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Identity-Based Elections

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Abstract

We study how media choice driven by political identity can influence electoral results. Citizens gather information from mainstream news but also from possibly partisan media sources which filter news in particular predetermined ways. We assume that citizens process all information they receive correctly but choose their own media sources in a behavioral self-serving way to try to preserve their political faith/identity. That is, they attempt to rationally counteract mainstream news that they might view as unfavorable. In the baseline setup, we assume that citizens on either side of the political spectrum are exposed to different extents to mainstream news, as in the U.S. case. This endogenous media choice generates an electoral advantage for the less exposed side, which can turn into a sure electoral victory even for the wrong candidate in a democracy. Results are robust to forms of media distrust and are stronger if citizens have biased priors. In contrast, we show that, in illiberal democracies, where the government controls the media, official media propaganda works only if citizens are unaware of its bias, but otherwise backfires entirely without censorship of other media.

JEL Classification: D72, D83, D9

Keywords: information design, Belief-based utility, information aggregation

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April 9, 2022

Abstract

We study how media choice driven by political identity can influence electoral results. Citizens gather information from mainstream news but also from possibly partisan media sources which filter news in particular predetermined ways. We assume that citizens process all information they receive correctly but choose their own media sources in a behavioral self-serving way to try to preserve their political faith/identity. That is, they attempt to rationally counteract mainstream news that they might view as unfavorable. In the baseline setup, we assume that citizens on either side of the political spectrum are exposed to different extents to mainstream news, as in the U.S. case. This endogenous media choice generates an electoral advantage for the less exposed side, which can turn into a sure electoral victory even for the wrong candidate in a democracy. Results are robust to forms of media distrust and are stronger if citizens have biased priors. In contrast, we show that, in illiberal democracies, where the government controls the media, official media propaganda works only if citizens are unaware of its bias or if the government can engage in censorship. Otherwise, propaganda backfires in the presence of freely available chosen media.

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1 Introduction

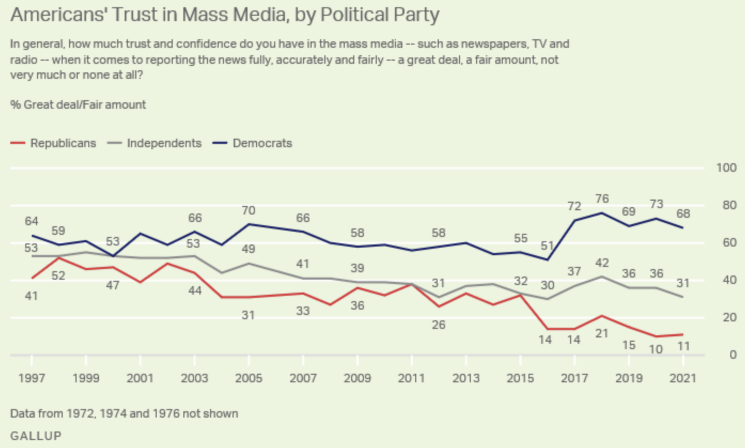
"More often than not, citizens do not choose which party to support based on policy opinion; they alter their policy opinion according to which party they support."

Mason (2018)

In the current environment, people can choose to consume news from a plethora of possible media sources. Although traditional mainstream news sources continue to exist, many new media sources have emerged in just the past two decades. The richness of new media has perhaps benefited people by allowing them to more accurately tailor their media choices to their wants. However, the incredible diversity of viewpoints on offer, combined with new technologies, has made it easier for citizens to form "echo chambers" or "filter bubbles" through which they become insulated from possibly contrary perspectives offered by traditional media outlets.

At the same time, trust in traditional media has declined markedly over the past two decades.. Especially in the past five years, this media distrust has followed radically different paths on either side of the political spectrum in the United States. As we can see in figure 1 below, the gap in media trust between Republicans and Democrats is staggering.

Figure 1: Asymmetry in trust in mass media



Indeed, as the Pew Foundation noted Jurkowitz et al. (2020): "one of the clearest examples of America's political divide is that many more Democrats express trust in a far greater number of news sources than Republicans." For instance, during the 2016 US presidential campaign, according to Bond (2017) "Pro-Clinton audiences were highly attentive to traditional media outlets, which continued to be the most prominent outlets across the public sphere, alongside more left-oriented online sites. But pro-Trump audiences paid

the majority of their attention to polarized outlets that have developed recently, many of them only since the 2008 election. ... Breitbart News became the center of a distinct right-wing media ecosystem, surrounded by Fox News, the Daily Caller, the Gateway Pundit, the Washington Examiner, Infowars, Conservative Treehouse, and Truthfeed."[1]

These two phenomena — the emergence of a dense array of media outlets and partisan distrust of media — have repercussions on how political beliefs are formed and updated and, as a consequence, on people's decisions on election day. But can this new information environment generate aggregate beliefs biased enough to swing an election? We seek to shed light on how this new asymmetric media landscape shapes electoral outcomes.

The influence of the above-mentioned phenomena on aggregate electoral outcomes is compounded, especially in the U.S., by the presence of a very polarized landscape in which traditional ideological, religious, and racial identities are being replaced by overlapping *meta-identities* captured almost entirely by the Democratic and Republican political faiths. Citizens have become less responsive to new info or real national problems, as if political affiliations determine what information people absorb, rather than the other way around (see, for instance, Mason (2018)).

To tackle these questions we build a model where political identities drive media choices. To model media choice, our basic premise is a dichotomy in types of media. This premise, in addition, allows us to study the case of both liberal and illiberal democracies under the same broad framework: we assume that each citizen chooses to follow certain specific media, but that to some extent she is also exposed to the broader media environment — to media she does not explicitly choose. Each citizen fully believes the media sources she decides to follow, as they are tailored to her preferences: we denote these as Inside media (or In-media, henceforth). However, she may hold different beliefs with regard to the media not chosen (Outside media or Out-media, henceforth).

Different assumptions on Outside media allow us to tackle different questions. In the context of a liberal democracy, as in the U.S. example above, we can think of Outside media as mainstream media[2], which citizens trust to possibly different extents, implying different exposure and, as a consequence, different impacts on their beliefs.[3] In the

[1] Lee (2010) finds that trust in media is negatively correlated with conservatism and Republican-leaning. Pennycook & Rand (2019) notes that Democrats trust mainstream news more than Republicans, with the difference ranging between 11.5 and 14.7 percent. According to Jones (2004), "*only 16.5 percent of Democrats (including Democratic-leaning independents) can be classified as media skeptics compared with nearly 40 percent of Republicans and Republican-leaning independents*".

[2] To be sure, it is hard to define mainstream media in the current rapidly evolving changing media environment. In broad terms, however, when we use the term mainstream, we are referring to traditional corporate legacy outlets; these have standard fact-checking processes and try to synthesize and diffuse responsibly the best information by experts.

[3] second part of the paper on (true or perceived) propaganda.

context of an illiberal democracy, we will refer to Outside media as official government media that promotes a government propaganda message some, or most, of the time. We describe the U.S. case first and later focus on propaganda in an illiberal democracy.

The core setup of the model is decision-theoretic and very simple. A citizen receives two pieces of news: one from exogenous Outside media and one from Inside media, i.e., a media source endogenously chosen by the citizen. Different exposure to Outside information means that Outside information is noisier for certain citizens and thus affects their beliefs to a lesser extent. The In-media source is chosen in a self-serving behavioral way, as explained below. Citizens are fully rational in the way they process all information they receive and update their beliefs based on the two signals and vote according to their posterior for the better candidate. In sum, the election aggregates all votes, each based on two conditionally independent signals of which of two candidates is preferable.

The key behavioral assumption of our model regards not information processing but the preference that drives each citizen's choice of In-media, i.e., the tailored media outlets, each of which we view as a particular known signal structure (under commitment). We assume that each citizen identifies with a party, left or right, and aims to preserve this political identity/faith.. They choose In-media to maximize the likelihood they will believe the party they identify with is the better match for the state of the world, after their beliefs are rationally updated. Such beliefs are based on just two signals: the exogenous Out-media signal and the signal of the In-media outlet of their choice. In other words, citizens make their media choice attempting to shield themselves from possibly unfavorable (from their point of view) mainstream news to which they are sometimes exposed. Equivalently, one can think of agents as having two selves — a heart and a mind. The heart chooses the media to follow attempting to preserve its political identity/faith, whereas the mind processes all information it receives rationally and votes for the party she believes is better.[4] Our setup allows for several interpretations: we may view the In-media readership as a long-term choice that people make not necessarily instrumental to a particular vote in a specific upcoming election (so the utility is not derived from the voting action but from sheer ex-post beliefs), or as one they make instrumentally to particular vote, in which case we can think of agents deriving explicit utility from the action of voting for the party aligned with their identity or not.

To highlight the electoral consequences of different partisan exposure to mainstream media, we present our benchmark results of a setup in which the two sides are perfectly symmetric, except for how right- and left-affiliated citizens are exposed to information

[4] As we note below, this kind of objective is consistent with an *expressive* approach to partisanship.

from mainstream media.[5] An asymmetry in the exposure of agents to mainstream information (Out-media) implies that the type of media they actively choose to consume (In-media) can be drastically different. This difference in media choice has surprising implications for electoral outcomes. In the example below, we study the size of the electoral advantage of the side less-exposed side to mainstream media assuming that each citizen votes for the party she rationally beliefs to be superior. Our main results are qualitatively unchanged if we assume that each citizen votes for her culturally affiliated party only if she believes it is better, and abstains otherwise, namely if we assume turnout/abstention margins determine electoral outcomes. In this case, all winning margins would simply be halved.

Illustrative example: Assume a symmetric benchmark in which partisans of either side, left L and right R, are equal in number. There are two equally likely states of the world, $\omega = L, R$, denoting which of two candidates is the better one. The only asymmetry between the two sides is that the left is more exposed to mainstream news than the right. Assume, for instance, that the left-wing citizens receive iid symmetric binary signals from mainstream news with precision $t_L = 0.75$, while right-wing citizens receive noisier mainstream signals, namely with lower precision $t_R = 0.51$. As a baseline, if the individual media choice is not available, mainstream news (Out-media) is the only signal available; in this case, the outcome of an election based on only mainstream information of different precisions is perfectly symmetric — the winning margin and winning probability for the R side are:

	Ex-Ante	$\omega = R$	$\omega = L$
R Win Margin	**0**%	$+$**26**%	$-$**26**%
R Win Prob	**50**%	100%	0%

Thus, asymmetric exposure to mainstream media generates symmetric electoral outcomes. In this baseline case, the ideal candidate is always elected, i.e., information is perfectly aggregated. No personal media choice is made by citizens, and thus Political Faith, R or L, plays no role.

If, instead, citizens can also choose optimally the media they wish to follow (In-media), then the decision is made after updating rationally on two signals, not one. If the media

[5]This has, in recent years, been a well documented and robust phenomenon that has only been exacerbated by Donald Trump's labeling of news media as "Fake News" or even "Enemy of the People". This phenomenon is well- documented, so one example will suffice: on April 5, 2019, Donald Trump tweeted "*The press is doing everything within their power to fight the magnificence of the phrase, MAKE AMERICA GREAT AGAIN! They can't stand the fact that this Administration has done more than virtually any other Administration in its first 2yrs. They are truly the ENEMY OF THE PEOPLE!*" - source

is chosen to maximize the chance of political faith preservation, then the outcome of the election is no longer symmetric. In fact, it may be drastically skewed. In this example, the winning margin and winning probability for the R side are:

	Ex-Ante	$\omega = R$	$\omega = L$
R Win Margin	+28%	+54%	+**2**%
R Win Prob	**100**%	100%	100%

In this case, the R side has an ex-ante winning margin advantage in the election, but, surprisingly, it also has an advantage ex-post. Namely, the R side wins the election in all states in this example and information is not aggregated, despite agents voting based solely on (rational updating of) the information they received.

The key drivers of the vote aggregation result above are based on two key features of citizens' media choice. First, because media choice is based on preserving, as often as possible, political identity, it is equivalent, in the aggregate, to maximizing the ex-ante winning margin of the party with which each citizen identifies. However, this is different from maximizing the probability of winning of their party, which is more related to the ex-post winning margin conditional on the realized state.

Second, in a certain parameter range, the media choices made by citizens on either side are not only quantitatively but also, crucially, qualitatively different. The choice of the less-exposed side (the right in our example) is a one-sided signal structure, for which favorable news is very frequent and thus not so informative. In addition, unfavorable news is rare and hence damning, which is similar to a partisan outlet. Whereas the choice of the more exposed side (the left in our example) resembles more balanced news, which can be mixed, favorable or unfavorable, in either state.

Importantly, in a world without a rich set of signal structures (In-media) available to agents to select from, even if partisan biases still drove media choice, we would not see such a stark electoral aggregate bias as in the example above.

Failure of information aggregation occurs when the two sides are symmetric in every respect other than the fact that one side has average exposure to mainstream media and the other has little exposure to it. As we show, party R would also win regardless of the state even if there were slightly more agents of type L than R, or when the prior, w, leans towards the L side. Our symmetric common priors benchmark assumption stacks the cards against us. If agents on the two sides have heterogenous priors biased towards their side, then the effect is much stronger, and the scope for the failure of information aggregation expands. Our model is malleable to other behavioral assumptions. Results

do not change in a misspecified model in which R side *distrusts* the mainstream signal, that is, believes that the mainstream signal is noisier than it actually is.

Our modeling strategy based on the dichotomy between Inside media and Outside media can also be used to explore other key questions. We initially assume that the Outside media news is unbiased, but assuming it is biased allows us to think about a model of government propaganda.

In the second part of the paper, we first imagine a regime with propaganda. Citizens know that the information from the official media is biased and pro-government; put another way, the official media delivers a noisy unbiased message only with some probability and a pro-government message otherwise. The government cares little about the truthful reporting of unbiased news, this is common knowledge, and citizens have limited exposure/attention to the government message. In a media censorship regime, in contrast, the official media is the only media available. In this benchmark, information is aggregated correctly only if the bias is low; for a large enough bias, the propaganda works, and the government wins an election regardless of the state. Without censorship, however, citizens, who support or oppose the government, can also obtain information from other information sources of their choice. Assuming that citizens make this choice to try to preserve their political faith, then the electoral outcome is starkly different. First, the pro-government party does not win in all states in no region of the parameter space. Second, if the government media bias is high enough. the opposing side can win regardless of the state. Thus, propaganda backfires without censorship of non-governmental media; when there is a failure of information aggregation, it is in favor of the anti-government side. This full reversion is surprising and occurs because, in that parameter range, the In-media choices from citizens on either side are qualitatively different. This suggests why crackdowns of free media are key in authoritarian states for government propaganda to work when citizens are aware of it.

The general setup can be adapted to explore salient misspecified versions of this model, namely setups in which some of the citizens also have a cognitive bias. If some citizens behaviorally misperceive the actual distribution of the Out-Media signal, then their In-Media choice may be suboptimal individually but, as we show, not necessarily on aggregate. The cognitive bias case in which the Out-media signal is unbiased, but citizens from one side (mistakenly) believe it is biassed against their side, is of particular interest as it may arguably apply to some liberal democracies, such as the US. By contrast, the case in which the official government Out-media signal is biased, but pro-government citizens (mistakenly) believe it is unbiased, may arguably apply to some illiberal democracies.

2 Related Literature

This paper considers the electoral implications of behavioral biases in information acquisition, following in this respect the tradition of Levy & Razin (2015) and Ortoleva & Snowberg (2015). In both these papers, the bias considered is correlation neglect - agents underestimate the correlation between their information sources.[6] The spirit of our exercise is very similar to theirs: a simple decision-theoretic problem that is aggregated to derive expected electoral outcomes, but is fundamentally different since the behavioral bias in our benchmark case is not cognitive but in the preferences which, in turn, drive information collection: in our setup agents update rationally all the information they receive.

Though cast in a different context, our decision model has a similar flavor to Köszegi (2006) model of overconfidence, in that agents are unbiased in their beliefs (as they start from a correct prior and update rationally), but end up with a systematic bias in their choice due to a bias in their information collection process. Intuitively, since agents derive intrinsic utility from believing that "something" is the case (namely that they have superior ability in some task, as in Köszegi, or that their party is the better one, as in our case) then they voluntarily tend to collect information that makes them believe that is the case, as often as rationally possible. The tradition of agents deriving utility from their beliefs goes back to Akerlof & Dickens (1982) which incorporates beliefs explicitly in the decision maker's utility function. In that paper, beliefs are a choice variable, whereas in our paper, beliefs are a stochastic outcome of choosing a particular signal structure.[7]

Our agents choose the media to follow to try to rationally believe the party they identify with is the better one, deviating from the game-theoretic tradition in political economy which assumes partisanship is *instrumental* namely driven solely by party performance (see Fiorina (1978)), ideological beliefs (see Markus & Converse (1979)) and the proximity of a party's position to the voter's ideal point on a policy space (see Downs (1957)). An alternative approach is that partisanship is *expressive* (see Green et al. (2008)), that is a persistent emotional affiliation with a party that is strengthened by social ties to gender, ethnic, and religious groups.[8] Further, partisans absorb and seek information

[6]For an excellent survey of the recent literature on the electoral outcomes of these and similar cognitive biases, see Levy & Razin (2019). This literature keeps growing, for instance, see Little et al. (2020) on motivated reasoning cognitive bias.

[7]Caplin & Leahy (2001) also considers belief-dependent utility, and builds a two-period model of portfolio choice with anticipatory beliefs included in the agent's utility function. In Brunnermeier & Parker (2005), agents choose beliefs to maximize their lifetime well-being under the assumption that agents gain utility from anticipating gains.

[8]As is noted in Huddy et al. (2015), "*[t]he expressive approach has gained growing popularity because it can account for the stability of partisan attachments, their relative immunity to short-term economic and political fluc-*

that aligns with their identity (see, for instance, Malka & Lelkes (2010) and Swire et al. (2017)). Our model blends somewhat the different approaches as it features an expressive gain from preserving political faith by citizens which nonetheless are constrained by their rationality when processing the information they receive.

Our work uses and then aggregates the theoretical techniques of Bayesian persuasion which considers an information design game between a sender and a receiver and characterizes the optimal information structure from the sender's perspective. In particular, we adapt and distill results developed in Kolotilin (2018) who builds on Kamenica & Gentzkow (2011) by requiring the sender to choose an information structure while being uncertain about the receiver's type, which is similar to our agent's problem of choosing an information structure while bracing for an Outside signal. Lipnowski & Mathevet (2018) considers an information design problem with a benevolent sender choosing a signal structure for a receiver with psychological preferences, which is related to our model of information choice by agents who derive belief-based utility.

Our model assumes citizens can choose their In-media from a dense distribution of sources, spanning all possible biases, thus our media are passive, non-strategic, and media consumption is demand-driven only. Motivated by the fast-changing media landscape there is a burgeoning literature inspecting media bias albeit from the supply side, namely where media are strategic. In Perego & Yuksel (2022) growing competition between information providers leads to news specialization which thus amplifies social disagreement, a result with a similar flavor to ours. In Gentzkow & Shapiro (2006) media slant their reports to conform to prior beliefs held by agents and finds that media bias reduces in the presence of Outside information, while in our paper the presence of asymmetrically precise Outside information may cause failures of information aggregation. Gentzkow et al. (2021) finds belief divergence among agents seeking to learn a sequence of states as a result of small ideological differences in agents' trust in information sources and beliefs about the state of the world. A strategic media that biases its news to induce greater viewership by citizens may increase polarization, as in Bernhardt et al. (2008). Their results hold even though citizens are aware of the media bias and update rationally. In Mullainathan & Shleifer (2005) agents demand different news outlets depending on their desire to confirm their pre-existing biases and finds that media strategically offer slanted news — an effect that is exacerbated with more competition among media.

On the empirical front, our voting results are consistent with several studies that show

tuations, the powerful influence of partisanship on vote choice independently of issue preferences, and the power of partisan elites to influence rank-and-file partisan opinion, evidence of which is difficult to reconcile with the instrumental model".

how the introduction of new media outlets like Fox News resulted in a persistent and significant increase in Republican vote share. DellaVigna & Kaplan (2007) and Martin & Yurukoglu (2017). Our model shows that wrong electoral outcomes may emerge without assuming fake news, which we do not model.[9] We describe the workhorse model in the next section, then we apply it to liberal democracies and look at illiberal democracies last.

3 Model

3.1 Setup

There is a continuum of agents, they each are one of two types (R and L), which correspond to political identities. There are two states of the world (R and L) and two political sides/parties (R and L). All agents share a common and symmetric prior regarding the state of the world ($\mathbb{P}[\omega = R] := w = 0.5$).[10]

Each agent receives two signals about the state of the world, an *Inside* signal and an *Outside* signal. The Inside signal is generated from a chosen signal structure, while the signal structure of the Outside signal is exogenously specified. We interpret the Inside signal as being generated from the media that the agent chooses to consume. The Outside signal is generated from mainstream media and the agent may be (potentially imperfectly) exposed to it. Additionally, we consider the case where the Outside signal is biased or is perceived to be biased.

The timing of the game is as follows. First, each agent of either type chooses her Inside signal structure. Second, the agent receives Inside and Outside signals. Third, agents form Bayesian posteriors and realize belief-based utility. An agent gains utility from holding a posterior belief that the state of the world more likely matches her type. Finally, agents vote sincerely. The action of voting does not impact the agent's utility and is non-strategic.

We can specify an equivalent model in which actions are strategic. Suppose each agent has two selves, a heart (sender) and a mind (receiver). The sender-self is of type R or L and chooses the In-media signal structure. The receiver-self votes sincerely based on her updated beliefs. The receiver-self forms her beliefs rationally after observing both, the Inside and Outside signals. The objective of a type R (L) sender-self is to maximize the likelihood that the receiver-self votes for party R (L). This alternative specification may

[9] As Angelucci & Prat (2021) show that belief in fake news, while present, does not have a systematic partisan bias.

[10] As we show in subsection 4.3, the key results of the model are robust to biased and non-common priors.

be thought of as another interpretation of the agent's problem. In the rest of this paper, we study the model described in the previous paragraph, where each agent has a single self that has belief-based utility.[11]

All results in this model are robust to considering an additive function where the agent has a relatively small gain from voting for the *correct* party. Further, if we suppose that the agent gains linearly from holding posteriors favorable to her party, in addition to the gain from political faith preservation, we get identical results.

Since the game is symmetric, we specify the problem for a type R agent; the specification for a type L agent is analogous. The utility function of an agent of type R is:

$$U_R = \begin{cases} 1 & \text{if } \mathbb{P}[\omega = R|S, s] \geq 0.5 \\ 0 & \text{otherwise} \end{cases}$$

Where S is the signal generated by the Inside signal structure, while s is the Outside signal. For the agent, maximizing her expected utility is equivalent to maximizing the likelihood that she holds a posterior in which she believes that her type more likely matches the state of the world. We call this form of a self-serving bias *Political Faith Preservation*. The agent's objective can, therefore, be more simply expressed as:

$$\mathbb{E}[U_R] = \mathbb{P}\Big[\mathbb{P}[\omega = R|S, s] \geq 0.5\Big] \tag{1}$$

The agent's objective is to choose the signal structure that generates her Inside signal to maximize equation 1. The action set available to the agent is the set of Inside signal structures specified in the paragraph below. We assume that in addition to choosing the Inside signal structure, the agent also takes the non-strategic action of sincere voting.[12] We can alternatively assume that the agent abstains if her beliefs don't allow her to sincerely vote for her preferred party. In each case we get qualitatively the same results – the winning margins are simply halved in the latter case.

We are interested in electoral outcomes, particularly in situations where the *incorrect* party wins. We call these situations information aggregation failures. We do not link information misaggregation to welfare loss because, in our model, the agents gain no

[11] Both versions of the model described so far suppose that agents vote sincerely. Alternatively, we could allow agents to abstain by supposing that agents only vote if they can do so sincerely for their preferred party. If they believe that the state more likely matches the other party, they abstain. Under this specification, the results remain the same qualitatively – only the winning margins are halved.

[12] In the case of a tie, she votes for her preferred party.

utility from voting or electoral outcomes.[13]

Inside signal structure. The Inside signal structure comprises a finite set of signals ($S = \{S_1, S_2, ...S_n\}$) that are correlated with the state of the world. The choice of signal structure must abide by the Martingale property

$$\sum_{i=1}^{n} \mathbb{P}[S_i] \cdot \mathbb{P}[\omega = R|S_i] = \mathbb{P}[\omega = R] = 0.5 \tag{2}$$

Where S_i is a signal i that has the probability $\mathbb{P}[S_i]$ of being generated given the signal structure and $\mathbb{P}[\omega = R|S_i]$ is the interim posterior belief induced by S_i before the Outside signal is observed.

We interpret this choice of signal structure as an agent choosing which combination of news media to consume. The rich set of signal structures reflects the rich media landscape available to voters today. Further, while the agent can choose a news media (a signal structure), she cannot choose the programming (a realization of a signal).

Outside signal structure Each agent also receives an Outside signal ($s \in \{r, l\}$) with distribution:

$$\mathbb{P}[s = l|\omega = L] = k, \qquad \mathbb{P}[s = r|\omega = R] = m$$

where $k \in [0, 1]$ and $m \in [0, 1]$. Depending on the structure imposed on k and m, the Outside signal may be modified to study a variety of environments. In the baseline model illustrated in subsection 4.1, we consider an environment with unbiased Outside signal structures by setting $k = m$ and asymmetric exposure to Outside media by assuming agents of type R receive a less precise signal than agents of type L. In subsection 4.2 we study media distrust by supposing that agents of type R *believe incorrectly* that they receive a less precise signal than agents of type L. We model propaganda in favor of party L in section 5 by imposing $k > m$. In that section, we consider the implications of censorship, and of citizens being believing incorrectly that the mainstream media is unbiased. Finally, we consider *perceived* propaganda in favor of party L, in subsection 6.2, by setting $k = m$, and imposing that type R agents believing incorrectly that $k > m$.

[13]The alternative interpretation of this model as a dual-self, intra-agent persuasion problem permits a welfare analysis. If we give at least as much weight to the utility of the receiver as we do to the utility of the sender-self, then the full revelation of the state followed by sincere voting will always be at least as good as the persuasion outcome.

We assume that both, the Inside signal, and the Outside signal are realized independently for all agents, conditional on the state. This is a reasonable assumption in a media-rich environment where different media choices might have the same signal structure, but different realizations of the signal. With the independent realization of signals, there is no aggregate uncertainty in outcomes. Introducing correlation is straightforward and the results have a similar flavor, albeit with aggregate uncertainty.

3.2 Structure of solution

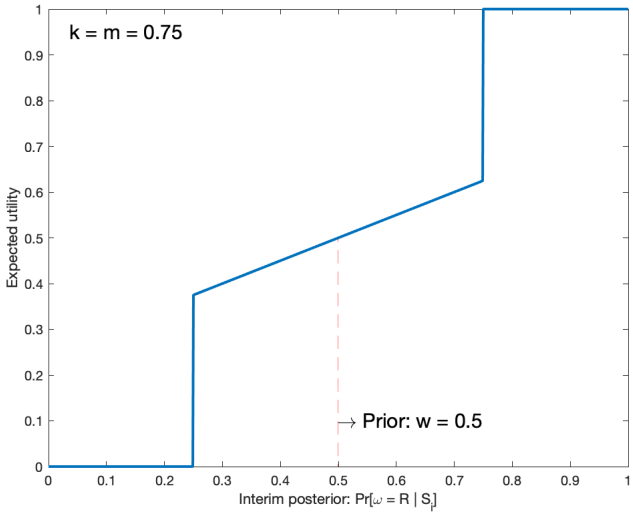
We solve the model with the general Outside signal in appendix A and then apply the solutions to specific structures of the Outside signal that have particular interpretations. We illustrate the solution for a type R agent, the solution for a type L agent is analogous. The solution of the agent's problem in this model applies the techniques developed in Kamenica & Gentzkow (2011) and Kolotilin (2018). As such, we are merely distilling existing results in the persuasion literature. The purpose of providing the solution structure below is to illustrate the intuition and drivers of our main results which concern the aggregation of beliefs and votes of a continuum of agents.

This is an optimization problem for an agent, where her objective is to maximize 1 subject to the Martingale constraint specified in equation 2. Simply put, the agent chooses the Inside signal structure to maximize the likelihood of political faith preservation subject to the constraint on the Inside signal structure that the expectation of the posterior belief equals the prior belief. We assume that the agent also votes sincerely following her belief realization.

Expected utility To solve the agent's problem of choosing an In-media signal structure to maximize her likelihood of preserving her political faith, we first calculate the agent's expected utility as a function of her interim priors – after she has received the In-media signal, and before she has received the Out-media signal. We denote this interim posterior $\mathbb{P}[\omega = R|S_i]$.

In figure 2, we plot a type R agent's expected utility as a function of her interim posterior for an Outside signal structure such that $k = m = 0.75$. For values of the interim posterior between 0 and 0.25, regardless of the realization of the Outside signal, the agent is never able to preserve her political faith. If the agent has an interim posterior equal to 0.25 and she receives a favorable outside signal, her posterior expectation that the state of the world is R then equals 0.5 and she is *just* able to preserve her political faith. For values of interim posteriors between 0.25 and 0.75, the agent can preserve her political

Figure 2: Expected utility as a function of interim posteriors



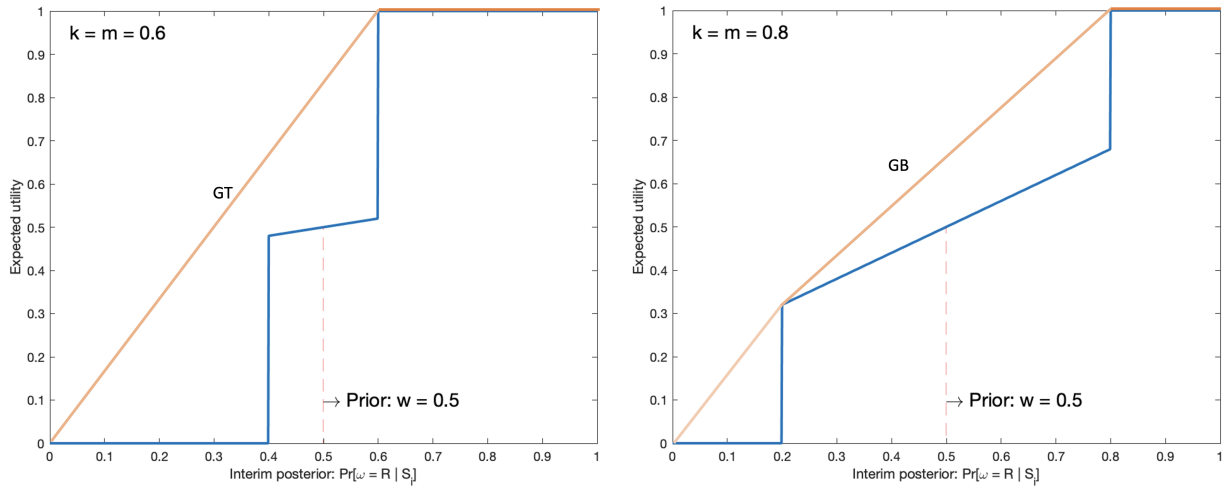
faith if she receives a favorable Outside signal, $s = r$. The likelihood that she receives a favorable Outside signal increases in her expectation that the state of the world is $\omega = R$. Finally, if the agent's interim posterior is at least 0.75, she is able to preserve her political faith regardless of the Outside signal.

Three interim posteriors will be key to solving the agent's problem. First, an interim posterior such that the agent is *just* able to preserve her political faith if she receives an unfavorable Outside signal ($\mathbb{P}[\omega = R|S_i] = 0.75$ in figure 2). We call an Inside signal that generates such an interim posterior a *Good* (G) signal. Second, an interim posterior that allows the agent to *just* preserve her political faith only if she receives a favorable Outside signal ($\mathbb{P}[\omega = R|S_i] = 0.25$ in figure 2). We call an Inside signal that generates such an interim posterior a *Bad* (B) signal. Finally, an interim posterior such that the agent is certain that the state does not match with her preferred party ($\mathbb{P}[\omega = R|S_i] = 0$). We call an Inside signal that generates such an interim posterior a *Terrible* (T) signal.

We show in Appendix A that the agent needs to consider only the three signals described above, *Good*, *Bad*, and *Terrible*, to solve her problem. Any other signals would be suboptimal. Further, those combined in two signal structures, GT or GB, are sufficient to solve the agent's problem. Note that the GT signal structure is one-sided, in the sense that in the favorable state of the world, only signal G is realized. We interpret it as media that has a high political slant.[14] Favorable news reported by these outlets is par for the course, and thus, not very informative to Bayesian agents. When these outlets report news unfavorable to their side, it is very informative for Bayesian agents, and would convince such

[14]For instance, media sources like *Breitbart News* for Republicans or *Huffington Post* for Democrats.

Figure 3: Expected utility as a function of interim posteriors



(a) Lower precision of Out-media signal

(b) Higher precision of Out-media signal

agents that the state of the world is not favorable to their side.

On the other hand, GB is two-sided in that either G or B may be realized in either state of the world, according to a predetermined probability distribution. This is akin to the agent consuming less one-sided media insofar as it provides her with a mix of positive and negative news in either state of the world.[15] The mixing probability changes depending upon the state. The fact that a negative signal is shown by these media in either state of the world means that a negative signal is less informative, and is designed to be such that it can be countered by a favorable Outside signal.

In figure 3, we plot the agent's expected utility as a function of the interim posterior he has after observing the In-media signal and before observing the Out-media signal. The graph on the left considers a case where the Out-media has a less precise signal. Here, the interim posterior that allows an agent to *just* preserve her political faith if she receives a favorable Outside signal is close to her prior (at $\mathbb{P}[\omega = R|S_i] = 0.4$). Similarly, the agent preserves her political faith regardless of the realization of the Outside signal if her interim posterior is at least $\mathbb{P}[\omega = R|S_i] = 0.6$. The graph on the right side of figure 3 considers a more precise Outside signal structure, which implies that the two key interim posteriors described above are more spread out away from the prior of $w = 0.5$.

For lower values of precision of the Outside signal, such as the left side of figure 3, the concave closure[16] of the expected utility function is such that it would be optimal for the

[15] We interpret the GB signal structure as media sources like *Wall Street Journal* for Republicans or *New York Times* for Democrats.

[16] We follow the definition of concave closure in Kamenica & Gentzkow (2011).

agent to choose a signal structure that mixes between G and T – a GT signal structure. On the other hand, if the Outside signal is more precise, as it is on the right-side graph in figure 3, we plot the concave closure of the expected utility and find that the optimal signal structure is GB.

In Appendix A.3, we show that the structure of this problem and the optimal signal structures are robust to a small amount of uncertainty or noise in the threshold of belief required for political faith preservation by the citizen. This kind of robustness is also noted in Kamenica & Gentzkow (2011), where the key results and the structure of the solution hold in the presence of noise which makes the receiver's belief threshold for choosing the sender-preferred action stochastic.

In the following applications, we consider specific structures of k and m that admit particular interpretations and aggregate to understand the electoral implications of motivated media choice.

4 Liberal democracy

Consider the case of a liberal democracy where the media is not influenced by the state. The mainstream media is unbiased and is perceived to be unbiased by citizens. We interpret the case where the media is influenced by a political party as an illiberal democracy with propagandizing rulers. We study that case in subsections 5.1, 5.2, and 6.1. We also study a situation where citizens incorrectly believe that the mainstream media is systematically biased in favor of one political party democracy in subsection 6.2.

4.1 Asymmetric exposure to mainstream media

This specification builds on the illustrative example in the introduction section. Suppose that exposure to mainstream media, or attention paid to it, differs systematically by party preference. Here, there is an asymmetry in the informational insularity of citizens of differing political persuasions. This may be due to a difference in the trust placed on mainstream news or due to the media ecosystem allowing for information silos that may be more prevalent on one side of the political spectrum. Citizens in this environment have access to a wide array of news and opinion outlets that allow them to consume a specific diet of chosen media. We are interested in their choice of In-media as a function of their exposure to Out-media and the electoral outcomes. In this section, both agents receive unbiased Outside signals that are not fully informative, and we suppose that an agent of type R receives a noisier signal than an agent of type L does.

The Out-media signal has the following structure

$$\mathbb{P}\left[s = l|\omega = L\right] = \tau \cdot t + (1-\tau)\cdot\frac{1}{2}, \qquad \mathbb{P}\left[s = r|\omega = R\right] = \tau \cdot t + (1-\tau)\cdot\frac{1}{2}$$

where $t \in [0.5, 1]$ is the precision of the Outside signal and τ is the extent of exposure to that signal. We model the asymmetry in exposure by supposing $\tau = 1$ for agents of type L and $\tau \in [0, 1]$ for type R agents Another isomorphic setup could simply specify two different Outside signal precisions for the two types of agents such that the Outside signal precision for an agent of type R is lower than that of an agent of type L.

One interpretation of the precision of and exposure to the Outside signal is *attention*. The attention, or lack thereof, could be a feature of the media landscape or social circle that determines the intensity, frequency, or clarity with which agents receive the signal from Outside their chosen media. An alternative interpretation is that the signal precision and exposure capture the openness of agents to receiving a signal from Outside the chosen In-media. It can, therefore, be thought of as capturing the agent's preference, rather than a feature of the media system.

In the illustrative example in the Introduction, we set $t_R = 0.51$ and $t_L = 0.75$. That is equivalent to setting $t = 0.75$ and $\tau = 0.04$.[17] For these parameter values, we find that introducing the ability to choose media transforms a fully symmetric election into one with failure of information aggregation in that party R wins the election in both states of the world. This is despite agents being rational in their information processing.

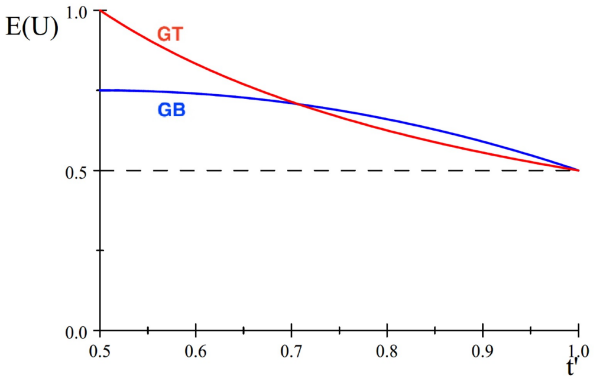
Table 1: Results without and with In-media

Parameters: $t = 0.75$, $\tau = 0.04$						
	Without In-media			With In-media		
	Ex-Ante	$\omega = R$	$\omega = L$	*Ex-Ante*	$\omega = R$	$\omega = L$
R Win Margin	0%	+26%	−26%	+28%	+54%	+2%
R Win Prob	**50**%	100%	0%	**100**%	100%	100%

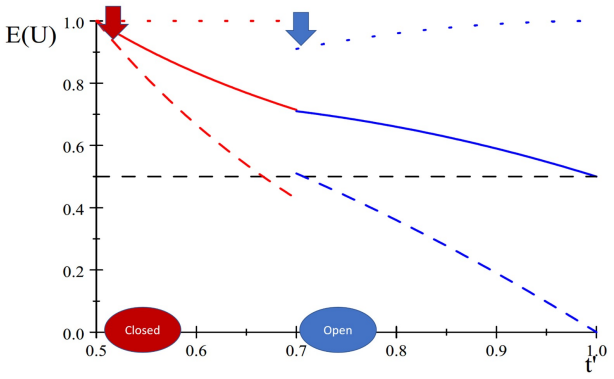
As we can see in the table 1, without In-media, asymmetric exposure to mainstream media does not provide side R with any winning margin or winning probability advantage. The correct side wins in each state of the world. When the state of the world is R, then 51% of type R agents and 75% of type L agents receive an outside signal which indicates that the state of the world is more likely R, and these agents vote for party R which implies that it wins with a margin of 26%. Because the Outside signal is unbiased, party L wins with the same margin in state L.

[17] This value of $\tau = 0.04$ is only relevant for type R agents because we have fixed $\tau = 1$ for type L agents.

Figure 4: Mechanism behind results



(a) *GT* versus *GB*



(b) Political faith preservation conditional on the state of the world

The agents share symmetric priors about the state of the world and update rationally. There are an equal number of each type of agent, and both types of agents want to maximize the likelihood that they preserve their political faith. This is equivalent to the agent maximizing the likelihood that she votes for her preferred party if she votes sincerely. As such, one might not expect ex-ante that the introduction of the Inside signal in the lower half of table 1 would result in information aggregation failure that allows party R to win regardless of the state of the world.

As we see in panel (a) of figure 4, a GT signal structure provides an agent with a higher utility if the perceived precision of the outside signal ($t' = \tau t + \frac{(1-\tau)}{2}$) is low enough. For higher values of perceived precision, a GB signal is optimal. Under the parameter values described above ($t = 0.75$ and $\tau = 0.04$), a type R agent chooses a GT signal structure while a type L agent chooses a GB signal structure.[18]

Panel (b) of figure 4 illustrates the probability of political faith preservation conditional on the state of the world. In the illustrative example, we considered values parameter values such that the perceived precision for type R agents is quite low, which corresponds to relatively closed informational silos. On the other had, type L agents have a higher perceived precision of the Outside signal which reflects more openness to outside information. In the favorable state, GT allows an agent to preserve her political faith for sure because the agent receives the *Good* signal. Compared with a GT signal, a GB signal allows the agent to preserve her political faith with a higher likelihood in the unfavorable

[18] In Appendix B.1, we show that the signal structure GT is optimal for type R agents if and only if $\tau \cdot t + (1-\tau) \cdot \frac{1}{2} \leq \frac{1}{\sqrt{2}}$. Because type L agents receive an Out-media signal with a perceived precision t, they choose a GT signal structure for all values of $t \leq \frac{1}{\sqrt{2}}$ and a GB signal otherwise.

state, but with a probability that is less than 1 in the favorable state of the world. Given the parameter values in table 1, when the state of the world is R, all type R vote for party R. Type L agents receive a mix of *Good* and *Bad* signals and 43.75% of them vote for party L. Therefore, party R wins in state R. When the state of the world is L, type R agents receive a mix between *Good* and *Terrible* signals and 96.08% of them vote for party R. Type L agents receive a more favorable mix of *Good* and *Bad* signals than they do in state R. 93.75% of them vote for party L. Therefore, party R wins even in state L.[19]

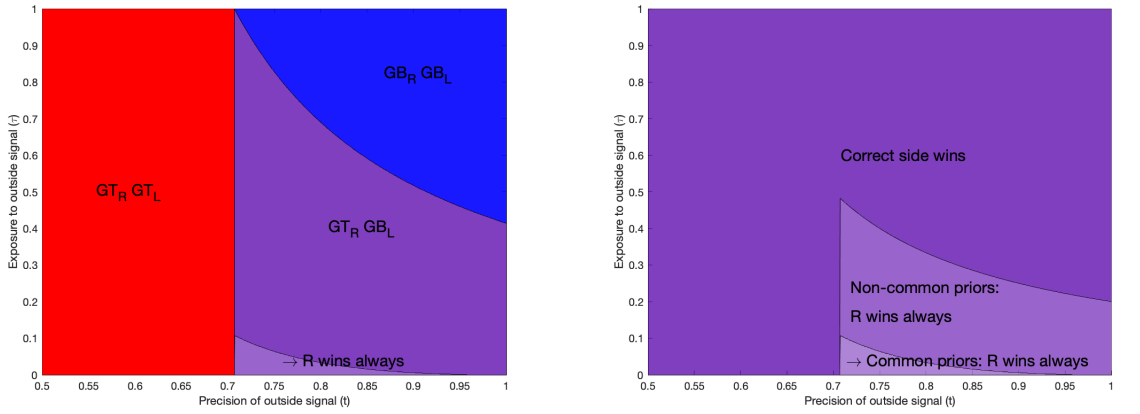
While each agent individually maximizes her likelihood of political faith preservation, for some parameters, this implies that party L loses regardless of the state of the world. If, instead, type L agents choose GT as their Inside signal structure, then party L could win in the correct state – implying that an ex-ante suboptimal individual choice can allow ex-post optimal policy choice. In other words, party L could benefit if it could convince its electorate to consume more politically slanted news.

It is crucial to note that information aggregation failure occurs for low values of exposure (τ) and intermediate values of precision (t) of the Outside signal. If the outside signal were less precise, for instance, $t = 0.7$, then both types of agents would choose a GT signal structure and the correct party would win always. On the other hand, if the Outside signal were very precise, then too, the correct party would win always. If the state of the world is L, then compared to the outcomes in table 1, type L agents would be more likely to receive a *Good* signal and vote for party L in state L. Similarly, type R agents would be more likely to receive a *Terrible* signal and vote for party L. Party L would, therefore, receive more votes than party R in state L.

In panel (a) of figure 5, we consider all values of signal precision (t) and exposure (τ). The area shaded in red corresponds to the region where both types of agents choose a GT signal structure for their In-media. The blue-shaded area denotes the region where both types of agents choose a GB signal structure. In the purple-shaded region, type R agents choose a GT signal structure while type L agents choose a GB signal structure. There is no region where type R agents choose a GB signal structure and type L agents choose a GT signal structure. As we claim in proposition 1 below, there is a region where information aggregation fails and it is contained within the purple-shaded region where type R and type L agents choose a GT and GB signal structure respectively.

[19] Recall that upon receiving a *Good* signal, an agent is always able to preserve her political faith and vote for her preferred party. If the agent receives a *Bad* signal, she votes for her preferred party only if she also receives a favorable Outside signal – otherwise she votes for the other party. If she receives a *Terrible* signal, she is certain that the state does not match her preferred party and she always votes for her non-preferred party.

Figure 5: Signal choices and results with asymmetric exposure



(a) Common priors

(b) Non-common priors: $w_R = 0.6$, $w_L = 0.4$

Proposition 1 *In the environment specified in subsection 4.1, the correct candidate wins except in a region with intermediate precision the of Outside signal and low exposure for type R agents. In the region of information misaggregation, type-R agents choose a GT signal structure and type L agents choose a GB signal structure.*

As we show in appendix B.1, the result in the example above is not knife-edge, and that the voting margins are continuous in τ and t in the neighborhood of $\tau = 0.04$ and $t = 0.75$. In figure 5, we see that the light-purple shaded area that denotes the region of information aggregation failure exists for low values of media exposure on the right (τ) and moderate values of Out-media precision (t).

When both types of agents choose a GT signal structure for their respective In-media, then if the state of the world is R, all type R agents and some type L agents vote for party R. If the state of the world is L, then all type L agents and some type R agents vote for party L. In this case, information aggregation failure is not possible. We show in appendix B.1 that the party that matches the state wins for all values of τ and t such that a GB signal structure is optimal for both types. Further, the parameter space is such that there is no situation where type R agents choose a GB signal structure and type L agents choose a GB signal structure.

While the region of information aggregation failure in panel (a) of figure 5 seems small, we argue that those parameter values are particularly relevant to consider in the US case. The intermediate values of Out-media precision where information misaggregation takes place are high enough that type L agents choose a two-sided, GB In-media signal structure, but not so high that party L wins in state L. Further, as we see in subsection 4.3, the

parameter space where information misaggregation occurs expands greatly when agents have non-common priors in favor of their preferred parties. While it is unsurprising party R is granted a winning margin advantage through the lower exposure type R agents have to Out-media, the fact that it can be large enough to swing an election is interesting and novel.

4.2 Distrust in mainstream media precision

We considered an environment where type R agents receive a less precise Outside signal than type L agents, so the model is correctly specified. We now show that the results are identical if the correct precision of the Outside signal is as type L agents believe but type R agents *incorrectly* believe that the precision of the Outside signal is lower than it actually is. This misspecified model is particularly applicable to the US if we consider the asymmetry in the trust in mainstream media by voters of the two main political parties as documented in the introduction. Crucially, note that Republicans have a lower level of trust and that key Republican leaders have sought to exacerbate that distrust. Here, we interpret asymmetric distrust as reflecting agents' judgment on the *quality* of mainstream media. In subsection 6.2, we interpret the asymmetric distrust as a judgment on the *bias* of mainstream media.

The Outside signal has the following structure:

$$\mathbb{P}\left[s = l|\omega = L\right] = \tau \cdot t + (1-\tau)\cdot\frac{1}{2}, \qquad \mathbb{P}\left[s = r|\omega = R\right] = \tau \cdot t + (1-\tau)\cdot\frac{1}{2}$$

where $t \in [0.5, 1]$ is the true precision of the Outside signal and τ is the extent of trust in the Outside signal agents have. We specify the asymmetry in distrust by supposing that type L agents have $\tau = 1$ and $\tau \in [0, 1]$ for type R agents.

The choice of signal structures by either type of agent is identical to the previous specification. The region of parameters where there is a misaggregation of information is, again, within the region where type R agents choose a GT signal structure and type L agents choose a GB signal structure. Since type L agents are correct about the process generating the Outside signal and because the Outside signal doesn't impact the likelihood of political faith preservation for type R agents, the region of misaggregation of information where party R wins regardless of the state is identical to the region presented in panel (a) of figure 5.

We considered an interpretation of the lower precision of the Outside signal for agents of type R where that asymmetry comes not from less exposure, but through an incorrect

belief regarding the Outside media. We find that party R is imbued with such a large electoral advantage by this asymmetry that, for some parameter values, it can win regardless of the state of the world. In sum, whether we consider an asymmetry in exposure to Out-media or distrust in the quality of Out-media (see figure 1), we get identical results.

4.3 Non-common priors

In addition to cultural-political affiliations that define the agent's type, it may be reasonable to consider the possibility that agents who are culturally affiliated with a political party may hold more favorable priors towards it. We can very simply extend the baseline model to consider the implication of such non-common priors. Suppose that type R agent holds a prior $\mathbb{P}_R[\omega = R] := w_R$ greater than that for a type L agent (w_L). As we show here, by assuming common priors, we have stacked the cards against our results.

We see in panel (b) of figure 5 that the region of information aggregation failure, where party R wins regardless of the state of the world, is much larger with non-common priors than with common and symmetric priors ($\mathbb{P}[\omega = R] := w = 0.5$). All calculations are detailed in Appendix B.3.

Here, the agent can optimally choose a non-informative In-media signal structure if the prior allows the agent to preserve her political faith regardless of the realization of the Out-media signal. We call that kind of In-media signal *Neutral* or *Nonsense* news. This is akin to consuming opinion news commentary that has a commonly known political bias do not claim to be providing journalistic facts.

We have, therefore, tied our hands by assuming that agents share common priors. The key result of information aggregation failure holds for a larger subset of parameters when agents do not have common priors, and instead, hold priors that favor their preferred party.

In the next section, we consider the implications of a propagandized (biased) Outside signal on the agents' choice of In-media as well as electoral outcomes.

5 Propaganda

State influence on mainstream media reporting is a telltale sign of decaying democracy. Here, we consider propaganda, which we define as a bias in the reporting of mainstream media. In the model, this bias emanates from an asymmetry in the realization of favorable and unfavorable news for political parties as a function of the state of the world. We are interested in the impact of propaganda, or bias in mainstream media reporting, on the

choice of Inside-media by agents as well as electoral outcomes. In particular, this model allows us to study if an agent's ability to choose Inside-media can counteract propaganda. Further, we learn whether that same ability can lead to information aggregation failure if the agent incorrectly believes that the mainstream media is biased.

Suppose that the Outside signal is biased in favor of party L such that the signal l is realized more often. Specifically

$$\mathbb{P}\left[s = l|\omega = L\right] = \tau \cdot t + (1-\tau)\cdot 1, \qquad \mathbb{P}\left[s = r|\omega = R\right) = \tau \cdot t + (1-\tau)\cdot 0$$

where $t \in [0.5, 1]$ is the precision of the Outside signal and $\tau \in [0, 1]$ is the extent of unbiasedness of state-influenced media. A high level of τ corresponds to a less biased signal, while a low level of τ corresponds to a very biased signal. This bias is commonly known by all agents and is the true process that generates the Outside signal.

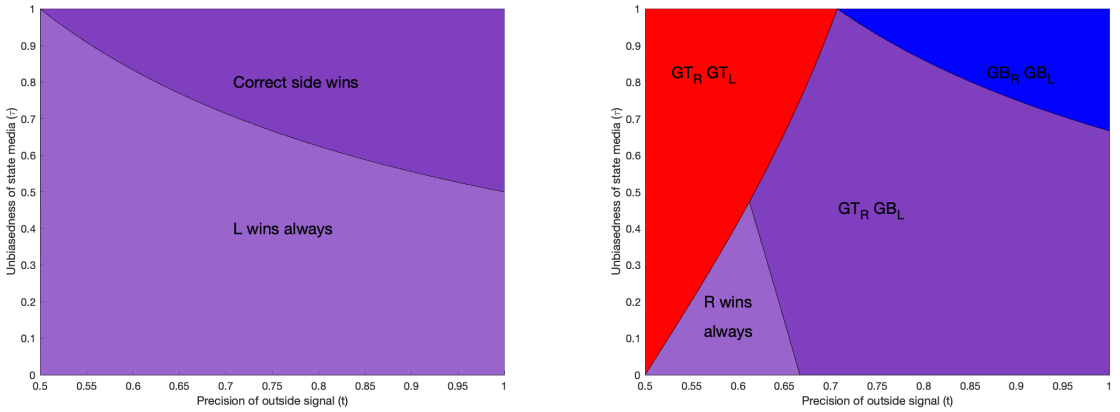
An environment where such a signal structure for the Outside or mainstream media may be possible is where the state exerts control over mainstream media outlets. Suppose, for instance, that a strongman leader of an Eastern European nation forces the state-run media to run positive stories often, but cannot prevent the occasional negative story from being run. In such an environment, it is also reasonable to consider the possibility that the strongman leader can censor media outlets so that agents can't receive an Inside signal. In the next two subsections, we consider the implications of propaganda with and without censorship.

5.1 With censorship

Suppose that neither type of agent has access to any information other than her prior and the realized Outside signal. This scenario may be interpreted either as the party in power shutting down all media other than the propagandized state-controlled media. An alternative interpretation is that the media environment is not rich because we are considering a time before the environment became rich through the proliferation of news outlets and social media. We consider this benchmark of censorship as it will help us highlight the role that the ability to choose Inside media plays.

It is straightforward to show that because the agents share common and symmetric priors, and because the Outside signal is informative that the realization of the Outside signal determines whether the agent preserves her political faith. The condition for party L to win in state L is simply that the Outside signal l is realized more often than the signal r. This always holds. The details of this and the following calculations are presented in appendix B.4.

Figure 6: Propaganda with and without censorship



(a) Results with censorship

(b) Signal choices and results without censorship

If the state of the world is R, then the Outside signal l is realized more often if $\tau t < 0.5$. If this condition holds, then we have information misaggregation and party L wins regardless of the realization of the state of the world. This region is illustrated in panel (a) of figure 6 above. In the next subsection, we allow agents to design a chosen signal structure.

If a ruler of an illiberal democracy can influence the mainstream media and also, prevent citizens from independently accessing information, then it can ensure that it would win in the favorable state of the world, and for a large parameter space, also in the unfavorable state of the world. Censorship along with propaganda is, therefore, a powerful combination of tools in an illiberal democracy.

5.2 Without censorship

Here, the agents can curate their Inside signal structure. Since agents are rational, they find an Outside signal favorable to the propagandizing side (party L) to be less informative than an Outside signal unfavorable to that party. Recall that a *Good* signal from the Inside signal structure is designed to *just* counteract an unfavorable Outside signal. For type R agents, the unfavorable Outside signal, l, is relatively easy to counteract because it is less effective. For type L agents, the unfavorable Outside signal is more expensive to counteract. As we see in panel (b) of figure 6, there is a large subset of parameters where type R agents optimally choose a GT signal structure and type L agents choose a GB signal structure. The region of information misaggregation lies within this subset of parameter values.

In the region of information misaggregation, party R wins regardless of the state of the world. The intuition behind this result is that if the state of the world is R, then party R must win because all type R agents and some type L agents vote for party R. If the state of the world is L, then the informativeness of the Outside signal r, implies that not enough type L agents preserve their political faith and thereby vote for party L. For propaganda to backfire, it must be that the Out-media is biased enough, and the precision of the Out signal is strong enough to push type L agents to choose a GB signal structure for their In-media. However, if the precision of the Out-media signal is high, then party L would win in state L, and there would be no misaggregation of information.

Table 2: Results with and without censorship

Parameters: $t = 0.6$, $\tau = 0.3$						
	With censorship			Without censorship		
	Ex-Ante	$\omega = R$	$\omega = L$	*Ex-Ante*	$\omega = R$	$\omega = L$
L Win Margin	$+70\%$	$+\mathbf{64}\%$	$+76\%$	-9%	-16%	$-\mathbf{3}\%$
L Win Prob	$\mathbf{100}\%$	100%	100%	$\mathbf{0}\%$	0%	0%

In table 2, we consider parameter values where $t = 0.6$ and $\tau = 0.3$. All calculations for these parameters are easily done by plugging in those values into the expressions derived in appendix B.4 and B.5. These parameter values correspond to a situation where the Outside signal is fairly precise, and the party L influenced media is known to be very biased. We see that with censorship, party L can win always, and with very high margins that are reminiscent of electoral results seen in some Eastern European "democracies" that are led by strongmen leaders. On the other hand, without censorship, party L loses in either state of the world. Therefore, for a substantial subset of parameters, there is a reversal in the electoral outcomes when censorship is disallowed. Suppose that party L cannot perfectly target propaganda and that there is a likelihood of mistakes that assigns a positive probability to all levels of bias and precision. Then, to benefit from propaganda, party L must also institute censorship. Otherwise, with a positive chance, propaganda backfires.

Proposition 2 *In the environment specified in section 5.2, the correct candidate wins except in a region with low to intermediate precision and a highly biased Outside signal. In the region of information misaggregation, type-R agents choose a GT signal structure and type L agents choose a GB signal structure.*

The calculations and the proof is detailed in appendix B.5. We find that without censorship, propaganda is not simply weak, it backfires. Propaganda, by its very nature,

implies that news favorable to the propagandizing party is discounted by Bayesian citizens and does not move their posteriors substantially. News unfavorable to the ruling party is very informative because it is rare. If citizens can independently access information, then type R citizens need very little to counteract the state-influenced media's propaganda for party L. Type L citizens need a much stronger signal to counteract unfavorable news from the state-influenced media. For all parameters, party R wins in the state it is supposed to (state R). For a substantial parameter space, party R also wins in state L.

6 Misperceived Propaganda

Here, we consider two types of misperception of propaganda. In subsection 6.1, we consider an environment where propaganda is present and agents, or a subset of agents, believe that the Out-media provides an unbiased signal. This reflects a situation where the ruler of an illiberal democracy manages to influence mainstream media into reporting propagandized news while also convincing citizens that it is unbiased. While this may imbue the propagandizing side with some advantage, the fact that agents are not prevented from choosing In-media signals could counteract the propaganda. In subsection 6.2, we suppose that while the Out-media signal is unbiased, agents of type R believe that it is biased in favor of party L. As noted earlier, this is an alternative interpretation of the asymmetric trust in mainstream media in the US (see figure 1). The incorrect beliefs held by type R agents influence their choice of In-media and their belief updating. This can have important electoral consequences.

6.1 Propaganda with oblivious citizens

We model the rather insidious situation where the mainstream media is biased in favor of party L but citizens are convinced that the mainstream media is unbiased. We first consider the case where both types of agents are oblivious to the bias in the Outside signal. Later in this subsection, we consider the cases where either only type R or only type L agents are oblivious to the bias. In each case, at least some citizens choose their In-media signal structure under incorrect beliefs. The mainstream media, which is biased toward party L, generates a signal favorable to party L more often than it does for party R.

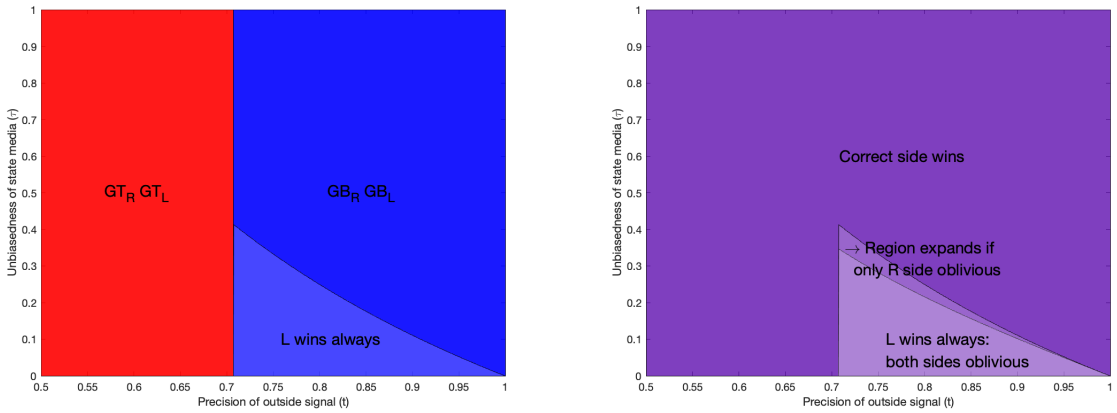
The true process that generates the Out-media signal is biased in favor of party L and

takes the following form:

$$\mathbb{P}\left[s = l|\omega = L\right] = \tau \cdot t + (1-\tau)\cdot 1, \qquad \mathbb{P}\left[s = r|\omega = R\right] = \tau \cdot t + (1-\tau)\cdot 0$$

where $t \in [0.5, 1]$ is the precision of the Outside signal and $\tau \in [0, 1]$ is the true unbiasedness of the Outside signal. The first case we consider is where both types of agents incorrectly believe that $\tau = 1$.

Figure 7: Signal choices and results in propaganda with oblivious citizens



(a) Signal choices and results with all citizens oblivious

(b) Results with only type R citizens oblivious

As we see in panel (a) of figure 7, both types of agents choose a GB signal structure for their In-media in the region of information aggregation failure. Detailed calculations are provided in appendix B.6.

While the agents are Bayesian, because their beliefs about this process are incorrect, they update incorrectly and choose their In-media signal structure sub-optimally. Type R agents update too much upon receiving an unfavorable outside signal and so they try to counteract that by choosing an Inside signal structure that is too informative. They, therefore, preserve their political faith less often than they could have. Similarly, type L citizens update too little upon receiving unfavorable outside information – this works to their benefit. As we show in proposition 3, for low values of Out-media unbiasedness (τ) and moderate to high values of Out-media precision (t), party L has so substantial an advantage, that it can win regardless of the realized state of the world.

Proposition 3 *In the environment specified in subsection 6.1, the correct candidate wins except in a region with intermediate precision and highly biased Outside signal. In the region of information misaggregation, both types of agents choose a GB signal structure.*

The proof and detailed calculations are in appendix B.6. The existence of such a region of information aggregation failure shows us why propagandizing outlets go to great lengths to portray themselves as accurate and balanced.

Censorship: We consider the implications of censorship in an environment where the Out-media is biased but citizens wrongly believe it is not. Party L wins regardless of the state if the Out-media signal favorable to party L is generated more often in either state of the world. As in subsection 5.1, this condition holds if $\tau t < 0.5$. The electoral results are, therefore, also the same and are illustrated in panel (a) of figure 6. The only difference from subsection 5.1 is that citizens hold more or less intense beliefs regarding the parties they vote for.

L **agents oblivious:** In this section, so far we have considered the case where both types of players are oblivious to the bias in the Outside signal. Suppose, now, that only L type agents believe that the Outside signal is unbiased while type R citizens know that the Outside signal is biased. Agents of type L update less than they should when faced with an unfavorable Outside signal, and their Inside signal structure choice is the same as in figure 7. Agents of type R choose their Inside signal structure as shown in figure 6. The correct side always wins in this specification, which, for party L, is an improvement over the backfiring of propaganda we saw in subsection 5.2.

R **agents oblivious:** Here, we suppose that only agents of type R are unaware of the bias in the Outside signal. Type L agents know that the Outside signal structure is biased in favor of Party L. Type L agents choose their Inside signal structure correctly, and it is the same as in panel (b) of figure 6. Type R agents hold incorrect beliefs and choose their Inside signal structure such that it is the same as in panel (a) of figure 7.

As we see in panel (b) of figure 7, the region where party L wins regardless of the state of the world expands if only type R agents, rather than both types, are oblivious to the bias in the Outside signal. This illustrates that for propaganda to benefit the ruler of an illiberal democracy, the opposing side should be unaware of it. Alternatively, the propagandizers could use censorship to win regardless of the state.

6.2 Perceived propaganda

What happens if there is no actual propaganda and yet some citizens believe there is? This is a form of distrust in the unbiasedness of the Outside media. Here, we suppose

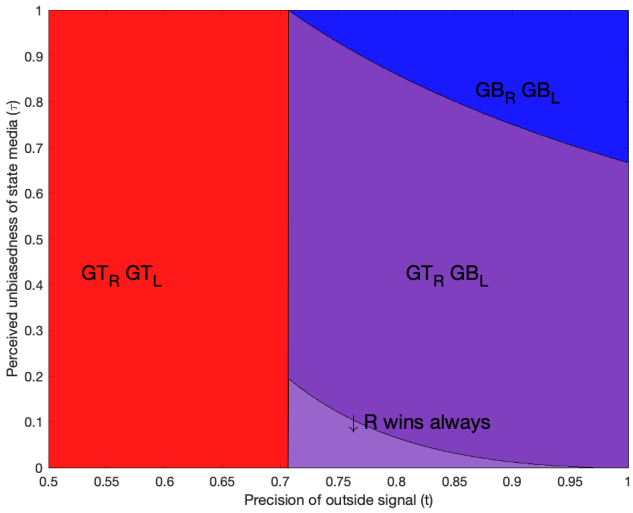
that type R agents believe the Outside media to be biased when it truly isn't.

Suppose the Outside signal structure is unbiased and has a precision, $t \in [0.5, 1]$. Type R agents hold an incorrect belief and perceive the media to be biased when it is not. They believe that the Outside signal structure follows

$$\mathbb{P}[s = l|\omega = L] = \tau \cdot t + (1 - \tau) \cdot 1, \qquad \mathbb{P}[s = r|\omega = R) = \tau \cdot t + (1 - \tau) \cdot 0$$

where $\tau \in [0, 1]$ is the belief in the extent unbiasedness of the Outside signal held by type R agents. Type L agents correctly believe that the process that generates the Outside signal is unbiased, which is equivalent to them believing that $\tau = 1$ in the process described above.

Figure 8: Signal choices and results with perceived propaganda



In figure 8, we see the Inside signal structure choices for each type of agent as well as the region of information aggregation failure. This region occurs where type R agents perceive the media to be highly biased, and where the Outside signal is at least moderately precise. The intuition for this result is similar to the one provided in subsection 5.2 — that the perception of bias in the Outside signal structure makes an unfavorable Outside signal less informative for type R agents. Therefore, an asymmetry in the perception of bias by the mainstream imbues party R with an advantage that allows it to win regardless of the state for a subset of parameters. The calculations are provided in appendix B.7.

Proposition 4 *In the environment specified in subsection 6.2, the correct candidate wins except in a region with intermediate precision and low perceived unbiasedness of the Outside signal. In*

the region of information misaggregation, type-R agents choose a GT signal structure and type L agents choose a GB signal structure.

We find that the perception of propaganda is a strong political implement. One implication of this specification of this model is that party R has an incentive to convince type R voters that the mainstream media is biased in favor of party L. As noted in the introduction, in the US, President Trump railed against the mainstream media, accusing it of being biased. Our model suggests that if type R voters believe that the mainstream media is biased in favor of party L, then that influences the In-media choices of type R voters. This imbues party R with a big electoral advantage, and for a substantial subset of parameters, party R can win regardless of the state of the world.

7 Conclusion

We have tried to understand how instrumental media choice driven by political identity can drive aggregate electoral results. In the core setup, the bias we assume is only in the preferences that drive media choice and is not cognitive. Specifically, all citizens update rationally all the information they receive and vote according to this information. Later, we added cognitive biases to see how results change.

For liberal democracies, such as the US, our premise is a perfectly symmetric benchmark where the only asymmetry between the two sides is either in the exposure to Outside media or in the bias of Outside media. In these contexts showed how skewed the electoral outcomes become and highlight situations in which information aggregation fails. In these cases one candidate wins in all states, thus also when it is the worse candidate, i.e. when *average/expected* rational beliefs after *any* media signal, chosen or not, are unfavorable to them. A key determinant of this failure of information aggregation is that one side has low exposure, or low trust, in mainstream media, while the other side has moderate exposure/trust in it: in this region, the presence of a rich new media environment allows for a winning margin advantage to the less exposed side so substantial that it is enough to swing elections for the less exposed side in all states. This misaggregation region (characterized by low and moderate exposure on either side of the political spectrum) seems particularly salient in countries as the US, and suggests why some parties have incentives to sow distrust in mainstream media. If we consider in addition cognitive biases such as biased priors which may also be salient, this misaggregation region becomes more prominent.

In an illiberal democracy, our key insight is that for government propaganda to work

it is crucial that citizens are unaware of it, namely citizens also have a cognitive bias. If that is not the case then the presence of free media undermines government propaganda spectacularly: propaganda may backfire entirely making the anti-government side win regardless of the state. This suggests why it is not enough for authoritarian governments to control the official media message and to promote government propaganda when citizens are aware of it. For such governments to maintain power, it is also fundamental to crack down on the free press and any dissenting news outlets, namely wall off their populations from possibly inconvenient truths revealed by non-governmental media.

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A Solution for general model

Suppose that the agent an agent believes (correctly or incorrectly) that

$$\mathbb{P}\left[s = l|\omega = L\right] = k, \qquad \mathbb{P}\left[s = r|\omega = R\right] = m$$

The agent's expected utility still follows equation 1 and the signal structure must satisfy the Martingale constraint specified in equation 2.

The agent's interim posteriors on observing the outside signal and without observing the signal from the chosen signal structure are such that:

$$\mathbb{P}[\omega = L|s = l] = \frac{k}{1+k-m}, \qquad \mathbb{P}[\omega = L|s = r] = \frac{1-k}{1+m-k}$$

The G, B, and T signals are described section 3. A type R agent is able to preserve her political faith as long has her posterior upon observing both signals is such that $\mathbb{P}[\omega = R|s, S] \geq 0.5$. Therefore, the G, B, and T signals must be such that:

$$\begin{aligned}\mathbb{P}[\omega = R|S = G] =& \frac{k}{1+k-m} \\ \mathbb{P}[\omega = R|S = B] =& \frac{1-k}{1+m-k} \\ \mathbb{P}[\omega = R|S = T] =& 0\end{aligned}$$

Claim 1 *It is sufficient to consider three signals used in two possible signal structures when solving the agent's problem described above.*

Proof. The following proof follows directly from Kolotilin (2018) and Kamenica & Gentzkow (2011).We use the linear optimization technique of comparing marginal utility to price ratios of different signals. In figure 2, the marginal utility to price ratio of a signal is the slope of the line joining the origin to the point on the expected utility curve that corresponds to the interim posterior generated by that signal. In that sense, the next parts of the proof are simply confirming the shape of the concave closure of the expected utility curve.

Lemma 2 *Any signal M_i which generates a posterior $\mathbb{P}[\omega = R|M_i] \in (\frac{k}{1+k-m}, 1]$ is sub-optimal when compared to a signal M_G, where M_G is such that $\mathbb{P}[\omega = R|M_G] = \frac{k}{1+k-m}$.*

Proof.

Regardless of whether the agent observes a signal M_i or M_G, the agent will have the same expected utility. This is because the agent would be able to preserve her political faith regardless of the realization of the outside signal.

However, it is more costly (according to the Martingale constraint) to generate the signal M_i. Therefore, the Marginal utility to price ratio of generating M_i is lower than for generating M_G. This implies that any signal structure where $\mathbb{P}[M_i] > 0$ will have a lower ex-ante expected utility than a signal structure which assigns $\mathbb{P}[M_i] = 0$ and adds $\frac{\mathbb{P}[\omega=R|M_G]}{\mathbb{P}[\omega=R|M_G]}\mathbb{P}[M_i]$ to the probability that M_G is generated. Therefore, no M_i such that

$\mathbb{P}[\omega = R|M_i] \in (\frac{k}{1+k-m}, 1]$ will be chosen by the agent. Equivalently, M_i is sub-optimal when compared to M_G.

■

Lemma 3 *Any signal M_i which generates a posterior $\mathbb{P}[\omega = R|M_i] \in (\frac{1-k}{1+m-k}, \frac{k}{1+k-m})$ is sub-optimal compared to a signal M_B, where M_B is such that $\mathbb{P}[\omega = R|M_B] = \frac{1-k}{1+m-k}$.*

Proof. For M_i, the ex-ante expected utility of the agent is given by

$$\begin{aligned}\mathbb{P}\Big[\mathbb{P}[\omega = R|M_i, s] \geq 0.5\Big] &= m\mathbb{P}[\omega = R|M_i] + (1-k)(1 - \mathbb{P}[\omega = R|M_i]) \\ &= 1 - k + \mathbb{P}[\omega = R|M_i](m + k - 1)\end{aligned}$$

This implies that the marginal utility to price ratio is

$$(m + k - 1) + \frac{(1-k)}{\mathbb{P}[\omega = R|M_i]}$$

For M_B, the ex-ante expected utility is

$$\mathbb{P}\Big[\mathbb{P}[\omega = R|M_B, s] \geq 0.5\Big] = m(\frac{1-k}{1+m-k}) + (1-k)(1 - (\frac{1-k}{1+m-k})) = 2m(\frac{1-k}{1+m-k})$$

This means that the marginal utility to price ratio is

$$2m = (m + k - 1) + \frac{(1-k)}{(\frac{1-k}{1+m-k})}$$

Since $\mathbb{P}[\omega = R|M_i] > \frac{1-k}{1+m-k}$, the MU-Price ratio for generating a signal-structure posterior M_i is lower than for M_B. Therefore, no $M_i \in (\frac{1-k}{1+m-k}, \frac{k}{1+k-m})$ will be chosen by the agent. Equivalently, M_i would be sub-optimal when compared to M_B.

■

Lemma 4 *Any signal M_i which generates a posterior $\mathbb{P}[\omega = R|M_i] \in (0, \frac{1-k}{1+m-k})$ is sub-optimal compared to a signal M_T, where M_T is such that $\mathbb{P}[\omega = R|M_T] = 0$.*

Proof.

For M_i, the ex-ante expected utility is zero. This is because regardless of the realization of the outside signal, the agent is never able to preserve her political faith. The same is true for M_T. However $M_i > 0$, which implies that the cost for generating a signal M_i

is higher than for M_T. Therefore, no $M_i \in (0, \frac{1-k}{1+m-k})$ will be chosen by the sender-self. Equivalently, M_i would be sub-optimal when compared to M_T.

■

The agent requires only three signals to solve her problem. In fact, any signal that generates a posterior different from these three would be sub-optimal. M_G, which generates a posterior $\mathbb{P}[\omega = R|M_G] = \frac{k}{1+k-m}$, is abbreviated to G. M_B, which generates a posterior $\mathbb{P}[\omega = R|M_B] = \frac{1-k}{1+m-k}$, is abbreviated to B. Finally, M_T, which generates a posterior $\mathbb{P}[\omega = R|M_T] = 0$, is abbreviated to T.

A signal structure is a combination of signal realizations. The three possible signals are G, B, and T. Therefore, the possible signal structures are GT, GB, and GBT.[20]

We argue that while GBT is feasible according to the budget constraint, and can even be an optimal choice for some parameters, it is safe to ignore it. Whenever it is optimal, a simpler signal structure (GB or GT) is also optimal and feasible. In other words, this signal structure never offers strictly greater expected utility to the agent (than the max of GB, and GT), and is, therefore, not required to solve the agent's problem. Either the MU-Price ratio of G is higher than of B in which case GT should be implemented, and not GBT. Or the MU-Price ratio of B is higher than of G in which case GB should be implemented, and not GBT. Or, finally, the MU-Price ratio of G and B are equal, in which case either GB or GT give the sender-self the same expected utility as GBT, and therefore, GBT can be safely ignored.

Therefore, we state that a set of signal structures that are sufficient to solve the agent's problem are GT and GB.

■

A.1 Type R agent's problem

Recall that

$$\mathbb{P}\left[s = l|\omega = L\right] = k, \qquad \mathbb{P}\left[s = r|\omega = R\right] = m$$

This is a linear optimization problem. Therefore, the agent chooses to employ the signals with the highest marginal utility to price (MU-P) ratio.

For signal G, the MU is 1. This is because regardless of the outside signal, the agent

[20]There are a number of signal structures that are ruled out because they violate the Martingale constraint. Specifically, G, B, T, and BT are ruled out for this reason. While we assume that the agents share a common symmetric prior belief that $\mathbb{P}[\omega = R] = 0.5$, this result is robust to values of $\mathbb{P}[\omega = R]$ such that $\frac{1-k}{1+m-k} < \mathbb{P}[\omega = R] < \frac{k}{1+k-m}$.

is able to preserve her political faith. For signal B, the MU is equal to the likelihood that the outside signal is favorable (r, for a type R agent) given that B is realized. This equals $2m(\frac{1-k}{1+m-k})$. Finally, for T, the agent is never able to preserve her political faith, and therefore, the MU is 0.

The *price* of each of these signals is determined according to coefficient corresponding to it in the Martingale constraint $(\frac{k}{1+k-m}) \cdot P_G + (\frac{1-k}{1+m-k}) \cdot P_B + 0 \cdot P_T = 0.5$. This price is simply the intermediate posterior generated by the signal.

The MU-P ratio for the signal G is $\frac{1}{\frac{k}{1+k-m}}$, for signal B, it is $\frac{2m(\frac{1-k}{1+m-k})}{(\frac{1-k}{1+m-k})} = 2m$, and for signal T, it is undefined.

The signal-structure GT is optimal when $MU - P_G \geq MU - P_B$. This simplifies to $1 + k - m - 2km \geq 0$. If $1 + k - m - 2km \leq 0$, then signal-structure GB is optimal. This is equivalent to saying that the concave closure of the expected utility curve shown in the graphs in figure 3 has a kink if and only if $1 + k - m - 2km < 0$. If a kink exists in that curve, then a GB signal gives the agent a higher expected utility than a GT signal.

We can now calculate the probability of realization of different signals, utility, and the likelihood of voting for the preferred party under the signal structures GT and GB. Our calculations are for the type R agent, the calculations for a type L agent are analogous. [21]

The probabilities of realization of different signals will help us calculate expected utilities as well as the outcome of the election.

Signal structure GT**:** Unconditional on the state, the likelihood that the signal G is realized is $P_G = \frac{1+k-m}{2k}$. This is also the ex-ante expected utility of the agent.

Conditional on the state being $\omega = R$, the signal G is always realized and so the agent's expected utility is $E[U_R|_{GT \cap \omega=R}] = \mathbb{P}[G|\omega = R] = 1$.

Conditional on the state being $\omega = L$, the likelihood that signal G is realized is $\frac{1-m}{k}$. Whenever signal G is realized, the agent is able to preserve her political faith. Therefore, this also equals the agent's expected utility ($E[U_R|_{G \cap |\omega=L}]$)

[21] All one would have to do is to replace w with $1 - w$ and replace k and m.

Signal structure GB**:** This signal structure is a little more complicated. So, we use the following three equations.

$$\mathbb{P}[G|GB] + \mathbb{P}[B|GB] = 1 \tag{3}$$

$$\frac{\mathbb{P}[G|\omega = L]}{\mathbb{P}[G|\omega = R]} = \frac{1-m}{k} \tag{4}$$

$$\frac{\mathbb{P}[B|\omega = L]}{\mathbb{P}[B|\omega = R]} = \frac{m}{1-k} \tag{5}$$

Given that the signal structure is GB

$$\begin{aligned} 1 &= \mathbb{P}[G] + \mathbb{P}[B] \\ &= \left(\mathbb{P}[G|\omega = R] \cdot \frac{1}{2} + \mathbb{P}[G|\omega = L] \cdot (\frac{1}{2})\right) + \left(\mathbb{P}[B|\omega = R] \cdot \frac{1}{2} + \mathbb{P}[B|\omega = L] \cdot (\frac{1}{2})\right) \\ &= \frac{1}{2}\left((\mathbb{P}[G|\omega = R])\left(1 + \frac{\mathbb{P}[G|\omega = L]}{\mathbb{P}[G|\omega = R]}\right) + (\mathbb{P}[B|\omega = R])\left(1 + \frac{\mathbb{P}[B|\omega = L]}{\mathbb{P}[B|\omega = R]}\right)\right) \end{aligned}$$

This simplifies to

$$1 = \mathbb{P}[G|\omega = R]\frac{(1+k-m)}{2k} + (1 - \mathbb{P}[G|\omega = R])\frac{(1+m-k)}{2(1-k)}$$

Therefore, conditional on the state,

$$\mathbb{P}[G|GB \cap \omega = R] = k, \qquad \mathbb{P}[B|GB \cap \omega = R] = 1-k$$
$$\mathbb{P}[G|GB \cap \omega = L] = 1-m, \qquad \mathbb{P}[B|GB \cap \omega = L] = m$$

and unconditional on the state:

$$\mathbb{P}[G|GB] = \frac{1+k-m}{2}, \qquad \mathbb{P}[B|GB] = \frac{1+m-k}{2}$$

To calculate the likelihood of political faith preservation, and therefore, expected utility, it is helpful to recall that

$$\mathbb{P}\left[s = l|\omega = L\right] = k, \qquad \mathbb{P}\left[s = r|\omega = R\right] = m$$

The agent's expected utility conditional on the state being $\omega = R$ is:

$$\begin{aligned} E[U_R|_{GB\cap\omega=R}] &= \mathbb{P}[G|GB \cap \omega = R] + \mathbb{P}[r|B \cap \omega = R] \cdot \mathbb{P}[B|GB \cap \omega = R] \\ &= k + m\,(1-k) \end{aligned}$$

The agent's expected utility conditional on the state being $\omega = L$ is:

$$\begin{aligned} E[U_R|_{GB\cap\omega=L}] &= \mathbb{P}[G|GB \cap \omega = L] + \mathbb{P}[r|B \cap \omega = L] \cdot \mathbb{P}[B|GB \cap \omega = L] \\ &= (1-m) + (1-k)m \end{aligned}$$

The unconditional expected utility is simply a weighted average of the conditional expected utilities. If the agent's beliefs about the signal structure of the outside signal are correct, then:

$$\begin{aligned} E[U_R|_{GB}] &= \frac{1}{2} \cdot E[U_R|_{GB\cap\omega=R}] + \frac{1}{2} \cdot E[U_R|_{GB\cap\omega=L}] \\ &= \frac{1+k+m-2km}{2} \end{aligned}$$

A.2 Type L agent's problem

Recall that:

$$\mathbb{P}\left[s = l|\omega = L\right] = k, \qquad \mathbb{P}\left[s = r|\omega = R\right] = m$$

For signal G, the MU is 1. This is because regardless of the outside signal, the agent is able to preserve her political faith. For signal B, the MU is equal to the likelihood that the outside signal is favorable (l, for a type L agent) given that B is realized. This equals $2k(\frac{1-m}{1+k-m})$. Finally, for T, the agent is never able to preserve her political faith, and therefore, the MU is 0.

The *price* of each of these signals is determined according to coefficient corresponding to it in the Martingale constraint $(\frac{m}{1+m-k}) \cdot P_G + (\frac{1-m}{1+k-m}) \cdot P_B + 0 \cdot P_T = 0.5$. This price is simply the intermediate posterior generated by the signal.

The MU-P ratio for the signal G is $\frac{1}{\frac{m}{1+m-k}}$, for signal B, it is $\frac{2k(\frac{1-m}{1+k-m})}{(\frac{1-m}{1+k-m})} = 2k$, and for signal T, it is undefined.

The signal-structure GT is optimal when $MU - P_G \geq MU - P_B$. This simplifies to $1 + m - k - 2km \geq 0$. If $1 + m - k - 2km \leq 0$, then signal-structure GB is optimal.

We can now calculate the probability of realization of different signals, utility, and the likelihood of voting for the preferred party under the signal structures GT and GB.

The probabilities of realization of different signals will help us calculate expected utilities as well as the outcome of the election.

Signal structure GT**:** Unconditional on the state, the likelihood that the signal G is realized is $\mathbb{P}[G] = \frac{1+m-k}{2m}$. This is also the ex-ante expected utility of the agent.

Conditional on the state being $\omega = L$, the signal G is always realized and so the agent's expected utility is $E[U_L|_{GT\cap\omega=L}] = \mathbb{P}[G|\omega = L] = 1$.

Conditional on the state being $\omega = R$, the likelihood that signal G is realized is $\frac{1-k}{m}$. Whenever signal G is realized, the agent is able to preserve her political faith. Therefore, this also equals the agent's expected utility ($E[U_L|_{G\cap|\omega=R}]$)

Signal structure GB**:** This signal structure is a little more complicated. So, we use the following three equations.

$$\mathbb{P}[G|GB] + \mathbb{P}[B|GB] = 1 \tag{6}$$

$$\frac{\mathbb{P}[G|\omega = R]}{\mathbb{P}[G|\omega = L]} = \frac{1-k}{m} \tag{7}$$

$$\frac{\mathbb{P}[B|\omega = R]}{\mathbb{P}[B|\omega = L]} = \frac{k}{1-m} \tag{8}$$

Conditional on the state,

$$\mathbb{P}[G|GB \cap \omega = L] = m, \qquad \mathbb{P}[B|GB \cap \omega = L] = 1 - m$$
$$\mathbb{P}[G|GB \cap \omega = R] = 1 - k, \qquad \mathbb{P}[B|GB \cap \omega = R] = k$$

and unconditional on the state:

$$\mathbb{P}[G|GB] = \frac{1+m-k}{2}, \qquad \mathbb{P}[B|GB] = \frac{1+k-m}{2}$$

To calculate the likelihood of political faith preservation, and therefore, expected utility, it is helpful to recall that

$$\mathbb{P}[s = l|\omega = L] = k, \qquad \mathbb{P}[s = r|\omega = R] = m$$

The agent's expected utility conditional on the state being $\omega = L$ is:

$$\begin{aligned} E[U_L|_{GB\cap\omega=L}] &= \mathbb{P}[G|GB \cap \omega = L] + \mathbb{P}[l|B \cap \omega = L] \cdot \mathbb{P}[B|GB \cap \omega = L] \\ &= m + k(1-m) \end{aligned}$$

The agent's expected utility conditional on the state being $\omega = R$ is:

$$\begin{aligned} E[U_L|_{GB\cap\omega=R}] &= \mathbb{P}[G|GB \cap \omega = R] + \mathbb{P}[l|B \cap \omega = R] \cdot \mathbb{P}[B|GB \cap \omega = R] \\ &= (1-k) + (1-m)k \end{aligned}$$

The unconditional expected utility is simply a weighted average of the conditional expected utilities. If the agent's beliefs about the signal structure of the outside signal are correct, then:

$$\begin{aligned} E[U_L|_{GB}] &= \frac{1}{2} \cdot E[U_L|_{GB\cap\omega=R}] + \frac{1}{2} \cdot E[U_L|_{GB\cap\omega=L}] \\ &= \frac{1+k+m-2km}{2} \end{aligned}$$

A.3 Robustness to noise

Suppose that the belief threshold that type R agents have for the preservation of their political faith is stochastic with the mean at $\mathbb{P}[\omega = R|S_i, s_i] = 0.5$. If we have a small amount of mean-zero, normally-distributed noise in this threshold, we see in figure 9 that for less precise Outside signal structure, a G^+T signal is optimal. The G^+signal generates an interim posterior that is more favorable to party R than a G signal and in the case of normally-distributed noise, it is optimal because it allows the agent to preserve her political faith for a large proportion of the possible realizations of the noise.

Similarly, for high precision Outside signals, a G^+B^+ signal structure is optimal for type R agents. For minute levels of noise, the optimal signal structures remain almost identical and would result in almost the same signal structures being chosen.

Since the key results in propositions 1, 2, 3, and 4 were not knife-edge, they are robust to stochasticity in the belief threshold, as long as that the variance of the noise is low.

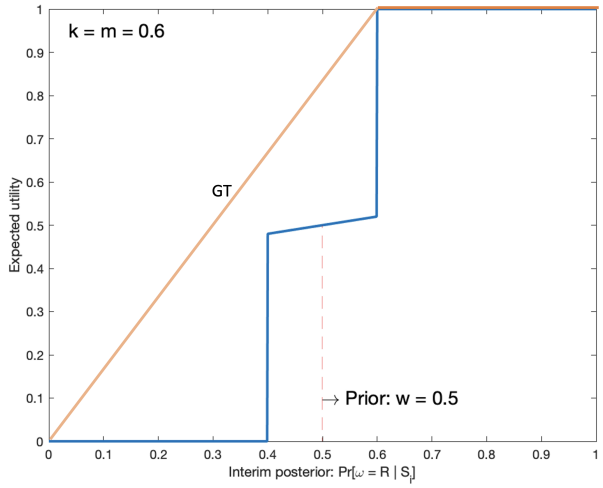
B Applications

B.1 Asymmetric exposure to unbiased outside signal

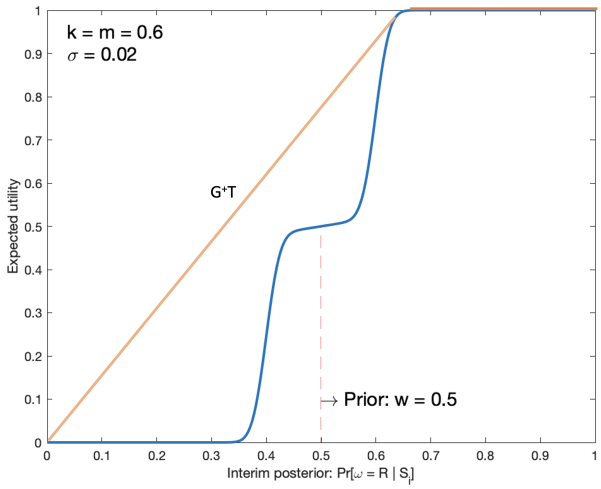
An agent of type L receives an outside signal such that

$$\mathbb{P}\left[s = l|\omega = L\right] = t \in [0.5, 1], \qquad \mathbb{P}\left[s = r|\omega = R\right] = t \in [0.5, 1]$$

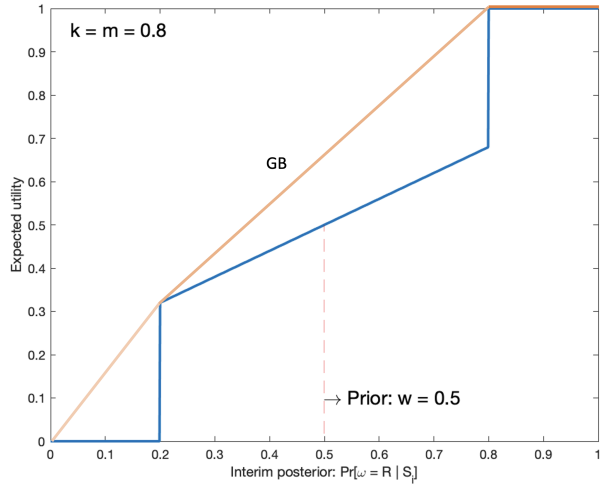
Figure 9: Expected utility as a function of interim posteriors



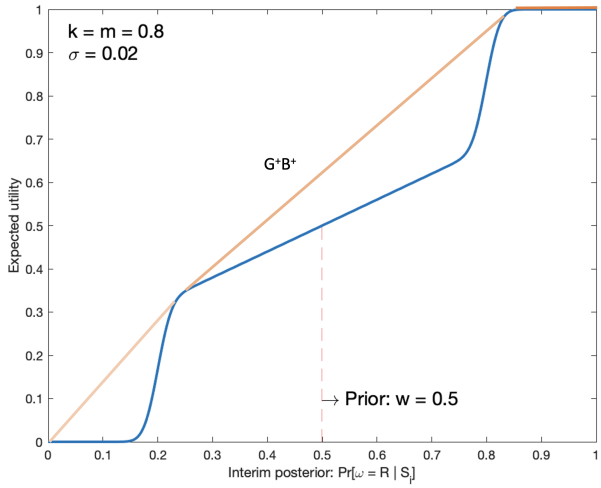
(a) Lower precision Out-media



(b) Lower precision Out-media with noise



(c) Higher precision Out-media



(d) Higher precision Out-media with noise

An agent of type R receives a less precise outside signal.

$$\mathbb{P}\left[s = l|\omega = L\right] = \tau \cdot t + (1-\tau) \cdot \frac{1}{2} \in [0.5, 1], \quad \mathbb{P}\left[s = r|\omega = R\right] = \tau \cdot t + (1-\tau) \cdot \frac{1}{2} \in [0.5, 1]$$

where $\tau \in [0, 1]$

B.1.1 Type R agent

We use the results developed in appendix A.1 and simply plug in $k = m = \frac{1-\tau}{2} + \tau t$.

Signal structure GT**:** Chosen if $\tau \cdot t + (1-\tau) \cdot \frac{1}{2} \leq \frac{1}{\sqrt{2}} \simeq 0.71$.

The agent's expected utilities are the same as the likelihood of political faith preservation for the agent, and they equal:

$$E[U_R|_{GT\cap\omega=R}] = 1, \qquad E[U_R|_{GT\cap\omega=L}] = \frac{1+\tau-2\tau t}{1-\tau+2\tau t}$$

Unconditioned on the realization of the state, the ex-ante expected utility is

$$E[U_R|_{GT}] = \frac{1}{1-\tau+2\tau t}$$

Signal structure GB**:** Chosen if $\tau \cdot t + (1-\tau)\cdot\frac{1}{2} \geq \frac{1}{\sqrt{2}} \simeq 0.71$.

The agent's expected utilities are the same as the likelihood of political faith preservation for the agent, and they equal:

$$E[U_R|_{GB\cap\omega=R}] = \frac{3}{4} + \tau t - \frac{\tau}{2} - \tau^2\left(\frac{1}{4} + t^2 - t\right), \quad E[U_R|_{GB\cap\omega=L}] = 1 - \left(\frac{1-\tau+2\tau t}{2}\right)^2$$

Unconditioned on the realization of the state, the ex-ante expected utility is

$$E[U_R|_{GB}] = \frac{3}{4} - \tau^2\left(t^2 + \frac{1}{4} - t\right)$$

B.1.2 Type L agent

Signal structure GT**:** Chosen if $t \leq \frac{1}{\sqrt{2}} \simeq 0.71$.

$$E[U_L|_{GT\cap\omega=R}] = \frac{1-t}{t}, \qquad E[U_L|_{GT\cap\omega=L}] = 1$$

Signal structure GB**:** Chosen if $t \geq \frac{1}{\sqrt{2}} \simeq 0.71$.

$$E[U_L|_{GB\cap\omega=R}] = 1 - t^2, \qquad E[U_L|_{GB\cap\omega=L}] = 2t - t^2$$

B.1.3 Proof of proposition 1

Proof.

Suppose that $\tau = 0.04$ and $t = 0.75$. A type R agent chooses a GT signal structure because $\tau \cdot t + (1-\tau)\cdot\frac{1}{2} = 0.51 < \frac{1}{\sqrt{2}}$. A type L agent chooses a GB signal structure because $t = 0.75 > \frac{1}{\sqrt{2}}$. These conditions hold in the neighborhood of the parameter values $\tau = 0.04$ and $t = 0.75$. Since the likelihood of political faith preservation is continuous in

these parameter values, and since the margin of victory for party R in state L at these parameter values is bounded away from zero, the result of information aggregation failure holds for a non-trivial subset of values.

When both types of agents choose a GT type signal structure. If the state of the world is R, then all type R agents vote for party R, and some type L agents vote for party R. If the state of the world is L, then all type L agents vote for party L and some type R agents vote for party L. Clearly, the correct party wins in either state.

It is not possible, given the parameters, to have any parameter space where type R agents choose a GB signal structure while type L agents choose a GT signals structure.

When both types of agents choose a GB signal structure, if the state of the world is R, then party R wins if

$$\frac{3}{4} + \tau t - \frac{\tau}{2} - \tau^2 \left(\frac{1}{4} + t^2 - t \right) > 1 - t^2$$

This simplifies to

$$\tau \left(t - \frac{1}{2} \right) \left(1 - \tau \left(t - \frac{1}{2} \right) \right) + \left(t^2 - \frac{1}{4} \right) > 0$$

which always holds

Similarly, if the state of the world is L, then party L wins if

$$1 - \left(\frac{1 - \tau + 2\tau t}{2} \right)^2 < 2t - t^2$$

which simplifies to

$$\left(\frac{1 - \tau + 2\tau t}{2} \right)^2 - (1 - t)^2 > 0$$

This always holds because $1 - t \in [0, 0.5]$ while $\left(\frac{1-\tau+2\tau t}{2} \right) \in [0.5, 1]$.

■

B.2 Distrust in mainstream media

Suppose that type R agents believe (incorrectly) that the media is less precise than it actually is. In particular, an agent of type L correctly believes that the process generating the outside signal is such that

$$\mathbb{P}\left[s = l | \omega = L \right] = t \in [0.5, 1], \qquad \mathbb{P}\left[s = r | \omega = R \right] = t \in [0.5, 1]$$

An agent of type R incorrectly believes that the process that generates the outside signal is more noisy

$$\mathbb{P}\left[s = l|\omega = L\right] = \tau \cdot t + (1-\tau) \cdot \frac{1}{2} \in [0.5, 1], \quad \mathbb{P}\left[s = r|\omega = R\right] = \tau \cdot t + (1-\tau) \cdot \frac{1}{2} \in [0.5, 1]$$

where $\tau \in [0, 1]$

This is very similar to an asymmetry in exposure to mainstream media. As such, the signal choices and expected[22] utilities are identical to those calculated in subsection B.1.

For type L agents, the probability of political faith preservation is identical to the expected utilities calculated in subsection B.1.

For type R agents, if the chosen signal is of type GT, then the probability of political faith preservation is identical to the expected utility calculated in subsection B.1. If the chosen signal is of type GB, then the type R agent's probability of political faith preservation is calculated conditioned on the state.

If the state is $\omega = R$

$$\begin{aligned}
\mathbb{P}[PFP_R|_{GB\cap\omega=R}] &= \mathbb{P}[G|GB \cap \omega = R] + \mathbb{P}[r|B \cap \omega = R] \cdot \mathbb{P}[B|GB \cap \omega = R] \\
&= \left(\frac{1-\tau}{2} + \tau t\right) + t \cdot \left(\frac{1+\tau}{2} - \tau t\right) \\
&= \frac{1}{2}\left(1 - \tau + t + 3\tau t - 2\tau t^2\right)
\end{aligned}$$

If the state is $\omega = L$

$$\begin{aligned}
\mathbb{P}[PFP_R|_{GB\cap\omega=L}] &= \mathbb{P}[G|GB \cap \omega = L] + \mathbb{P}[r|B \cap \omega = L] \cdot \mathbb{P}[B|GB \cap \omega = L] \\
&= \left(\frac{1+\tau}{2} - \tau t\right) + (1-t) \cdot \left(\frac{1-\tau}{2} + \tau t\right) \\
&= \frac{1}{2}\left(2 - t + \tau t - 2\tau t^2\right)
\end{aligned}$$

B.3 Non-common priors

Suppose that type R and L have different priors. Specifically

$$\mathbb{P}_R[\omega = R] := w_R \qquad\qquad \mathbb{P}_L[\omega = R] := w_L$$

where $w_L < 0.5 < w_R$

[22] For type R agents, the expectations are based on incorrect beliefs. We will, therefore, separately calculate the probability of political faith preservation.

As in subsection 4.1, an agent of type L receives an outside signal such that

$$\mathbb{P}\left[s = l|\omega = L\right] = t \in [0.5, 1], \qquad \mathbb{P}\left[s = r|\omega = R\right] = t \in [0.5, 1]$$

An agent of type R receives a less precise outside signal.

$$\mathbb{P}\left[s = l|\omega = L\right] = \tau \cdot t + (1-\tau) \cdot \frac{1}{2} \in [0.5, 1], \quad \mathbb{P}\left[s = r|\omega = R\right] = \tau \cdot t + (1-\tau) \cdot \frac{1}{2} \in [0.5, 1]$$

where $\tau \in [0, 1]$

B.3.1 Type R agent

We use the results developed in appendix A.1 and allow for $w_R > 0.5$ while plugging in $k = m = \frac{1-\tau}{2} + \tau t$.

Signal structure N: Chosen if $\tau \cdot t + (1-\tau) \cdot \frac{1}{2} \leq w_R$

The agent is able to preserve her political faith regardless of the realization of the outside signal.

$$E[U_R|_{N \cap \omega = R}] = 1, \qquad E[U_R|_{N \cap \omega = L}] = 1$$

Signal structure GT: Chosen if $w_R < \tau \cdot t + (1-\tau) \cdot \frac{1}{2} \leq \frac{1}{\sqrt{2}} \simeq 0.71$.

The agent's expected utilities are the same as the likelihood of political faith preservation for the agent, and they equal:

$$E[U_R|_{GT \cap \omega = R}] = 1, \qquad E[U_R|_{GT \cap \omega = L}] = \frac{w_R(1 + \tau - 2\tau t)}{(1 - w_R)(1 - \tau + 2\tau t)}$$

Signal structure GB: Chosen if $\tau \cdot t + (1-\tau) \cdot \frac{1}{2} \geq max\{\frac{1}{\sqrt{2}}, w_R\}$.

The agent's expected utilities are the same as the likelihood of political faith preservation for the agent, and they equal:

$$E[U_R|_{GB \cap \omega = R}] = \frac{(2\tau t + 1 - \tau)(2\tau t - 1 - \tau)}{4w_R\tau(2t-1)} + \frac{(2\tau t + 1 - \tau)(2\tau t + 1 - \tau - 2w_R)(1 + \tau - 2\tau t)}{8w_R\tau(2t-1)}$$

and

$$E[U_R|_{GB \cap \omega = L}] = \frac{(1 + \tau - 2\tau t)(2\tau t - 1 - \tau)}{4(1 - w_R)\tau(2t-1)} + \frac{(2\tau t + 1 - \tau)(2\tau t + 1 - \tau - 2w_R)(1 + \tau - 2\tau t)}{8(1 - w_R)\tau(2t-1)}$$

B.3.2 Type L agent

Signal structure N: Chosen if $t \leq 1 - w_L$

The agent is able to preserve her political faith regardless of the realization of the outside signal.

$$E[U_L|_{N\cap\omega=R}] = 1, \qquad E[U_L|_{N\cap\omega=L}] = 1$$

Signal structure GT: Chosen if $1 - w_L < t \leq \frac{1}{\sqrt{2}} \simeq 0.71$.

$$E[U_L|_{GT\cap\omega=R}] = \frac{(1-w_L)(1-t)}{w_L t}, \qquad E[U_L|_{GT\cap\omega=L}] = 1$$

Signal structure GB: Chosen if $t \geq max\{\frac{1}{\sqrt{2}}, 1 - w_L\}$.

$$E[U_L|_{GB\cap\omega=R}] = \frac{(1-t)(t-w)}{w(2t-1)} + \frac{t(1-t)(t+w-1)}{w(2t-1)}$$

and

$$E[U_L|_{GB\cap\omega=L}] = \frac{t(2t-1-t^2+(1-w)t)}{(1-w)(2t-1)}$$

B.4 Propagandized outside signal with censorship

Suppose that the outside signal is biased towards party L. Suppose, also, that this bias is common knowledge. The true structure of the outside signal is

$$\mathbb{P}[s = l|\omega = L] = \tau \cdot t + (1-\tau)\cdot 1, \qquad \mathbb{P}[s = r|\omega = R] = \tau \cdot t + (1-\tau)\cdot 0$$

where $t > 0.5$.

We can use the results from appendix A.1 and A.2 by simply plugging in $k = 1 + \tau t - \tau$ and $m = \tau t$.

Suppose, also, that neither type of agent has access to any information other than her prior and the realized outside signal. This scenario may be interpreted either as the party in power shutting down all media other than the propagandized state-controlled media. An alternative interpretation is that the media environment is not rich because we are considering a time before the environment became rich through the proliferation of news outlets and social media.

Because agents share common and symmetric priors, their posteriors on observing the outside signals are:

$$Pr[\omega = L|s = l] = \frac{1 + \tau t - \tau}{2 - \tau}$$

Because $t > 0.5$, $Pr[\omega = L|s = l] > 0.5$

and

$$Pr[\omega = L|s = r] = 1 - t$$

Because $t > 0.5$, $Pr[\omega = L|s = r] < 0.5$

For party L to win in state R, we require that $Pr\left(s = l|\omega = R\right) > Pr\left(s = r|\omega = R\right)$ or $1 - \tau t > \tau t$. That is, $\tau t < 0.5$.

For party L to win in state L, we require that $Pr\left(s = l|\omega = L\right) > Pr\left(s = r|\omega = L\right)$ or $1 + \tau t - \tau > \tau - \tau t$. That is, $\tau(1 - t) < 0.5$. If $\tau \in [0, 1]$, and $t > 0.5$, or if $\tau \in (0, 1]$ and $t \geq 0.5$ then this always holds.

This benchmark assumes that there is no chosen signal structure - it demonstrates the strength of propaganda when it is accompanied by censorship that prevents agents from choosing a signal structure to inform them.

Next, we re-introduce the ability of agents to design a chosen signal structure. Our interest is primarily in the region where propaganda can backfire once agents are able to choose a signal structure.

B.5 Propagandized outside signal without censorship

Suppose that the outside signal is biased towards party L. Suppose, also, that this bias is common knowledge. The true structure of the outside signal is

$$\mathbb{P}\left[s = l|\omega = L\right] = \tau \cdot t + (1 - \tau) \cdot 1, \qquad \mathbb{P}\left[s = r|\omega = R\right] = \tau \cdot t + (1 - \tau) \cdot 0$$

where $t > 0.5$.

We can use the results from appendix A.1 and A.2 by simply plugging in $k = 1 + \tau t - \tau$ and $m = \tau t$.

B.5.1 Type R agent's problem

GT **signal structure:** Chosen if $2 - \tau - 2\tau t - 2\tau^2 t^2 + 2\tau^2 t \geq 0$.

The agent's expected utilities are:

$$E[U_R|_{GT\cap\omega=R}] = 1, \qquad E[U_R|_{GT\cap\omega=L}] = \frac{1-\tau t}{1+\tau t-\tau}$$

GB **signal structure:** Chosen if $2-\tau-2\tau t-2\tau^2t^2+2\tau^2t \leq 0$.

The agent's expected utilities are:

$$E[U_R|_{GB\cap\omega=R}] = 1-\tau+\tau t+\tau^2t-\tau^2t^2, \qquad E[U_R|_{GB\cap\omega=L}] = 1-\tau t+\tau^2t-\tau^2t^2$$

B.5.2 Type L agent's problem

GT **signal structure:** Chosen if $\tau(1-2t-2\tau t^2+2\tau t) \geq 0$ The agent's expected utilities are:

$$E[U_L|_{GT\cap\omega=R}] = \frac{1-t}{t}, \qquad E[U_L|_{GT\cap\omega=L}] = 1$$

GB **signal structure:** Chosen if $\tau(1-2t-2\tau t^2+2\tau t) \leq 0$ The agent's expected utilities are:

$$E[U_L|_{GB\cap\omega=R}] = 1-\tau t+\tau^2t-\tau^2t^2, \qquad E[U_L|_{GB\cap\omega=L}] = 1-\tau+\tau t+\tau^2t-\tau^2t^2$$

B.5.3 Proof of proposition 2

Proof.

Suppose that $\tau = 0.3$ and $t = 0.6$. A type R agent chooses a GT signal structure because $2-\tau-2\tau t-2\tau^2t^2+2\tau^2t = 1.3832 > 0$. A type L agent chooses a GB signal structure because $\tau(1-2t-2\tau t^2+2\tau t) = -0.0168 < 0$. These conditions hold in the neighborhood of the parameter values $\tau = 0.3$ and $t = 0.6$. Since the likelihood of political faith preservation is continuous in these parameter values, and since the margin of victory for party R in state L at these parameter values is bounded away from zero, the result of information aggregation failure holds for a non-trivial subset of values.

When both types of agents choose a GT type signal structure. If the state of the world is R, then all type R agents vote for party R, and some type L agents vote for party R. If the state of the world is L, then all type L agents vote for party L and some type R agents vote for party L. Clearly, the correct party wins in either state.

It is not possible, given the parameters, to have any parameter space where type R agents choose a GB signal structure while type L agents choose a GT signals structure.

When both types of agents choose a GB signal structure, if the state of the world is R, then party R wins if

$$1-\tau+\tau t+\tau^2 t-\tau^2 t^2 > 1-\tau t+\tau^2 t-\tau^2 t^2$$

This simplifies to

$$\tau(2t-1) > 0$$

which always holds

Similarly, if the state of the world is L, then party L wins if

$$1-\tau+\tau t+\tau^2 t-\tau^2 t^2 > 1-\tau t+\tau^2 t-\tau^2 t^2$$

which simplifies to

$$\tau(2t-1) > 0$$

Which always holds.

■

B.6 Propaganda with oblivious citizens

Suppose that the true process of the outside signal is

$$\mathbb{P}\left[s=l|\omega=L\right]=\tau\cdot t+(1-\tau)\cdot 1, \qquad \mathbb{P}\left[s=r|\omega=R\right]=\tau\cdot t+(1-\tau)\cdot 0$$

where $\tau\in[0,1]$ and $t\in[0.5,1]$ Agents don't know that the true process, and believe that the process that generates the outside signal is unbiased and is as follows

$$\mathbb{P}\left[s=l|\omega=L\right]=t, \qquad \mathbb{P}\left[s=r|\omega=R\right]=t$$

B.6.1 Type R agent's problem

GT **signal structure:** Chosen if $t\leq\frac{1}{\sqrt{2}}$

The agent's expected utilities are:

$$E[U_R|_{GT\cap\omega=R}]=1, \qquad E[U_R|_{GT\cap\omega=L}]=\frac{1-t}{t}$$

When the agent chooses a GT type signal structure, the likelihood of political faith preservation doesn't depend on the realization of the outside signal. Therefore, the likelihood of political faith preservation is the same as the expected utility.

GB **signal structure:** Chosen if $t \geq \frac{1}{\sqrt{2}}$ The agent's expected utilities (under incorrect beliefs) are:

$$E[U_R|_{GB\cap\omega=R}] = 2t - t^2, \qquad E[U_R|_{GB\cap\omega=L}] = 1 - t^2$$

Here, the likelihood of political faith preservation differs from the agent's expected utility.

$$\mathbb{P}[PFP_R|_{GB\cap\omega=R}] = t(1+\tau-\tau t), \qquad \mathbb{P}[PFP_R|_{GB\cap\omega=L}] = (1+\tau t)(1-t)$$

B.6.2 Type L agent's problem

GT **signal structure:** Chosen if $t \leq \frac{1}{\sqrt{2}}$

The agent's expected utilities are:

$$E[U_L|_{GT\cap\omega=R}] = \frac{1-t}{t}, \qquad E[U_L|_{GT\cap\omega=L}] = 1$$

When the agent chooses a GT type signal structure, the likelihood of political faith preservation doesn't depend on the realization of the outside signal. Therefore, the likelihood of political faith preservation is the same as the expected utility.

GB **signal structure:** Chosen if $t \geq \frac{1}{\sqrt{2}}$

The agent's expected utilities (under incorrect beliefs) are:

$$E[U_L|_{GB\cap\omega=R}] = 1 - t^2, \qquad E[U_L|_{GB\cap\omega=L}] = 2t - t^2$$

Here, the likelihood of political faith preservation differs from the agent's expected utility.

$$\mathbb{P}[PFP_L|_{GB\cap\omega=R}] = 1 - \tau t^2, \qquad \mathbb{P}[PFP_L|_{GB\cap\omega=L}] = 1 - \tau(1-t)^2$$

B.6.3 Proof of proposition 3

Proof.

Suppose that $\tau = 0.1$ and $t = 0.75$. Both types of agents choose a GB signal structure for their In-media because $t > \frac{1}{\sqrt{2}}$. These conditions hold in the neighborhood of the

parameter values $\tau = 0.1$ and $t = 0.75$. Since the likelihood of political faith preservation is continuous in these parameter values, and since the margin of victory for party L in state R at these parameter values is bounded away from zero, the result of information aggregation failure holds for a non-trivial subset of values.

When both types of agents choose a GT type signal structure. If the state of the world is R, then all type R agents vote for party R, and some type L agents vote for party R. If the state of the world is L, then all type L agents vote for party L and some type R agents vote for party L. Clearly, the correct party wins in either state.

It is not possible, given the parameters, to have any parameter space the two types of agents choose different signal structures for their respective In-media consumption.

When both types of agents choose a GB signal structure, if the state of the world is L, then party L wins if

$$1 - \tau(1-t)^2 > (1+\tau t)(1-t)$$

This simplifies to

$$t + \tau t - \tau > 0$$

which always holds

Further, if the state of the world is R, then party L wins if

$$1 - \tau t^2 > t(1+\tau-\tau t)$$

which simplifies to

$$t < \frac{1}{1+\tau}$$

Therefore, party L wins regardless of the state if $t \in (\frac{1}{\sqrt{2}}, \frac{1}{1+\tau})$. There are no parameter values where party R can win in state L.

■

B.7 Perceived propaganda

Suppose that the true process of the outside signal is

$$\mathbb{P}[s = l|\omega = L] = t \in [0.5, 1], \qquad \mathbb{P}[s = r|\omega = R] = t \in [0.5, 1]$$

L type agents know the true process, while type R agents believe that the process of the outside signal is biased in the following way

$$\mathbb{P}\left[s = l|\omega = L\right] = \tau \cdot t + (1-\tau)\cdot 1, \qquad \mathbb{P}\left[s = r|\omega = R\right] = \tau \cdot t + (1-\tau)\cdot 0$$

where $\tau \in [0,1]$

B.7.1 Type R agent's problem

GT **signal structure:** Chosen if $2 - \tau - 2\tau t - 2\tau^2 t^2 + 2\tau^2 t \geq 0$

The agent's expected utilities are:

$$E[U_R|_{GT\cap\omega=R}] = 1, \qquad E[U_R|_{GT\cap\omega=L}] = \frac{1-\tau t}{1+\tau t-\tau}$$

When the agent chooses a *GT* type signal structure, the likelihood of political faith preservation doesn't depend on the realization of the outside signal. Therefore, the likelihood of political faith preservation is the same as the expected utility.

GB **signal structure:** Chosen if $2 - \tau - 2\tau t - 2\tau^2 t^2 + 2\tau^2 t \leq 0$ The agent's expected utilities (under incorrect beliefs) are:

$$E[U_R|_{GB\cap\omega=R}] = 1 - \tau + \tau t + \tau^2 t - \tau^2 t^2, \qquad E[U_R|_{GB\cap\omega=L}] = 1 - \tau t + \tau^2 t - \tau^2 t^2$$

Here, the likelihood of political faith preservation differs from the agent's expected utility.

$$\mathbb{P}[PFP_R|_{GB\cap\omega=R}] = 1 - \tau + 2\tau t - \tau t^2, \qquad \mathbb{P}[PFP_R|_{GB\cap\omega=L}] = 1 - \tau t^2$$

B.7.2 Type L agent's problem

GT **signal structure:** Chosen if $t \leq \frac{1}{\sqrt{2}}$

The agent's expected utilities are:

$$E[U_L|_{GT\cap\omega=R}] = \frac{1-t}{t}, \qquad E[U_L|_{GT\cap\omega=L}] = 1$$

GB **signal structure:** Chosen if $t \geq \frac{1}{\sqrt{2}}$

The agent's expected utilities are:

$$E[U_L|_{GB\cap\omega=R}] = 1 - t^2, \qquad E[U_L|_{GB\cap\omega=L}] = 2t - t^2$$

B.7.3 Proof of proposition 4

Proof.

Suppose that $\tau = 0.1$ and $t = 0.75$. A type R agent chooses a GT signal structure because $2 - \tau - 2\tau t - 2\tau^2 t^2 + 2\tau^2 t \simeq 1.75 > 0$. A type L agent chooses a GB signal structure because $t = 0.75 > \frac{1}{\sqrt{2}}$. These conditions hold in the neighborhood of the parameter values $\tau = 0.1$ and $t = 0.75$. Since the likelihood of political faith preservation is continuous in these parameter values, and since the margin of victory for party R in state L at these parameter values is bounded away from zero, the result of information aggregation failure holds for a non-trivial subset of values.

When both types of agents choose a GT type signal structure. If the state of the world is R, then all type R agents vote for party R, and some type L agents vote for party R. If the state of the world is L, then all type L agents vote for party L and some type R agents vote for party L. Clearly, the correct party wins in either state.

It is not possible, given the parameters, to have any parameter space where type R agents choose a GB signal structure while type L agents choose a GT signals structure.

When both types of agents choose a GB signal structure, if the state of the world is R, then party R wins if

$$1 - \tau + 2\tau t - \tau t^2 > 1 - t^2$$

This simplifies to

$$\tau(2t - 1) + t^2(1 - \tau) > 0$$

which always holds

Similarly, if the state of the world is L, then party L wins if

$$2t - t^2 > 1 - \tau t^2$$

which simplifies to

$$(2t - 1) - t^2(1 - \tau) > 0$$

Which holds for values of $t \in [\frac{1}{\sqrt{2}}, 1]$ and $\tau \in [\frac{2}{3}, 1]$. The region where both types of agents choose a GB signal structure is a subset of the region where $t \in [\frac{1}{\sqrt{2}}, 1]$ and $\tau \in [\frac{2}{3}, 1]$. Therefore, if both types of agents choose a GB signal structure, then the correct party wins.

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