_{\mathcal{FC}}^{\emptyset}) = 0$. Since $F_{\mathcal{FC}}(\cdot)$ is constant thereafter, but by definition $F_{\mathcal{FC}}(1) = F_{\mathcal{I}}(1) = 1$, property (10) has to hold. To see this, suppose there was a point, denoted by $\tilde{\rho}_v$, with $\tilde{\rho}_v \geq \rho_{\mathcal{FC}}^{\emptyset}$ and such that $\int_0^{\tilde{\rho}_v} F_{\mathcal{FC}}(\rho) d\rho_v < \int_0^{\tilde{\rho}_v} F_{\mathcal{I}}(\rho_v) d\rho_v$. First of all, notice that because $\rho_{\mathcal{I}}^{\emptyset} > \rho_{\mathcal{FC}}^{\emptyset}$ and F_j being increasing for both $j \in \{\mathcal{FC}, \mathcal{I}\}$ but $F_{\mathcal{FC}}(\cdot)$ being constant after $\rho_{\mathcal{FC}}^{\emptyset}$, it has to be the case that $F_{\mathcal{I}}(\tilde{\rho}_v) > F_{\mathcal{FC}}(\tilde{\rho}_v)$. Moreover, since again $F_{\mathcal{FC}}(\cdot)$ is constant for all $\rho_v > \tilde{\rho}_v$ but $F_j(\cdot)$ is increasing, if $\int_0^{\tilde{\rho}_v} F_{\mathcal{FC}}(\rho_v) d\rho_v < \int_0^{\tilde{\rho}_v} F_{\mathcal{I}}(\rho_v) d\rho_v$ we would have $\int_0^{\rho_v} F_A(t) dt < \int_0^{\rho_v} F_B(t) dt$ for all $\rho_v \geq \tilde{\rho}_v$,

contradicting the fact that $\int_0^1 F_A(t)dt = \int_0^1 F_B(t)dt$.

Notice that this argument does not depend on whether the reader can distinguish news based on facts from those based on rumors.

□

Proof of Proposition 2

Proof. First of all, notice that as N goes to infinity, a reader consulting all available media becomes fully informed, independently of the type of equilibrium. Under the Fact-Checking Equilibrium, the probability of a scandal not being detected, i.e., $(\gamma_n^1)^N$, goes to zero as N goes to infinity: with a large number of outlets, there is always going to be at least one of them reporting when a scandal exists, and only facts are reported because all outlets fact-check. Under the Inaccurate Equilibrium, instead, a reader having access to a very large number of outlets can simply learn the state of the world by looking at the fraction of outlets that report/not report. By the Law of Large Numbers, as N grows the fraction of non-reporting outlets will move closer and closer to γ_n^ω.

Consider now the first part of the proposition. To see that increasing the number of media might decrease the amount of information provided by the media market, we evaluate the posteriors. Conditional on there being at least one fact (or at least one rumor with the state being $\omega = 1$), some outlet reports and the posterior in the Fact-Checking Equilibrium is equal to 1, whereas when no media has a fact there is no report and the posterior is equal to:

$$\rho^{\emptyset}_{\mathcal{FC},N} = \frac{p(\gamma_1^n)^N}{p(\gamma_1^n)^N + (1-p)} \tag{15}$$

Therefore, the posterior distribution is constant for ρ_v larger than $\rho^{\emptyset}_{\mathcal{FC},N}$.

Suppose now that the number of media increases to $\tilde{N}$, but, following Corollary 1, the equilibrium switches to Inaccurate because of the increased competition. Conditional on there being at least one report, the posterior is now strictly lower than 1. Conditional on

there being no report, the posterior is:

$$\rho^{\emptyset}_{\mathcal{I},\tilde{N}} = \frac{p(\gamma^1_n)^{\tilde{N}}}{p(\gamma^1_n)^{\tilde{N}} + (1-p)(\gamma^0_n)^{\tilde{N}}} \tag{16}$$

Notice that $\rho^{cit}_{0,\tilde{N}} > \rho^{cit}_{0,N}$ if and only if:

$$\frac{p(\gamma^1_n)^{\tilde{N}}}{p(\gamma^1_n)^{\tilde{N}} + (1-p)(\gamma^n_0)^{\tilde{N}}} > \frac{p(\gamma^1_n)^{N}}{p(\gamma^1_n)^{N} + (1-p)} \tag{17}$$

which, since $(\gamma^1_n)^{\tilde{N}} < (\gamma^1_n)^{N}$, implies that: that

$$p(\gamma^1_n)^{\tilde{N}} + (1-p)(\gamma^0_n)^{\tilde{N}} < p(\gamma^1_n)^{N} + (1-p) \tag{18}$$

As a consequence of this, we have that $F_{\mathcal{FC}}(\rho^{\emptyset}_{\mathcal{FC},N}) > F_{\mathcal{I}}(\rho^{\emptyset}_{\mathcal{I},N})$. Now, since $F_{\mathcal{FC}}(\cdot)$ is constant for $\rho_v > \rho^{\emptyset}_{\mathcal{FC},N}$, following the same argument as in the proof of Corollary 2, condition (10) is satisfied and the environment with $N < \tilde{N}$ media but the Fact-Checking Equilibrium rather than the Inaccurate Equilibrium provides a higher welfare.

□

Proof of Proposition 3

Proof. Under the Fact-Checking Equilibrium, if some media outlet reports the scandal, a Scandal-Biased reader sees it and knows that a scandal exists. When no outlet reports, a Scandal-Biased reader knows that all outlets received nothing. This gives rise to the exact same posteriors of a rational reader consulting all outlets, and following 2, as N grows large such a reader perfectly learns the state of the world.

Consider now the Inaccurate Equilibrium: conditional on seeing a scandal, a Scandal-Biased reader realizes that at least one outlet reported, i.e, at least one outlet received either a fact or a rumor. Since as N grows large the probability that at least some outlet has some information, which is equal to $p[1-(\gamma^0_n)^N] + (1-p)[1-(\gamma^1_n)^N]$, converges to 1, the Scandal-Biased reader is left with no information (that is, the posterior conditional on seeing a report converges to the prio p). □

Proof of Proposition 4

Proof. Notice that the Fact-Checking Equilibrium is not affected by the inclusion of a debunking benefit b because false news are never published in the first stage anyway. However, the extra cost d of being debunked does change the incentives to deviate from such equilibrium. In particular, the expected payoff of publishing becomes $1-(1-\rho)\left(c+d\left(1-{\gamma_n^0}^{N-1}\right)\right)$. Since the expected payoff of fact-checking does not change, the condition for the existence of the fact checking equilibrium is:

$$1-(1-\rho)\left(c+d\left(1-{\gamma_n^0}^{N-1}\right)\right)\leq\rho\left(1-\gamma_f^1\right)^{N-1} \tag{19}$$

Rearranging the terms we obtain the new threshold c_d^{FC} that guarantees the existence of the Fact-Checking Equilibrium. It is immediate to check that the extra cost of being debunked relaxes the condition for the existence of the Fact-Checking Equilibrium.

$$c\geq c_d^{FC}:=c^{FC}-\left(1-{\gamma_n^0}^{N-1}\right)d \tag{20}$$

Regarding the Inaccurate Equilibrium, notice that, in this case, the cost of being debunked does not affect the equilibrium. The reason is that, given that all firms receiving a rumor publish, none of them fact-checks the information. Thus, it is the benefit of debunking that can change the necessary conditions for the existence of the Inaccurate Equilibrium. In particular, when a media outlet receives a rumor in the first stage, allowing for debunking modifies the expected payoff of fact-checking. If the outlet believes that all other firms report conditional on at least seeing the rumor, the payoff for waiting until the fact-checking stage is $\rho{\gamma_n^1}^{N-1}+(1-\rho)\left(1-{\gamma_n^0}^{N-1}\right)b$. The condition for the existence of the Inaccurate Equilibrium becomes, therefore:

$$1-c(1-\rho)\geq\rho{\gamma_n^1}^{N-1}+(1-\rho)\left(1-{\gamma_n^0}^{N-1}\right)b \tag{21}$$

Rearranging the terms, we get:

$$c \leq c_d^I := c^I - \left(1 - {\gamma_n^0}^{N-1}\right) b \tag{22}$$

Finally, notice that when b is large enough with respect to the cost d of being debunked, the existence of an equilibrium in pure strategies is not guaranteed, since c_d^I might fall below c^{FC}, leaving an interval of values where neither the Fact-Checking nor the Inaccurate Equilibrium exist. More precisely, existence requires $c_d^{FC} \leq c_d^I$, which holds if and only if $b - d \leq \frac{\rho}{1-\rho} \frac{\left(1-\gamma_f^1\right)^{N-1} - {\gamma_n^1}^{N-1}}{1-{\gamma_n^0}^{N-1}}$. Therefore, a sufficient condition for the existence of an equilibrium in pure strategies is that $b \leq d$. □

Proof of Corollary 3

Proof. a) From proposition 4 we have:

$$c_d^{FC} := c^{FC} - d(1 - (\gamma_n^0)^{N-1}) = 1 + \frac{\rho}{1-\rho}\left(1 - (1-\gamma_f^1)^{N-1}\right) - d(1 - (\gamma_n^0)^{N-1}) \tag{23}$$

We take the derivative with respect to N:

$$\frac{d}{dN} c_d^{FC} = -\frac{\rho}{1-\rho}(1-\gamma_f^1)^{N-1} \ln(1-\gamma_f^1) - d{\gamma_n^0}^{N-1} \ln(\gamma_n^0) \tag{24}$$

We equalize to 0 and we solve for d and we obtain:

$$\hat{d} = \frac{\rho}{1-\rho}\left(\frac{1-\gamma_f^1}{\gamma_n^0}\right)^{N-1} \frac{\ln(1-\gamma_f^1)}{\ln \gamma_n^0} \tag{25}$$

And c_d^{FC} is increasing in N when $d \leq \hat{d}$ and decreasing when $d > \hat{d}$.

b) From proposition 4 we have:

$$c_d^I := c^I - \left(1 - {\gamma_n^0}^{N-1}\right) b = 1 + \frac{\rho}{1-\rho}\left(1 - {\gamma_n^1}^{N-1}\right) - \left(1 - {\gamma_n^0}^{N-1}\right) b \tag{26}$$

We take the derivative with respect to N:

$$\frac{d}{dN} c_d^I = \frac{\rho}{1-\rho}(\gamma_n^1)^{N-1} \ln(\gamma_n^1) + b{\gamma_n^0}^{N-1} \ln(\gamma_n^0) \tag{27}$$

We equalize to 0 and we solve for b and we obtain:

$$\hat{b} = \frac{\rho}{1-\rho} \left(\frac{\gamma_n^1}{\gamma_n^0} \right)^{N-1} \frac{\ln \gamma_n^1}{\ln \gamma_n^0} \tag{28}$$

And c_d^I is increasing in N when $b \leq \hat{b}$ and decreasing when $b > \hat{b}$.

□