Evidence Acquisition and Concealment in Voting under Diverse Worldviews*

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Abstract

We investigate voting environments where leaders have institutional mandates to search for evidence that might be useful to voters. In practice, research efforts may result unsuccessful, which allows for strategic evidence concealment. In addition, people can disagree about the available voting alternatives due only to different opinions about relevant variables. We use these two considerations to build a model where leaders make an strategic use of their research efforts and evidence concealment whenever the decisive voter is like-minded but would disagree based on some evidence. In such situations, leaders conceal unfavorable evidence always. However, when the institutionally required efforts increase further, leaders may end up concealing favorable evidence as well. We investigate how both strategic evidence acquisition and concealment vary upon changes in voting rules and in the evidence-acquisition technology. Allowing for different opinions enables interesting subjective well-being assessments, crucial for our welfare implications. We present and discuss diverse empirical evidence consistent with our model's implications.

Keywords: Evidence Acquisition; Strategic Concealment; Voting Rules

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1 Introduction

Leaders in political and voting environments—political elections, committees, or shareholder voting—are often subject to institutional mandates to search for evidence relevant to make voting decisions. Government agencies must seek for evidence on a variety of variables of interest to voters, such as public health or economic conditions. Coordinators of hiring committees must gather evidence about job candidates. Campaign leaders are often enforced by law to provide evidence supporting their claims. Board leaders must conduct research about prospective mergers prior to the approval of the shareholders. Nonetheless, such leaders frequently care themselves about the voting outcome and this might lead to critical tensions with outcome-decisive voters.

Understanding the implications of such tensions is important to propose regulations in such type of political and voting scenarios with mandatory evidence-acquisition efforts. Under which circumstances do mandatory evidence-acquisition policies enhance the actual provision of evidence? What drives leaders to disclose or conceal obtained evidence? How do voting rules, or the available research technologies, affect incentives to raise research efforts? Can leaders find valuable to conceal even evidence favorable to their interests? How are the well-beings of the different actors affected by voting rules and by the available research technologies? To investigate these questions, we develop a simple model where a leader must, at least, make a minimum (costly) effort to obtain evidence about a variable of interest before deciding on its public disclosure to a group of voters.

Our first central assumption is to consider differences of opinions across individuals who, nonetheless, hold identical fundamental preferences. We use the idea of diverse worldviews to motivate disagreements of opinions about unknown relevant variables. Given such fundamentally opinion-based discrepancies, an interesting political economy scenario arises when leaders acquire and disclose evidence about relevant variables, possibly changing preferred alternatives and, sometimes, even the voting outcome.

To illustrate the above features of our model, consider a committee of experts that must either accept or reject the development of an infrastructure project through voting. Suppose that a civil engineer and a financial expert are two members of the committee and that—possibly due to their different backgrounds or expertises—they reason under diverse worldviews. Then, they could have different opinions about the suitability of the project due only to different predictions of variables that affect its profitability. The opinion of the civil engineer might be more driven by the likelihood she places on the successful completion of the roads of the project, whereas the financial expert might focus more on fund-raising prospects.[1] Then, the acquisition and disclosure by a committee leader of biophysical evidence that the subsoil is muddy, or of survey evidence that local residents are willing to financially support the project, may change the opinions of these two committee members and, in consequence, their preferred votes on the project. This may have a considerable impact on welfare due to induced changes both in the actual voting outcome and in the voters' subjective assessments about the suitability of each possible alternative. Crucially, since the opinions of the leader and the voters determine their subjective well-beings, the leader's evidence acquisition effort and his disclosure have welfare implications that cannot be addressed under the premise of common opinions.

The second central assumption is that research efforts may be unsuccessful and, in such a case, this cannot be proved. This assumption, commonly known as *partial provability*, leaves the leader room to conceal evidence that would harm him if disclosed.

Our first insight is concerned with the leader's incentives to conceal the obtained evidence. It is intuitive that (i) if the leader agrees with the resulting decisive voter on the best alternative based on each possible piece of evidence, then no concealment is necessary to achieve the leader's preferred voting outcome. We then show that (ii) if the leader and the decisive voter are not like-minded based on their initial opinions, then evidence concealment is in fact ineffective to influence the voting outcome. This implication rests on the signaling mechanism that stems from the leader's concealment strategies. Upon the leader reporting that he has obtained no evidence, voters discount this strategic behavior and assess the honesty of the leader. When no evidence is reported, voters' posterior beliefs about the relevant variable end up being a convex combination of their initial opinions and any possible posteriors based on evidence. We then use this implication to show (Proposition 1) that if the initial opinion of the decisive voter is not favorable to the leader, then the induced posteriors based on reporting no evidence cannot be favorable either.

In any of the two previous situations (i) or (ii) (that is, either agreement based on any possible piece of evidence or disagreement based on initial opinions), since acquiring evidence is costly, the leader makes only the institutionally-required minimum effort and discloses all the—arbitrarily small amount of—evidence obtained. We then study the consequences of varying the voting rule in a way such that any of the two situations (i) or (ii) above prevail. In general, voting rules that make the decisive voter either very similar to the leader or very far away from him, based on some evidence, disincentivize evidence acquisition and

[1] We would like to emphasize situations where, owning solely to disagreeing opinions and not to underlying preferences, the civil engineer and the financial expert would answer differently. For instance, they would express different opinions about the suitability of the project even if they did not care personally about whether the project is actually developed.

bolsters full disclosure of the obtained evidence. For environments with large numbers of voters whose opinions distribute relatively uniformly and low institutionally-required efforts, the implication is that either very unanimous or very dictatorial voting rules incentivize the leader to make only the minimum effort and disclose all obtained evidence. In such environments, simple majority rules raise the likelihood of more evidence acquisition, and of some strategic concealment as well.

We then show that the leader wants to increase further his research efforts (above the institutionally-required minimum) and conceal some evidence if and only if he and the decisive voter are like-minded based on their initial opinions but disagree based on evidence unfavorable to the leader. For low institutionally-required efforts, the leader conceals only the unfavorable evidence.[2] Another, more counterintuitive, implication follows as well: if the institutionally-required effort increases, then the leader may end up concealing also favorable evidence. Our model provides a logic under which stringent institutional requirements that force leaders to make relatively high efforts may ultimately disincentivize the disclosure of evidence. High institutionally-required efforts heightens voters' suspicions of unfavorable evidence being concealed. In consequence, the leader wants to compensate such a "negative skepticism" by concealing favorable evidence as well. In short, when critically constrained by stringent mandates to conduct research, the leader wants to convey the message that he is dishonest always, also when he obtains favorable evidence.

Our second set of results deals with the incentives of the leader to acquire evidence when he finds valuable to conceal some of it. Uniqueness of equilibrium in our model allows for interesting comparative-statics exercises. Conditional on concealment being valuable for the leader, he lowers his research efforts either when more votes are required to achieve his preferred voting outcome or when the evidence-acquisition technology improves. When the leader needs to influence higher numbers of distant voters, he also needs to lower the skepticism induced by his concealment. Similarly, the leader needs to lower skepticism when he uses better evidence-acquisition technologies because better technologies entail higher probabilities of obtaining unfavorable evidence. In any of the two previous cases, the leader can more easily convince voters that he has obtained no evidence by lowering his research efforts. Otherwise, upon high efforts, the leader runs the risk of voters raising their eyebrows on the suspicion that such efforts have indeed yielded undisclosed evidence.

Our last set of results are concerned with the welfare implications of strategic evidence concealment. Since evidence acquisition is costly, the leader in principle prefers situations

[2] This implication is remarkably consistent with recent experimental findings (Zhe-Jin et al., 2021) that Senders disclose favorable evidence and conceal unfavorable pieces.

where he does not increase his efforts above the institutionally-required minimum. Therefore, the leader's well-being decreases whenever either the initial distribution of opinions, the existing voting rule, or the evidence-acquisition technology lead him to acquire more evidence in order to influence the decisive voter. As to the welfare of voters, when the leader has incentives to conceal evidence, more unanimous voting rules are welfare improving (Proposition 3). Unlike this, when the leader does not have incentives to conceal evidence, whether voting rules are more or less unanimous has no impact on the welfare of the voters (Proposition 4). Finally, if the leader benefits by switching from concealing to not concealing evidence, then, for certain distributions of initial opinions, more unanimous voting rules are detrimental to the welfare of voters (Proposition 5).

Our model identifies situations where the well-being of the leader rises while, at the same time, the well-beings of larger sets of voters increase as well. Our assumptions of different opinions and partial provability play a crucial role in these kinds of insights. In particular, partial provability allows the leader to benefit by reducing voters' skepticism through lower research efforts. On the other hand, due to their different opinions, the well-beings of larger sets of voters increase because the strategic concealment rises the probability of obtaining the voting outcome that such voters initially preferred. To the best of our knowledge, our environment of diverse subjective assessments of own well-beings gives rise in a novel way to non obvious welfare implications in voting environments.

Our benchmark model restricts attention to voting with a binary choice, either accept a proposal or remain in the status quo, such as it is the case in referendums (e.g., to remain or to leave the European Union, to implement or not stringent measures to fight a pandemic, to issue or not company shares). An extension to more than two alternatives for voting is discussed in Section 6.

At the end of the paper, we present evidence on some of our insights on research efforts and disclosure. We use data about policies and performances during the COVID-19 pandemic to obtain evidence on the relation between (1) leaders' opinions against a (hypothetical) decisive voter well-informed about the actual state of the pandemic and (2) efforts on evidence acquisition through COVID-19 testing efforts. We also review available evidence on the leader's strategic evidence disclosure addressed to like-minded voters.

Our paper contributes to a growing political economy literature on strategic evidence disclosure in voting environments. Building upon a diverse worldviews motivation to allow for different opinions is an essential part of our approach. The Harsanyi doctrine of common priors has been challenged recently by a number of papers in order to examine interesting implications to strategic communication of people having different opinions about variables of interest (Mullainathan and Shleifer, 2005; Alonso and Camara, 2016a; Che and Kartik, 2009). On the methodological usefulness of considering different opinions, Morris (1995) discusses why assuming heterogeneous priors can have a broad interest and appeals to bounded rationality considerations. In fact, we rely on the recent bounded rationality proposal of Mailath and Samuelson (2020) to diverse worldviews to justify our approach to different opinions across players.

Another central premise of our paper is that of *partial provability*, which originated in the accounting literature (Dye, 1985; Jung and Kwon, 1988) and has been subsequently used by economists as well (Che and Kartik, 2009; Jackson and Tan, 2013; Kartik et al., 2017; Shishkin, 2022). In addition, following Che and Kartik (2009)'s approach, we allow for the probability that research yields evidence to be endogenously chosen by the leader at a cost. The sort of questions investigated are different though. In a model without voting, the primary interest of Che and Kartik (2009) is to study which degree of discrepancies in opinions, relative to a Sender, would a Receiver prefer. Key ingredients of the two setups are also different.[3] Some of our results are reminiscent of theirs, in particular, when we consider what motivates the leader to switch from not wanting to conceal evidence to doing so. Our setup, though, identifies differently what Che and Kartik (2009) refer to as "some difference of opinion." In our case, the leader is motivated by like-mindedness in terms of initial opinions and differences in terms of some posteriors based on evidence. Furthermore, considering finite sets of alternatives and of pieces of evidence allows us to obtain quite different implications to theirs on how the leader reduces the voters' skepticism by reducing evidence acquisition efforts (conditional on concealment being valuable to the leader). The particular mechanism underlying our implications cannot be investigated in a setup with a continuum of alternatives and pieces of evidence.

A paper close to ours in terms of the questions asked is Jackson and Tan (2013). They also consider the partial provability approach to examine evidence concealment to a group of voters. However, the underlying mechanisms and welfare implications of the two papers are quite different. While players are identical in their fundamental preferences in our setup, Jackson and Tan (2013) consider heterogeneous preference biases across voters. In particular, difference of opinions based on evidence cannot be exploited in their model as an incentive to acquire and conceal evidence. Furthermore, differences of opinions naturally lead to differences in the subjective assessments of the players' own well-beings. This consideration is essential to conduct a welfare analysis based on subjective beliefs which, to the best of

[3] Che and Kartik (2009) consider a continuum of possible actions which involves a totally different approach to explore equilibrium, relative to the one considered in the current paper.

our knowledge, has not been investigated previously in these sort of evidence disclosure and voting environments.

The remainder of the paper is organized as follows. Subsection 1.1 illustrates some of our model's implications using media coverage of evidence-acquisition efforts and disclosure by campaign leaders during the 2016 Brexit referendum. Section 2 lays out the benchmark model and Section 3 explores the logic of evidence acquisition and concealment. Section 4 presents the paper's welfare implications. Section 5 presents and discusses a variety of empirical evidence that supports some of our paper's insights. An extension to more than two alternatives for voting is discussed in Section 6. Section 7 discusses further literature connections and Section 8 concludes. The proofs of all the results appear in the Appendix.

1.1 Evidence Acquisition and Disclosure during the Brexit Referendum

Recent history has provided anecdotal accounts that evidence acquisition and concealment by leaders are largely addressed toward voters initially like-minded that would nonetheless change their minds should unfavorable evidence be disclosed. According to media coverage, during the 2016 Brexit referendum, the campaign director of the Leave option, Dominic Cummings, spent months doing evidence-based research into the economic relationships between the United Kingdom and the European Union. Then, the Leave campaign displayed (mostly on buses) the famous statement "Let's give our NHS the £350 million the E.U. takes every week." However, the Office for National Statistics subsequently stated that such a £350 amount "did not take into account the rebate or other flows to the public sector (or flows to non-public sector bodies), alongside the suggestion that this could be spent elsewhere, without further explanation, was potentially misleading."[4] Thus, the Leave campaign made efforts to obtain evidence on the economic relationships between the United Kingdom and the European Union, but then it became subsequently known that some key pieces of evidence had not been disclosed. Clearly, efforts to obtain all the available evidence on this point can be unsuccessful and voters discount this—i.e., the partial provability premise.

Another key feature of this incomplete disclosure was that, to the extent that the disclosure of the £350 million figure was voiced out only through Leave campaign events and channels,[5] all indicates that concealing unfavorable evidence was largely targeted toward

[4] In the same direction, in an interview with BBC's journalist Andrew Marr, NHS chief executive questioned the veracity of the £350 million figure on the grounds of being an incomplete disclosure.

[5] Since the United Kingdom government supported the Remain option, most prominent Remain campaigners, including David Cameron, could use official government channels—sometimes even echoed through international meetings or institutions such as the IMF—to disclose evidence. For instance, United States president Barack Obama used government press conferences to campaign in favor of the Remain option. Leave campaigners, on the other hand, had to resort to non-official channels that, consequently, required a

followers with initial opinions already aligned with the Leave option. Our model offers a rationale for why making efforts to obtain evidence about such economic relationships and then concealing evidence about rebates was a sound strategy for the Leave campaign to address voters already favorable to leaving.

In a similar fashion, it was also notorious on the side of the Remain campaign the extensive reporting of the BBC on the statement by the Confederation of British Industry (CBI): "The CBI says that all the trade, investment, jobs and lower prices that come from our economic partnership with Europe is worth £3000 per year to every household." However, it became subsequently known that this was not a complete disclosure either.[6] Furthermore, not disclosing all the potentially available evidence was arguably aimed at influencing voters that paid attention to the BBC's reporting and, therefore, whose initial options were already closer to the Remain option. Such features have been widely documented. Interviews with campaigners, media content analysis, and post-referendum surveys reveal that the Leave campaign focused its disclosure on convincing voters already worried about immigration and restrictions imposed by the European Commission's regulation, whereas the Remain campaign focused its disclosure on convincing voters already in favor of a supranational, relatively more stable or reassuring, economic framework (Atikcan et al., 2020). These kinds of choices to gather evidence and then to selectively disclose (or conceal) pieces of obtained evidence illustrate the main features that we investigate in this paper.

2 The Model

2.1 Voting and Preferences

A finite group of voters $i \in N \equiv \{1, \ldots, n\}$ (each of them, she) must choose a *voting outcome* x from a binary set of alternatives $X \equiv \{A, R\}$, where $x = A$ means (A)cceptance of a certain proposal and $x = R$ means (R)ejection of the proposal (and thus remaining in the "status quo"). In order to choose a voting outcome, each voter $i \in N$ casts a *vote* $v_i \in X$, where $v_i = A$ means "in favor of A" and $v_i = R$ means "in favor of R." Let $v \equiv (v_1, \ldots, v_n) \in X^n$ be a *voting profile* and let us use $x(v) \in \{A, R\}$ to indicate the *voting outcome* obtained from the voting profile v. In particular, the proposal is (A)ccepted by means of voting if it

certain degree of involvement by attendees and followers. Presumably, such an audience was mainly composed of voters closer to the Leave option.

[6] United Kingdom in a Changing Europe Fellow Jonathan Portes detailed that such a disclosure was "based on a selection of studies produced at different times (some date back well over a decade), with different methodologies, and designed to answer different questions. Some looked at the economic impact of E.U. membership to date, and some at the future impact of a vote to leave. Some are not even specific to the United Kingdom."

obtains at least a certain number $k \in N$ of votes in favor. If less than k voters vote in favor of A, then the proposal is (R)ejected. Thus, k parameterizes the *k-voting rule*: $x(v) = A$ if $|\{i \in N \mid v_i = A\}| \geq k$ and $x(v) = R$ if $|\{i \in N \mid v_i = A\}| \leq k - 1$. Under the goal of accepting the proposal, we say that the k-voting rule becomes "more dictatorial" as k lowers and "more unanimous" as k rises.

A leader, who is not part of the group of voters, $i = l$ (he)—e.g., a politician or committee coordinator—is also interested in the voting outcome. There is an unknown *variable of interest* $\omega \in \Omega \equiv \{A, R\}$ which summarizes those features that the voters and the leader regard *relevant* to ascertain the most suitable choice x. The players $i \in N \cup \{l\}$ have preferences over $(v, \omega) \in X^n \times \Omega$. In particular, each voter $i \in N$ cares only about the suitability of her cast vote v_i according to a utility $u_i(v, \omega)$ such that $u_i(v, \omega) = 1$ if $v_i = \omega$ and $u_i(v, \omega) = 0$ if $v_i \neq \omega$. Each voter wants *her vote* to match the unknown variable. By explicitly considering that voters care only about their own votes, and not about the voting outcome, we avoid uninteresting equilibrium multiplicity issues.[7] More fundamentally, we want to capture situations where voters "value" their individual voting decisions and prefer to act according to their idiosyncratic beliefs (about the relevant variable), regardless of other considerations about the voting process. The leader cares about the suitability of the voting profile v according to a utility $u_l(v, \omega)$ such that $u_l(v, \omega) = 1$ if $x(v) = \omega$ and $u_l(v, \omega) = 0$ if $x(v) \neq \omega$. The leader wants *the choice selected by the voting process* to match ω.

Notice that, for any k-voting rule, if the variable ω were commonly known, then there would be no conflict of interests among the different actors. All the players agree on the best course of action conditional on knowing the realization of ω. Similarly to Che and Kartik (2009)'s approach in their single-Receiver model, the fundamental disagreement takes place at the level of opinions. These assumptions separate the premises of our model from those of other models on evidence disclosure in the presence of voting in which preferences are not aligned, such as Jackson and Tan (2013). Additionally, our central assumption that players work under diverse worldviews separate the conclusions as well, most notably, its welfare implications.

The following two subsections discuss the two key assumptions of our setup.

2.2 Assumption I: Diverse Worldviews and Different Opinions

The standard approach in game-theoretical models (sometimes referred to as the *Harsanyi doctrine*) is to consider that players share common priors over a state space Θ whose elements

[7] In a (different) game where voters cared about the voting outcome, they could be indifferent when their own votes do not affect the voting outcome, giving rise to equilibria irrelevant for the sort of questions we ask.

θ describe exhaustively all possible outcomes of uncertainty. We crucially deviate from this assumption. Rather, we rely upon recent bounded-rationality developments to justify our model's assumption that the players have different opinions about a variable of interest ω they deem relevant.

In particular, we rely upon Mailath and Samuelson (2020)'s approach, in which players work with (deliberately) incomplete *reasoning models* to understand the entire complex set of states of the world Θ that would resolve all uncertainty. We use such foundations to consider that, given an event $D \subset \Theta$ of interest, players act as "model-based reasoners" that partition Θ into two equivalence classes that they believe capture relevant information about D. We then label such equivalence classes as $\omega \in \{A, R\}$, so that $\Omega = \{A, R\}$ becomes the set of relevant "states" (variables) in "the players' reasoning models." In particular, $\omega = A$ if and only if $\theta \in D$. As we detail below, the players will construct their partitions of the complex set of states Θ differently, yet they will commonly label the resulting variable as $\omega \in \{A, R\}$. Mailath and Samuelson (2020) further assume that different players use different models to understand the complex state space Θ. They refer to such incomplete and different ways of understanding all uncertainty as the players having *diverse worldviews*.

Let us lay out a few formal ingredients, sticking to Mailath and Samuelson (2020)'s own formulation. Without loss of generality, we can express the entire set of states as $\Theta = Y^I$, where Y and I are finite sets. Consider then that each player $i \in N \cup \{l\}$ deliberately restricts attention to "truncated" realizations $\theta_{I_i} \in Y^{I_i}$ of θ, where $I_i \subset I$. In this way, players begin with incomplete information to form "interim" beliefs about the complex states θ. Specifically, each player i explains the occurrence of the event D using their own (incomplete) *reasoning model*, which is formally described by a function $f_i : Y^{I_i} \to [0, 1]$. Here, $f_i(\theta_{I_i})$ gives the probability that player i assigns to $\theta \in D$ (or, equivalently, to $\omega = A$). Thus, players work with incomplete *information classes* $\mathcal{I}_i$[8] that include the features about the world which they deem most salient (while ignoring others that they consider less relevant). Then, we assume that each player i begins with an idiosyncratic (interim) opinion $\mathbb{P}(\omega = A \mid \mathcal{I}_i) \in (0, 1)$ about the relevant variable ω, based on their own information class $\mathcal{I}_i$.

To illustrate these considerations, suppose that—as spelled out in the Introduction—a committee of experts faces the decision of whether or not to develop a certain infrastructure project. Consider that $\omega \in \{A, R\}$ is the variable that summarizes the overall benefit of such a project ($\omega = A$ has the accepted meaning of high benefit and $\omega = R$ of low benefit). In most practical situations of this sort, a state space Θ that resolves all uncertainty would consider

[8] The information class $\mathcal{I}_i$ corresponds to the σ-algebra on Θ generated by the subset I_i.

an overwhelmingly complex set of factors, with physical, economic, environmental, or even ideological, dimensions. A civil engineer would use her knowledge, or “model,” to focus on how to build the bridges and roads, while a financial advisor would use quite a different model to understand fund-raising issues or long-term profitability. Models of social gentrification would be in the mind of a sociologist but not in the way of understanding the project of a computer engineer. Environmental advisors would consider the foreseeable effects on the fauna and the animal species. When asked about the unknown profitability of the project, each person i would consider her own information class $\mathcal{I}_i$ to come up with an (interim) opinion $\mathbb{P}(\omega = A \mid \mathcal{I}_i)$. In short, our model assumes that the reasoning model and information class $(I_i, \mathcal{I}_i)$ of a civil engineer is different from those $(I_j, \mathcal{I}_j)$ of, say, an environmental advisor. Furthermore, building on the results of Mailath and Samuelson (2020), we consider that even if the civil engineer and the environmental advisor exchanged information repeatedly, then they would not necessarily attain complete agreement.[9]

The assumption of different opinions based on diverse worldviews will play a central role in our model's implications. In particular, different opinions will affect the leader's incentives to communicate with voters. Furthermore, different players will assess their foreseeable benefits from the voting process using different opinions, which will drive the welfare implications. Players will use subjective opinions to assess their well-beings.

We acknowledge though that the sort of practical situations described above have traditionally encountered fundamental challenges when formalized using game-theoretical models. Following an adaptation of Aumann (1976)'s “agreeing to disagree” famous theorem, Geanakoplos and Polemarchakis (1982) showed that if *fully-rational* players begin with different information (via different partitions of the state space) but (i) know (commonly) the description of all possible uncertainty (i.e., the partitions of everyone) and (ii) exchange information via a certain protocol (in which they observe an event and then update their beliefs in response to others' beliefs), then their different initial opinions cannot persist.[10]

Nonetheless, situations in which individuals hold persistently different opinions about unknown variables are commonplace in practice. Social scientists have recently followed several paths to get around those formal difficulties posed by the perfect rationality and common knowledge principles. One of such paths would consider that players have different informa-

[9] Turning to an illustration of a political voting scenario, we could think that leaders and voters in the 2016 Brexit referendum did not hold a common understanding of the entire set of states of the world that described the net benefits of leaving or staying in the European Union. Furthermore, leaving aside other strategic considerations, it is apparent that, by exchanging their opinions in public debates, the different actors did not come up with a common assessment of the uncertain features associated to leaving or staying.

[10] Also, using a learning perspective, Dekel et al. (2004) have argued that Nash equilibrium as a solution concept is difficult to justify without common priors.

tion (via different partitions) of the entire set of states of the world and, thus, simply allow for different priors. For those environments, if the analysis either precludes information exchange protocols à la Geanakoplos and Polemarchakis (1982) or assumes that the different partitions of different players are not commonly known, then different opinions *can* persist. While not always being explicit about such formal justifications, (persistent) heterogeneous priors to formalize different opinions (that drive interesting incentives in strategic communication) have been assumed, for instance, by Che and Kartik (2009), Mullainathan and Shleifer (2005), and Alonso and Camara (2016a).[11] On another path, Acemoglu et al. (2016) develop a formal approach to justify the persistence of different opinions in game-theoretical models by introducing uncertainty over (commonly-known) learning processes. Other efforts have followed more behavioral approaches by proposing models of categorical thinking, or "coarse-thinking," e.g., Mullainathan (2002) and Fryer and Jackson (2008).

As already mentioned, we opt in this paper for a justification that relies on the bounded-rationality approach that Mailath and Samuelson (2020) have nicely formalized. Let us lay out a few details about how our model makes use of their foundations. Mailath and Samuelson (2020) build upon Savage (1972)'s suggestion that players may escape the complexity of considering the entire set of states of the world Θ by partitioning such a set into elements that capture the most relevant factors, while ignoring others less relevant. Additionally, partitions are constructed differently by different actors thus leading to diverse worldviews. Most notably, the machinery of model-based reasoning investigated by Mailath and Samuelson (2020) proves formally that, unless trivial information is shared, exchange protocols à la Geanakoplos and Polemarchakis (1982) do not lead in general to common beliefs (Proposition 1) and that players with different worldviews do not aggregate correctly their information (Proposition 2).

We consider then such foundations as a compelling justification to assume that different players have different worldviews $(I_i, \mathcal{I}_i)$, and that, even if they were to exchange their information, they would continue to hold different beliefs. Formally, we will use $\beta_i \equiv \mathbb{P}(\omega = A \mid \mathcal{H}_i)$, where $\mathcal{H}_i \equiv (\mathcal{I}_i, \mathcal{B}_\infty^{-i})$ denotes the limiting filtration of information classes that player i possesses, to identify the limiting beliefs of the players about the variable ω after they possibly engaged in an infinite information-exchange protocol—à la Geanakoplos and Polemarchakis (1982).[12] In summary, we will use the implications of the described bounded-

[11] As mentioned in the Introduction, Morris (1995) discusses why assuming heterogeneous priors can be useful in economic models.

[12] Formally, $\mathcal{B}_\infty^{-i}$ stands for the the sigma-algebra on Θ induced for player i by an infinite sequence of announcements according to the protocol: (1) players i observe ω_{I_i}, (2) players i announce truthfully their (interim) beliefs $\mathbb{P}(\omega = A \mid \mathcal{I}_i)$, (3) players update their beliefs using everyone's announcements, (4) players announce their updated beliefs, update again, announce again, and so on ad infinitum.

rationality approach to assume that, even in situations where players had the opportunity to exchange their opinions repeatedly, they would still begin with different *opinions* β_i about the unknown variable ω which they deem relevant.

Without loss of generality, we will consider that the diverse opinions of the voters are arranged according to $0 < \beta_n < \cdots < \beta_1 < 1$. Then, based on her initial opinion, we will say that a voter i is R-biased if $\beta_i < 1/2$ and A-biased if $\beta_i \geq 1/2$. Without loss of generality, we will consider that $\beta_l > 1/2$ so that we will restrict attention to environments with an A-biased leader. This is just to ease the exposition and all of our conclusions continue to hold qualitatively (with the obvious symmetric adjustments) when one considers an R-biased leader. Finally, we will say that the leader is *moderate* when β_l is close to 1/2 and *radical* when β_l is close to 1.

2.3 Assumption II: Evidence Acquisition and Disclosure with Partial Provability

The leader has an institutional mandate to make a positive *research effort* $\lambda \in [\underline{\lambda}, 1)$, for $\underline{\lambda} > 0$, to obtain "hard evidence"—e.g., data, scientific reports—about the variable ω. After obtaining evidence, the leader decides on the public disclosure of such an evidence to the group of voters. The second central assumption of our model is that the leader's research efforts may be unsuccessful. In this respect, we follow the approach of *partial provability*: when the leader obtains no evidence, he cannot prove whether this is due to his efforts having been unsuccessful. Typically, when there is uncertainty about a Sender having evidence to disclose, he can pool between having no evidence and having unfavorable evidence (Dye, 1985; Jung and Kwon, 1988; Che and Kartik, 2009; Jackson and Tan, 2013; Kartik et al., 2017; Shishkin, 2022), breaking down the classical unravelling mechanism of verifiable disclosure (Grossman, 1981; Milgrom, 1981; Milgrom and Roberts, 1986).

Formally, the research effort λ exerted by the leader determines the probability of obtaining a (noisy) *signal* $s \in S \equiv \{a, r, \emptyset\}$ about the variable ω. We interpret signal $s = a$ as *evidence in favor of* A and signal $s = r$ as *evidence in favor of* R. Furthermore, given our benchmark consideration that the leader is in favor of alternative $x = A$, we will henceforth refer to $s = a$ as *favorable evidence* and to $s = r$ as *unfavorable evidence* (of course, relative to the leader's interests). Signal $s = \emptyset$ is interpreted as the research effort having been unsuccessful and the leader having obtained *no evidence*. The leader exerts the effort λ at a cost $c(\lambda) > 0$. By doing so, the leader chooses the likelihood of his research being successful. The cost function $c(\cdot)$ is smooth, increasing, convex, and satisfies $\lim_{\lambda \to 1} c(\lambda) \leq 1$. Notably, because of his institutional mandate, the leader does not have the option of not acquiring any evidence about the relevant variable. He must choose positive efforts $\lambda > 0$ to learn about the variable of interest, yet the required minimum effort $\underline{\lambda}$ can be arbitrarily small—and we will largely regard $\underline{\lambda}$ as being very small. Voters can verify the research effort λ exerted by the leader.

We consider a very simple form of evidence-acquisition technology. Taking into account that evidence acquisition efforts may be unsuccessful, effort λ delivers a signal $s \in S$ according to the conditional probability

$$\mathbb{P}(s \mid \omega; \lambda) = \begin{cases} \lambda q \;\text{ if }\; (s,\omega) \in \{(A,a),(R,r)\}; \\ \lambda(1-q) \;\text{ if }\; (s,\omega) \in \{(A,r),(R,a)\}; \\ (1-\lambda) \;\text{ if }\; s = \emptyset \;\text{ for any }\; \omega \in \{A,R\}, \end{cases} \tag{1}$$

for an *evidence-acquisition technology* parameter $q \in (1/2, 1)$. The technology assumed in Eq. (1) imposes strong symmetry requirements. The main qualitative messages of the paper, though, follow through under modifications of such a particular form. The advantage of the particular technology assumed in Eq. (1) is that it simplifies substantially the analysis and discussion of results. Such kinds of simple structures have been abundantly used in applications nonetheless.[13]

After learning privately the signal s obtained from his research effort, the leader chooses whether or not to disclose such findings *publicly to all* voters. The information contained in each $s \in \{a, r\}$ is "hard evidence" which cannot be modified or falsified. Thus, if the leader obtains evidence and discloses it, he is constrained to transmitting true information to the voters. In addition to the intensity of his research effort, the other strategic choice of the leader, therefore, is whether to disclose or to conceal obtained evidence. If voters are reported signal $s = \emptyset$, then they update their beliefs (in a Bayesian way) to assess whether the leader's research has indeed been unsuccessful, or he is instead concealing evidence. More specifically, for each signal $s \in S$ privately obtained by the leader from his research effort, he chooses the probability $\sigma(\hat{s} \mid s)$ according to which he reports signal $\hat{s} \in S$ publicly to all voters. Since signals $s \in \{a, r\}$ correspond to hard evidence, the leader is constrained by:

(i) $\sigma(\emptyset \mid s) = 1$ whenever $s = \emptyset$, and

(ii) $\sigma(\hat{s} \mid s) = 0$ for each pair $\hat{s}, s \in \{a, r\}$ such that $\hat{s} \neq s$.

[13] For instance, the form of partial provability and the evidence-acquisition technology in Eq. (1) follows closely the assumptions made by Kartik et al. (2017). However, in Kartik et al. (2017) players share common priors about the unknown variable but their preferences are not aligned. More importantly, the sort of questions that they address are very different from the ones explored in the current paper. In particular, they are not concerned about incentives to acquire and disclose evidence to a group of voters. Their research questions deal with competition between different Senders to provide evidence to a single Receiver under partial provability.

The leader (i) must disclose no evidence when he obtains no evidence and (ii) cannot disclose a piece of evidence different from the one that he actually obtained. However, the leader can report no evidence even when he has obtained a piece of evidence, that is, he can choose any $\sigma(\emptyset \mid s) \in [0,1]$ for $s \in \{a, r\}$. Thus, the leader conceals favorable evidence when he chooses $\sigma(\emptyset \mid a) > 0$ and unfavorable evidence when he chooses $\sigma(\emptyset \mid r) > 0$.

The strategy $\sigma(\hat{s} \mid s)$ that relates the signal s actually obtained by the leader and the signal $\hat{s}$ that he reports allows for a signaling protocol. Through this signaling protocol, voters can infer information about the actual signal obtained by the leader and, in this way, about his honesty as well.

2.4 Timeline

The timing of the game played by the leader and the group of voters is as follows.

(1) Nature chooses a value of the relevant variable $\omega \in \{A, R\}$, which remains unknown to everyone.[14]

(2) The leader chooses his research effort $\lambda \in [\underline{\lambda}, 1)$. The leader's research effort (or, alternatively, the research cost $c(\lambda)$ incurred) becomes commonly known to all voters. The leader privately observes the signal $s \in S$ obtained by his research effort and reports a signal $\hat{s} \in S$ to all voters—under the restrictions detailed earlier in (i) and (ii) of Subsection 2.3.

(3) For each reported signal $\hat{s}$, each voter i forms posteriors about ω using her idiosyncratic opinion β_i and the leader's concealment strategy σ. Each voter i chooses her preferred vote $v_i \in \{A, R\}$. Based on the existing k-voting rule, an outcome $x(v)$ is then chosen using the voting profile $v = (v_1, \ldots, v_n) \in \{A, R\}^n$.

A *(pure) strategy of voter* i is a mapping $v_i : S \to X$ where $v_i(\hat{s})$ is the vote cast by voter i upon observing the reported signal $\hat{s}$. Given the assumed preferences, it is without loss of generality to restrict attention to pure strategies for voters. Furthermore, we will select those equilibria in which $v_i(\hat{s}) = A$ when the voter is indifferent between the two alternatives upon observing $\hat{s}$. With this selection criterion, we simply want to restrict attention to equilibria in which the indifferent voter votes for the preferred alternative of the A-biased leader. A *profile of voting strategies* is $v(\hat{s}) \equiv (v_1(\hat{s}), \cdots, v_n(\hat{s})) \in X^n$. A *strategy of the leader* (λ, σ) is a pair that specifies a research effort λ and a concealment strategy σ. A *profile of strategies for the players* (λ, σ, v) is a strategy of the leader and a profile of voting strategies. The equilibrium notion that we will use is that of perfect Bayes equilibrium—to which we will simply refer as *equilibrium*.

[14] Alternatively, using the foundations described in Subsection 2.2, we can consider that Nature chooses a value $\theta \in \Theta$ of the complex set of states of the world, which in turn yields the relevant variable ω and the initial opinions β_i of the players.

Definition 1. An *equilibrium* is a profile of strategies for the players $(\lambda^*, \sigma^*, v^*)$ such that: (i) *voters' optimal votes upon reported signals*: for each voter $i \in N$, for each reported signal $\hat{s} \in S$,

$$v_i^*(\hat{s}) \in \arg\max_{v_i \in X} \mathbb{E}\big[u_i(v_i, \omega) \mid \mathcal{H}_i, \hat{s}; \sigma^*, \lambda^*\big],$$

where we select $v_i^*(\hat{s}) = A$ if $\arg\max_{v_i \in X} \mathbb{E}\big[u_i(v_i, \omega) \mid \mathcal{H}_i, \hat{s}; \sigma^*, \lambda^*\big] = X$;
(ii) *leader's optimal concealment upon observed evidence*: for each observed piece of evidence $s \in \{a, r\}$, and for each reported signal $\hat{s} \in \{s, \emptyset\}$, $\sigma^*(\hat{s} \mid s) > 0$ implies that

$$\mathbb{E}\big[u_l\big(v^*(\hat{s}), \omega\big) \mid \mathcal{H}_l, s; \sigma^*, \lambda^*\big] \geq \mathbb{E}\big[u_l\big(v^*(\hat{s}'), \omega\big) \mid \mathcal{H}_l, s; \sigma^*, \lambda^*\big] \quad \text{for each} \quad \hat{s}' \in S;$$

(iii) *leader's optimal research effort*:

$$\lambda^* \in \arg\max_{\lambda \in [\underline{\lambda}, 1)} \mathbb{E}\big[u_l\big(v^*, \omega\big) \mid \mathcal{H}_l; \sigma^*, \lambda\big] - c(\lambda).$$

The expected utility of the leader in condition (ii) of Definition 1 is an interim utility conditional on each possible signal s. The expected utility that appears in condition (iii) is the leader's ex-ante utility. The leader anticipates the signal that he will receive from his research effort, takes into account his concealment strategy, and discounts accordingly the choice achieved by voting. Specifically, for a signal $s \in S$, we use $\rho_i(s) \equiv \mathbb{P}(s \mid \mathcal{H}_i, \lambda) = \sum_\omega \mathbb{P}(s \mid \omega; \lambda)\mathbb{P}(\omega \mid \mathcal{H}_i)$ to denote the probability that, based on her information class $\mathcal{H}_i$ (and, thus, on her own opinion β_i), player i assigns to the leader receiving signal s conditional on the research effort λ. Then, for any player $i \in N \cup \{l\}$, we derive

$$\mathbb{E}\big[u_i\big(v, \omega\big) \mid \mathcal{H}_i; \sigma, \lambda\big] \equiv \sum_\omega \mathbb{P}(\omega \mid \mathcal{H}_i) \sum_{s, \hat{s}} \rho_i(s)\sigma(\hat{s} \mid s) u_i\big(v(\hat{s}), \omega\big), \tag{2}$$

an expression for the players' ex-ante utility which will be key to investigate our model's welfare implications.

2.5 Updating of Opinions

For voter $i \in N$, given her information class $\mathcal{H}_i$ (about the entire set of states Θ), we use $\mu_i^{\hat{s}} \equiv \mathbb{P}(\omega = A \mid \mathcal{H}_i, \hat{s}, \lambda)$ to describe her posterior belief (that $\omega = A$) conditional on a reported signal $\hat{s}$ and on a research effort λ by the leader. Similarly, the leader's posteriors are described by $\mu_l^s \equiv \mathbb{P}(\omega = A \mid \mathcal{H}_l, s, \lambda)$. When voter i observes a signal $\hat{s} \in \{a, r\}$, it necessarily corresponds to hard evidence so that $\hat{s} = s$. In these situations, by applying

Bayes' rule, any player i's posterior beliefs are given by

$$\mu_i^s = \frac{\mathbb{P}(s \mid \omega = A; \lambda)\beta_i}{\mathbb{P}(s \mid \mathcal{H}_i, \lambda)}. \tag{3}$$

The following lemma captures useful features of the posterior beliefs induced by pieces of evidence $s \in \{a, r\}$.

Lemma 1. For each evidence-acquisition technology $q \in (1/2, 1)$, it follows that
(i) $\mu_i^r < \beta_i < \mu_i^a$ for each player $i \in N \cup \{l\}$;
(ii) for each pair of players $i, j \in N \cup \{l\}$, $\beta_i < \beta_j$ implies $\mu_i^r < \mu_j^r$ and $\mu_i^a < \mu_j^a$.

Lemma 1 (i) establishes that observing evidence in favor of any of the two alternatives brings accordingly opinions closer to the alternative. From Lemma 1 (ii), we learn that, conditional on each given piece of evidence $s \in \{a, r\}$, the ordering of beliefs described by the voter's initial opinions is preserved.[15]

Voters need to be more sophisticated when the leader reports that he has obtained no evidence ($\hat{s} = \emptyset$). In such a case, they use Bayes' rule to assess if this is true or if, instead, the leader has obtained evidence that he is concealing. We interpret this as the voters assessing *the leader's honesty*. Given a concealment strategy σ, let $\delta_i(s \mid \emptyset) \equiv \mathbb{P}(s \mid \hat{s} = \emptyset, \mathcal{H}_i, \lambda, \sigma)$ be the probability that voter i assigns to the leader having actually observed evidence $s \in \{a, r\}$, conditional on his reporting of signal $\hat{s} = \emptyset$. Application of Bayes' rule yields

$$\delta_i(s \mid \emptyset) = \frac{\sigma(\emptyset \mid s)\rho_i(s)}{\sigma(\emptyset \mid a)\rho_i(a) + \sigma(\emptyset \mid r)\rho_i(r) + (1 - \lambda)}. \tag{4}$$

Higher values of $\delta_i(s \mid \emptyset)$ mean that voter i assesses lower honesty on the leader's side (with the particular form of a higher likelihood that he is concealing the piece of evidence s). Lemma 2 describes a couple of features of the voters' reaction upon observing $\hat{s} = \emptyset$.

Lemma 2. For each evidence-acquisition technology $q \in (1/2, 1)$, and each voter $i \in N$, it follows that
(i) for each signal $s \in \{a, r\}$, the probability $\delta_i(s \mid \emptyset)$ increases strictly with $\sigma(\emptyset \mid s)$ and decreases strictly with $\sigma(\emptyset \mid s')$ for $s' \in \{a, r\} \setminus \{s\}$;
(ii) for each given concealment strategy σ and each signal $s \in \{a, r\}$, the probability $\delta_i(s \mid \emptyset)$ increases strictly with $\lambda \in [\underline{\lambda}, 1)$.

[15] This result, however, does not preclude the possibility that, starting from $\beta_i < \beta_j$, the voters' posteriors satisfy $\mu_i^a > \mu_j^r$.

When the leader conceals a particular piece of evidence frequently, voters discount this and place high likelihood on the leader having concealed such evidence. Lemma 2 (ii) states that higher research effort naturally raises voters' skepticism when they are reported that research was unsuccessful ($\hat{s} = \emptyset$).

We now derive the posterior belief $\mu_i^{\hat{s}}$ of a voter i when the leader reports $\hat{s} = \emptyset$. In this case, the voter believes that the leader's research effort has been unsuccessful and, therefore, that he is reporting honestly, with probability $1 - \delta_i(a \mid \emptyset) - \delta_i(r \mid \emptyset)$. In this event, the voter is simply left with her initial opinion β_i to assess the occurrence of ω. On the other hand, the voter infers that the leader is concealing a given piece of evidence $s \in \{a, r\}$ according to probability $\delta_i(s \mid \emptyset)$. In this event, the voter places herself in the position of the leader to update her beliefs about ω. She then uses the piece of evidence s and her own initial opinion β_i with the technology described in Eq. (1). By putting together all those inferences, it follows that

$$\mu_i^{\emptyset} = \delta_i(a \mid \emptyset)\mu_i^a + \delta_i(r \mid \emptyset)\mu_i^r + \big(1 - \delta_i(a \mid \emptyset) - \delta_i(r \mid \emptyset)\big)\beta_i. \tag{5}$$

Thus, the posterior belief of a voter i, conditional on the leader not disclosing any piece of evidence is a convex combination of the beliefs $\{\mu_i^a, \beta_i, \mu_i^r\}$. Then, it follows from the implication $\mu_i^r < \beta_i < \mu_i^a$ of Lemma 1 (i) that $\mu_i^{\emptyset} \in co\{\mu_i^a, \mu_i^r\}$.[16]

3 Strategic Evidence Concealment

In this section, we address the fundamental question of when it is actually beneficial for the leader to conceal the evidence that he obtains from his research effort. We also investigate the optimal effort of the leader on evidence acquisition. To ease exposition, we will throughout consider that, based on any possible piece of evidence, the leader is always in favor of accepting the proposal, that is, $\mu_l^r \geq 1/2$.

Proposition 1. Consider a k-voting rule and assume that $\mu_l^r \geq 1/2$. Suppose that the research effort $\lambda \in [\underline{\lambda}, 1)$ is given. Then, it is beneficial for the leader to conceal evidence in equilibrium to the set of voters if and only if the following condition is satisfied:

(C) $\mu_k^r < 1/2$ and $\beta_k \geq 1/2$.

From the considered arrangement of opinions, it follows directly that voter $i = k$ is *decisive* (to switch the voting outcome from $x(v) = R$ to $x(v) = A$). Assuming that, based on any piece of evidence $s \in \{a, r\}$, the leader prefers always acceptance of the proposal, $x(v) = A$, is

[16] Given a set M, $co(M)$ denotes its convex hull.

basically to simplify discussions. The interesting conflict of interests between the leader and the group of voters arises as long as, based on any piece of evidence, the leader's posterior disagrees with the outcome that would follow from the voting process. In such cases, the leader wants to conceal evidence. In those cases, we want to ask then if such a concealment induces the decisive voter to change her preferred vote. Otherwise, the leader will not be interested in concealing any evidence in equilibrium.[17]

In principle, the leader wishes to influence the decisive voter k if they disagree about the best course of action $x(v)$ based on any possible posteriors induced by evidence. However, our A-biased leader would be able to influence such a decisive voter only if they disagree on the best course of action based on the posteriors upon unfavorable evidence ($s = r$). In this case, by means of acquiring evidence and then concealing (some of it), the leader is able to influence the decisive voter so as to make her vote in favor of the proposal, $v_k = A$. This is the case because, under the proposed partial provability mechanism, posteriors conditional on reporting no evidence are a convex combination of the beliefs $\{\mu_k^r, \beta_k, \mu_k^a\}$ (Eq. (5)).

From the expression in Eq. (5), one may wonder whether the leader would be able to induce $\mu_k^{\emptyset} = 1/2$, so as to influence the decisive voter, when they disagree based on their initial opinions, that is, when $\beta_k < 1/2$. That appears as a plausible option when $\mu_k^a > 1/2$ and the answer is not obvious. However, Proposition 1 shows that it is not feasible for the leader to induce such posteriors by reporting $\hat{s} = \emptyset$ when $\beta_k < 1/2$. In short, condition (C) tells us that the leader has incentives to conceal some of the acquired evidence when he and the decisive voter (i) are like-minded in terms of their initial opinions but (ii) disagree after seeing evidence unfavorable to the leader (to achieve his desired voting outcome).[18]

When condition (C) of Proposition 1 is not satisfied, the only equilibrium involves the leader disclosing each piece of evidence that he obtains. There are, though, two qualitatively different ways in which condition (C) may not be satisfied. First, if $\mu_k^r \geq 1/2$, then the decisive voter agrees with the A-biased leader for each possible piece of evidence. In this case, the leader *does not need to influence the decisive voter* to achieve his goals. Secondly, if $\beta_k < 1/2$, then the decisive voter disagrees with the A-biased leader upon, at least, the piece of evidence $s = r$ and the initial opinions. In this case, the leader actually wants to influence the decisive leader but *any feasible concealment strategy turns out ineffective.*

Finally, for the leader to conceal evidence in equilibrium, we note that the evidence-

[17] Totally symmetrical results to the ones provided by Proposition 1 would follow if we were to assume that, based on any piece of evidence, the leader is R-biased and prefers to remain in the status quo (i.e., if we assumed instead $\mu_l^a \leq 1/2$).

[18] Arguments totally symmetric to the ones in the proof of the proposition show that, if the leader were R-biased based on any piece of evidence, then concealment is part of an equilibrium whenever the two parties agree based on initial opinions and disagree based only on the signal favorable to the proposal ($s = a$).

acquisition technology must have a certain minimum quality. This a consequence of the fact that condition $\mu_k^r < 1/2$ is satisfied if and only if the primitives of the model are such that $q > \beta_k$ holds. Then, given the proposed arrangement of the voters' initial opinions (in which β_i decreases with the label $i \in N$), it follows that more unanimous k-voting rules make it easier for the evidence technology to meet the above condition $q > \beta_k$ (which is required for the leader to conceal evidence in equilibrium).

Fig. 1 displays a situation where condition (C) of Proposition 1 holds. In this case, the leader can select $\mu_k^{\emptyset} \in co\{\mu_k^r, \mu_k^a\}$ so as to achieve $\mu_k^{\emptyset} = 1/2$ and, in this way, influence the decisive voter $i = k$.

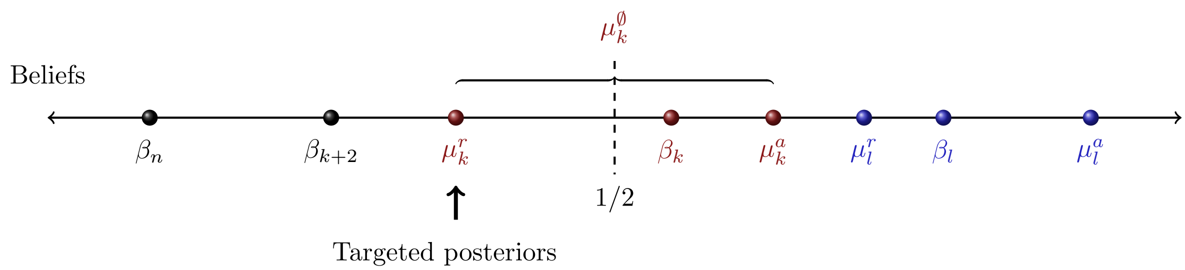

Figure 1 – Influencing the Beliefs of Decisive Voter upon $s = r$

The sort of "cherry picking" concealment strategy described by Proposition 1 can be interpreted in terms of signaling. The leader uses the possibility that research be unsuccessful to pool between $s = r$ and $s = \emptyset$. In the sort of situations described by condition (C) of Proposition 1, full revelation where the leader always discloses both pieces of evidence $s = r$ and $s = a$ is harmful for him. Instead, he benefits from concealing evidence in a way so as to signal honest reporting conditional on evidence $s = a$ and dishonest reporting conditional on evidence $s = r$. Given this partially disclosure behavior (which is also partially revealing in the traditional signaling terms), upon observing $\hat{s} = \emptyset$, voters will infer that the leader has either obtained no evidence or has obtained evidence $s = r$.

Proposition 2 describes the equilibrium research effort and concealment strategy in the interesting case in which the leader actually benefits from acquiring and concealing evidence.

Proposition 2. Consider a k-voting rule and assume that $\mu_l^r \geq 1/2$. Suppose that condition (C) of Proposition 1 holds. Then, the concealment strategy σ^* and the research effort λ^* in the unique equilibrium of the proposed disclosure game are given by:

(a) if we consider a value for $\underline{\lambda}$ such that $0 < \underline{\lambda} \leq (2\beta_k - 1)/(q + \beta_k - 1)$, then

$\sigma^*(r \mid r) = 0$, $\sigma^*(a \mid a) = 1$, and

$$\lambda^* = \frac{2\beta_k - 1}{q + \beta_k - 1};$$

(b) if we consider a value for $\underline{\lambda}$ such that $\underline{\lambda} > (2\beta_k - 1)/(q + \beta_k - 1)$, then $\sigma^*(r \mid r) = 0$, $\sigma^*(a \mid a) = (2\beta_k - 1)/\underline{\lambda}(q + \beta_k - 1) \in (0, 1)$, and $\lambda^* = \underline{\lambda}$.

Voting rules that induce a decisive voter k with posteriors in favor of the proposal (i.e., $\mu_k^r \geq 1/2$) would make the A-biased leader not benefiting from acquiring and concealing evidence. Therefore, on the one hand, if voting rules become more dictatorial so as to exceed a certain (upper) bound $\overline{k}$, under which $\mu_{\overline{k}}^r \geq 1/2$, then the A-biased leader exerts the minimum effort $\underline{\lambda}$ and discloses all obtained evidence. On the other hand, if voting rules become more unanimous so as to fall below a certain (lower) bound $\underline{k}$, under which $\beta_{\underline{k}} < 1/2$, then the A-biased leader does not benefit either by acquiring and concealing evidence. In consequence, he again exerts minimum effort $\underline{\lambda}$ and discloses all obtained evidence. These two cases describe situations in which changing the voting rule switches the primitives of the model from meeting condition (C) to not satisfying the condition. The general message here is that voting rules that make the decisive voter either very similar to the leader or very far away from him disincentivize evidence acquisition efforts and bolster full evidence disclosure.

In the type of equilibrium described by (b) in the proposition, the leader finds valuable to conceal the favorable evidence ($s = a$) as well. This situation may follow when relatively high institutionally-required minimum efforts $\underline{\lambda}$ are imposed. Furthermore, from the equilibrium expression of $\sigma^*(a \mid a)$, we note that the probability that the leader conceals the favorable evidence increases with the institutionally required minimum effort $\underline{\lambda}$. The strategic concealment in (b) of pieces of evidence favorable to the leader follows from the feasibility requirements that a concealment strategy σ must satisfy to be effective to influence the decisive voter (i.e., in a way so as to achieve $\mu_k^{\emptyset} = 1/2$). In turn, inducing such posteriors require a concealment $\sigma(\emptyset \mid a) > 0$ (or, equivalently, $\sigma(a \mid a) < 1$) when the leader is institutionally required to make at least a relatively high minimum effort $\underline{\lambda}$.

In such a type of equilibrium, the leader would like to choose a research effort below $\underline{\lambda}$. However, he is institutionally constrained by $\lambda \geq \underline{\lambda}$ and, therefore, ends up choosing $\lambda^* = \underline{\lambda}$. Roughly, this (corner-type) optimal choice heightens the voters' skepticism in a way forced by the institutional mandate on research efforts. This goes against the leader's goals because voters place higher likelihood on the leader's having obtained unfavorable evidence $s = r$ when he reports $\hat{s} = \emptyset$. Then, in order to achieve $\mu_k^{\emptyset} = 1/2$ (so as to influence the decisive voter), the leader must also make the decisive voter place higher likelihood on having obtained the favorable evidence ($s = a$) when he reports $\hat{s} = \emptyset$. This can only be achieved by concealing favorable evidence with a certain probability $\sigma(\emptyset \mid a) > 0$. In other words, the leader wants to conceal the favorable piece of evidence in order to compensate, by means of "positive" skepticism toward having obtained $s = a$, for the (institutionally forced) "negative" skepticism toward $s = r$. Furthermore, compensating for such a negative skepticism is part of the leader's optimal behavior since research efforts are costly. This gives us an interesting mechanism in which, by choosing $\sigma(\emptyset \mid a) > 0$, the leader wants to convey the message that he is dishonest always, when he obtains unfavorable evidence but also when he obtains favorable evidence. Although the underlying mechanisms are quite different, this implication is reminiscent of the concealment of positive signals explained by a "countersignaling" logic (Feltovich and Harbaugh, 2002; Bederson et al., 2018).[19]

Finally, we observe that the expression $(2\beta_k - 1)/(q + \beta_k - 1)$ increases with the opinion β_k of the decisive voter. Suppose that the opinion of the decisive voter draws her closer to indifference between the two alternatives ($\beta_k \to 1/2$ for $\beta_k > 1/2$). Then, this facilitates the above described concealment of favorable evidence, which is triggered by an stringent institutional mandate.

In our model, strategic evidence disclosure is favored by voting rules that make the decisive voter and the leader agree conditional on initial opinions and disagree conditional on some evidence.[20] These implications are reminiscent of Che and Kartik (2009)'s message that a Sender has more incentives to acquire and conceal evidence when facing a Receiver with dissimilar opinions, yet not very apart from his own.

The uniqueness of the equilibrium derived by Proposition 2 allows us to conduct static-comparative exercises when we allow the k-voting rule, or the evidence-acquisition quality parameter q, to vary—while condition (C) continues to hold.

Remark 1. Provided that both condition (C) of Proposition 1 and $\underline{\lambda} \leq (2\beta_k - 1)/(q + \beta_k - 1)$ continue to hold, either more unanimous k-voting rules or better evidence-acquisition technology (that is, higher values of q) make the leader lower his research effort in the type of equilibrium described by Proposition 2 (a).

The optimal research effort λ^* derived in Proposition 2 (a) is increasing in β_k, for each given $q \in (1/2, 1)$, and decreasing in q, for each given $\beta_k \geq 1/2$. Then, by noting that the suggested arrangement of the voters' initial opinions makes β_i decreasing with the label $i \in N$,

[19] Feltovich and Harbaugh (2002) introduced the idea of countersignaling by assuming that high-quality Senders can signal a self-confidence attribute by not separating themselves from medium-quality Senders.

[20] Analogous mechanisms would follow for the case of an R-biased leader. For the case of an R-biased leader that prefers to remain in the status quo conditional on any piece of evidence, condition (C) of Proposition 1 is simply rewritten as $\mu_k^a \geq 1/2$ and $\beta_k < 1/2$.

Remark 1 delivers the insight that, under the specified conditions, either more unanimous k-voting rules or better evidence-acquisition technology make the leader lower his research effort. Conditional on the leader being always able to influence the voting outcome as the k-voting rule increases (that is, $\beta_k \geq 1/2$ and $\beta_{k'} \geq 1/2$ when the voting rule moves from k to $k' > k$), if the opinion of the resulting decisive voter becomes closer to make voter k' prefer $v_{k'} = R$ (owing to $1/2 \leq \beta_{k'} \leq \beta_k$), then the leader lowers his equilibrium effort λ^*. The reason for this relies crucially on the fact that in equilibrium the leader wants to conceal unfavorable evidence ($s = r$) and make voters believe that he has obtained no evidence. When β_k lowers, so does μ_k^r (Lemma 1 (ii)). This heightens the leader's incentives to conceal unfavorable evidence. Furthermore, less effort lowers the voters' skepticism on the leader having obtained any evidence. Those arguments, together with the fact that evidence acquisition is costly, incentivize the leader to lower his research effort.[21]

These insights now contrast sharply the main messages of Che and Kartik (2009). In their model, the Sender—who can conceal evidence using the same sort of mechanism that we investigate—(i) raises his research effort to lower skepticism and (ii) if allowed, prefers to pick a Receiver with a certain difference of opinion. The difference in implications is a consequence of the fact that, in our model, voters make discrete voting choices and (in the interesting equilibrium) the leader wants to conceal one particular piece of evidence. Unlike this, Che and Kartik (2009) consider a setup with a continuum of actions for the Receiver and a continuum of pieces of evidence from which the Sender can conceal a subset. In that case, the Sender cant persuade a Receiver whose opinions get farther from his own by concealing larger sets of evidence, while keeping the Receiver's preferred action not far from his own preferred action. In their model, this can be achieved by acquiring more evidence. In our model, when the leader conceals some evidence in equilibrium, he wants to conceal one particular piece of evidence. As a consequence, he needs to acquire less evidence in order to lower the voters' skepticism. In such situations, only by acquiring less evidence, the leader can take advantage of reporting that his research effort has been unsuccessful.

Better evidence-acquisition technology q leads to that evidence $s = r$ induces posteriors that place relatively more weight on $\omega = R$ (compared to worse technology $q' < q$). Since the leader wants to conceal evidence $s = r$ in equilibrium (so as to pool between $s = r$ and $s = \emptyset$), he needs to lower his research effort to make voters less skeptical upon reporting $\hat{s} = \emptyset$. When he benefits by concealing evidence that harms him, the leader wants to compensate better

[21] The arguments behind Remark 1 can be readily replicated to obtain totally symmetric insights for the case of an R-biased leader based on any piece of evidence (i.e., a leader such that $\mu_l^a \leq 1/2$). Conditional on the leader actually benefiting from acquiring and concealing evidence (condition (C)), either more dictatorial k-voting rules or better evidence-acquisition technology make the leader lower his research effort.

technology by exerting less effort to acquire evidence. By showing less effort, he seeks to be more convincing about his reporting of not having obtained evidence.[22]

Remark 2. Provided that both condition (C) of Proposition 1 and $\underline{\lambda} > (2\beta_k - 1)/(q + \beta_k - 1)$ continue to hold, either more unanimous k-voting rules or better evidence-acquisition technology (that is, higher values of q) make the leader lower the disclosure probability $\sigma^*(a \mid a) \in (0, 1)$ described by Proposition 2 (b).

Remark 2 states that when the institutionally imposed minimum research effort $\underline{\lambda}$ is sufficiently high so as make the leader not to disclose the favorable evidence ($s = a$), then more unanimous k-voting rules and better evidence-acquisition technology lead to less disclosure of such a piece of evidence.

As noted, the comparative-statics insights provided by Remark 1 and Remark 2 depend crucially on that the required conditions on primitives (k and q) continue to hold after changing such primitives. Then, it is intuitive to see that such insights result more appealing when appliedto political voting scenarios with large numbers of voters. In those situations, it seems more natural to consider that changes in k and q would still allow the final values of such parameters to satisfy the respective conditions of Proposition 2 (which are required to keep the described endogenous equilibrium choices).

4 Welfare Implications of Strategic Concealment

We turn now to investigate the welfare implications for the various actors under the sort of equilibria with evidence concealment analyzed in Section 3. Our central assumption that players work with different worldviews shapes crucially the nature of the welfare implications. In particular, it allows us to obtain conclusions different from those of related papers that assume common priors. The key ingredient of our approach is that the players will use subjective opinions to assess their own well-beings.

[22] In a setup where an expert and a decision-maker have common priors and conflicting underlying preferences, Henry (2009) highlights an interesting mechanism through which the expert wants to raise his evidence-acquisition efforts in order to lower the decision-maker's skepticism. The crucial assumptions in Henry (2009)'s model that separate this implication from our insights in this respect are (i) higher effort raises the probability of obtaining more favorable evidence and (ii) the decision-maker cannot observe the expert's effort. Notably, "selling honesty" has opposing effects in the two setups. In our model, it is the possibility that efforts be unsuccessful what underlies the key mechanism that relates research efforts with perceived honesty.

4.1 *The Well-Being of the Leader*

We investigate first the implications on the well-being of our A-biased leader. We begin with those situations in which the leader strategically acquires and conceals pieces of evidence.[23] For the equilibrium choices described in Proposition 2 (a) the proposal is always accepted. Therefore, from an ex-ante perspective, the leader benefits only when $\omega = A$. Under his (ex-ante) subjective assessment, the probability that $\omega = A$ is simply β_l. Thus, the expression for the leader's ex-ante utility in Eq. (2) becomes

$$\mathbb{E}\big[u_l\big(v^*, \omega\big) \mid \mathcal{H}_l; \sigma^*, \lambda^*\big] - c(\lambda^*) = \beta_l - c(\lambda^*).$$

We can use the above expression to investigate how changes in the voting rule or in the quality of evidence acquisition affect the leader's welfare. Notice how the leader's well-being depends only on the evidence acquisition costs in which he incurs. The main insight is that more unanimous rules and/or better technologies of evidence acquisition increase the leader's well-being.

Remark 3. Provided that both condition (C) of Proposition 1 and $\underline{\lambda} \leq (2\beta_k - 1)/(q + \beta_k - 1)$ continue to hold upon the proposed changes in the primitives k or q, the leader is better off under more unanimous k-voting rules or better evidence-acquisition technology (that is, higher values of q).

In situations where disclosing favorable evidence ($s = a$) makes it harder to achieve his goal of inducing outcome $x(v) = A$, the leader lowers his effort. He wants to do so in order to lower the voters' skepticism while making them believe that he has obtained no evidence. That happens, in particular, if the leader needs to influence increasingly higher numbers of voters, as it is the case under more unanimous voting rules. A totally analogous mechanism based on reducing skepticism follows when the quality of the evidence-acquisition technology improves.[24]

We now study the implications on the well-being of the A-biased leader when changes in the k-voting rule or in the evidence-acquisition technology q lead him to switch from strategically acquiring and concealing evidence to not doing so. Thus, we are now interested in the comparative-statics exercise in which condition (C) ceases to hold upon proposed the changes in the primitives k and q. One interesting insight is that the leaders' welfare is

[23] That is, situations in which condition (C) of Proposition 1 is satisfied.

[24] These insights follow from the implication of Proposition 2 (a) that the value of λ^* in equilibrium lowers as the values of the primitives k or q increase. As in the cases studied by Remark 1–Remark 2, the insights provided by Remark 3 depend crucially on that the required conditions on primitives (β_k and q) continue to hold after changing such primitives.

affected differently depending on the particular way in which condition (C) fails to hold. Another insight is that the leader's welfare is also affected differently depending on whether he is moderate or radical.

Recall that there are two possible ways in which condition (C) may fail to hold: either (i) the leader does not need to influence the resulting decisive voter (i.e., $\mu_k^r \geq 1/2$) or (ii) any concealment strategy is ineffective to influence the resulting decisive voter (i.e., $\beta_k < 1/2$). On the one hand, in the kind of situations described by (i), the voting outcome is acceptance and the leader's (ex-ante) net utility amounts to $\beta_l - c(\underline{\lambda})$. Therefore, since $\lambda^* \geq \underline{\lambda}$ (for the equilibrium effort λ^* described in Proposition 2 (a)), the leader is better off by not concealing evidence (as a consequence of $\mu_k^r \geq 1/2$), compared to situations where he optimally chooses to conceal unfavorable evidence ($s = r$). On the other hand, in the kind of situations described by (ii), the voting outcome is rejection and the leader's (ex-ante) net utility amounts to $(1-\beta_l)-c(\underline{\lambda})$. Therefore, the leader is (weakly) better off by not concealing evidence (as a consequence of $\beta_k < 1/2$) compared to situations where he optimally chooses to conceal the unfavorable evidence ($s = r$), if and only if the following condition on the difference of evidence acquisition costs is satisfied:

$$c(\lambda^*) - c(\underline{\lambda}) \geq 2\beta_l - 1. \tag{6}$$

In short, this condition requires that the leader's utility gain when moving from concealing unfavorable evidence (as prescribed by the type of equilibrium in Proposition 2 (a)) to disclosing each piece of evidence overcomes the difference in research costs.

Let us now see how moderate ($\beta_l \to 1/2$) and radical leaders ($\beta_l \to 1$) are impacted differently. We restrict attention to those equilibrium values of the research effort described in Proposition 2 (a), which satisfy $\lambda^* > \underline{\lambda}$. Of course, these are the interesting equilibrium values to explore the condition on costs stated in Eq. (6). Then, if the leader is moderate ($\beta_l \to 1/2$), condition Eq. (6) is easily satisfied. On the other hand, it follows from our assumption that $\lim_{\lambda \to 1} c(\lambda) \leq 1$ that if the leader is radical ($\beta_l \to 1$), then it becomes much harder for condition Eq. (6) to be met. When Eq. (6) is not satisfied due to $\beta_l \to 1$, such a radical leader is better off by making higher efforts and by concealing unfavorable evidence.

4.2 The Well-Beings of the Voters

We turn now to explore the welfare consequences for the voters that follow from the leader's equilibrium concealment strategy. We will assess how changes in the k-voting rule or in the quality q of the evidence-acquisition technology affect the voters' (ex-ante) utilities. In particular, we investigate how many of the voters gain, lose, or remain unaffected by such changes both in the two different types of equilibrium presented (the one in which the leader values acquiring and concealing evidence and the one in which he does not) and when we switch from one such type of equilibrium to the other.

In the two types of equilibrium of Proposition 2, the leader conceals the unfavorable evidence ($s = r$) with probability one. Notably, the two types of equilibrium described by the proposition differ in the probability with which the leader discloses the favorable evidence ($s = a$). Nonetheless, it can be verified that the probability that each voter assigns to the leader receiving evidence $s = a$ and reporting honestly $\hat{s} = a$, is the same in these two types of equilibrium.[25] The well-beings of voters are thus ultimately not affected by changes in the model's primitives that make equilibrium move from one type to the other (within those equilibria described by Proposition 2). The results are as follows.

Proposition 3. Suppose that condition (C) of Proposition 1 continues to hold upon changes in either k or q. Then, for each type of equilibrium in Proposition 2:

(a) As k rises to $k' > k$ then, within the set of A-biased voters N_A, k voters remain unaffected, $k' - k$ voters become better off and $n_A - k'$ voters become worse off.

(b) As q rises, then, within the set of A-biased voters N_A, k voters remain unaffected and $n_A - k$ voters become worse off.

(c) Each R-biased voter that, upon observing $\hat{s} = a$, switches to vote for acceptance as k rises, becomes better off. Moreover, by not switching her rejection vote she remains unaffected.

(d) Each R-biased voter that, upon observing $\hat{s} = a$, switches to vote for acceptance as q rises, becomes worse off. Moreover, by not switching her rejection vote she becomes (weakly) better off.

As the number of votes required to accept the proposal rises, the number of voters that remain at least unaffected increases, whereas the number of voters who become worse off decreases. Here we can take the simple approach of assessing welfare variations for the group of voters by considering the cardinalities of the different groups of voters whose well-beings vary in one direction or another. Under this consideration, since more unanimous voting rules raise the number of voters whose well-beings improve, Proposition 3 provides the insight that voting rules which require a higher number of votes in favor of the leader's preferred alternative (i.e., more unanimous ones) are welfare improving (so long as condition (C) continues to apply under the proposed changes in k).

[25] See the proof of Proposition 3.

Going back to our example in the Introduction of committee voting on the development of an infrastructure project, suppose that the financial expert is initially in favor of rejecting the project and that the leader discloses survey evidence that local residents are willing to support the project. Then, Proposition 3 (c) says that her subjective assessment of the suitability of the project makes her better off when she switches to prefer the development of the project. On the other hand, if the civil engineer is also initially against the development the project, and such a survey evidence does not make her switch to considering the project a good idea, then her well-being remains unaffected. The ways in which the leader influences both the voting outcome and the opinions of the voters have welfare implications due to our key assumption of diverse opinions.

Recall that in the type of equilibrium of Proposition 2 (a) the leader is better off under more unanimous voting rules (Remark 3). It is then worthwhile highlighting that, upon changes in the voting rule, the well-beings of the leader and the group of voters move in the same direction. The reasons for such welfare variations are quite different though. As to the leader, as k rises, he needs to lower his equilibrium effort to reduce the skepticism of voters, and such decision raises his utility. As to the voters, the logic behind the implication of Proposition 3 is as follows. There is an increasing number $k' - k$ of A-biased voters strictly raise their well-beings as the voting rule becomes more unanimous. In particular, owing to the concealment strategy of the leader, upon observing $\hat{s} = \emptyset$, such voters switch their votes from rejection (R) to acceptance (A). Then, their initial opinions in favor of alternative A make them increase their subjective expected utilities. Notice also that the voters $i \leq k$ are not affected by changes in k or q, since they vote for acceptance (A) upon any reported signal $\hat{s} \in \{\emptyset, a\}$.[26]

Finally, the R-biased voters become worse off when a better technology induces them to vote for acceptance upon observing $\hat{s} = a$. Additionally, more unanimous voting rules are beneficial for them because as k rises they observe $\hat{s} = a$, and as a consequence vote for acceptance, less frequently.

The following Proposition 4 assesses the welfare of voters in the case in which the leader does not have incentives to conceal evidence.

PROPOSITION 4. Suppose condition (C) of Proposition 1 is not satisfied and, furthermore, it continues to not hold upon changes in k or q. Then, all voters are unaffected by changes in k. Moreover, upon an increase in q, we have the following implications:

(a) Each A-biased voter in the set $N \setminus \{1, \ldots, k\}$ becomes worse off if, upon observing

[26] There is also a shrinking number $n_A - k'$ of A-biased voters that become worse off as k rises. The reason is that such voters vote for rejection upon observing $\hat{s} = \emptyset$ and they now observe $\hat{s} = \emptyset$ more frequently.

$\hat{s} = r$, she switches to vote for rejection. If she does not switch her vote, she becomes (weakly) better off. The same holds for an A-biased voter in the set $\{1, \dots, k\}$ if condition (C) is not satisfied due to $\beta_k < 1/2$. If condition (C) is not satisfied due to $\mu_k^r \geq 1/2$, such voter remains unaffected.

(b) Each R-biased voter becomes worse off if, upon observing $\hat{s} = a$, she switches to vote for acceptance. If she does not switch her vote, she becomes (weakly) better off.

The key mechanism behind the results in Proposition 4 is that improvements of the evidence acquisition technology may lead voters to assess that the alternative they were initially biased against is indeed the more suitable one. This naturally harms them from their (ex ante) subjective viewpoints. Relative to the implications in Proposition 3, the main difference now is that no voter is affected by changes in the k-voting rule. This is the case because neither the equilibrium effort nor the leader's decision on whether to disclose any piece of evidence change.

Beyond the questions addressed in Proposition 3 and Proposition 4, we would like to investigate also the ways in which the voters are affected when changes in the primitives k or q make the leader switch from concealing evidence to not doing so. The results are as follows.

Proposition 5. Suppose that, for initial values of parameters k and q, condition (C) of Proposition 1 holds. Furthermore, suppose then that condition (C) ceases to hold owing to (i) k rises to $k' > k$ and thus we have $\beta_{k'} < 1/2$. Then:

(a) With respect to the two types of equilibrium described by Proposition 2, each A-biased voter becomes (weakly) worse off if she belongs to the set $\{1, \dots, k\}$. Otherwise, she becomes better off.

(b) Each R-biased voter becomes (weakly) better off (resp., worse off) with respect to the type of equilibrium described by Proposition 2 (a) (resp., Proposition 2 (b)).

(ii) q decreases and thus we have $\mu_k^r \geq 1/2$. Then, with respect to the two types of equilibrium described by Proposition 2:

(a) Each A-biased voter remains unaffected if she belongs to the set $\{1, \dots, k\}$. Otherwise, she becomes better off if, upon observing $\hat{s} = r$, she switches to vote for acceptance. If she does not switch her rejection vote, she becomes better off (resp., worse off) when she observes $\hat{s} = r$ with sufficiently small probability (resp., high probability) in the full disclosure equilibrium.

(b) Each R-biased voter becomes better off if, upon observing $\hat{s} = a$, she switches to vote for rejection. If she does not switch her acceptance vote, she becomes better off (resp., worse off) if she observes $\hat{s} = a$ less often (resp., more often) in the full disclosure equilibrium. She remains unaffected if, even before the decrease, she votes for rejection.

Proposition 5 (i) shows that, given distributions of initial opinions such that each voter $i > k$ is R-biased, if k rises, then the disclosure of all the evidence makes each voter (weakly) worse off with respect to the type of equilibrium described by Proposition 2 (b). In particular, R-biased voters become worse off because they may end up voting for acceptance upon observing $\hat{s} = a$. Then, the implications follow from the fact that the probability that the leader obtains $s = a$ and discloses $\hat{s} = a$ is higher in the full disclosure equilibrium than in the type of equilibrium described by Proposition 2 (b).[27] Once again, we take the simple approach of assessing welfare variations for the group of voters by considering the numbers of voters whose well-beings vary in one direction or another. Under this consideration, since more unanimous voting rules raise the number of voters whose well-beings deteriorate, Proposition 5 provides the insight that, for certain distributions of initial opinions, more unanimity is detrimental for welfare.

Our insights on the voters' well-beings can be viewed as complementary to the ones provided by Jackson and Tan (2013). However, our simple setup can perhaps allow for a starker investigation of who gains, who loses, and who remains unaffected when all the evidence is disclosed, relative to the situations in which the leader conceals evidence. In particular, Jackson and Tan (2013) emphasize that there might be specific situations in which "muzzling the expert" is welfare enhancing. At the same time, they acknowledge that such sort of implications are quite sensitive in their setup to the specification of the voters' preferences, in particular, to the strength of their preference biases. In our model, the distribution of initial opinions allows us to learn directly which voters experience welfare gains under concealment. In particular, our assumptions allow us to derive conclusions on whether evidence concealment is welfare improving based on the frequency with which voters observe the different pieces of evidence in the alternative full disclosure scenario. Consider any situation in which, under full disclosure of evidence, voters would observe relatively more often evidence that goes against their initial opinions. In such situations, Proposition 5 (ii) shows that voters naturally benefit from evidence concealment. This is a sort of "veil of ignorance" implication that follows in our diverse opinion framework: voters benefit from not seeing too often evidence that would make them ultimately vote against their initial opinions.

On another important related paper, Alonso and Camara (2016b) follow a Bayesian per-

[27] Such probability is smaller when the leader discloses all the evidence in relation to the type of equilibrium described by Proposition 2 (a). In this case, the R-biased voters become better off.

suasion approach to investigate the design of (ex-ante committed) policy experiments by political leaders to disclose additional information to voters. As regards to welfare implications, their insights highlight the presence of a bound on the number of voters who benefit from the leader's strategic design of his experiment. Although such a Bayesian persuasion approach implies fundamentally different mechanisms from the ones in our setup, the interpretations of the two models allow for somehow similar stories of information disclosure in voting contexts. As discussed earlier, following the results given in Proposition 5 (i), our model offers the insight that, under certain distributions of initial opinions, all voters may (weakly) benefit from the concealment strategy of the leader detailed in Proposition 2 (b), relative to situations in which all evidence is disclosed.

5 Empirical Evidence on Research Efforts and Concealment

Using our model, we have argued that (i) conditional on the leader benefiting from concealing evidence, higher discrepancies between the leader and the decisive voter disincentivize the leader's acquisition efforts and (ii) concealment strategies are largely addressed toward like-minded voters who would switch their opinions after observing unfavorable evidence. In this section, we present and discuss evidence on both predictions about the role of opinion discrepancies between leaders and decisive voters.

5.1 Evidence on Research Efforts

Because high evidence research efforts raise the skepticism of voters when the leader reports that he has obtained no evidence, our model predicts that if the leader wants to influence a like-minded decisive voter who, nevertheless, departs from the leader's preferred alternative when she observes unfavorable evidence, then he needs to lower his evidence acquisition effort.

The different testing policies that state governments in the United States have followed during the COVID-19 pandemic provide a benchmark to evaluate how leaders have chosen their research efforts to obtain evidence about the actual state of the pandemic through COVID-19 tests. After the start of the distribution of test kits for detecting the disease by the Centers for Disease Control and Prevention (C.D.C.) in February 2020 and the declaration of the National Emergency (March, 2020), state-level political leaders (basically, state governments) took the institutional mandate of making efforts to acquire evidence about the evolution of the disease by means of tests (and other measures as well, such as hospitalization rates, positivity rates, use of ventilators, or ICU occupations). This environment suits our model as state-level political leaders have had an institutional mandate to make efforts to learn about an uncertain variable and then have disclosed evidence (rendered by such efforts) to the public. Owing to the unprecedented features of the disease and the magnitude of its spread, it is apparent that evidence acquisition efforts have not always being successful (to obtain conclusive evidence), exactly as in our model.[28] The partial provability assumption seems to fit nicely into this environment. Furthermore, similarly to our model, state leaders face groups of people (health officials, constituencies,...) who, as the voters in our model, evaluate the suitability of taking either stringent or flexible measures to fight the spread and severity of the disease. Approval rates and subsequent votes in every state have been undoubtedly at stake for the various state leaders. The debate of whether to reopen the economy quickly or more cautiously has been ubiquitous. Similarly, the debate on whether or not to impose public masking mandates has been a heated one (certainly, not absent of political connotations). Finally, there is no much controversy in assuming that the recommendations that different people would have made must have been largely based on their different opinions about the state of the pandemic.[29]

To conduct a quantitative analysis on the relation of evidence acquisition efforts and discrepancies of opinions between the leader and a decisive voter, we have obtained data from the C.D.C. about testing and mortality rates from the date of the National Emergency declaration until January 2023. Such data is available from the C.D.C. database for 50 states, Iowa being the only exception.[30] We have also obtained data, available from those 50 state governments, about public masking mandates and domestic travel restrictions at each state. While some states chose neither public masking mandates nor travel restrictions, other chose only one of them, and other states decided for both. In this way, we construct a ternary indicator of how stringent were the measures implemented by the various states. Finally, we have also obtained the average of the Health care Assess and Quality (HAQ) indices across all ages for such 50 states in 2016.

[28] Key details of the actual state of the disease have remained not completely known at several stages of the pandemic. In particular, what caused the outbreak in the first place and the details of the long-term effects of the disease on many affected people (long Covid effects) remain largely unknown even at this point of time.

[29] Conceivably, if all opinions (either initial or based on evidence) had been biased toward the pandemic posing a dire threat to our very existence, then certainly everyone would have agreed on taking the most stringent measures available. It seems reasonable to consider common underlying preferences when it comes to taking actions relative to a disease that challenges so dramatically our health, and that the disagreement is mainly due to differences of opinions about the actual state of the pandemic.

[30] In the C.D.C. data, mortality accounts both for deaths confirmed to be caused by the disease as well as for deaths pending of confirmation but which yet can attributed to COVID-19. Interestingly, the methodology used by the C.D.C. to attribute deaths to the count has been very uniform across states. As it is the case with other internationally used metrics (e.g., excess mortality), including deaths that are unconfirmed but attributable allows for a more accurate measurement of the impact of the pandemic.

We view the acceptance alternative, $x = A$, as reopening the economy quickly and/or taking flexible measures. Taking such a reopening and/or flexible measures alternative during most stages of the pandemic has proven correlated to worse health indicators in the United States (Gupta et al., 2021). Our empirical approach rests on the consideration that the decisive voter is a (hypothetical) actor extremely well-informed about the actual state of the pandemic, whereas leaders can have varying opinions in favor of $x = A$. Thus, we have in mind a (hypothetical) decisive voter that would prefer the most suitable alternative (that is, being in favor of $x = A$ if and only if the state of the pandemic were good, $\omega = A$). Such a well-informed decisive voter would be capable of making very accurate predictions and suitable recommendations (if asked so). A practical example of the opinion of this well-informed hypothetical actor could be the views/recommendations of the C.D.C. in the United States, or of the W.H.O. at the international level.

Our exercise considers that state leaders may have varying opinions in favor of alternative $x = A$. We then look for observables that could suitably proxy such discrepancies between the beliefs of the leader in favor of $x = A$ and those of our (hypothetical) well-informed actor. The logic of our model is that, by choosing their research efforts, leaders aim at influencing decisive voters. If the distance between the leader and decisive voter is high, then our model predicts that the leader wants to lower his efforts. We have considered the total accumulated deaths (per 100K population) attributed to COVID-19 as a proxy indicator of how the corresponding political leader's beliefs in favor of taking flexible measures stood in opposition of very accurate (hypothetical) recommendations (which would come from our well-informed decisive voter). Then, our empirical exercise suggests that states that took measures more flexible than those that a well-informed actor (such as the C.D.C.) would have recommended did in fact experience higher mortality rates. In addition, we complement such a measure of tension between the leader and a well-informed (hypothetical) actor with the number of restrictions actually imposed at each state level. Similarly to the choice of accumulated mortality rates, we consider that little restrictive measures are a good indicator of high discrepancies between the leader and a well-informed actor, such as the C.D.C. Indeed, at the Federal level, the recommendation of the C.D.C. until February 2022 was to take the most stringent measures possible and, in particular, to keep public making mandates.[31] Then, we use the HAQ index as a control variable that captures the quality of the various state heath systems before the pandemic. This control variable is used for purposes of robustness check.

[31] Only in February 2022, at the time when the Omicron surge was subsiding, the C.D.C. stopped endorsing the universal masking mandate and issued new guidance that relaxed the recommendations of public masking and social distancing.

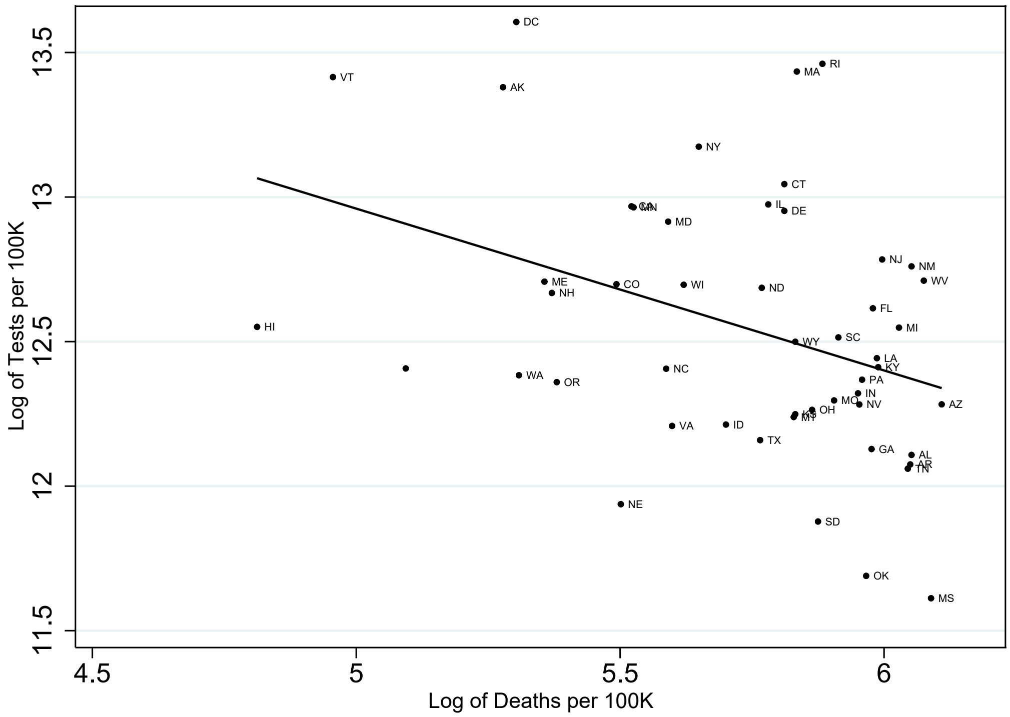

Figure 2 – Included are all U.S. states, with the exception of Iowa. The line is the predicted testing effort from an OLS regression of testing on mortality rates.

Using those suggested proxy variables, we can investigate the correlations between accumulated testing (per 100K population), on one side, and mortality rates and restrictions imposed, on the other side. Testing per capita and mortality rates are in logs and the restriction variable is at its level.

Given that we take high mortality rates as an indicator of less cautious measures, our model would predict a negative correlation between testing and mortality rates, on one side, and a positive correlation between testing and restrictions imposed, on the other side. Fig. 2 presents evidence on the negative relation between our proxy variables of testing efforts and discrepancies between the leader and a well-informed actor. We plot the relation between accumulated testing per capita and mortality rates.

Column 1 of Table 1, wherein we regress ln(#Tests per 100K) on ln(Mortality Rate), shows these findings quantitatively. Column 2 includes also the ternary variable that accounts for the number of restrictions to fight the spread of the disease. We observe that there is a statistically significant negative relation between mortality rates and testing per capita in the two models. Also, more restrictions are positively correlated to testing per capita. The third column adds the control for the quality of the health system previous to the pandemic.

This third column then shows that the negative relation between testing efforts and mortality rates, as well as the positive relation between testing efforts and restrictions, are robust to the inclusion of the quality of the health system.

For all three models, the Breusch-Pagan test shows that errors are homocedastic and the multi-collinearity test indicates absence of multi-collinearity.[32]

	(1)	(2)	(3)
ln(Mortality Rate)	-0.560**	-0.499*	-0.502*
	(-2.84)	(-2.60)	(-2.59)
#Restrictions	—	0.235*	0.236*
		(2.22)	(2.21)
ln(HAQ_{2016})	—	—	-0.0465
			(-0.31)
Constant	15.76***	15.14***	15.35***
	(13.91)	(13.45)	(11.50)
Number of Observations	50	50	50
R^2	0.144	0.225	0.226
Breusch-Pagan test (p-value)	0.453	0.0596	0.0656

The dependent variable is ln(#Tests per 100K)

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1 – Determinants of Testing Effort, U.S. states, Feb. 2020–Jan. 2023

The message of our exercise is that, if we consider that higher mortality rates and less restrictions are good proxy indicators of leaders' opinions far away from those of a well-informed decisive voter, then leaders would lower their evidence acquisition efforts in order to influence such a voter.

We obtain similar evidence by studying a sample of 50 countries that performed relatively bad against the pandemic. Compared to the homogeneous availability and methodology used to gather data in the United States, data at the international level has been more disperse, heterogeneous and, sometimes, very inaccurate. In particular, the measurement of mortality rates has been very heterogeneous across countries, some countries not reporting any accurate mortality data at all. We then resort to data obtained from an over-dispersed Poisson count framework. This methodology, which has been recently used by Msemburi et al. (2023), applies Bayesian inference techniques to estimate both expected deaths in the absence of a pandemic and the all-cause mortality data for countries that have not reported mortality

[32] The highest variance inflation factor (vif) across all explanatory variables and all regressions is 1.02.

data. To consider a uniform indicator to investigate the impact of the COVID-19 pandemic, Msemburi et al. (2023) have advocated for the P-score of each country. Specifically, the P-score of a country i is measured as the ratio (in percentage):

$$\text{P-score}_i \equiv \frac{\text{excess deaths}_i - \text{expected deaths}_i}{\text{expected deaths}_i} \times 100.$$

Also, compared to the benchmark of the United States, age structures vary dramatically across international countries, a fact that can bias enormously the estimates of mortality rates. Interestingly, the P-score incorporates and controls for both the size and the age structure of the population. The empirical exploration by Msemburi et al. (2023) of the impact of the COVID-19 pandemic across countries has been largely based on the use of the P-score indicator. Then, we select an initial sample of 50 countries. Our selection criterion focuses on those 50 countries which have experienced the highest P-scores during the pandemic (using the most recent P-score values available for each country to date) and, furthermore, for which data about performed testing is available as well. We then reduce the sample when data on other considered variables is not available for a few countries of the initial sample.

Fig. 3 plots the negative relation between our proxy variables that capture testing efforts and discrepancies between the leader and a well-informed actor. Table 2 shows the quantitative findings. Again, we observe that the coefficient which captures the interaction between testing efforts and our measure of discrepancies between the bias of the country leaders toward taking flexible measures and the actual state of the disease is negative and highly significant. The second column of Table 2 includes the Stringency Index (available from Our World in Data) for each 49 of those countries in 2020. Unlike the case of the United States, the Stringency Index is not significant in our sample of countries to explain the discrepancies between the leader and a well-informed decisive voter. Then, as a control variable, the third column adds the HAQ index for 47 of those countries in 2015 as a measure of the quality of their health systems previous to the pandemic. Though loosing weight, our key negative relation between testing efforts and mortality rates survives the inclusion of the control by the quality of the health system.

Similarly to our exercise for the United States, for all three models displayed in Table 2, errors are homocedastic and the multi-collinearity test indicates absence of multi-collinearity.[33]

Recent studies in corporate finance support also these sorts of qualitative implications on the relation between differences of opinions and evidence acquisition efforts. In particular,

[33] The highest variance inflation factor (vif) across all explanatory variables and all regressions is 1.21.

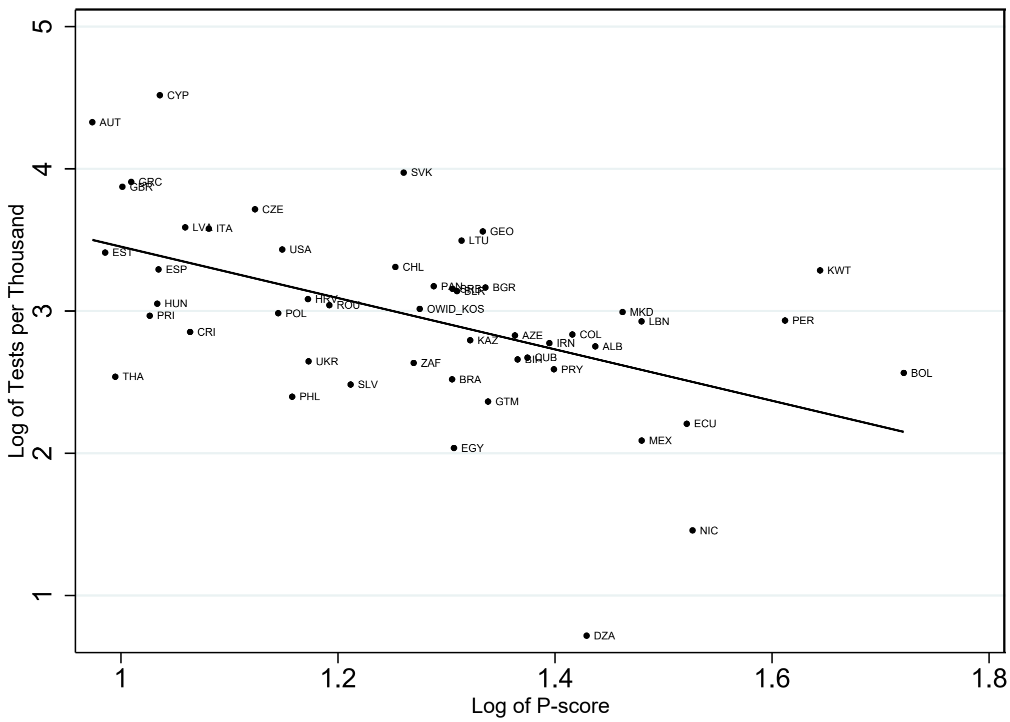

Figure 3 – Included are the 50 countries with highest P-scores that provide testing data. The line is the predicted testing effort from an OLS regression of testing on P-scores.

	(1)	(2)	(3)
ln(P-score)	-2.005***	-2.025***	-1.101*
	(-3.97)	(-3.94)	(-2.31)
Stringency Index_{2020}	—	0.00526	0.00646
		(1.08)	(1.40)
$\ln(\text{HAQ}_{2015})$	—	—	2.653***
			(4.68)
Constant	5.547***	5.492***	-7.031*
	(8.47)	(8.17)	(-2.57)
Number of Observations	50	49	47
R^2	0.247	0.273	0.521
Breusch-Pagan test (p-value)	0.306	0.254	0.0585

The dependent variable is ln(#Tests per thousand)

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2 – Determinants of Testing Effort, International

empirical work on mandatory disclosure by board leaders of companies suggests that leaders make more efforts to acquire evidence when voting rules induce the decisive voter to get closer to the leader own's opinions. For environments with large numbers of voters and relatively uniform distributions of initial opinions, simple majority rules facilitate that our condition (C) of Proposition 1 be satisfied. Then, under such conditions, our results go in the direction of the leader acquiring more evidence under simple majority rules, compared to situations under more extreme voting rules. Extreme rules would facilitate that the leader either does not need to influence the simple-majority decisive voter (i.e., using the specifics of our model, $\mu_k^r \geq 1/2$) or that any concealment is ineffective to influence such a voter (i.e., using our the specifics of our model, $\beta_k < 1/2$). In either of the two situations, condition (C) of Proposition 1 would not be satisfied. Mukhopadhyay and Shivakumar (2021) have explored the evidence disclosure implications of regulators requiring firms to approve their proposals through shareholder voting. In 2006, the Security and Exchange Commission (S.E.C.) of the United States introduced direct disclosure regulations to companies that made mandatory the disclosure of compensation-relevant metrics. However, similar in spirit to the mechanism proposed in our paper, board leaders can in practice disclose null pieces of evidence to shareholders. Omitting details, or presenting them in "obscure" ways,[34] were commonly reported ways of concealing evidence after the 2006 S.E.C. ruling. Subsequently, in 2011, the S.E.C. introduced a "Say on Pay" voting requirement by shareholders of companies. No further ruling on disclosure was issued by the S.E.C. at that time. Mukhopadhyay and Shivakumar (2021) take advantage of such two separate regulations to propose an empirical strategy to isolate the role of introducing the simple majority rule for accepting proposals. Specifically, the authors construct a measure of the key performance indicators disclosures of the companies listed as subject to regulation (between 2007 and 2017). Using such a measure, their analysis shows that the introduction of the simple majority as majority rule, in contrast to other more extreme voting rules, accounted for an increase (of roughly 20 percent) in the amount of evidence acquired and disclosed by board leaders.

5.2 Evidence Concealment Strategies

Some evidence on governmental actions to conceal evidence on the state of the COVID-19 pandemic support our model's views on strategic concealment. In July 2020, the United States government changed the rules that applied for hospitals to disclose their COVID-19 evidence to state agencies. In particular, all hospitals were required to stop reporting to

[34] The corporate governance literature uses *fog indexes* to empirically account for difficulties in interpreting and digesting pieces of reported evidence.

the C.D.C. and to pass on their collected evidence instead to the Department of Health and Human Services (H.H.S.). Shortly after this change of rules, several media outlets revealed a number of Emails which involved top health officials in the H.H.S. In particular, such publicly exposed Emails made it apparent that President Trump's administration was taking action to silence data that the C.D.C. could potentially gather on the state of the pandemic. Indeed, public health experts expressed deep concerns about evidence on the spread and severity of the disease ceasing to be available to researchers, physicians, and the general public. For example, the New York Times reported extensively on the above alluded efforts to conceal evidence that research on the evolution of the pandemic could potentially gather.[35] Under the premise that the Trump's administration took action to conceal evidence, our model would suggest that such a concealment strategy would be targeted to bring to the government's side precisely like-minded voters. The logic behind our main insights tells us that concealing evidence to voters far away from the views of the administration would be ineffective to influence them (Proposition 1). We turn then to discuss some empirical evidence that supports the previous arguments. In April 2020, respondents of the *American News Pathways Project* of the Pew Research Center were asked to name the source they relied on most for pandemic news. In August 2021, the Pew Research Center asked Americans adults their vaccination status. Out of the 10,348 respondents who took the August 2021 survey, 6,686 had also taken the April 2020 survey. The conclusion was that citizens who relied most on Mr. Trump for COVID-19 news were less likely to be vaccinated. Only 59% who relied most on Trump were vaccinated. The proportions raise for those respondents relying on local (72%), national (83%) or international (78 %) outlets, public health organizations (82%) and state officials (76%). A sharp distinction is that 92% of those relying most on Trump were either republicans or independents who leaned toward the Republican Party. Conversely, only 7% were Democrats or Democratic leaners. In every other COVID-19 news source category, Democrats accounted for no less than 49% and Republicans accounted for more than 44%.[36] Therefore, such empirical data seem to support our model's implication that the concealment strategy of Mr. Trump's administration was largely aimed at influencing those voters that hold initial opinions relatively more aligned with the Republican Party and with President Trump.

[35] The full articles by the New York Times are available at https://www.nytimes.com/2020/07/14/us/politics/trump-cdc-coronavirus.html; https://www.nytimes.com/2020/09/18/us/politics/trump-cdc-coronavirus.html.

[36] The details of the Pew Research Center's survey can be found at https://www.pewresearch.org/fact-tank/2021/09/23/americans-who-relied-most-on-trump-for-covid-19-news-among-least-likely-to-be-vaccinated/.

6 An Extension to Multiple Alternatives

In this section, we discuss an extension of the benchmark model with three possible alternatives $x \in X \equiv \{A, B, R\}$ and a voting rule that (roughly) selects the most voted alternative. Alternatives $x = A$ and $x = B$ are two different proposals and alternative $x = R$ is remaining in the status quo. To gauge the suitability of each choice, the players care about a relevant variable $\omega \in \Omega \equiv \{A, B, R\}$.

Each voter i must cast a vote $v_i \in X$ in favor of one alternative. Given a voting profile $v = (v_1, \ldots, v_n)$, let $v_x \equiv |\{i \in N \mid v_i = x\}|$ be the number of votes in favor of alternative x. To determine the choice selected from the voting process, we consider first choices $x(v) \in \arg\max_{x \in X} v_x$. Then, ties between $x = A$ and any other alternative $x \in \{B, R\}$ are broken in favor of $x = A$. Ties between the alternatives $x = B$ and $x = R$ are randomly broken (with probability 1/2) in favor of either alternative. Hence, the choice selected by means of voting is the one most voted, but alternative $x = A$ is selected in case of a tie. Exactly as in the benchmark model, preferences satisfy $u_i(v, \omega) = 1$ if $v_i = \omega$ and $u_i(v, \omega) = 0$ if $v_i \neq \omega$ for each voter $i \in N$, whereas $u_l(v, \omega) = 1$ if $x(v) = \omega$ and $u_l(v, \omega) = 0$ if $x(v) \neq \omega$ for the leader.

Player i's initial opinion about ω is now described by a probability distribution $\beta_i \equiv (\beta_i(\omega))_{\omega \in \Omega} \in int(\Delta(\Omega))$, where $\beta_i(\omega) \equiv \mathbb{P}(\omega \mid \mathcal{H}_i)$.[37] The leader's research effort $\lambda \in [\underline{\lambda}, 1)$ can deliver a signal $s \in S \equiv \{a, b, r, \emptyset\}$, where $s = a$ is interpreted as evidence in favor of proposal A, $s = b$ as evidence in favor of proposal B, and $s = r$ as evidence in favor of remaining in the status quo. As in the benchmark model, $s = \emptyset$ means that the research effort delivers no evidence. The evidence-acquisition technology is now described by

$$\mathbb{P}(s \mid \omega; \lambda) = \begin{cases} \lambda q \ \text{ if } \ (s, \omega) \in \{(a, A), (b, B), (r, R)\}; \\ \lambda(1 - q)/2 \ \text{ if } \ (s, \omega) \in \{(a, B), (a, R)(b, A), (b, R), (r, A), (r, B)\}; \\ (1 - \lambda) \text{ if } \ s = \emptyset \ \text{ for any } \ \omega \in \{A, B, R\}. \end{cases} \tag{7}$$

for an *evidence-acquisition technology* parameter $q \in (1/3, 1)$. The assumed technology follows exactly the same sort of symmetry requirements imposed for the two-alternative benchmark case.

As in the benchmark model, a (pure) strategy of voter i is a mapping $v_i : S \to X$. We now select those equilibria in which $v_i(\hat{s}) = A$ when voter i is indifferent between proposal A and any other alternative. For each signal $s \in S$, the leader chooses the probability $\sigma(\hat{s} \mid s)$

[37] As usual, $\Delta(Q)$ denotes the set of Borel probability distributions over the set Q.

of reporting signal $\hat{s} \in S$ to all voters. The restrictions on signals are now:

(i) $\sigma(\emptyset \mid s) = 1$ whenever $s = \emptyset$, and

(ii) $\sigma(\hat{s} \mid s) = 0$ for each pair $\hat{s}, s \in \{a, b, r\}$ such that $\hat{s} \neq s$.

We now use $\mu_i^{\hat{s}} \equiv (\mu_i^{\hat{s}}(\omega))_{\omega \in \Omega} \in \Delta(\Omega)$, where $\mu_i^{\hat{s}}(\omega) \equiv \mathbb{P}(\omega \mid \mathcal{H}_i, \hat{s}, \lambda)$, to denote voter i's posteriors conditional on a reported signal $\hat{s}$. Similarly, for the leader, we use $\mu_l^s \equiv (\mu_l^s(\omega))_{\omega \in \Omega} \in \Delta(\Omega)$, where $\mu_l^s(\omega) \equiv \mathbb{P}(\omega \mid \mathcal{H}_l, s, \lambda)$. By applying Bayes' rule, any player i's posterior beliefs upon evidence $s = \hat{s} \in \{a, b, r\}$ are given by

$$\mu_i^s(\omega) = \frac{\mathbb{P}(s \mid \omega; \lambda)\beta_i(\omega)}{\sum_{\omega'} \mathbb{P}(s \mid \omega'; \lambda)\beta_i(\omega')}. \tag{8}$$

For a signal $s \in \{a, b, r\}$, let us now use $\rho_i(s) \equiv \mathbb{P}(s \mid \mathcal{H}_i, \lambda) = \sum_\omega \mathbb{P}(s \mid \omega; \lambda)\beta_i(\omega)$ to denote the probability that player i assigns to the leader receiving signal s conditional on the research effort λ.

Lemma 3 offers somewhat parallel insights to those obtained earlier, in Lemma 1, about how evidence affects posterior beliefs and about the ordering of posteriors across players.

Lemma 3. For each evidence-acquisition technology $q \in (1/3, 1)$, for each given value $\omega \in \Omega$, and for the piece of evidence $s = \omega$, it follows that

(i) for each piece of evidence $s' \neq \omega$ (that is, evidence against value ω), we have $\mu_i^{s'}(\omega) < \beta_i(\omega) < \mu_i^s(\omega)$ for each player $i \in N \cup \{l\}$;

(ii) for each pair of players $i, j \in N \cup \{l\}$, $\beta_i(\omega) < \beta_j(\omega)$ implies $\mu_i^s(\omega) < \mu_j^s(\omega)$.

Fig. 4 illustrates how evidence can affect a player's initial opinion following the result of Lemma 3 (i). Starting from an opinion β_i, the shaded areas describe possible regions for posteriors conditional on each piece of evidence. In particular, the description of each area is given by:

(I) $\mu_i^a(A) > \beta_i(A)$, $\mu_i^a(B) < \beta_i(B)$, and $\mu_i^a(R) < \beta_i(R)$;

(II) $\mu_i^b(B) > \beta_i(B)$, $\mu_i^b(A) < \beta_i(A)$, and $\mu_i^b(R) < \beta_i(R)$;

(III) $\mu_i^r(R) > \beta_i(R)$, $\mu_i^r(A) < \beta_i(A)$, and $\mu_i^r(B) < \beta_i(B)$.

As illustrated in the figure, note that this result implies that $\beta_i \in co\{\mu_i^a, \mu_i^b, \mu_i^r\}$ for each each voter $i \in N$.

We turn now to describe how voters discount the leader's honesty based on his concealment strategy. As in the benchmark model, let $\delta_i(s \mid \emptyset) \equiv \mathbb{P}(s \mid \hat{s} = \emptyset, \mathcal{H}_i, \lambda, \sigma)$ be the probability that voter i assigns to the leader having actually observed signal $s \in S$, conditional on observing the reported signal $\hat{s} = \emptyset$. For each $s \in S$, application of Bayes' rule

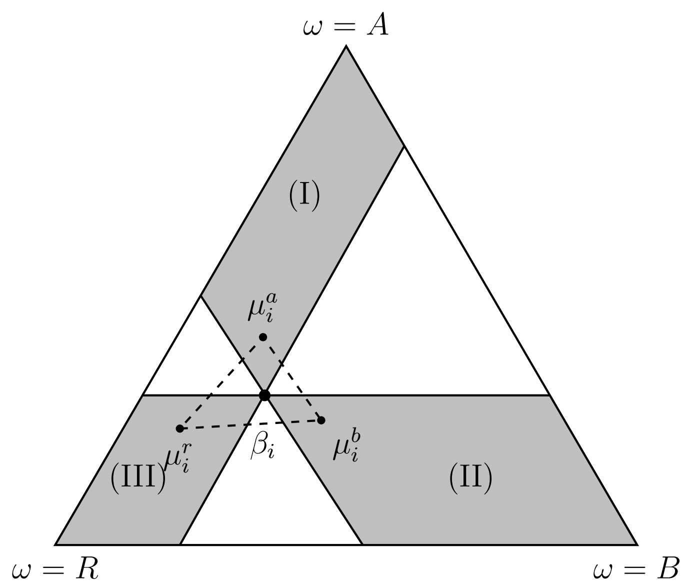

Figure 4 – Simplex Representing How Evidence Can Influence Beliefs

yields

$$\delta_i(s \mid \emptyset) = \frac{\sigma(\emptyset \mid s)\rho_i(s)}{(1-\lambda) + \sum_{s' \neq \emptyset} \sigma(\emptyset \mid s')\rho_i(s')}. \tag{9}$$

As in the benchmark case, higher values of $\delta_i(s \mid \emptyset)$ are interpreted as voter i anticipating the leader concealing the piece of evidence s with higher likelihood. The insights obtained in Lemma 2 on the voters' reaction upon observing $\hat{s} = \emptyset$, follow through, with no changes, in this extension. Furthermore, conditional on the leader reporting no evidence, $\hat{s} = \emptyset$, voters follow exactly the same updating process as the one described for the benchmark model in Eq. (5). In particular, upon observing $\hat{s} = \emptyset$, voter i makes inferences according to

$$\mu_i^{\emptyset} = \sum_{s \neq \emptyset} \delta_i(s \mid \emptyset)\mu_i^s + \Big(1 - \sum_{s \neq \emptyset} \delta_i(s \mid \emptyset)\Big)\beta_i. \tag{10}$$

The expression in Eq. (10) is a direct extension of the condition obtained earlier in Eq. (5). Hence, the posterior belief $\mu_i^{\emptyset}$ of a voter i is a convex combination of the posteriors $\{\mu_i^a, \mu_i^b, \mu_i^r, \beta_i\}$. It follows from the result of Lemma 3 (i) that $\mu_i^{\emptyset} \in co\{\mu_i^a, \mu_i^b, \mu_i^r\}$. Once again, these implications tell us important features about how the leader can manipulate voters by means of concealing evidence.

As in the benchmark model, we assume that, conditional on his initial opinion and on any piece of evidence, the leader always prefers that the voting process selects proposal A, $x(v) = A$. Let us use $\Delta_l \equiv \{\mu \in \Delta(\Omega) \mid \mu(A) \geq \mu(\omega) \;\; \forall \omega \in \Omega\}$ to denote the subset of beliefs such that value $\omega = A$ is (weakly) the most likely one. Then, we restrict attention to situations where the leader's beliefs satisfy $\mu_l^s \in int(\Delta_l)$ for each $s \in S$.

Following the ideas developed by the benchmark model, we can consider situations of conflict of interests where the leader wants to conceal evidence in order to influence a given voter i because $\mu_i^s \notin \Delta_l$ conditional on some piece of evidence $s \in \{b, r\}$. The following example illustrates this.

Example 1. Suppose that $\mu_i^r \notin \Delta_l$ so that the leader wants to conceal the unfavorable evidence ($s = r$) in equilibrium, that is, $\sigma(\emptyset \mid r) = 1$. Furthermore, suppose also that $\mu_i^a, \mu_i^b \in \Delta_l$ so that the leader is interested in fully disclosing the favorable pieces of evidence $s = a$ and $s = b$, that is, $\sigma(\emptyset \mid a) = 0$ and $\sigma(\emptyset \mid b) = 0$. Note that this instance replicates the incentives for concealing evidence studied by Proposition 1 and the sort of equilibrium choices described by Proposition 2 for the two-alternative benchmark case. This particular situation is depicted in Fig. 5 under the additional feature that $\beta_i \in \Delta_l$.

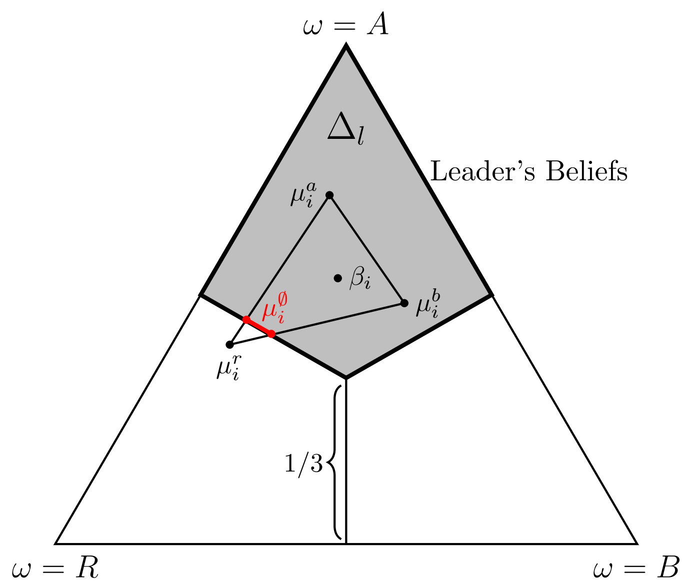

Figure 5 – Influencing a Voter who Favors $v_i = R$ upon $s = r$

Fix a given value $\omega \in \Omega$. Combination of the expression for the posterior $\mu_i^\emptyset$ given in

Eq. (10) with the derivations in Eq. (8) and Eq. (9) yields

$$\begin{aligned}\mu_i^{\emptyset}(\omega) &= \beta_i(\omega) + \sum_{s\neq\emptyset} \delta_i(s \mid \emptyset)\big[\mu_i^s(\omega) - \beta_i(\omega)\big] \\ &= \beta_i(\omega)\left\{1 + \frac{\sum_{s\neq\emptyset} \sigma(\emptyset \mid s)\big[\mathbb{P}(s \mid \omega; \lambda) - \rho_i(s)\big]}{(1-\lambda) + \sum_{s\neq\emptyset} \sigma(\emptyset \mid s)\rho_i(s)}\right\} \\ &= \beta_i(\omega)\left\{\frac{(1+\lambda) + \sum_{s\neq\emptyset} \sigma(\emptyset \mid s)\mathbb{P}(s \mid \omega; \lambda)}{(1-\lambda) + \sum_{s\neq\emptyset} \sigma(\emptyset \mid s) \sum_{\omega'} \mathbb{P}(s \mid \omega'; \lambda)\beta_i(\omega')}\right\}.\end{aligned} \tag{11}$$

Then, substitution of described choices of the leader in the expression derived in Eq. (11) yields

$$\mu_i^{\emptyset}(\omega) = \beta_i(\omega)\left\{\frac{(1+\lambda) + \mathbb{P}(s = r \mid \omega; \lambda)}{(1-\lambda) + \sum_{\omega'} \mathbb{P}(s = r \mid \omega'; \lambda)\beta_i(\omega')}\right\}. \tag{12}$$

Since $\mu_i^{\emptyset} \in co\{\mu_i^a, \mu_i^b, \mu_i^r\}$, we observe from Fig. 5 that the leader wants to induce a belief $\mu_i^{\emptyset}$ that lies in the segment depicted in red. By doing so, the leader would ensure that, conditional on observing $\hat{s} = \emptyset$, voter i is indifferent between alternatives $x = A$ and $x = R$ since, in that case, we would have $\mu_i^{\emptyset}(A) = \mu_i^{\emptyset}(R)$. Also, voter i would prefer alternative $x = A$ over alternative $x = B$ since, in that case, we would have $\mu_i^{\emptyset}(A) \geq \mu_i^{\emptyset}(B)$. Since we are focusing on equilibria in which a voter i who is indifferent between choice $x = A$ and any other alternative votes according to $v_i = A$, this would guarantee that $v_i(\emptyset) = A$ in equilibrium. If voter i is decisive in order to achieve the outcome $x(v(\emptyset)) = A$, then the leader can target such a voter i and conceal evidence as described to achieve his preferred voting outcome. Once again, this logic replicates completely the arguments provided for the benchmark model by Proposition 1 and Proposition 2.

The condition that $\mu_i^{\emptyset}(A) = \mu_i^{\emptyset}(R)$ of the described equilibrium, together with the particular form of evidence-acquisition technology in Eq. (7), allows us to use Eq. (12) to obtain that such an equilibrium requires

$$\begin{aligned}\beta_i(A)\big[(1+\lambda) + \lambda(1-q)/2\big] &= \beta_i(R)\big[(1+\lambda) + \lambda q\big] \\ \Leftrightarrow \lambda^* &= \frac{\beta_i(A) - \beta_i(R)}{(1+q)\beta_i(R) - (3-q)\beta_i(A)/2}.\end{aligned} \tag{13}$$

Furthermore, the condition $\mu_i^{\emptyset}(A) \geq \mu_i^{\emptyset}(B)$ leads to the requirement $\beta_i(A) \geq \beta_i(B)$, which is automatically satisfied since we are considering $\beta_i \in \Delta_l$. Then, it can be verified that, under certain conditions,[38] the value for the research effort $\lambda^* \in (0, 1)$ derived in Eq. (13) is well-defined. Since such an effort λ^* makes voter i choose $v_i^* = A$ upon observing $\hat{s} = \emptyset$, then,

[38] Such conditions are $q > \frac{1}{2\beta_i(R)+\beta_i(B)} \max\{3\beta_i(A) - 2\beta_i(R), 5\beta_i(A) - 4\beta_i(R)\}$.

conditional on having obtained $s = r$, the leader has strict incentives to choose $\sigma^*(\emptyset \mid r) = 1$. In addition, conditional on having obtained signals $s \in \{a, b\}$, the leader has strict incentives to choose $\sigma^*(\emptyset \mid a) = \sigma^*(\emptyset \mid b) = 0$. This concludes the arguments required to show that, in an equilibrium where the leader influences voter i, he conceals unfavorable evidence $s = r$, reveals favorable evidence $s \in \{a, b\}$, and exerts the effort λ^* derived in Eq. (13).

From the expression in Eq. (13), we observe that, for each $q \in (1/3, 1)$, the equilibrium research effort λ^* increases in the probability $\beta_i(A)$ and decreases in the probability $\beta_i(R)$. Hence, initial opinions of voter i closer to the leader's opinions incentive the leader to exert more effort in his research. With the same logic as in the benchmark model, opinions of a decisive voter farther away from the leader's own opinion incentivize him to exert less effort in order to lower the voter skepticism when he reports signal $\hat{s} = \emptyset$.

Furthermore, this example is useful to illustrate that having three alternatives for voting introduce a new perspective, which is absent in the two-alternative benchmark model. To see this, suppose that the beliefs of a group of voters $i \in \hat{N} \subset N$ satisfy the conditions described by this example. Furthermore, consider the a critical situation in which the leader wants to influence only one voter k from the set $\hat{N}$ because such a voter is decisive to switch from $x(v) = R$ to $x(v) = A$. Then, the leader has incentives to conceal the piece of hard evidence $s = r$ (to all voters) in order to influence only one of such voters $k \in \hat{N}$. Now, determining who is the decisive voter is not as straightforward as in the two-alternative benchmark model because voters' opinions cannot be ranked using a single dimension. We observe that the leader would like to choose such a decisive voter from the set $\hat{N}$ so as to minimize the research effort λ^* identified in Eq. (13). Using the expression in Eq. (13), the decisive voter k would be determined as

$$k \in \arg\min_{i \in \hat{N}} \frac{\beta_i(A) - \beta_i(R)}{(1+q)\beta_i(R) - (3-q)\beta_i(A)/2}.$$

First, selecting a decisive voter in this situation requires one to consider the two-dimensional belief variable $(\beta_i(A), \beta_i(R))$. Secondly, if we further consider a common probability $\beta_i(A) = \beta(A)$ for $i \in \hat{N}$ in favor of the alternative preferred by the leader, then picking the decisive voter requires choosing the voter from the set of candidates $\hat{N}$ whose opinions on favor of $\omega = R$ are the least favorable for the leader, i.e., the lowest $\beta_i(R)$. The logic for this lies in that, provided that such a voter can in fact be influenced by reporting $\hat{s} = \emptyset$, doing so is achieved by selecting the lowest research effort possible. Again, this is the case because the leader needs to lower the skepticism of the voters' side when he reports that his research effort has been unsuccessful.

7 Further Literature Connections

The partial provability assumption used in this paper allows for incomplete evidence disclosure, breaking down the classical unravelling mechanism of verifiable disclosure (Grossman, 1981; Milgrom, 1981; Milgrom and Roberts, 1986). Another paper where the unravelling mechanism of verifiable evidence fails is Dziuda (2011), wherein the Sender may provide a number of bits of evidence in support of one alternative or the other. In this case, it is the assumption that Receivers are uncertain about the total number of bits available for disclosure what breaks down the unravelling mechanism. Similarly, Kolb et al. (2023) have recently shown that Senders' uncertainty about the information that they can ultimately have may allow for the concealment of verifiable evidence as well.

The provision of hard evidence in voting environments is also explored by Titova (2021) using the Bayesian persuasion approach. The two papers are very different though. First, a key ingredient of Titova (2021)'s analysis is the assumption that leaders have the ability to target voters individually so as to follow fully discriminatory disclosure policies. Unlike this, leaders must in our model disclose evidence publicly to all voters, thus lacking any discrimination power in their disclosure strategies. More importantly, the underlying mechanisms are quite different. In particular, the driving assumptions behind Titova (2021)'s analysis are quite different from our key assumptions of diverse opinions and evidence disclosure under partial provability.

The incentives to disclose evidence under mandatory research efforts are also investigated by Henry (2009) and Wong and Yang (2018). Unlike our setup, though, the focus of both papers is on the monitoring possibilities by a decision-maker over an expert's research technology. The classical unraveling mechanism continues to hold in Henry (2009)'s model, wherein both evidence-research efforts and full disclosure of evidence are incentivized when the expert's effort is not observable. This provides an interesting mechanism where no monitoring of efforts harms the expert. Building upon Henry (2009)'s approach, Wong and Yang (2018), add the possibility of research efforts being unsuccessful, which allows them to obtain strategic concealment of evidence, as in our paper. In their model, whether or not monitoring is ultimately beneficial to the expert and the decision-maker depends on the size of their conflict of interests. The approach of both papers is quite different from ours as we assume that voters can perfectly monitor evidence-acquisition efforts. The sort of questions asked and underlying mechanisms are very different as well. Nevertheless, some of their implications are reminiscent to our insight that, in some circumstances, the leader prefers to lower his evidence-acquisition efforts.

The political economy literature has explored key questions of influential communication to voters using other traditional models of strategic information revelation. For instance, multi-dimensional cheap-talk from leaders to voters has been by analyzed by Schnakenberg (2015). A model of signaling by political platforms in the presence of information acquisition on the voters' side has been studied by Bandyopadhyay et al. (2020) to propose a logic for radicalization in the information choices of electoral platforms. Cheap-talk persuasion by leaders when the actions of voters are mediated by political parties is investigated by Chakraborty et al. (2020). In their model, the leader can either engage in communication with parties or with voters directly. These considerations allow them to investigate interesting welfare implications when comparing indirect and direct democracy systems. Bayesian persuasion in voting environments has been studied by Alonso and Camara (2016b) and by Chan et al. (2019). Alonso and Camara (2016b) consider a voting environment in which an uninformed expert strategically designs a policy experiment, and commits to transmitting the resulting information, in order to persuade a group of voters who have different preferences but common priors. Chan et al. (2019) consider a framework in which voting is costly and the sender may provide voters with private signals. The focus of Chan et al. (2019) is thus on the analysis of the benefits of private persuasion in voting environments. Also, in an environment where voters have private information of their own, vote-buying screening mechanisms have been studied by Eguia and Xefteris (2021). As to other models in which voters are not rational, a behavioral approach to information processing on the side of voters has recently been considered by Bonomi et al. (2021) to explore influential communication in voting environments.

Manipulative behavior from informed Senders is also connected to media biased reporting. Using a bias confirmatory approach where Receivers wish to see their own opinions confirmed by new information, Mullainathan and Shleifer (2005) investigate slanting in media reporting. Also, exploiting reputation concerns of media firms to signal high qualities, Gentzkow and Shapiro (2006) provide a rationale for such sources of information strategically adjusting their reporting to the Receivers' opinions.

While our paper does not consider how competition among leaders affect their disclosure policies, there are also connections with our motivation to study the incentives of leaders to withhold information. A fast-developing literature on political science has investigated the effects of increased competition on the informative content of the leaders' disclosures. When voters are rational, an insight largely put forward by this strand of the literature is that competition forces leaders to align better their incentives with those of the voters, thereby enabling more precise information disclosure. This is the general message conveyed, among others, by Baron (2006); Chan and Suen (2009); Anderson and McLaren (2012); Duggan and Martinelli (2011). However, following recent empirical evidence on the role played by traditional and social media in polarization (Gentzkow and Shapiro, 2010; Allcott et al., 2020), the direction of this insight has been questioned recently by Perego and Yuksel (2022). In their model, information providers are non-partisans and compete for profits. Using the key consideration of different dimensions of interest in the voters' preferences, Perego and Yuksel (2022)'s main takeaway is that competition among information providers may boost disagreement across voters.

Finally, at a more empirical level, our interest on evidence concealment behaviors has also some connections with the empirical research of Kono (2006) on the transparency of trade policies followed by leaders to influence voters.

8 Conclusions

Our model proposes a logic for evidence research efforts and disclosure by leaders which rests solely on differences of opinions. Leaders may be interested in strategically acquiring and concealing evidence even when everyone would agree if the relevant variable were known. Leaders in our model are crucially motivated by their needs to switch the voting outcome and by their actual chances of influencing the decisive voter. Our model conveys sharp messages relative to either low or high discrepancies between a leader's opinions and those of the decisive voter. If there is either full agreement based on each possible piece of evidence or disagreement based on initial opinions, then our model predicts that the leader will invest the institutionally required minimum and disclose all the so obtained evidence (Proposition 1). In practical situations, our model allows us to map voting rules to such situations of minimum effort and full disclosure. The most interesting strategic behavior takes place when the leader and the decisive voter are initially like-minded but would disagree should some evidence (unfavorable to the leader) be released.

Our model also suggests a novel mechanism for the leader wishing to conceal even favorable evidence (Proposition 2). When institutionally forced to make high research efforts, leaders wish to compensate for the so heightened negative skepticism (that is, toward unfavorable evidence having been obtained). To do so, leaders find convenient to conceal pieces of favorable evidence as well, in order to influence the decisive voter when they report that no evidence has been obtained. Institutionally heightened research efforts combined with concealment of favorable evidence have no effects on the well-beings of the voters in our model (Proposition 3). This follows directly from our implication that such higher efforts, combined with lower disclosure, leave the probabilities with which voters receive any piece of evidence unchanged. Only the leader gets hurt from more stringent institutional requirements because of the required higher efforts. The non-obvious policy implication in this respect is that increasing the institutionally-required minimum research efforts that leader must make is not necessarily welfare improving. In particular, our model suggests that this might be case in environments where research efforts can be unsuccessful and then the leader can exploit this possibility to strategically conceal obtained evidence. Partial provability considerations lead the leader to compensate for imposed higher effort on evidence acquisition.

Finally, our model suggests a logic for the well-beings of the leader and the group of voters to move in a common direction when, based on unfavorable evidence, the decisive voter gets farther away from the leader. In this case, it becomes harder for the leader to influence the voting outcome by acquiring and concealing evidence. Then, the leader benefits by lowering his research efforts to reduce skepticism and, in this way, by being able to influence a more distant decisive voter. On the other side, the group of voters benefit because a higher number of them see their initial opinions confirmed by the voting outcome. Our approach of different opinions across players is thus also essential to obtain this sort of implications that involve subjective well-beings.

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Appendix—Proofs

Proof of Lemma 1. From the particular evidence-acquisition technology proposed in Eq. (1) it follows that

$$\rho_i(a) = \lambda[q\beta_i + (1-q)(1-\beta_i)] \quad \text{and} \quad \rho_i(r) = \lambda[(1-q)\beta_i + q(1-\beta_i)]. \tag{14}$$

Take a given evidence-acquisition technology $q \in (1/2, 1)$.

(i) Fix a player $i \in N \cup \{l\}$. Since $q > 1/2$, it follows from the posteriors derived in Eq. (3) that

$$\mu_i^a - \beta_i = \frac{\beta_i(1-\beta_i)(2q-1)}{q\beta_i + (1-q)(1-\beta_i)} > 0$$

and

$$\mu_i^r - \beta_i = \frac{\beta_i(1-\beta_i)(1-2q)}{(1-q)\beta_i + q(1-\beta_i)} < 0.$$

Therefore, the relation $\mu_i^r < \beta_i < \mu_i^a$ is satisfied.

(ii) Fix two players $i, j \in N \cup \{l\}$ such that $\beta_i < \beta_j$. Consider the pair of functions

$F_a, F_r : (0,1) \to \mathbb{R}$

defined, respectively, as

$$F_a(\beta) \equiv \frac{q\beta}{q\beta + (1-q)(1-\beta)} \quad \text{and} \quad F_r(\beta) \equiv \frac{(1-q)\beta}{(1-q)\beta + q(1-\beta)}.$$

The two functions F_a and F_r are differentiable on β and it follows that

$$F_a'(\beta) = \frac{q(1-q)}{[q\beta + (1-q)(1-\beta)]^2} > 0 \quad \text{and} \quad F_r'(\beta) = \frac{q(1-q)}{[(1-q)\beta + q(1-\beta)]^2} > 0$$

for each value $\beta \in (0,1)$ and for the given $q \in (1/2, 1)$. Therefore, we can establish thatr $F_r(\beta_i) < F_r(\beta_j)$ and $F_a(\beta_i) < F_a(\beta_j)$. Equivalently, using the descriptions in Eq. (3), it follows $\mu_i^r < \mu_j^r$ and $\mu_i^a < \mu_j^a$. ∎

Proof of Lemma 2. Take a given evidence-acquisition technology $q \in (1/2, 1)$ and a given voter $i \in N$. Fix a piece of evidence $s \in \{a, r\}$ and consider the alternative piece of evidence $s' \in \{a, r\} \setminus \{s\}$. For each given $\lambda \in [\underline{\lambda}, 1)$, consider the function $G_s : (0,1)^2 \to \mathbb{R}$ defined as

$$G_s(x, y; \lambda) \equiv \frac{x\rho_i(s)}{x\rho_i(s) + y\rho_i(s') + (1-\lambda)}.$$

This function G_s is differentiable on $(x, y) \in (0,1)^2$.

(i) We observe that, for each fixed pair $\rho_i(s), \rho_i(s') \in (0,1)$ and each $(x,y) \in (0,1)^2$,

$$\frac{\partial G_s}{\partial x}(x,y;\lambda) = \frac{\rho_i(s)[y\rho_i(s') + (1-\lambda)]}{[x\rho_i(s) + y\rho_i(s') + (1-\lambda)]^2} > 0 \quad \text{and} \quad \frac{\partial G_s}{\partial y}(x,y;\lambda) < 0.$$

Using the description in Eq. (4), it then follows that $\delta_i(s \mid \emptyset)$ increases strictly with $\sigma(\emptyset \mid s)$ and decreases strictly with $\sigma(\emptyset \mid s')$.

(ii) It is straightforward to observe that, for each given $s \in \{a, r\}$ and $s' \in \{a, r\} \setminus \{s\}$, for each fixed pair $x, y \in (0,1)$, the function $G_s(x,y;\lambda)$ is strictly increasing in parameter λ. From the particular expression provided by Eq. (4), it then follows that $\delta_i(s \mid \emptyset)$ increases strictly with $\lambda \in [\underline{\lambda}, 1)$. ∎

Proof of Proposition 1. Consider a k-voting rule and assume that $\mu_l^r \geq 1/2$. Take a given value for the research effort $\lambda \in [\underline{\lambda}, 1)$.

We prove first the if part of the proposition.

(i) Suppose first that condition (C) does not hold due to that $\mu_k^r \geq 1/2$. Then, it follows from Lemma 1 (i) that $\beta_k \geq 1/2$. In this case, given the considered arrangement of the leader's beliefs and of the voters' initial opinions, it follows that, if the leader has obtained $s = \emptyset$ and the voters observe $\hat{s} = \emptyset$, then voters $i \in \{1, 2, \ldots, k\}$ prefer $v_i^*(\hat{s}) = A$, which in equilibrium leads to $x(v^*(\hat{s})) = A$, the preferred alternative of the leader conditional on having obtained $s = \emptyset$. Likewise, when the leader has obtained $s = r$ and the voters observe $\hat{s} = r$, voters $i \in \{1, 2, \ldots, k\}$ prefer $v_i^*(\hat{s}) = A$, which again leads to $x(v^*(\hat{s})) = A$, the preferred alternative of the leader, conditional on having obtained $s = r$. Hence, the leader has no incentives to conceal any piece of evidence $s \in \{a, r\}$ that he receives.

(ii) Secondly, suppose that condition (C) does not hold due to that $\mu_k^a < 1/2$. Then, by combining the implications of Lemma 1 (i) that $\mu_k^r < \beta_k < \mu_k^a$ and of Eq. (5), it follows that the leader is not able to influence the beliefs of voter k by affecting $\mu_k^\emptyset$ because we have $\mu_k^\emptyset < 1/2$ for any concealment strategy. Therefore, the leader cannot influence the choice $x(v)$ selected from the voting process by concealing evidence.

In these two cases, the only equilibrium involves the leader disclosing fully, that is, $\sigma^*(s \mid s) = 1$ for each $s \in \{a, r\}$.

(iii) Thirdly, suppose that condition (C) does not hold due to that $\beta_k < 1/2$ and $\mu_k^a > 1/2$. Then, let us consider first a full disclosure strategy σ by the leader so that $\sigma(s \mid s) = 1$ for each $s \in \{a, r\}$. Then, since $\mu_k^r < \beta_k < 1/2$, the choice selected from the voting process is $x(v^*(\hat{s})) = R$ conditional on the voters being reported any $\hat{s} \in \{r, \emptyset\}$. However, when the leader has obtained $s \in \{r, \emptyset\}$, he prefers $x(v) = A$. In particular, we have $\mathbb{E}\big[u_l(v(s), \omega) \mid \mathcal{H}_l, s; \sigma, \lambda\big] = 0$ for each $s \in \{r, \emptyset\}$. However, this completely full disclosure satisfies the equilibrium requirement (ii) in Definition 1 since the leader cannot benefit by deviating. Given that the voters select $x(v^*(\emptyset)) = R$, the leader does not benefit by pooling between $s = r$ and $s = \emptyset$. In particular, for a concealment strategy σ' such that $\sigma'(\emptyset \mid r) > 0$, we have $\mathbb{E}\big[u_l(v(s), \omega) \mid \mathcal{H}_l, s; \sigma', \lambda\big] = 0$ for each $s \in \{r, \emptyset\}$.

For $\beta_k < 1/2$ and $\mu_k^a > 1/2$, let us now consider the only other plausible equilibrium. The following proposal gives the only other plausible equilibrium because, under the hard evidence requirements of evidence, conditional on having obtained $s = r$, the leader can only report either $\hat{s} = r$ or $\hat{s} = \emptyset$. By plugging into Eq. (5) the expressions for the probabilities δ_i obtained in Eq. (4) and the posteriors described by Eq. (14) and Eq. (3), the indifference requirement $\mu_i^\emptyset = 1/2$ can be equivalently rewritten as

$$\lambda\big(1 - q - \beta_i\big)\sigma(\emptyset \mid a) + \lambda(q - \beta_i)\sigma(\emptyset \mid r) = (1 - \lambda)\big[2\beta_i - 1\big]. \tag{15}$$

Then, based on the indifference condition detailed in Eq. (15), the leader would like to do better than under full disclosure. In particular, since $\mu_k^a > 1/2$ holds, the leader could perhaps be able to induce $\mu_k^\emptyset = 1/2$ by selecting appropriately the induced posterior $\mu_k^\emptyset \in co\{\mu_k^r, \mu_k^a\}$. If he manages to do so, then voter k would be indifferent between $v_k = A$ and $v_k = R$, and all voters $i \in \{1, 2, \ldots, k\}$ would prefer $v_i = A$. Using the proposed equilibrium selection in this case of indifference for voter k, it would follow that $x(v^*(\emptyset)) = A$ if $\mu_k^\emptyset = 1/2$. Now, if the leader is able to influence voters so as to induce $x(v^*(\emptyset)) = A$, then any disclosure $\sigma(r \mid r) > 0$ would be harmful for the leader conditional on having obtained $s = r$. In this case, condition (ii) of Definition 1 is only satisfied if $\sigma^*(r \mid r) = 0$ or, equivalently, if $\sigma^*(\emptyset \mid r) = 1$. Upon plugging this choice into the indifference requirement specified in Eq. (15), condition (ii) in Definition 1 would then require the leader to choose a value for $\sigma^*(a \mid a)$ such that

$$\sigma^*(a \mid a) = \frac{1 - 2\beta_k}{\lambda(1 - q - \beta_k)}, \tag{16}$$

where $1 - 2\beta_k > 0$ since we are considering that $\beta_k < 1/2$. Now, from Eq. (16), it follows that a well-defined probability $\sigma^*(a \mid a)$ such that $\sigma^*(a \mid a) \geq 0$ requires $q < 1 - \beta_k$ since $\lambda > 0$. In addition, in order to comply with $\sigma^*(a \mid a) \leq 1$, we note from Eq. (16) that it must be the case that $\lambda \geq (1 - 2\beta_k)/(1 - q - \beta_k)$. However, if such a condition $\lambda \geq (1 - 2\beta_k)/(1 - q - \beta_k)$ holds, then the natural requirement $\lambda < 1$ can be met only if $q < \beta_k$. In turn, this is incompatible with $q < 1 - \beta_k$ for $\beta_k < 1/2$. Therefore, the suggested influential concealment is not feasible. Choosing $\sigma^*(r \mid r) = 0$ does not form part of any equilibrium if $\beta_k < 1/2$ and $\mu_k^a > 1/2$. When $\beta_k < 1/2$ and $\mu_k^a > 1/2$, the only equilibrium involves the leader disclosing fully. For the same reasons provided above, it then follows that the leader optimally chooses

$\lambda^* = \underline{\lambda}$ in this third case. By considering this three cases (i)-(iii), we observe that if condition (C) is not satisfied, then it is not beneficial for the leader to conceal evidence.

We turn now to the if part. Suppose that condition (C) is satisfied. First, the arguments provided above to show the existence of an equilibrium where the leader fully discloses do not hold. Secondly, note that it follows directly from the expression that Eq. (3) provides for the particular posterior μ_k^r that $\mu_k^r < 1/2$ is satisfied if and only if condition $q > \beta_k$ holds. Thus, condition (C) requires automatically that the quality of the information acquisition technology be sufficiently high with the particular form $q > \beta_k$.

Now, since $\mu_k^r < 1/2$ and $\beta_k \geq 1/2$, the leader has (strict) incentives to pool between $s = r$ and $s = \emptyset$. Full disclosure does not satisfy the equilibrium requirement (ii) in Definition 1 since the leader benefits by deviating from $\sigma(r \mid r) = 1$.

We turn then to explore the only other possible equilibrium, in which we could have $\sigma^*(r \mid r) = 0$. Using the arguments above (case (iii)) to construct an equilibrium in which the leader chooses $\sigma^*(r \mid r) = 0$, it now follows that he would be able to influence voter k so as to achieve $\mu_k^{\emptyset} = 1/2$ if the leader also chooses a value for $\sigma^*(a \mid a)$ such that

$$\sigma^*(a \mid a) = \frac{2\beta_k - 1}{\lambda(q + \beta_k - 1)}, \tag{17}$$

where $2\beta_k - 1 \geq 0$ since we are now considering that $\beta_k \geq 1/2$. From Eq. (16), we note that a well-defined probability $\sigma^*(a \mid a)$ such that $\sigma^*(a \mid a) \geq 0$ requires that $q \geq 1 - \beta_k$ since $\lambda > 0$. In addition, in order to comply with $\sigma^*(a \mid a) \leq 1$, we note from Eq. (16) that it must be the case that $\lambda \geq (2\beta_k - 1)/(q + \beta_k - 1)$. Now, such a condition is compatible with the natural requirement that $\lambda < 1$ only if $q > \beta_k$. As we have argued above, this condition $q > \beta_k$ holds directly under condition (C). Furthermore, in this case, we have that $q > \beta_k$ implies $q > \beta_k - 1$ for $\beta_k \geq 1/2$. Therefore, condition $q > \beta_k$ guarantees that the leader can choose $\sigma^*(r \mid r) = 0$ and $\sigma^*(a \mid a) \in [0, 1]$ in equilibrium, for a given research effort $\lambda \in [\underline{\lambda}, 1)$, conditional on $\underline{\lambda} > 0$ being arbitrarily small. In consequence, if condition (C) is satisfied, then it is beneficial for the leader to conceal evidence. ∎

Proof of PROPOSITION 2. Consider a k-voting rule and assume that $\mu_l^r \geq 1/2$. Suppose that condition (C) $\mu_k^r < 1/2$ and $\beta_k \geq 1/2$ holds. Let us allow the leader to choose the effort $\lambda \in [\underline{\lambda}, 1)$ at cost $c(\lambda)$. Note first that the assumption $\lim_{\lambda \to 1} c(\lambda) \leq 1$ guarantees that the leader can exert any research effort $\lambda \in [\underline{\lambda}, 1)$ in order to influence the choice $x(v)$ of the voting process. Secondly, we make use of the concealment strategy that is part of the unique possible equilibrium under condition (C) identified in the proof of Proposition 1. Such a concealment strategy is characterized by $\sigma^*(r \mid r) = 0$ and $\sigma^*(a \mid a) \in [0, 1]$ such that

$$\sigma^*(a \mid a) = \frac{2\beta_k - 1}{\lambda(q + \beta_k - 1)}. \tag{18}$$

Use of such a concealment strategy in the expression for the leader ex-ante utility in Eq. (2) and of the expression for $\rho_l(a)$ given in Eq. (14) yield

$$\begin{aligned}\mathbb{E}\big[u_l\big(v,\omega\big) \mid \mathcal{H}_l; \sigma^*, \lambda\big] - c(\lambda) &= \beta_l\Big[\rho_l(a)[1] + \rho_l(r)[1] + (1-\lambda)[1]\Big] \\ &\quad + (1-\beta_l)\Big[\rho_l(a)[0] + \rho_l(r)[0] + (1-\lambda)[0]\Big] - c(\lambda) \\ &= \beta_l - c(\lambda).\end{aligned}$$

Hence, the net utility $\mathbb{E}\big[u_l\big(v,\omega\big) \mid \mathcal{H}_l; \sigma^*, \lambda\big] - c(\lambda)$ is decreasing in $\lambda \in [\underline{\lambda}, 1)$. Therefore, the leader wants to choose λ as low as possible. It follows from Eq. (18) that, if $\underline{\lambda} \leq (2\beta_k - 1)/(q + \beta_k - 1)$, then the leader can choose $\sigma^*(a \mid a) = 1$ combined with the research effort $\lambda^* = (2\beta_k - 1)/(q + \beta_k - 1)$. On the other hand, if $\underline{\lambda} > (2\beta_k - 1)/(q + \beta_k - 1)$, then the requirement of Eq. (18) leads to that the leader is restricted to choosing the probability $\sigma^*(a \mid a) = (2\beta_k - 1)/\underline{\lambda}(q + \beta_k - 1) \in (0, 1)$ combined with the minimum research effort $\lambda^* = \underline{\lambda}$. ∎

Proof of Proposition 3. Let us begin by commenting on three points. First, we are restricting attention to situations in which $\beta_{k'} \geq 1/2$ holds for any $k' > k$. Secondly, we are not considering non-generic situations in which $\beta_i = 1/2$ for some voter $i \in N$. Thirdly, we will be now using the notation $\mu_i^a(q)$ to be explicit about the fact that, for each voter i, such a posterior belief μ_i^a depends on q. In particular, from Eq. (1) and Eq. (3) it follows that $\mu_i^a(q)$ increases with q.

The (ex-ante) utility of voter i when the leader receives a piece of evidence $s \in \{a, r\}$ from his research effort (which happens in equilibrium with probability λ^*) is

$$\mathbb{E}\big[u_i(v_i^*, \omega) \mid \mathcal{H}_i; \sigma^*, \lambda^*, s \in \{a, r\}\big] = \sum_{\omega} \mathbb{P}(\omega \mid \mathcal{H}_i) \sum_{s, \hat{s}} \rho_i^*(s)\sigma^*(\hat{s} \mid s) u_i\big(v_i^*(\hat{s}), \omega\big). \tag{19}$$

The (ex-ante) utility of voter i when the leader receives signal $s = \emptyset$ (which happens in equilibrium with probability $1 - \lambda^*$) is

$$\mathbb{E}\big[u_i(v_i^*, \omega) \mid \mathcal{H}_i; \sigma^*, \lambda^*, s = \emptyset\big] = \sum_{\omega} \mathbb{P}(\omega \mid \mathcal{H}_i) u_i\big(v_i^*(\emptyset), \omega\big). \tag{20}$$

The (ex-ante) utility of voter i is then given by the expectation of the expressions in Eq. (19) and Eq. (20), computed according to the probability λ^* of the leader obtaining a piece of evidence.

Let $N_A = \{i \in N \mid \beta_i \geq 1/2\}$ be the set of A-biased voters with $n_A = |N_A|$ and let $N_R = \{i \in N \mid \beta_i < 1/2\}$ be the set of R-biased voters with $n_R = |N_R|$. Let $\gamma_i^a = \beta_i \mathbf{1}_{\mu_i^a < 1/2} + (1-\beta_i)\mathbf{1}_{\mu_i^a \geq 1/2}$, where $\mathbf{1}_t$ is an indicator function that takes value 1 when statement t is true, zero otherwise.

Suppose that upon the proposed changes in k or q, condition (C) continues to hold. Suppose also that the leader does not change his equilibrium strategy from (a) to (b) in Proposition 2, or vice versa. Then:

(a) Consider the equilibrium strategy $\sigma^*(r \mid r) = 0$, $\sigma^*(a \mid a) = 1$ and $\lambda^* = (2\beta_k - 1)/(q + \beta_k - 1)$ (Proposition 2 (a)). Given such a strategy and the expression for $\mu_k^{\emptyset}$ in Eq. (5), it follows that $\mu_m^{\emptyset} > \mu_k^{\emptyset} = 1/2 > \mu_l^{\emptyset}$, for voters m and l such that $l > k > m$. The reason is that for such voters $\delta_m^*(r \mid \emptyset) < \delta_k^*(r \mid \emptyset) < \delta_l^*(r \mid \emptyset)$ and, by Lemma 1, it holds that $\mu_i^r < \beta_i$ for each i. Using Eq. (19) and Eq. (20), the ex-ante utility of a voter i can be expressed as

$$\mathbb{E}\big[u_i(v_i, \omega) \mid \mathcal{H}_i; \sigma^*, \lambda^*\big] = 1 - \begin{cases} (1 - \beta_i) & \text{if} \quad i \leq k \\ \rho_i^*(a)[\gamma_i^a - \beta_i] + \beta_i & \text{if} \quad i > k. \end{cases} \tag{21}$$

From Eq. (21) it directly follows that no voter $i \leq k$ is affected by changes in k or q. The analysis then focuses on the $n - k$ voters $i \in N \setminus \{1, \ldots, k\}$.

First, consider that k rises. In this case β_k decreases. As $\partial \lambda^* / \partial \beta_k > 0$, a more unanimous voting rule results in a smaller equilibrium effort λ^*. From Eq. (14), it directly follows that $\rho^*(a)$ is also smaller. For a voter i we need to analyze two possible cases:

(i) if $\mu_i^a(q) < 1/2$ then Eq. (21) becomes $1 - \beta_i$. In this case voter i remains the same.

(ii) if $\mu_i^a(q) \geq 1/2$, then Eq. (21) becomes $1 - [\rho_i^*(a)(1 - 2\beta_i) + \beta_i]$. Thus, if voter i is A-biased, an increase in q makes her worse off, whereas if she is R-biased, such an increase makes her better off.

Notice also that when k rises to $k' > k$ there may be a voter i such that $i > k$ but $i \leq k'$. As we consider that $\beta_{k'} \geq 1/2$ holds for any $k' > k$, in this case, such A-biased voter becomes better off. The reason is that she votes for acceptance upon any received signal when $i \leq k'$, whereas when $i > k$ she votes for rejection upon observing $\hat{s} = \emptyset$, as for her $\mu_i^{\emptyset} < 1/2$, as argued above.

We thus conclude that, as k rises: each voter $i \in (k, k']$, who is A-biased, becomes better off. Also, by (ii), each of the $n_A - k'$ voters, who is A-biased, becomes worse off. Finally, each voter $i \in N_R$ either remains unaffected (case i) or becomes better off (case ii).

Second, consider an increase in q, to say, $q' > q$. It follows from Eq. (14) and from the equilibrium effort λ^*, that the sign of $\partial\rho_i^*(a)/\partial q$ equals the sign of $-2\beta_k(2\beta_k - 1)(1 - \beta_k)$, which is negative since voter k is A-biased. For any voter $i \neq k$ we need to analyze three possible cases:

(i) if $\mu_i^a(q') < 1/2$, then Eq. (21) becomes $1 - \beta_i$, hence she remains the same.

(ii) if $\mu_i^a(q) \geq 1/2$, then Eq. (21) becomes $1 - [\rho_i^*(a)(1 - 2\beta_i) + \beta_i]$. Therefore, if voter i is A-biased, an increase in q makes her worse off, whereas if she is R-biased, such an increase makes her better off.

(iii) if $\mu_i^a(q) < 1/2$ and $\mu_i^a(q') \geq 1/2$, the loss is β_i under q and $\rho_i^*(a)(1 - 2\beta_i) + \beta_i > \beta_i$ under $q' > q$, provided that $\beta_i < 1/2$. Thus, such voter i is worse off.

We thus conclude that as q rises: the $n_A - k$ voters, who are A-biased, become worse off (case (ii)). Also, each of the R-biased voters either remains unaffected (case i), becomes better off (case (ii)) or becomes worse off (case (iii)).

(b) Consider the equilibrium strategy $\sigma^*(r \mid r) = 0$, $\sigma^*(a \mid a) = (2\beta_k - 1)/(\underline{\lambda}(q + \beta_k - 1))$ and $\lambda^* = \underline{\lambda}$ (Proposition 2 (b)). In this case the ex-ante utility of voter i can be expressed as

$$\mathbb{E}\big[u_i(v_i, \omega) \mid \mathcal{H}_i; \sigma^*, \lambda^*\big] = 1 - \begin{cases} (1 - \beta_i) & \text{if} \quad i \leq k \\ \rho_i^*(a)\sigma^*(a \mid a)[\gamma_i^a - \beta_i] + \beta_i & \text{if} \quad i > k. \end{cases} \tag{22}$$

Given Eq. (14) and $\lambda^* = \underline{\lambda}$, we have that $\rho_i^*(a)\sigma^*(a \mid a) = [q\beta_i + (1 - q)(1 - \beta_i)](2\beta_k - 1)/(q + \beta_k - 1)$. This expression is the same than the one for $\rho_i^*(a)$ in Eq. (21), where $\lambda^* = (2\beta_k - 1)/(q + \beta_k - 1)$ and $\sigma^*(a \mid a) = 1$. The same analysis than in case (a) thus follows. ∎

Proof of Proposition 4. Analogously to the proof of Proposition 3, for each voter i let us write $\mu_i^s(q)$, $s \in \{a, r\}$. Recall also the expression of γ_i^a from such proof. Let also $\gamma_i^{\beta_i} = \beta_i \mathbf{1}_{\beta_i < 1/2} + (1 - \beta_i)\mathbf{1}_{\beta_i \geq 1/2}$ and $\gamma_i^r = \beta_i \mathbf{1}_{\mu_i^r < 1/2} + (1 - \beta_i)\mathbf{1}_{\mu_i^r \geq 1/2}$, where $\mathbf{1}_t$ is an indicator function that takes value 1 when statement t is true, zero otherwise. Finally, for a signal $s \in S$, let $\underline{\rho}_i(s) \equiv \mathbb{P}(s \mid \mathcal{H}_i, \underline{\lambda})$. Then, consider the two reasons as to why (C) does not hold: First consider that under k and q (C) does not hold because $\beta_k < 1/2$. Then, the ex-ante utility of a voter i can be expressed as

$$\mathbb{E}\big[u_i(v_i, \omega) \mid \mathcal{H}_i; \sigma^*, \underline{\lambda}\big] = 1 - \begin{cases} \underline{\rho}_i(a)\gamma_i^a + \underline{\rho}_i(r)\gamma_i^r + (1 - \underline{\lambda})\gamma_i^{\beta_i} & \text{if} \quad i < k \\ \underline{\rho}_i(a)[\gamma_i^a - \beta_i] + \beta_i & \text{if} \quad i \geq k. \end{cases} \tag{23}$$

It is direct to observe that as k rises to $k' > k$ no voter $i \geq k'$ or $i < k$ is affected, because neither the effort exerted by the leader nor his decision on whether to disclose evidence change. That is also the case when $i \geq k$ but $i < k'$. As such a voter is R-biased, the two parts of Eq. (23) consist on the same expression. Let then q increase to $q' > q$. We need to consider two cases:

(i) Each A-biased voter i loses $(1-\underline{\rho}_i(r))(1-\beta_i)+\underline{\rho}_i(r)\gamma_i^r$. Then, if $\mu_i^r(q) < 1/2$ she becomes better off, because an increase in q reduces $\underline{\rho}_i(r)$. If $\mu_i^r(q) > 1/2$ and also $\mu_i^r(q') > 1/2$, she loses $(1-\beta_i)$ in either case. Thus she is not affected. Finally, if $\mu_i^r(q) > 1/2$ but $\mu_i^r(q') < 1/2$, voter i was previosuly losing $(1-\beta_i)$. However, for q' she loses $(1-\underline{\rho}_i(r))(1-\beta_i)+\rho_i^*(r)\beta_i > (1-\beta_i)$. Thus, she becomes worse off.

(ii) Each R-biased voter i loses $(1-\underline{\rho}_i(a))\beta_i + \underline{\rho}_i(a)\gamma_i^a$. Then if $\mu_i^a(q) > 1/2$ she becomes better off, because an increase in q reduces $\underline{\rho}_i(a)$. If $\mu_i^a(q) < 1/2$ and $\mu_i^a(q') < 1/2$, she loses β_i in either case. Thus she is not affected. Finally if $\mu_i^a(q) < 1/2$ but $\mu_i^a(q') \geq 1/2$, she was previosuly losing β_i. However, for q' she loses $(1-\underline{\rho}_i(a))\beta_i + \underline{\rho}_i(a)(1-\beta_i) > \beta_i$. Thus, she becomes worse off.

Second, consider that under k and q, (C) does not hold because $\mu_k^r \geq 1/2$. In this case the ex-ante utility of each voter i is

$$\mathbb{E}\big[u_i(v_i,\omega) \mid \mathcal{H}_i; \sigma^*, \underline{\lambda}\big] = 1 - \begin{cases} 1-\beta_i & \text{if} \quad i \leq k \\ \underline{\rho}_i(a)\gamma_i^a + \underline{\rho}_i(r)\gamma_i^r + (1-\underline{\lambda})\gamma_i^{\beta_i} & \text{if} \quad i > k. \end{cases} \tag{24}$$

As above, no voter is affected by changes in k. Let q rise to $q' > q$. Only voters $i > k$ can be affected by such change. If i is A-biased, the analysis is analogous than the one in (i) above. Thus, notice that, in particular, A-biased voters $i \leq k$, that is, those in the set $\{1,\ldots,k\}$, remain unaffected if (C) does not hold because $\mu_k^r \geq 1/2$, but if (C) does not hold because $\beta_k < 1/2$, are affected as described by (i). If voter i is R-biased, the analysis is analogous than the one in (ii) above. ∎

Proof of PROPOSITION 5. As in the proof of Proposition 4, for each voter i, we use $\mu_i^s(q)$, $s \in \{a, r\}$ and the expressions for $\gamma_i^{\beta_i}$, γ_i^r and γ_i^a there introduced. For each voter i and for a signal $s \in S$, let $\rho_i^*(s) \equiv \mathbb{P}(s \mid \mathcal{H}_i, \lambda^*)$. Notice that $\rho_i^*(s)$ and λ^* depend on the type of equilibrium in Proposition 2. Along the proof, we make explicit the type of equilibrium we refer to. Also, let $\underline{\rho}_i(s) \equiv \mathbb{P}(s \mid \mathcal{H}_i, \underline{\lambda})$.

First, consider that departing from the type of equilibrium described by Proposition 2 (a), condition (C) ceases to hold. Then, the leader discloses each signal $s \in \{a, r\}$ he receives and makes the minimum possible effort $\underline{\lambda}$. We need to consider two possible cases:

(i) Condition (C) ceases to hold because k rises to $k' > k$, and, as a consequence, $\beta_{k'} < 1/2$. The ex-ante utility of a voter i can be then expressed as

$$\mathbb{E}\big[u_i(v_i,\omega) \mid \mathcal{H}_i; \sigma^*, \underline{\lambda}\big] = 1 - \begin{cases} (1-\underline{\rho}_i(r))(1-\beta_i) + \underline{\rho}_i(r)\gamma_i^r & \text{if} \quad i \leq k \\ \underline{\rho}_i(a)\gamma_i^a + \underline{\rho}_i(r)\gamma_i^r + (1-\underline{\lambda})\gamma_i^{\beta_i} & \text{if} \quad k < i < k' \\ \underline{\rho}_i(a)[\gamma_i^a - \beta_i] + \beta_i & \text{if} \quad i \geq k'. \end{cases} \tag{25}$$

Using the expression for the ex-ante utility of a voter i in Eq. (21) associated to the type of equilibrium described by Proposition 2 (a) we conclude that: each A-biased voter $i \leq k$ is (weakly) worse off, as she may incur in a loss of β_i when she votes for rejection upon observing $\hat{s} = r$. Each R-biased voter $i \geq k'$ is (weakly) better off as $\lambda^* \geq \underline{\lambda}$. Additionally, for a voter i such that $k < i < k'$: (i) if she is R-biased she is better off under full disclosure by the same reasoning as above. (ii) If she is A-biased, she loses

$$\underline{\rho}_i(r))(\gamma_i^r - (1-\beta_i)) + (1-\beta_i), \tag{26}$$

under full disclosure. Under the type of equilibrium in Proposition 2 (a) she loses

$$(1-\beta_i)\rho_i^*(a) + (1-\rho_i^*(a))\beta_i, \tag{27}$$

where $\underline{\rho}_i(r) = \underline{\lambda}[q(1-\beta_i) + (1-q)\beta_i]$ and $\rho_i^*(a) = \lambda^*[q\beta_i + (1-q)(1-\beta_i)]$.

If $\gamma_i^r = 1-\beta_i$ the loss in Eq. (26) is $1-\beta_i$. Thus, she is better off under full disclosure. If $\gamma_i^r = \beta_i$, we rewrite Eq. (26) as $\underline{\rho}_i(r))(2\beta_i - 1) + (1-\beta_i)$ and Eq. (27) as $\rho_i^*(a))(1-2\beta_i) + \beta_i$. The difference between Eq. (26) and Eq. (27) is $D \equiv [1-2\beta_i][1-[\underline{\rho}_i(r) + \rho_i^*(a)]]$. Then, substitute $\underline{\lambda}$ by $\lambda^* \geq \underline{\lambda}$ in $\underline{\rho}_i(r)$. It then follows that still $\underline{\rho}_i(r) + \rho_i^*(a) = \lambda^* < 1$. Thus, $D < 0$, implying that she is better off under full disclosure.

(ii) Condition (C) ceases hold because q decreases to $q' < q$ and, as a consequence, $\mu_k^r(q') \geq 1/2$. The ex-ante utility of a voter i is

$$\mathbb{E}\big[u_i(v_i,\omega) \mid \mathcal{H}_i; \sigma^*, \underline{\lambda}\big] = 1 - \begin{cases} 1-\beta_i & \text{if} \quad i \leq k \\ \underline{\rho}_i(a)\gamma_i^a + \underline{\rho}_i(r)\gamma_i^r + (1-\underline{\lambda})\gamma_i^{\beta_i} & \text{if} \quad i > k. \end{cases} \tag{28}$$

Then, with respect to the type of equilibrium described by Proposition 2 (a):

(a) Each A-biased voter $i \leq k$ remains the same, as she now votes for aceptance also upon observing $\hat{s} = r$.

(b) Each R-biased voter $i > k$ such that $\mu_i^a(q') < 1/2$, loses β_i. Thus, if $\mu_i^a(q) \geq 1/2$ her utility is higher. Otherwise, her utility is the same. If voter i is such that $\mu_i^a(q') \geq 1/2$, she loses $\underline{\rho}(a)(1-2\beta_i)+\beta_i$ under full disclosure. This loss is smaller if and only if $\underline{\rho}_i(a) < \rho_i^*(a)$.

(c) Each voter $i > k$ such that $\mu_i^r(q') \geq 1/2$ loses $1-\beta_i$. Notice she is A-biased with $\mu_i^r(q) < 1/2$ as by (C) it holds that $\mu_k^r(q) < 1/2$ and by Lemma 1 posterior beliefs preserve the order of initial opinions. Then she is better off since since she votes for acceptance upon any reported signal. Finally:

(d) Each A-biased voter $i > k$ such that $\mu_i^r(q') < 1/2$ loses

$$\underline{\rho}_i(a)(1-\beta_i)+(1-\underline{\lambda})(1-\beta_i)+\underline{\rho}_i(r)\beta_i, \tag{29}$$

under full disclosure. In this case $\underline{\rho}_i(a)=\underline{\lambda}[q'\beta_i+(1-q')(1-\beta_i)]$ and $\underline{\rho}_i(r)=\underline{\lambda}[(1-q')\beta_i+q'(1-\beta_i)]$. In the type of equilibrium described by Proposition 2 (a) she loses

$$\rho_i^*(a)(1-\beta_i)+(1-\lambda^*)\beta_i+\rho_i^*(r)\beta_i, \tag{30}$$

where $\rho_i^*(a)=\lambda^*[q\beta_i+(1-q)(1-\beta_i)]$ and $\rho_i^*(r)=\lambda^*[(1-q)\beta_i+q(1-\beta_i)]$.

As Eq. (29) minus Eq. (30) equals $D \equiv [1-2\beta_i][1-[\underline{\rho}_i(r)+\rho_i^*(a)]]$ voter i is better off under full disclosure if $\underline{\rho}_i(r)+\rho_i^*(a) < 1$. Otherwise, she is worse off.

Second, consider that departing from the type of equilibrium described by Proposition 2 (b) condition (C) no longer holds. Then, the leader discloses each piece of evidence $s \in \{a, r\}$ he receives and makes effort $\underline{\lambda}$. There are two possible cases:

(i) Condition (C) ceases to hold because for $k' > k$ we have $\beta_{k'} < 1/2$. The ex-ante utility of a voter i is expressed in Eq. (25). With respect to the type of equilibrium described by Proposition 2 (b): each A-biased voter $i \leq k$ is (weakly) worse off under full disclosure by the same reasoning as in (i) in the type of equilibrium described by Proposition 2 (a). Each R-biased voter $i \geq k'$ is worse off. Specifically, her utility in the type of equilibrium described by Proposition 2 (b) (see Eq. (22)) is higher, since $\rho_i^*(a)\sigma^*(a \mid a) < \underline{\rho}_i(a)$ as $(2\beta_k-1)/(q+\beta_k-1) < \underline{\lambda}$. Let voter i be such that $k < i < k'$: (i) if she is R-biased she is again worse off under full disclosure. (ii) If she is A-biased, in the full disclosure equilibrium she loses the amount expressed in Eq. (26). Under the type of equilibrium described by Proposition 2 (b) she loses

$$(1-\beta_i)\rho_i^*(a)\sigma^*(a \mid a)+(1-\rho_i^*(a)\sigma^*(a \mid a))\beta_i, \tag{31}$$

where $\rho_i^*(a)=\underline{\lambda}[q\beta_i+(1-q)(1-\beta_i)]$. If $\gamma_i^r=1-\beta_i$ the loss in Eq. (26) is $1-\beta_i$. Thus, she is better off under full disclosure. If $\gamma_i^r=\beta_i$, it turns out that Eq. (26) minus Eq. (27)

equals $D \equiv [1-2\beta_i][1-[\underline{\rho}_i(r)+\rho_i^*(a)\sigma^*(a \mid a)]]$. Then, substitute $(2\beta_k-1)/(q+\beta_k-1)$, present in expression $\rho_i^*(a)\sigma^*(a \mid a)$, by $\underline{\lambda}$, and recall that $\underline{\lambda} > (2\beta_k-1)/(q+\beta_k-1)$. Then $\underline{\rho}_i(r)+\rho_i^*(a)\sigma^*(a \mid a) = \underline{\lambda} < 1$, so that $D < 0$. Hence, she is better off under full disclosure.

(ii) Condition (C) ceases to hold because for $q' < q$ we have that $\mu_k^r(q') \geq 1/2$. In this case the ex-ante utility of a voter i is expressed in Eq. (28). Then:

(a) Each A-biased voter $i \leq k$, and each R-biased voter $i > k$ such that $\mu_i^a(q') < 1/2$, react to changes in q as in the type of equilibrium described by Proposition 2 (a).

(b) Each R-biased voter $i > k$ such that $\mu_i^a(q') \geq 1/2$, loses $\underline{\rho}(a)(1-2\beta_i)+\beta_i$ under full disclosure. This loss is higher than the loss in the type of equilibrium described by Proposition 2 (b) as $\underline{\rho}_i(a) > \rho_i^*(a)\sigma^*(a \mid a)$. Thus, she is worse off under full disclosure.

(c) Each voter $i > k$ such that $\mu_i^r(q') \geq 1/2$ loses $(1-\beta_i)$. Notice that such voter is A-biased with $\mu_i^r(q) < 1/2$, as by (C) it holds that $\mu_k^r(q) < 1/2$ and by Lemma 1 posterior beliefs preserve the order of initial opinions. Then she is better off under full disclosure because she votes for acceptance upon any reported signal.

(d) Each A-biased voter $i > k$ such that $\mu_i^r(q') < 1/2$ loses the amount specified in Eq. (29) under the full disclosure equilibrium. In the type of equilibrium described by Proposition 2 (b) she loses

$$\rho_i^*(a)\sigma^*(a \mid a)(1-\beta_i)+(1-\rho_i^*(a)\sigma^*(a \mid a))\beta_i. \tag{32}$$

Eq. (29) minus Eq. (32) equals $[1-2\beta_i][1-[\underline{\rho}_i(r)+\rho_i^*(a)\sigma^*(a \mid a)]]$. Thus, she is better off under full disclosure if $\underline{\rho}_i(r)+\rho_i^*(a)\sigma^*(a \mid a) < 1$. Otherwise, she is (weakly) worse off. ∎

Proof of Lemma 3. Take a given evidence-acquisition technology $q \in (1/3, 1)$.
(i) From the particular form of evidence-acquisition technology proposed in Eq. (7) it follows that

$$\rho_i(s) = \lambda\Big[q\beta_i(s) + \left(\frac{1-q}{2}\right)\sum_{\omega \neq s}\beta_i(\omega)\Big] \tag{33}$$

for each piece of evidence $s = \hat{s} \in \{a, b, r\}$. Fix a player $i \in N \cup \{l\}$. Fix a given value $\omega \in \Omega$ and the piece of evidence $s = \omega$. Using the posterior beliefs in Eq. (8) we can derive

$$\mu_i^s(\omega) = \frac{1}{1+\left(\frac{1-q}{2q}\right)\sum_{\omega' \neq \omega}\frac{\beta_i(\omega')}{\beta_i(\omega)}}. \tag{34}$$

Since $q > 1/3$, it can be verified that the sign of the difference $\mu_i^s(\omega) - \beta_i(\omega)$ coincides with the sign of the difference

$$1-\beta_i(\omega) - \left(\frac{1-q}{2q}\right)\sum_{\omega' \neq \omega}\beta_i(\omega') = \left(\frac{3q-1}{2q}\right)\sum_{\omega' \neq \omega}\beta_i(\omega') > 0.$$

Therefore, $\mu_i^s(\omega) > \beta_i(\omega)$ for $s = \omega$.

In addition, for a value given $\omega \in \Omega$, a given piece of evidence $s' \neq \omega$, and for the remaining value $\omega' \in \Omega$ such that $\omega' \neq \omega$ and $\omega' \neq s'$, we have from Eq. (8) that

$$\mu_i^{s'}(\omega) = \frac{1}{1 + \frac{\beta_i(\omega')}{\beta_i(\omega)} + \left(\frac{2q}{1-q}\right)\frac{\beta_i(s')}{\beta_i(\omega)}}. \tag{35}$$

Since $q \in (1/3, 1)$, it can be verified that the sign of the difference $\mu_i^{s'}(\omega) - \beta_i(\omega)$ coincides with the sign of the difference

$$1 - \beta_i(\omega) - \beta_i(\omega') - \left(\frac{2q}{1-q}\right)\beta_i(s') = \left(\frac{1-3q}{1-q}\right)\beta_i(s') < 0.$$

Therefore, $\mu_i^{s'}(\omega) < \beta_i(\omega)$ for $s' \neq \omega$, as stated.

(ii) Fix a value $\omega \in \Omega$ and two players $i, j \in N \cup \{l\}$ such that $\beta_i(\omega) < \beta_j(\omega)$. Let us consider the function $F : (0,1) \to \mathbb{R}$ defined as

$$F(\beta) \equiv \frac{q\beta}{q\beta + \left(\frac{1-q}{2}\right)(1-\beta)}.$$

This function F is differentiable on β and it follows that

$$F'(\beta) = \frac{q\left(\frac{1-q}{2}\right)}{\left[q\beta + \left(\frac{1-q}{2}\right)(1-\beta)\right]^2} > 0$$

for each value $\beta \in (0,1)$ and for the given $q \in (1/3, 1)$. Therefore, we can establish that $F(\beta_i(\omega)) < F(\beta_j(\omega))$. Using the description in Eq. (34), we then obtain $\mu_i^s(\omega) < \mu_j^s(\omega)$. ∎