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ABSTRACT

I present a model in which competing special interests seek policy influence through the news media. In the model a journalist reports on expert opinion to a voter. Two competing interested parties can invest to acquire credentialed advocates to represent their positions in the press. Because advocates are easier to obtain when expert opinion is divided, the activities of special interests can reveal useful information to the voter. However, competition among special interests can also reduce the amount of information communicated to the voter, especially on issues with large economic stakes and a high likelihood of a scientific consensus. The model provides an account of persistent voter ignorance on climate change and other high-stakes scientific topics.

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1 Introduction

The First Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 1990) crystallized a scientific consensus that the climate is warming and that the cause is at least partly anthropogenic. The subsequent decade saw an explosion of activity by conservative think tanks and other organizations attempting to persuade the public that "the scientific evidence for global warming is highly uncertain" (McCright and Dunlap 2000). Much of this activity was directed at generating or influencing media coverage, for example by placing like-minded scientists in contact with journalists (Cushman 1998).

Climate change skeptics have indeed had a prominent voice in public discourse. National newspapers in the 2000s mentioned the top five skeptical scientists about one-fourth as often as their mainstream counterparts (Grundmann and Scott 2012). As recently as the early 2000s the majority of articles in national newspapers and segments in nightly news broadcasts about climate change were "balanced" in the sense of giving "roughly equal attention" to both sides (Boykoff and Boykoff 2004; Boykoff 2008). In 2010, only 52 percent of Americans reported that "most scientists believe that global warming is occurring" (Saad 2013).

As I argue below, it is common for special interests to attempt to influence public opinion and public policy through the strategic placement of credentialed advocates in the news media. These actions exploit rules and norms of balanced reporting to create the impression of scientific controversy, leading the public to doubt even settled scientific conclusions. Although economists have long recognized that pressure groups try to influence public discourse,[1] prominent theories of special interests (e.g., Grossman and Helpman 1994) have focused mainly on attempts to influence who is elected or how politicians behave while in office.

In this paper I present a model in which competing special interests seek policy influence through the news media. I use the model to study how competition among special interests affects voter information, to explain the prevalence of balanced reporting, to evaluate the effects of media content regulation, and to account for persistent voter ignorance on important topics such as climate change.

In the model, a voter makes a policy decision. The optimal policy depends on an unknown, binary state. There is a large population of disinterested experts who each receive a binary signal about the true state. Expert opinion is either evenly divided or is unanimous and correct. There are two interested parties, each wishing the voter to believe in a particular state. Each party may, at some cost, affiliate an expert with its position. The cost is higher when experts are united against the party's position, because the party must compensate its affiliate for a loss of professional stature.

[1] Becker (1983) writes that "research findings that oppose the interests of powerful pressure groups frequently have little political impact because they are offset by the dissemination of selected information and by other appeals to public opinion and legislatures."

The voter learns about expert opinion from the report of a journalist. To make her report the journalist first learns the opinion of a single, random expert. The journalist then solicits a comment from the party opposed to the random expert's opinion. If this opposition party has an affiliated expert, the journalist reports both the opinion of the original, random expert and that of the affiliated, opposition expert. I argue that this simple model of the reporting process captures longstanding journalistic practices, sometimes enshrined in government regulation, designed to ensure fairness or impartiality in media reports.

On most topics, competition among special interests is innocuous and may even benefit the voter. Because it is easier to affiliate an expert when experts are divided, there can be a separating equilibrium in which parties have affiliates only when experts are divided. In such an equilibrium, the journalist reports both sides of the issue only when the science is indeed uncertain, and the voter always chooses the optimal policy given the distribution of expert opinion.

On high-stakes topics with a high likelihood of expert consensus, competition among special interests leads to a breakdown of informative communication. High policy stakes mean that changing the voter's beliefs is very valuable, so the parties want to affiliate an expert even when there is an opposing scientific consensus. A high likelihood of expert consensus similarly encourages investment by the parties, because when consensus is likely, the unchallenged opinion of a random expert conveys a lot of information to the voter. If the parties' incentives are strong enough, then both parties have affiliates regardless of the distribution of expert opinion, the journalist's report always says that the issue has two sides, and the voter learns nothing.

According to the model, then, persistent public ignorance on climate change arises because, not in spite of, the issue's importance and its amenability to empirical science. Perversely, greater scientific ambiguity would help the public, by dampening special interests' incentives to challenge expert opinion.

I use the model to evaluate regulations, such as the US Fairness Doctrine and the UK Impartiality Rule, that require broadcast media to present a balanced viewpoint. It is immediate that for topics like climate change balanced reporting is less informative than unbalanced reporting that simply reports the position of a single random expert. I go further, however, and show that balanced reporting is less informative than reporting by an opinionated journalist who is motivated to convince the voter of a particular position. The reason, familiar from Milgrom and Roberts (1986), is that an opinionated journalist has an interest in correctly revealing expert opinion when it accords with her preferred viewpoint. I argue that this implication of the model is consistent with evidence that some partisan-leaning cable news media have presented a one-sided (and, hence, accurate) picture of climate science.

Regulations are only one reason why journalists pursue balance. I show that norms of balanced reporting

can arise endogenously due to reputational concerns. Formally, allow that with a small probability the journalist is an opinionated type who wishes to persuade the voter of her point of view, and suppose that unopinionated journalists are motivated to convince the voter that they are not opinionated. The opinionated journalist will always want to make an unbalanced report when the opinion of the random expert is consistent with her position. Balanced, uninformative reporting therefore emerges in equilibrium as a way for an unopinionated journalist to reveal her type to the voter. This explanation of balanced reporting is consistent with sociological accounts of the emergence and persistence of norms of objectivity in US journalism (e.g. Schudson 1978, 2001), which locate the birth of these norms in a period of intense influence activity by public relations firms.

I conclude by presenting a range of evidence from the case of climate change that is consistent with the model's implications. I consider first the implication that reporting is uninformative. Strikingly, I find that Americans who consume more news are not more likely to believe in climate change than those who consume less news, even though consuming news is highly correlated with bland factual knowledge about both politics and science. I turn next to the implication that norms of objectivity in journalism exacerbate the effect of special interests. I show that the US public is the least accepting of anthropogenic climate change among OECD countries, and that the US also stands out in having the strongest journalistic norm of objectivity. Across an admittedly small sample of countries, I find that those whose journalists express less concern about balance also devote less media attention to climate-change skeptics and have less skeptical publics. I also briefly discuss applications of the model to ozone depletion and to the vaccine-autism connection.

This paper's principal contribution is an economic account of the US public's persistent skepticism of climate change, the US media's persistent coverage of skeptical opinion, and the divergence between US and international public opinion. The paper thus contributes to a large literature, mostly outside of economics, on the communication of scientific findings to the public (Mazur 1973; Check 1987; Limoges 1993; Dearing 1995; Boykoff and Boykoff 2004), and on the role of expert communities in environmental policy (Haas 1989, 2000; Toke 1999).[2]

The paper also contributes to the large literature in economics on special interests. Most economic models of special interests' influence on public policy treat the expenditure of resources to influence voter beliefs and information implicitly, either as part of a reduced-form function relating expenditures to votes or influence or as a motivation for politicians to seek campaign resources from interest groups (e.g., Stigler

[2]Most formal models of policy expertise focus on agency frictions that arise when policymaking is delegated to an informed actor such as a bureaucrat or committee (e.g., Gilligan and Krehbiel 1987; Callander 2008).

1971; Peltzman 1976; Becker 1983; Grossman and Helpman 1994). An important exception is Yu (2005), who models influence on voter belief formation but does not explicitly incorporate media institutions.[3] In contrast to Strömberg (2004) and Dyck et al. (2013), in my model mass media need not dampen the policy influence of special interests. And in contrast to Sobbrio (2011), my model allows for special interest competition to improve as well as to worsen the communication of information to voters.[4] By allowing for both positive and negative aspects of special interest competition, my model makes clear when such competition will benefit the voter, and illustrates the effects of media content regulation on public policy.

Finally, the paper contributes to the economics of the mass media by providing a model in which norms of balanced reporting arise endogenously due to reputational concerns.[5] In the model, an unopinionated media outlet facilitates obfuscation by special interests despite receiving no direct transfers from interest groups (as in Petrova 2012) and having no indirect incentives to support the group's interests (as in Germano and Meier 2013). The paper thus contributes a formal economic model to a large sociological literature on the origins of objectivity as a professional norm in journalism (Tuchman 1972; Schudson 2001).

The remainder of the paper is organized as follows. Section 2 motivates the model with a discussion of case evidence. Section 3 defines the model. Section 4 characterizes the equilibrium behavior of the interested parties, taking the journalist's reporting strategy as given. Section 5 endogenizes the reporting strategy of the journalist in a model with reputation. Section 6 applies the model to climate change and other scientific topics of public importance. Section 7 concludes.

2 Background

2.1 How Special Interests Influence the News

It is common for special interests who wish to affect public perception of a scientific issue to recruit sympathetic experts and to make these experts accessible to the news media.

A leaked 1998 memo by a public relations representative of the American Petroleum Institute outlined a "Global Climate Science Communications Plan" that would "identify, recruit and train a team of five independent scientists to participate in media outreach," "conduct briefings by media-trained scientists for science writers in the top 20 media markets," and "distribute a steady stream of climate science information

[3] Stone (2011) models interest groups' strategic choice of both research and lobbying activity, though in a model without a media actor.

[4] The finding that competition among special interests can be socially productive relates broadly to theories of advocacy and expertise (e.g., Dewatripont and Tirole 1999; Krishna and Morgan 2001) and to the literature on the effect of political competition on voter information (e.g., Heidhues and Lagerlöf 2003; Murphy and Shleifer 2004; Glaeser 2005).

[5] Morris (2001), Ottaviani and Sørensen (2006) and Gentzkow and Shapiro (2006) also show that reputational concerns can inhibit the transmission of information by an informed party.

via facsimile and e-mail to science writers around the country." A proposed "Global Climate Science Data Center" would be used for "identifying and establishing cooperative relationships with all major scientists whose research in this field supports our position" and "responding to claims from the scientific alarmists and the media." The plan proposed a budget and concrete metrics of success including "the percent of media articles that raise questions about climate science" (Walker 1998; see also Cushman 1998).

The tactics outlined in the Global Climate Science Communications Plan are used routinely by special interests who want to affect public perception of a scientific issue (Oreskes and Conway 2010). For example, in the face of rising concern in the 1980s over the health effects of secondhand smoke, the industry-funded Tobacco Institute formed the "Scientific Witness Team," a group of scientific consultants whose "businesses are to market their scientific expertise" (Drope and Chapman 2001). These consultants formed part of a larger group of affiliated experts, including 14 academics, who were expected to conduct media tours, "appear on television and radio talk shows–often in debate formats," and "assist the industry in responding to media reports by preparing critiques of adverse research" (Tobacco Institute 1988).

The US press has devoted significant attention to the views of climate-change skeptics, even though nearly all active climate researchers accept the core tenets of the IPCC consensus (Oreskes 2004; Doran and Zimmerman 2009; Anderegg et al. 2010). From 2000 to 2010, two of the most prominent skeptics—Frederick Seitz and S. Fred Singer—were cited in the top 10 US newspapers 31 percent as often as the most-cited scientific advocate for anthropogenic climate change (Grundmann and Scott 2012).[6] Seitz was a prominent signatory to the "Leipzig Declaration," which stated that "there does not exist today a general scientific consensus about the importance of greenhouse warming from rising levels of carbon dioxide" (Science and Environmental Policy Project 1995). Singer testified to a Senate panel that there is "no appreciable climate warming" (Singer 2000).[7]

It is difficult for the press and public to dismiss climate-change skeptics' views out of hand. Seitz was a former president of the National Academy of Sciences and a highly respected solid-state physicist.[8] Singer is an atmospheric physicist who served as the first director of the US Satellite Weather Service. Some commentators have accused skeptics of having ulterior motives (e.g., Begley 2007; Oreskes and Conway 2010). But accusations of bias run both ways: Skeptics contend that government-funded organizations like

[6] As recently as 2009-10, 34 percent of climate-change articles in the *New York Times* or *Wall Street Journal* included a skeptical voice on climate change (Painter and Ashe 2012).

[7] Singer is also a lead co-author of the 868-page Nongovernmental International Panel on Climate Change (NIPCC) assessment report, which states that "natural causes are very likely to be the dominant cause" of any climate change (Idso and Singer 2009).

[8] A later petition with similar themes to the Leipzig Declaration was circulated under a cover letter written by Seitz. The petition was accompanied by an article typeset in the style of the *Proceedings of the National Academy of Sciences*. This prompted a letter from the then-president of the National Academy of Sciences dissociating the academy from the article and petition (National Academy of Sciences Council 1998).

the IPCC exaggerate the risks of climate change because they have an interest in increasing the state's role in economic activity.[9]

Televised debates between skeptics and advocates contribute to an impression that key tenets of the IPCC consensus are in doubt. In November 2009, Singer debated (now Sir) Robert Watson, the chief scientific advisor at the UK's Department for Environment, Food and Rural Affairs, on a BBC Two program (BBC 2009). Both Singer and Watson have strong records of public service, speak calmly and sensibly, and look distinguished and serious. From the content of the debate, it is unclear how a lay viewer could tell that Watson speaks for the scientific consensus and Singer for a vocal minority.[10] Such ambiguity is common in televised debates on the subject.[11]

Press citations to skeptics also help to create the impression of ongoing scientific controversy. For example, a *Los Angeles Times* article in 1998 that cited Singer was titled "1997 ranks as warmest year of the century. New figures raise concerns about risks of global heating. Some remain skeptical of phenomenon" (Gerstenzang 1998). Singer was similarly cited in a *New York Times* article about a new geological study attributing global warming to human activity (Revkin 2000), and a *Philadelphia Inquirer* article about evidence that recent climatic changes are very unusual in long-term perspective (Toner 2006). Quantitative content studies by Boykoff and Boykoff (2004) and Boykoff (2007) find that such "balanced" treatment was the norm in the US press until the mid-2000s.

[9]The NIPCC states that "Because we do not work for any governments, we are not biased toward the assumption that greater government activity is necessary" (NIPCC 2011). In a 1996 Op-ed in the *Wall Street Journal*, Seitz accused the IPCC of releasing a report that had been substantially altered after its content was approved by a panel of scientific contributors (Seitz 1996). In 2003, Singer wrote a letter to the editor of the journal *Science* accusing its editor of using "his Editorials inappropriately to advocate politically derived goals" (Singer 2003).

[10]Arguably, Singer gets the better of the encounter, scoring a point on the subject of the interdecadal variability in global temperatures predicted by climate change models:

> The models actually don't do that unless you train them to do this. These variations that my colleague here described were put in after the fact to explain why there was, for example, a cooling between 1940 and 1975...when people worried about the coming Ice Age. I was not among those.

At this point, the moderator changes the topic of discussion to the ClimateGate scandal, in which leaked e-mails from scientists at the University of East Anglia led some to accuse the scientists of deliberately withholding data from the public.

[11]In October 1997, CNN aired a Crossfire episode featuring Carol Browner, the Administrator of the US Environmental Protection Agency (Press and Sununu 1997). John Sununu, the show's co-host and a former Governor of New Hampshire, criticized Browner's stance in favor of then-President Clinton's proposed emissions policy:

> BROWNER: Why would you reject 2500 scientists who have no interest in the outcome of this, who say we are in fact, putting too much pollution in the air. That pollution will warm the earth's climate. It has begun to happen and we will feel consequences—irreversible consequences—if we fail to act. How can you walk away from 2500 renowned scientists?
>
> SUNUNU: Because there are 2500 on the other side.

Sununu was no stranger to this debate. As Chief of Staff under President George H. W. Bush, Sununu adopted a skeptical stance on policy remedies to climate change. In a *New York Times* opinion article called "Sununu vs. Scientists," Leslie Gelb criticized Sununu for ignoring the scientific consensus (Gelb 1991). In a Letter to the Editor, MIT Professor of Meteorology Richard S. Lindzen (1991) excoriated Gelb, noting that Sununu had a doctorate from MIT and saying "I can think of no previous White House chief of staff as capable of deeply understanding scientific issues." Lindzen went on to question the strength of the scientific consensus as portrayed by Gelb, and to call out a scientific inaccuracy in Gelb's article.

2.2 Rules and Norms of Balanced Reporting

Skeptics receive significant media coverage in part because of the journalistic principle of objectivity. This principle is enforced both by explicit regulation and by strongly held professional norms.

It is common for government regulators to mandate impartiality or fairness on the part of private broadcasters (Barendt 1993). In the UK, the Office of Competition's Broadcasting Codes require that news is "presented with due impartiality," meaning that "an appropriately wide range of significant views must be included and given due weight in each program or in clearly linked and timely programs" (Ofcom 2013). In the US, the so-called Fairness Doctrine held that "broadcast licensees have an affirmative duty generally to encourage and implement the broadcast of all sides of controversial public issues over their facilities" (Federal Communications Commission 1949). Although enforcement of the Fairness Doctrine ended in 1987, debate continues about its reinstatement (Ruane 2012).

When not imposed by regulation, objectivity is enforced by the professional norms of modern journalism. Although somewhat amorphous, in practice objectivity is interpreted as balance, i.e. giving "airtime" to all sides of an issue (Tuchman 1972).[12] Asked what objectivity means, a sample of US journalists rated "express[ing] fairly the position of each side" ahead of "not allow[ing] the journalist's own political beliefs to affect the presentation of the subject" (Donsbach and Klett 1993). Balance often goes surprisingly far: it was not until 1979 that the *New York Times* stopped routinely quoting Tobacco Industry representatives to provide the "other side" of the smoking-cancer link (Hoyt 2008).

Balanced reporting protects journalists from accusations of one-sidedness. Journalists often report claims they cannot verify directly. Quoting someone critical (or likely to be critical) of a given claim provides a routine way to avoid appearing to endorse the original claim (Tuchman 1972).[13] This is important because evidence of one-sided reporting, especially when it seems to favor an interest of the news organization, is extremely damaging reputationally. For example, the *New York Times* lost face over its reporting on the presence of weapons of mass destruction in Iraq when subsequent events revealed that quoted sources exaggerated the case for the presence of such weapons (Okrent 2004; The *Times* and Iraq 2004). This instance was especially costly because of the appearance that the *Times* had tilted its reporting in order

[12]The Code of Ethics of the Radio Television Digital News Association (RTDNA) calls upon journalists to "present a diversity of expressions, opinions, and ideas in context" (RTDNA 2013).

[13]Tuchman's (1972) seminal sociological account of objectivity in the newsroom offers the following abstract example. "A [Democratic] US senator may claim that America lags behind the Soviet Union in the development of a specific type of missile. A reporter certainly cannot check that claim in time to meet his deadline, and it is possible he could never locate adequate information with which to assess the extent to which the claim is a 'fact'...He can, however, write that the [Republican] secretary of defense stated [the charge is 'false']...Presenting both truth-claim 'A' attributed to the senator and truth-claim 'B' attributed to the secretary of defense, the newsman may then claim he is 'objective' because he has presented 'both sides of the story' without favoring either man or political party."

to retain access to administration sources (Foer 2004).

Objectivity was crystallized as the centerpiece of Anglo-American journalistic ethics in the 1920s, at the end of a long transition from explicit partisanship to political independence (Schudson 1978, 2001). Schudson (2001) argues that the objectivity norm arose in part in response to the rise of the public relations industry and other organized efforts to influence media coverage. With the private sector devoting substantial resources to manipulating the press, journalists felt it especially important to "assert their collective integrity" and to show that they did not pander to one side of an issue (Schudson 2001).

In the analysis that follows, I consider the effects of exogenously imposed rules of balanced reporting, and I show formally how balanced reporting can arise endogenously from reputational incentives.

3 Model

I model an environment in which a pair of interested parties wish to affect a voter's policy choice by influencing the voter's belief about a binary state of the world. There is a population of informed, disinterested experts and a journalist who reports on expert opinion to the voter. The journalist may be opinionated (aligned with one of the parties) or may be unopinionated.

The game proceeds as follows. Nature determines the policy-relevant state, the opinions of the experts, and the journalist's type. The interested parties observe the distribution of expert opinion and choose whether to invest in acquiring an affiliated expert. The journalist learns the opinion of a random expert and may seek a rejoinder from an affiliated expert. The journalist then makes a report to the voter. The voter chooses a policy, payoffs are realized, and the game ends.

Formally the state of the world is $\omega \in \{0,1\}$ with $\Pr(\omega = 1) = \frac{1}{2}$. A journalist sends a message m to a voter who does not know ω and who chooses a policy $a \in [0,1]$ after observing m. After making her policy choice the voter learns the true state and suffers a loss given by

$$L(a,\omega) = (a-\omega)^2 \tag{1}$$

Each of two interested parties, denoted 0 and 1, then receives a payoff that depends on the voter's policy choice. Party j has ideal policy $a = j$ and obtains a bounty equal to $aj + (1-a)(1-j)$.

There is a unit mass of experts. Each expert forms a binary opinion. With probability $(2\gamma - 1)$ all experts form opinion ω. With probability $2(1-\gamma)$ experts are evenly divided, with half forming opinion 0 and half forming opinion 1. The unconditional probability that a randomly chosen expert has a correct opinion is $\gamma \in \left(\frac{1}{2}, 1\right)$. Let $\sigma \in \left\{0, \frac{1}{2}, 1\right\}$ denote the realized share of experts with opinion 1.

The parameter γ measures the amenability of the topic to empirical science. When γ is high, data are likely to be decisive, and experts are likely to be unanimous. When γ is low, data are likely to be indecisive, and experts are likely to be divided, either because they observe some data privately or because they have differing interpretations of public data.

After observing the distribution σ of expert opinion, each party decides whether to hire an affiliated expert.[14] A given expert may affiliate with either party, but pays a professional cost that is (strictly) increasing and convex in the share of other experts who disagree with the party's position, and equal to zero when all experts agree with the party's position. The party must compensate an affiliated expert for this professional cost.

We can define constants $0 < \underline{c} < \overline{c}$ such that the cost to party j of hiring an affiliate is $\overline{c}$ if $\sigma = 1 - j$, $\underline{c}/2$ if $\sigma = \frac{1}{2}$, and 0 if $\sigma = j$. The parameter $\overline{c}$ measures the strength of ethical norms in the relevant expert community, which in turn determine the professional cost borne by an expert who stands against the scientific consensus.[15] The parameters $\underline{c}$ and $\overline{c}$ can also be thought of as (inverse) measures of the policy stakes: scaling each party's bounty by some constant $v > 0$ is equivalent to scaling the costs $\underline{c}$ and $\overline{c}$ by $1/v$.

The journalist solicits the opinion s of a randomly chosen expert. The journalist then chooses whether to report $m = s$ or to contact the opposition party $1 - s$ for a rejoinder. In the latter case, if the party has no affiliated expert, the rejoinder is "no comment" and the journalist reports $m = s$. If instead the party has an affiliated expert, the affiliated expert gives her opinion and the journalist reports the unordered set $m = \{s, 1-s\}$, which I abbreviate as $m = \frac{1}{2}$.

With probability $\lambda < 1$ the journalist is an opinionated type concerned about persuading the voter. This type's payoff is equally likely to be a or $1 - a$. With probability $1 - \lambda$, the journalist is an unopinionated type concerned about her reputation for honesty. Motivated by the sociological literature I discuss above, I assume that the unopinionated type's payoff is a strictly decreasing function of $\hat{\lambda}(m)$, where $\hat{\lambda}(m)$ is the posterior probability that the voter assigns to the event that the journalist is opinionated, conditional on observing message m.[16] I will think of λ as small.

[14] The assumption that parties make their investment decisions after observing σ is reasonable in light of the narrative evidence in the cases I discuss above. Tobacco industry representatives, for example, conducted extensive reviews of scientists' research prior to choosing potential affiliates (Michaels 2008).

[15] The parameter $\overline{c}$ can also be thought of as a measure of voter sophistication. Consider an alternative microfoundation in which a party opposed to the consensus cannot affiliate any experts but can pay a resource cost $\overline{c}$ to groom a non-expert to appear like an expert. This might involve, for example, creating an institute headed by the non-expert, funding the non-expert's participation in scientific conferences, etc. If such tactics are harder to employ against a sophisticated voter, then $\overline{c}$ naturally increases with the voter's sophistication.

[16] Following Morris (2001), we may motivate this payoff by imagining a second round of play in which the journalist observes a random expert's opinion and makes a cheap-talk report. An opinionated journalist's report in such a round will be uninformative, so if the unopinionated journalist has a commercial motivation to increase the expected value of her report, she will wish to behave in the first round so as to minimize the voter's assessment that she is opinionated.

After the voter observes the message m, the voter updates her beliefs about the journalist's type and the journalist realizes her reputational payoff. The voter then chooses a policy a, and party j obtains profits equal to its bounty net of the cost (if any) paid to its affiliated expert. Finally, the voter realizes loss $L(a,\omega)$ as a function of the state ω and her action a.

I will use Perfect Bayesian Equilibrium as a solution concept. An equilibrium is a set of voter beliefs, voter strategies, and party strategies such that (i) voter beliefs given message m are consistent with Bayes' Rule for any message m observed with positive probability on the equilibrium path, (ii) the voter chooses her action to minimize her expected loss for any m given her beliefs, (iii) each type of journalist maximizes its expected payoff given the observed s and the strategies of the voter and interested parties, and (iv) each party maximizes its expected profits given the observed σ and the strategies of the voter and journalists.

I will sometimes restrict attention to symmetric equilibria. A symmetric equilibrium is one in which the action of party j depends only on the share of experts $\sigma j + (1-\sigma)(1-j)$ whose opinions align with the party's position and not on the party's identity.

Because of the quadratic form of the voter's loss function, the voter's optimal action $a(m)$ given message m is given by $a(m) = \mathrm{E}(\omega|m)$ for any m with positive probability on the equilibrium path. For m with zero probability, any $a(m) \in [0,1]$ is optimal. I will treat $a(m)$ as a description of both the voter's beliefs and her actions.

I will treat the *ex ante* expected loss $\mathrm{E}(L(a,\omega))$ as a measure of the informativeness of an equilibrium. A voter who will learn only her prior has $\mathrm{E}(L(a,\omega)) = \frac{1}{4}$. A voter who will learn the true state has $\mathrm{E}(L(a,\omega)) = 0$. A voter who will learn the distribution σ of expert opinion has $\mathrm{E}(L(a,\omega)) = \frac{1}{2}(1-\gamma) \in \left(0, \frac{1}{4}\right)$.

4 Equilibrium under Balanced and Unbalanced Reporting

4.1 Equilibrium under Balanced Reporting

Suppose that the journalist always contacts the opposition party, a case I will call *balanced reporting*. In section 5 below, I show that balanced reporting arises endogenously in the model. For now we may imagine that balanced reporting is imposed exogenously by a regulation such as the Fairness Doctrine or Impartiality Rule.[17]

Under balanced reporting, if $\sigma = 0$, then party 1 is willing to invest if $a\left(\frac{1}{2}\right) - a(0) \geq \overline{c}$. If $\sigma = \frac{1}{2}$, then

[17] To fit this case formally into the model, suppose that $\lambda = 0$, so that voter beliefs $\hat{\lambda}(m) = 0$ for all m are trivially consistent with Bayes' Rule and with any reporting strategy of the journalist.

party 1 is willing to invest if $a\left(\frac{1}{2}\right) - a(0) \geq \underline{c}$. Party 0's incentives are analogous.

It is instructive to characterize the set of symmetric equilibria in pure strategies. If the parties invest if and only if $\sigma = \frac{1}{2}$, then $m = \sigma$, $a(m) = m$, and $\mathrm{E}(L(a,\omega)) = \frac{1}{2}(1-\gamma)$. Such a *separating* equilibrium exists if and only if $\overline{c} \geq \frac{1}{2} \geq \underline{c}$. No equilibrium can be more informative than a separating equilibrium, because a separating equilibrium reveals σ to the voter.

If the parties do not invest at all, then $a(1) = \gamma = 1 - a(0)$ and $\mathrm{E}(L(a,\omega)) = \gamma(1-\gamma)$. In order for the parties to be willing not to invest, it must be that $\underline{c} \geq \gamma - \min\left\{a\left(\frac{1}{2}\right), 1 - a\left(\frac{1}{2}\right)\right\}$. Such a *no-investment* equilibrium exists if and only if $\underline{c} \geq \gamma - \frac{1}{2}$. A no-investment equilibrium is less informative than a separating equilibrium.

If the parties invest regardless of σ, then $m = \frac{1}{2}$ with probability 1, $a\left(\frac{1}{2}\right) = \frac{1}{2}$, and $\mathrm{E}(L(a,\omega)) = \frac{1}{4}$. In order for the interested parties to be willing to invest, it must be that $\min\left\{a(1) - \frac{1}{2}, \frac{1}{2} - a(0)\right\} \geq \overline{c}$. Such a *full-investment* equilibrium exists if and only if $\overline{c} \leq \frac{1}{2}$. A full-investment equilibrium is uninformative.

One of these three types of equilibria always exists, and these three are exhaustive of the possible types of symmetric equilibria in pure strategies.[18] To summarize:

Proposition 1. *Under balanced reporting, an equilibrium exists. There exists a separating equilibrium if and only if* $\overline{c} \geq \frac{1}{2} \geq \underline{c}$*, a no-investment equilibrium if and only if* $\underline{c} \geq \gamma - \frac{1}{2}$*, and a full-investment equilibrium if and only if* $\overline{c} \leq \frac{1}{2}$.

Figure 1 summarizes the comparative statics implied by proposition 1.[19] The figure plots the informativeness of the most informative symmetric equilibrium in pure strategies as a function of the parameters $\overline{c}$, $\underline{c}$, and γ.

As panel A of figure 1 illustrates, the strategic behavior of special interests can be socially productive. When $\overline{c}$ is high and $\underline{c}$ is low, there is an equilibrium in which the voter learns σ with certainty. In practice, such a case is most likely to arise when (i) the stakes are low or moderate and (ii) a strong professional norm makes it difficult for experts to speak out against a consensus view. This is the typical case: most scientific findings (e.g., a comet has struck the sun) are reported uncontroversially in the press.

Importantly, though, as panel B of figure 1 illustrates, the strategic behavior of special interests can also be counterproductive. When $\overline{c} < \frac{1}{2}$ and $\underline{c} < \gamma - \frac{1}{2}$, the parties invest regardless of σ, so the voter learns nothing.

[18] The assumption that $\overline{c} > \underline{c}$ rules out the possibility of an equilibrium in which parties invest when $\sigma \in \{0,1\}$ but not when $\sigma = \frac{1}{2}$.

[19] In the online appendix, I document the robustness of these comparative statics by showing that the informativeness of equilibria in pure strategies is, in the strong set order, increasing in $\overline{c}$, increasing in $\underline{c}$ for $\overline{c} \leq \frac{1}{2}$, and decreasing in $\underline{c}$ for $\overline{c} > \frac{1}{2}$.

The condition that $\overline{c} < \frac{1}{2}$ is intuitive; more surprising is the condition that $\underline{c} < \gamma - \frac{1}{2}$, which means that a higher γ can make voters less informed despite making experts more informed. The reason is that when γ is large, an uncontested report of $m = 0$ or $m = 1$ is highly informative to the voter, creating a strong incentive for the parties to invest.

The result that informative reporting collapses when $\overline{c} < \frac{1}{2}$ and $\underline{c} < \gamma - \frac{1}{2}$ holds when we consider the full set of equilibria. This is established in the following proposition, whose proof illustrates the economic intuition I have sketched:

Proposition 2. *Under balanced reporting there exists an informative equilibrium if and only if* $\overline{c} \geq \frac{1}{2}$ *or* $\underline{c} \geq \gamma - \frac{1}{2}$.

Proof. The "if" direction is implied by proposition 1. To prove the "only if" direction, observe first that optimization by the parties implies that any party j is at least as likely to invest if $\sigma = \frac{1}{2}$ as it is if $\sigma = 1 - j$. Together with Bayes' Rule, this optimization condition implies that if message $m = 1$ is on the equilibrium path, then $a(1) \geq \gamma$, and symmetrically for message $m = 0$.

Now pick $\overline{c} < \frac{1}{2}$ and $\underline{c} < \gamma - \frac{1}{2}$ and consider that in an informative equilibrium at least one of $m = 1$ or $m = 0$ must occur on the equilibrium path. If only one of these messages occurs, say $m = 1$, then party 1 must invest with certainty, so by Bayes' Rule $a\left(\frac{1}{2}\right) \leq \frac{1}{2}$. Because $a(1) - a\left(\frac{1}{2}\right) \geq \gamma - \frac{1}{2} > \underline{c}$, party 0 invests with certainty when $\sigma = \frac{1}{2}$. But then $a(1) = 1$, so that party 0 invests with certainty when $\sigma = 1$, implying the contradiction that $m = 1$ is not observed. If both $m = 1$ and $m = 0$ occur on the equilibrium path, then either $a\left(\frac{1}{2}\right) \leq \frac{1}{2}$ or $a\left(\frac{1}{2}\right) \geq \frac{1}{2}$; say it is the former. Then party 0 will invest with certainty when $\sigma = \frac{1}{2}$; following the logic above this implies that the party will also invest with certainty when $\sigma = 1$ and hence that $m = 1$ is not observed in equilibrium. □

The finding that communication is least informative when $\overline{c} < \frac{1}{2}$ and $\underline{c} < \gamma - \frac{1}{2}$ provides a lens through which to understand persistent public ignorance on climate change. The large economic stakes attached to environmental policies (e.g., carbon taxes) lead to low $\overline{c}$ and $\underline{c}$. The fact that data are likely to be dispositive on at least some key elements of climate science (e.g., whether the earth has gotten warmer in recent decades) means that uncontested news reports of scientific conclusions contain a lot of information. Together, these features create a strong incentive for special interests to place credentialed advocates in the media.

Note that the collapse of informative communication hinges critically on competition among the two interested parties. To see this, consider a benchmark in which there is a single interested party, say party 0. If party 0 does not invest, then message $m = \frac{1}{2}$ is off the equilibrium path. Setting $a\left(\frac{1}{2}\right) = a(1)$ means that there will be no incentive for party 0 to invest regardless of the costs $\overline{c}$ and $\underline{c}$, even though a (hypothetical)

party 1 would want to invest for sufficiently low cost $\underline{c}$. Therefore there is always an equilibrium with no investment. To summarize:

Proposition 3. *With a single interested party, there always exists an informative equilibrium.*

4.2 Equilibrium under Unbalanced Reporting

Suppose now that the journalist does not contact the opposition party, a case I will call *unbalanced reporting*. Then the interested parties do not invest, so $m = s$, and by Bayes' Rule, $a(1) = \gamma = 1 - a(0)$ and $\mathrm{E}(L(a,\omega)) = \gamma(1-\gamma)$. The following is then immediate from proposition 2:

Corollary 4. *If $\overline{c} < \frac{1}{2}$ and $\underline{c} < \gamma - \frac{1}{2}$, then equilibrium under unbalanced reporting is more informative than equilibrium under balanced reporting.*

Consistent with corollary 4, many analysts (e.g., Check 1987; Russell 2010) have argued that traditional standards of balance are inappropriate for scientific journalism, where (with γ being high) there should be no presumption that issues have two legitimate sides.

Arguments in this spirit have surfaced in recent media policy debates. Partly due to criticism of the BBC's coverage of climate change and other scientific topics (Jones 2011), the BBC's 2010 Editorial Guidelines were revised to clarify that "minority views should not necessarily be given equal weight to the prevailing consensus" (Lyons 2010).[20]

A possible reason to preserve rules requiring balance, despite the logic of corollary 4, is that such standards prevent broadcasts from being captive to the opinion of the broadcaster.[21]

The model shows, however, that even overtly partisan journalism can be more informative than balanced journalism. To see this, define *partisan journalism* to mean that the journalist has payoff a (and that this is common knowledge). Under partisan journalism, party 0 will never invest. The reason is that if $a(1) > a\left(\frac{1}{2}\right)$, a necessary condition for investment, then the journalist will not contact the opposition when $s = 1$. Since $m = \frac{1}{2}$ must then mean that $s = 0$, the voter can infer the value of s in any equilibrium, so that any equilibrium must be at least as informative as one in which the voter learns s directly:

Proposition 5. *Any equilibrium under partisan journalism is at least as informative as a no-investment equilibrium.*

[20] The 2005 guidelines called for a "commitment to impartiality," meaning that the BBC would "strive to reflect a wide range of opinion and explore a range and conflict of views" (Thompson 2005).

[21] Indeed, the UK's Broadcasting Codes explicitly require that "programs...must exclude all expressions of the views and opinions of the person providing the service" (Ofcom 2013).

An immediate corollary of propositions 2 and 5 is that:

Corollary 6. *If $\overline{c} < \frac{1}{2}$ and $\underline{c} < \gamma - \frac{1}{2}$, then any equilibrium under partisan journalism is more informative than equilibrium under balanced reporting.*

It is also straightforward to show that an equilibrium always exists under partisan journalism.[22]

These results follow from simple economics. A partisan journalist will always want to present the strongest possible case for her side, so if the random expert supports the journalist's position, there is no value in providing the opposition an opportunity to supply an affiliate. Hence the voter learns the random expert's opinion directly whenever that opinion is favored by the journalist. But voter rationality says more than this: if the journalist does bring on an opposing expert, the correct inference is that the random expert must have disagreed with the journalist's preferred position. The voter therefore learns the random expert's opinion even when the journalist would like to conceal it.

These predictions match up well with data on the presentation of climate change advocates and skeptics on cable news networks in the US. The Fox Cable News Network, which is widely perceived as aligned with the American political right, was far more likely to present balanced broadcasts (with equal numbers of advocates and skeptics) than was MSNBC, which is widely perceived as aligned with the left (Feldman et al. 2012). Were the broadcasts reversed, with MSNBC presenting more balance than Fox, it would be reasonable to infer that the scientific data favored the right's position rather than the left's. In this sense, partisan cable news networks have arguably been more informative on climate change than prestige print media. Imposing a rule requiring a balance of views could easily reduce the information conveyed by the cable networks.

Importantly, the arguments above do not presuppose any political pluralism in the media: partisanship may be preferable to balance even if the news media contain advocates for only one side of an issue. Note also that these arguments do not even require common knowledge of the journalist's opinion. In particular, suppose that it is commonly known that the journalist is opinionated but that nature draws either payoff a or payoff $1-a$ with some probability. The probability is commonly known but the payoff realization is known only to the journalist. Then it is straightforward to show that equilibrium is more informative than under balanced reporting when $\overline{c} < \frac{1}{2}$ and $\underline{c} < \gamma - \frac{1}{2}$.[23]

[22] For example, an informative equilibrium exists in which the parties do not invest and the journalist never calls the opposition.

[23] In an uninformative equilibrium, both parties invest with certainty and the journalist always seeks opposition comment. The parties' investment conditions then imply that $a(1) > a\left(\frac{1}{2}\right) > a(0)$, which means that for any journalist payoff there exists some realization of the random expert's opinion s such that the journalist does not seek opposition comment. Therefore in any equilibrium $m = s$ with positive probability. What remains is to prove existence, which follows by construction: an informative equilibrium exists in which the parties do not invest and the journalist never calls the opposition.

The arguments in this section show that partisan media may be preferable to a mandate of balance. This case for partisan media is especially strong on issues such as climate change where high stakes make it likely that special interests will find credentialed advocates for any position, regardless of its scientific merit. The case for partisan media is weaker on issues for which advocates will be found only when the scientific consensus is shaky, in which case the separating equilibrium in proposition 1 shows that balanced reporting can be highly socially productive. Taken together these results suggest that the voter may learn the most from a media market consisting of some outlets pursuing partisan agendas and others pursuing balance.

5 Endogenous Reporting Norms

In this section I complete the analysis of the model by showing how balanced reporting arises endogenously from reputational concerns. Formally, I consider the case of $\lambda \in (0,1)$ and I define balanced reporting to mean that the unopinionated journalist calls the opposition.

I first show, constructively, that an equilibrium with balanced reporting exists. Consider the incentive of the unopinionated journalist to call the opposition. If no party invests, this incentive is satisfied trivially as the journalist's reporting strategy does not affect the message m. If both parties invest with positive probability, then $a(1) > a\left(\frac{1}{2}\right) > a(0)$, so the opinionated journalist will call the opposition if and only if she disagrees with the signal s. It follows that message $m = \frac{1}{2}$ is evidence that the journalist is unopinionated, i.e. that $\hat{\lambda}\left(\frac{1}{2}\right) < \lambda < \hat{\lambda}(0), \hat{\lambda}(1)$, and hence that the unopinionated journalist wishes to call the opposition.[24]

It remains to be shown that balanced reporting is consistent with equilibrium investment behavior by the parties. I provide conditions for symmetric equilibria in pure strategies that mirror those in section 4.1, accounting now for the fact that the opinionated journalist calls the opposition only when she disagrees with the signal s.

In a separating equilibrium the parties invest if and only if $\sigma = \frac{1}{2}$. Then if the journalist is unopinionated $m = \sigma$, but if the journalist is opinionated message $m \in \{0,1\}$ is possible even if $\sigma = \frac{1}{2}$. By symmetry $a\left(\frac{1}{2}\right) = \frac{1}{2}$. By Bayes' Rule, $a(1) = 1 - \varepsilon(\lambda) = 1 - a(0)$ where $\varepsilon(\lambda)$ is a function, continuous and strictly increasing in λ, with $\varepsilon(0) = 0$ and $\varepsilon(\lambda) \in (0, 1-\gamma)$ for $\lambda > 0$. Such an equilibrium exists if and only if $\bar{c} \geq \left(1 - \frac{1}{2}\lambda\right)\left(\frac{1}{2} - \varepsilon(\lambda)\right) \geq \underline{c}$. The voter's expected loss is continuous and strictly increasing in λ with $\mathrm{E}(L(a,\omega)) < \frac{1}{4}$ for $\lambda = 1$ and $\lim_{\lambda \to 0} \mathrm{E}(L(a,\omega)) = \frac{1}{2}(1-\gamma)$.

[24] A similar argument applies if only a single party j invests with positive probability. In this case party j must strictly prefer policy $a\left(\frac{1}{2}\right)$ to policy $a(1-j)$. Therefore an opinionated journalist receiving signal $s = 1-j$ will call the opposition if and only if she agrees with party j. It follows that $\hat{\lambda}\left(\frac{1}{2}\right) < \hat{\lambda}(1-j)$. Therefore the unopinionated journalist is willing to call the opposition after receiving signal $s = 1-j$. (The incentive of the journalist is trivial if she receives signal $s = j$ as the reporting strategy does not affect the message m in this case.)

In a no-investment equilibrium $a(1) = \gamma = 1 - a(0)$ and message $m = \frac{1}{2}$ is off the equilibrium path. Such an equilibrium exists if and only if $\underline{c} \geq (1-\lambda)\left(\gamma - \frac{1}{2}\right)$. The voter's expected loss is $\mathrm{E}(L(a,\omega)) = \gamma(1-\gamma)$.

In a full-investment equilibrium $a(1) = \gamma = 1 - a(0)$ and $a\left(\frac{1}{2}\right) = \frac{1}{2}$. Such an equilibrium exists if and only if $\left(1 - \frac{1}{2}\lambda\right)\left(\gamma - \frac{1}{2}\right) \geq \overline{c}$. The voter's expected loss $\mathrm{E}(L(a,\omega)) > \gamma(1-\gamma)$ is continuous and strictly decreasing in λ with $\lim_{\lambda \to 0} \mathrm{E}(L(a,\omega)) = \frac{1}{4}$.

To complete the proof of existence I show in the appendix that an equilibrium in which the parties invest when $\sigma = \frac{1}{2}$ and mix when $\sigma \in \{0,1\}$ exists if and only if $\left(1 - \frac{1}{2}\lambda\right)\left(\frac{1}{2} - \varepsilon(\lambda)\right) \geq \overline{c} \geq \left(1 - \frac{1}{2}\lambda\right)\left(\gamma - \frac{1}{2}\right)$.

To summarize:

Proposition 7. *An equilibrium with balanced reporting exists. Under balanced reporting there exists a separating equilibrium if and only if* $\overline{c} \geq \left(1 - \frac{1}{2}\lambda\right)\left(\frac{1}{2} - \varepsilon(\lambda)\right) \geq \underline{c}$*, a no-investment equilibrium if and only if* $\underline{c} \geq (1-\lambda)\left(\gamma - \frac{1}{2}\right)$*, and a full-investment equilibrium if and only if* $\overline{c} \leq \left(1 - \frac{1}{2}\lambda\right)\left(\gamma - \frac{1}{2}\right)$.

Turning to comparative statics, note that the existence of the opinionated journalist makes even a full-investment equilibrium informative. However, the information content of the equilibrium vanishes as λ approaches zero.

Say that the equilibria for some $\overline{c}$, $\underline{c}$, and γ are *robustly informative* if the informativeness of the most informative equilibrium is bounded away from that of an uninformative equilibrium as λ approaches 0. The results above establish that equilibria are robustly informative if $\overline{c} \geq \frac{1}{2}$ or $\underline{c} \geq \gamma - \frac{1}{2}$. In fact, these conditions are necessary: if either fails, then for small λ the only equilibria have approximately full investment and are therefore almost uninformative. This is summarized in the following proposition, whose proof is in the appendix:

Proposition 8. *Under balanced reporting, equilibria are robustly informative if and only if* $\overline{c} \geq \frac{1}{2}$ *or* $\underline{c} \geq \gamma - \frac{1}{2}$.

Propositions 7 and 8 close the model by showing that arbitrarily uninformative reports can emerge in equilibrium when journalists have a desire to appear objective, even with no exogenous requirement of fair reporting. The idea that a journalist might use balanced reporting to prove to her reader that she is impartial resonates with the sociological literature that I summarize in section 2.2 above.

The model can also be reconciled with evidence, discussed in greater detail below, that norms of journalism vary significantly across countries (Donsbach and Klett 1993). In the model, there is always an equilibrium in which the unopinionated journalist does not call the opposition. The reason is that the parties will not invest if the journalist will not call them, and the journalist will have no incentive to call if

the parties will always say "no comment."[25] This interdependence between journalistic norms and special interest activity is consonant with Schudson's (2001) observation that the objectivity norm in US journalism emerged in the early twentieth century alongside a growing public relations industry and hence a rise in public concern about media capture.[26]

Robustness: Richer Message Space

In the model I have analyzed, a journalist who finds that the opposition has its own expert must report $m = \frac{1}{2}$, a message that obscures the original signal s of the random expert. The message space therefore somewhat artificially prevents the journalist from reporting everything she knows to the voter.

Even with a richer message space, reputational incentives can induce the unopinionated journalist to make an uninformative report. To see this, suppose that all journalists must call the opposition party. A journalist who finds that the opposition party has no expert must report $m = s$, but a journalist who finds that the opposition party does have an expert may report either $m = \frac{1}{2}$ or $m = (s, 1-s)$. The latter report reveals the random expert's opinion directly to the voter.

I show in the appendix that if an equilibrium exists in the baseline game in which the unopinionated journalist makes an uninformative report, such an equilibrium exists in this alternative game as well. The intuition is that, as in the baseline model, a report of $m = \frac{1}{2}$ allows the unopinionated journalist to communicate to the voter that she is unopinionated, because the opinionated journalist wishes to report $m = (s, 1-s)$ whenever she agrees with the opinion s.

6 Evidence on Public Opinion

In this section I use public opinion data to test the model's implication that voter ignorance on climate change is due to a failure of the media to inform the public of an expert consensus, and that this failure is in turn due to journalistic norms of objectivity. I also relate the model to two other prominent cases of public scientific controversy.

The model implies that when there are large policy stakes and a high likelihood of scientific consensus, as in the case of climate change, media reports will fail to inform news consumers of an expert consensus. Consistent with this prediction, figure 2 shows that after a period of growing acceptance of climate change

[25] More formally, if no type of journalist calls the opposition and no party invests, then no player has an incentive to deviate: neither investment by the parties nor a change in reporting strategy would affect the message delivered to the voter.

[26] "[J]ournalists...sought to disaffiliate from the public relations specialists and propagandists who were suddenly all around them" (Schudson 2001).

in the 1990s, the US public's beliefs largely stopped converging towards those of experts in the 2000s. This is true despite a broad trend of growing media attention to climate change (Boykoff 2011; Grundmann and Scott 2012), and despite no overall trend in factual knowledge of science (National Science Board 2010). The public remains skeptical both of the existence of climate change and of the existence of an expert consensus on the subject.[27]

Tables 1 and 2 provide a more direct test of the model's prediction, by comparing the climate change beliefs of more or less intensive news consumers. Strikingly, those who read a newspaper daily are only slightly (and statistically insignificantly) more likely to report that there is "solid evidence that the earth has been getting warmer." I show in the online appendix that this is true for Republicans, Democrats, and Independents, indicating that it does not represent a partisan bias in the processing of information.

If, as in the model, the media are uninformative because press accounts entertain skeptical positions, then the evidence should show that media are informative on questions for which there is no meaningful controversy. Tables 1 and 2 show that this is indeed the case: those who consume more news consistently know more about bland factual matters. For example, those who read a newspaper daily are 18 percentage points more likely to know the majority party in the US House than those who do not, and those who follow the news closely are 22 percentage points more likely to know that fracking is a process for extracting natural gas than those who do not. The gap in factual knowledge is highly statistically significantly different from the corresponding gap in climate change beliefs.

The model implies that media would be more informative if journalistic norms permitted one-sided reporting. Variation in journalistic norms across countries affords a test of this prediction. Table 3 shows that US journalists are nearly twice as likely as their German counterparts to say that objectivity means "express[ing] fairly the position of each side in a political dispute."[28] Correspondingly, the German press gives far less attention than the US press to skeptical researchers when reporting on climate change, and the German public is far more accepting of anthropogenic climate change than is the US public.[29] The table shows that similar patterns hold across Italy and the UK, and figure 4 shows that there is a relationship between journalistic norms and climate change beliefs in an even broader set of countries.

One difficulty with interpreting the evidence I have presented is that citizens' beliefs about climate

[27] Few citizens believe there is a consensus position *against* global warming, but many believe that scientists remain divided on the topic. In a 2004 poll, for example, 52 percent of those expressing an opinion said that "scientists are divided on the existence of global warming and its impact" and 45 percent said that "there is a consensus among the great majority of scientists that global warming exists and could do significant damage." Only the small remaining share of respondents said that "there is a consensus...that global warming does not exist and therefore poses no significant threat" (Nisbet and Myers 2007).

[28] Among German journalists, the most common answer is that objectivity means "go[ing] beyond the statements of the contending sides to the hard facts of a political dispute."

[29] Indeed, as figure 3 shows, the US public is the least accepting of anthropogenic climate change among OECD countries.

change have much greater public consequences than personal consequences. Given the low personal stakes, stated beliefs may reflect deep ideological convictions rather than opinions of scientific fact (Prior 2007; Bullock et al. 2013). Similar patterns of media coverage and public opinion can be observed, however, in public health domains where citizens make consequential personal decisions based on their assessment of scientific evidence.

Consider, for example, the controversy over the connection between autism and measles, mumps, and rubella (MMR) vaccination in children. In 1998 UK-based physician Andrew Wakefield and collaborators published a study in *Lancet* about bowel disorders and developmental disorders in children. In a press conference held to announce the findings Wakefield said that a possible causal connection between MMR vaccine and autism meant that he could "not support the continued use" of the MMR vaccine (Mnookin 2012). Subsequent authoritative reviews of the medical evidence find no support for a connection between the MMR vaccine and autism (Institute of Medicine of the National Academies 2004; Demicheli et al. 2012), and Wakefield's study was eventually retracted (Dyer 2010).

There is an organized and energetic opposition to the scientific consensus on the MMR-autism link (Mnookin 2012),[30] and the media have devoted significant attention to non-consensus views. This is especially true in the UK, where nearly one-third of articles on the subject from 1998 to 2006 presented arguments both in favor of and against an MMR-autism link (Clarke 2008; see also Boyce 2006). The hypothesis of an MMR-autism link gained significant traction over this period, with 53 percent of British adults reporting that there is "equal evidence on both sides of the [MMR-autism] debate" (Lewis and Speers 2003).[31] More importantly, childhood MMR vaccine coverage fell significantly from 1998 to 2004 (Burgess et al. 2006). As figure 5 illustrates, this decline in coverage is not observed for other vaccines in the UK that were not the target of Wakefield's criticism. Unlike responses to public opinion surveys, childhood vaccination decisions have direct personal consequences: in 2012, measles cases in England and Wales reached their highest levels in decades (BBC 2013).

It is important to stress that the model does not predict persistent public ignorance on all issues. In the case of climate change, it is a combination of high policy stakes and a high likelihood of scientific consensus that leads to a breakdown of informative communication under balanced journalism. In practice, there are

[30] There are financial stakes. Wakefield's initial interest in the effects of the measles vaccine may have grown out of an attempt to sue vaccine manufacturers (Deer 2011). In the US, thousands of families have filed for compensation for harm done by the MMR vaccine (Sugarman 2007). However, in many cases the motivation for pursuing the case against vaccination seems to stem more from personal conviction than from financial self-interest (Mnookin 2012). This conviction has proved a powerful driver of public activism. Following an ethics ruling against Wakefield by the UK's General Medical Council (GMC), activist groups rallied behind Wakefield (Cox 2010; Dominus 2011), with one organization calling the events surrounding the GMC ruling a "vaccine-industry funded media circus" (Williams 2011).

[31] Dixon and Clarke (2012) present experimental evidence that reading a balanced news account of the MMR-autism link makes laboratory participants more uncertain about the link and more likely to believe that experts are divided.

important topics on which the scientific consensus has reached the public quickly and decisively. A famous example is the case of ozone depletion. In the early 1970s, evidence emerged that chlorofluorocarbons (CFCs) deplete atmospheric ozone (Dotto and Schiff 1978). Consumers of aerosol spray cans substituted rapidly to sprays using non-CFC propellants, and the US banned non-essential uses of CFCs before the decade's end (Dotto and Schiff 1978; Morisette 1989).

While there are many differences between ozone depletion and global warming, one that stands out in light of the model is that the economic stakes were far lower in the case of ozone depletion. Substitutes for CFCs were readily available for many purposes, and abatement costs were correspondingly small (Dotto and Schiff 1978; Palmer et al. 1980).[32] Consistent with this interpretation, although industrial producers of CFCs initially mounted an organized public relations campaign (Dotto and Schiff 1978), during the 1970s voices from academia and the government seem to have dominated those from industry (Anderson and Sarma 2002).

7 Conclusions

I model special interests' efforts to influence voter opinion through the news media. I find that special interests' activities can benefit the voter by revealing private information about the distribution of expert opinion, or harm the voter by obfuscating an expert consensus. The latter case arises when the economic stakes are large and the likelihood of an expert consensus is high. I show that obfuscation by special interests can be supported even by unbiased media with no material stake in the issue in question. I use the model to evaluate media content regulations and to explain persistent voter ignorance on climate change and other important scientific topics.

[32] Indeed, in the mid-1980s, DuPont publicly supported an international treaty restricting CFC production, a move that some interpret as a reflection of DuPont's advances over its competitors in developing CFC alternatives (Litfin 1994; Levy and Newell 2000).

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Table 1: Belief and political knowledge by level of news consumption

Panel A: Global warming beliefs

	Reads newspaper daily	Does not read newspaper daily	Difference	*N*
Solid evidence of global warming	0.7124	0.6819	0.0305	1500
	(0.0161)	(0.0175)	(0.0238)	

Panel B: Political knowledge

	Reads newspaper daily	Does not read newspaper daily	Difference	*N*
US House majority	0.6118	0.4332	0.1786	3609
	(0.0105)	(0.0131)	(0.0167)	
US Secretary of State	0.5003	0.3343	0.1660	3609
	(0.0107)	(0.0124)	(0.0164)	
British Prime Minister	0.3450	0.1972	0.1479	3609
	(0.0102)	(0.0105)	(0.0146)	
Share of political questions correct	*0.4857*	*0.3216*	*0.1641*	*3609*
	(0.0079)	*(0.0090)*	*(0.0120)*	
p-value of test that global warming difference is equal to political question share difference			0.0000	

Note: Data are from the Pew Research Center for the People and the Press (2013). Data in panel A come from the June News Interest/Believability Survey (June 2006). The "reads newspaper daily" column consists of those who answer "yes" to the question "Some people are so busy that they don't get to read a newspaper every day. How about you – do you get a chance to read a newspaper just about every day, or not?" The "solid evidence of global warming" row reports the fraction of respondents who answered "yes" to the question "From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades, or not?" Data in panel B come from the Biennial Media Consumption Survey (April 2008). The "reads newspaper daily" column consists of those who answer "yes" to the question "Do you happen to read any daily newspapers regularly, or not?" The "US House majority" row reports the fraction of respondents who answer "Yes, Democrat" to the question "Do you happen to know which political party has a majority in the US House of Representatives?" The "US Secretary of State" row reports the fraction of respondents who answer "Yes, Condoleezza Rice/Condi/Rice" to the question "Can you tell me the name of the current US Secretary of State?" The "British Prime Minister" row reports the fraction of respondents who answer "Gordon Brown" to the question "Who is the current prime minister of Great Britain?" The "share of political questions correct" row is the share correct across the three political knowledge questions. The last row reports the *p*-value of the test that the global warming difference is equal to the difference in the share of political questions correct. All calculations use recommended sample weights. Standard errors are reported in parentheses.

Table 2: Belief and scientific knowledge by level of news consumption

Panel A: Global warming beliefs

	Reads newspaper daily	Does not read newspaper daily	Difference	*N*
Solid evidence of global warming	0.7124	0.6819	0.0305	1500
	(0.0161)	(0.0175)	(0.0238)	

Panel B: Scientific knowledge

	Follows news closely	Does not follow news closely	Difference	*N*
Radiation sunscreen protects against	0.8810	0.7875	0.0935	1006
	(0.0139)	(0.0191)	(0.0236)	
Nanotechnology deals with things that are...	0.6945	0.6025	0.0920	1006
	(0.0198)	(0.0228)	(0.0302)	
Major concern about overuse of antibiotics	0.8403	0.7035	0.1368	1006
	(0.0157)	(0.0213)	(0.0265)	
Gas that causes temperatures to rise	0.6527	0.5213	0.1314	1006
	(0.0204)	(0.0233)	(0.0310)	
Resource extracted in "fracking"	0.6249	0.4080	0.2169	1006
	(0.0208)	(0.0229)	(0.0309)	
Share of scientific questions correct	*0.7386*	*0.6046*	*0.1341*	*1006*
	(0.0120)	*(0.0138)*	*(0.0183)*	
p-value of test that global warming difference is equal to scientific question share difference			0.0006	

Note: Data are from the Pew Research Center for the People and the Press (2013). Data in panel A come from the June News Interest/Believability Survey (June 2006). The "reads newspaper daily" column consists of those who answer "yes" to the question "Some people are so busy that they don't get to read a newspaper every day. How about you – do you get a chance to read a newspaper just about every day, or not?" The "solid evidence of global warming" row reports the fraction of respondents who answered "yes" to the question "From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades, or not?" Data in panel B come from the 2013 Omnibus Survey (March 2013). The "follows news closely" column consists of those who answer "very closely" or "fairly closely" to at least three of the following five questions: "Did you follow (i) reports about the condition of the US economy (ii) automatic government spending cuts that began on March 1st (iii) reports about the US stock market (iv) the death of Hugo Chavez, the President of Venezuela (v) Catholic cardinals meeting in Rome to select a new pope very closely, fairly closely, not too closely, or not at all closely?" The "radiation sunscreen protects against" row reports the fraction of respondents who answer "ultraviolet" to the question "Which one of the following types of solar radiation does sunscreen protect the skin from?" The "nanotechnology deals with things that are..." row reports the fraction of respondents who answer "small" to the question "Does nanotechnology deal with things that are extremely...?" The "major concern about overuse of antibiotics" row reports the fraction of respondents who answer "it can lead to antibiotic-resistant bacteria" to the question "Which of these is a major concern about the overuse of antibiotics?" The "gas that causes temperatures to rise" row reports the fraction of respondents who answer "carbon dioxide" to the question "What gas do most scientists believe causes temperatures in the atmosphere to rise?" The "resource extracted in 'fracking"' row reports the fraction of respondents who answer "natural gas" to the question "Which natural resource is extracted in a process known as 'fracking'?" The "share of scientific questions correct" row is the share correct across the five scientific knowledge questions. The last row reports the *p*-value of the test that the global warming difference is equal to the difference in the share of scientific questions correct. All calculations use recommended sample weights. Standard errors are reported in parentheses.

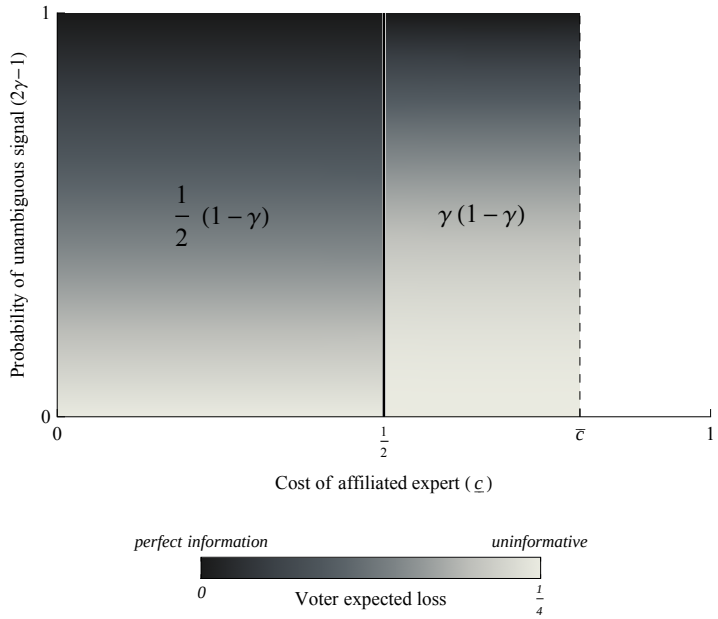
Table 3: Cross-country comparisons of journalistic norms, media coverage, and beliefs in climate change

Share of...	Time period	Germany	Italy	United Kingdom	United States
...*journalists* who think objective reporting expresses fairly the position of each side	1990-1992	0.21	0.28	0.31	0.40
...*newspaper articles* mentioning skeptical scientists	2000-2010	0.02	—	0.17	0.24
...*adults* who believe that rising temperatures have a human cause	2010	0.60	0.57	0.38	0.36

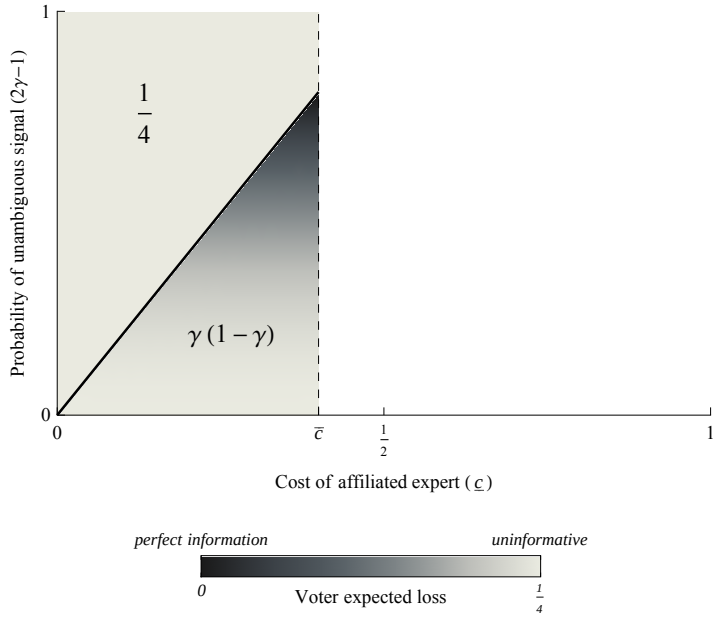
Note: Share who think objective reporting expresses fairly the position of each side is from Donsbach and Klett's (1993) survey of journalists that asked: "Please look at the five statements about good news reporting. Which comes closest to your understanding of the term 'objectivity'? Good news reporting (i) does not allow the journalist's own political beliefs to affect the presentation of the subject, (ii) expresses fairly the position of each side in a political dispute, (iii) requires an equally thorough questioning of each side in a political dispute, (iv) goes beyond the statements of the contending sides to the hard facts of a political dispute, (v) makes clear which side in a political dispute has the better position." The value reported is the share who answered (ii). Share of newspaper articles mentioning skeptical scientists is from Grundmann and Scott (2012). The value reported is the count of articles mentioning scientific researchers who are skeptical of climate change, as a fraction of articles mentioning both advocates and skeptics, in the top 10 newspapers in each country by climate change coverage. Share of adults who believe that rising temperatures have a human cause is from a 2010 Gallup survey (Ray and Pugliese 2011) that asked: "Temperature rise is a part of global warming or climate change. Do you think rising temperatures are (i) a result of human activities, (ii) a result of natural causes, (iii) both [if volunteered], (iv) don't know/refused (v) not aware of global warming." The value reported is the share who answered (i), excluding those who answered (v).

Figure 1: Voter's expected loss in equilibrium

Panel A: High cost of affiliated expert when experts are unanimously opposed ($\overline{c} > \frac{1}{2}$)

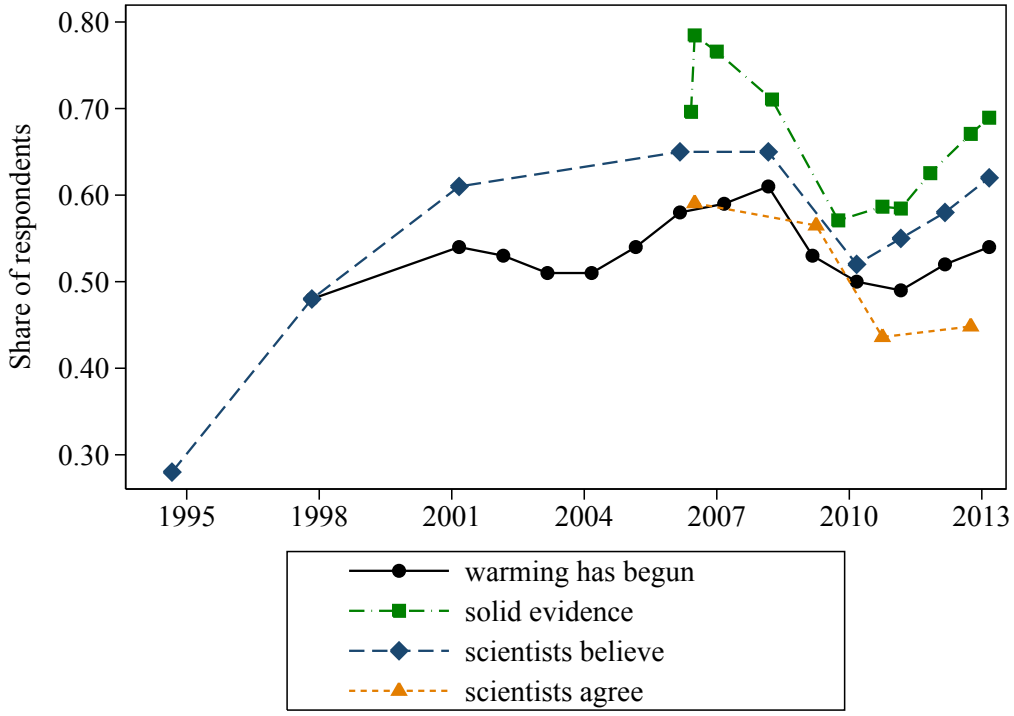


Panel B: Low cost of affiliated expert when experts are unanimously opposed ($\overline{c} < \frac{1}{2}$)



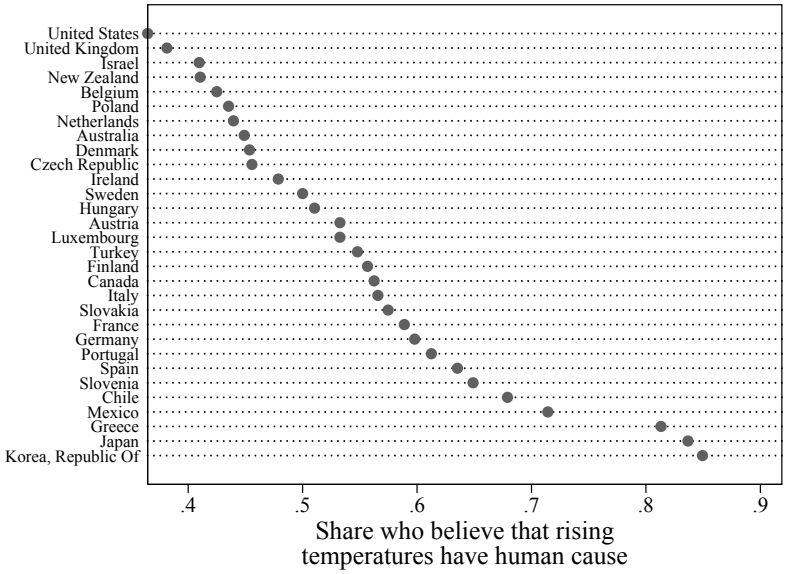
Note: Plot shows the voter's *ex ante* expected loss $\mathrm{E}(L(a,\omega))$ in the most informative symmetric equilibrium in pure strategies as a function of γ and $\underline{c}$. Panel A is drawn for the case of $\overline{c} = 0.8$. Panel B is drawn for the case of $\overline{c} = 0.4$.

Figure 2: Trends in public beliefs about climate change in the US



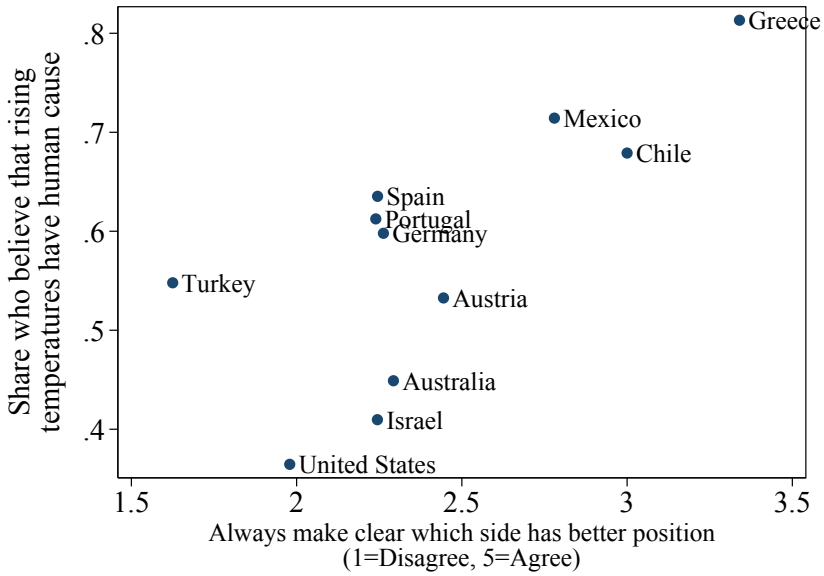
Notes: Series "warming has begun" is from Saad (2013). The series shows the share of respondents replying "they have already begun to happen" in response to the question "Which of the following statements reflects your view of when the effects of global warming will begin to happen? (i) they have already begun to happen (ii) they will start happening within a few years, (iii) they will start happening within your lifetime, (iv) they will not happen within your lifetime, but they will affect future generations, or (v) they will never happen." Series "solid evidence" is from the Pew Research Center for the People and the Press (2013). Studies used are the June News Interest/Believability Survey (June 2006), the July Religion and Public Life Survey (July 2006), the January News Interest Index Survey (January 2007), the April Political Survey (April 2008), the October Political Survey (October 2009, October 2010, and October 2012), the March Political Typology Survey (March 2011), the November Religion and Politics Survey (November 2011), and the March Political Survey (March 2013). The series shows the share of respondents replying "yes" to the question "From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades, or not?" Series "scientists believe" is from Nisbet and Myers (2007) and Saad (2013). The series shows the share of respondents replying "most scientists believe that global warming is occurring" in response to the question "On the environmental issue known as global warming, just your impression, which one of the following statements do you think is most accurate: (i) most scientists believe that global warming is occurring, (ii) most scientists believe that global warming is not occurring, or (iii) most scientists are unsure about whether global warming is occurring or not?" Series "scientists agree" is from the Pew Research Center for the People and the Press (2013). Studies used are the Religion and Public Life Survey (July 2006), the April General Public Science Survey (April 2009), and the October Political Survey (October 2010 and October 2012). The series shows the share of respondents replying "yes" to the question "From what you've heard or read, is there general agreement among scientists that the earth is getting warmer because of human activity, or not?"

Figure 3: Climate change beliefs across countries



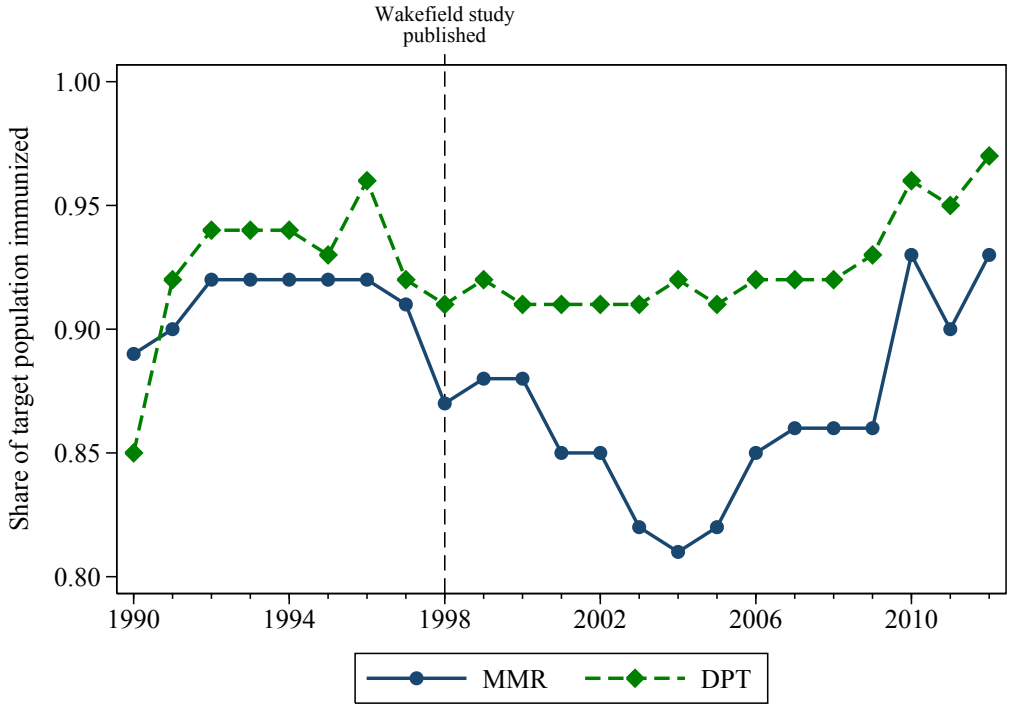
Note: Data are from a 2010 Gallup survey (Ray and Pugliese 2011) that asked: "Temperature rise is a part of global warming or climate change. Do you think rising temperatures are (i) a result of human activities, (ii) a result of natural causes, (iii) both [if volunteered], (iv) don't know/refused (v) not aware of global warming." The plot shows the share who answered (i), excluding those who answered (v). Sample is restricted to OECD countries.

Figure 4: Journalistic norms and climate change beliefs across countries



Note: Data for the y-axis are from a 2010 Gallup survey (Ray and Pugliese 2011) that asked: "Temperature rise is a part of global warming or climate change. Do you think rising temperatures are (i) a result of human activities, (ii) a result of natural causes, (iii) both [if volunteered], (iv) don't know/refused (v) not aware of global warming." The y-axis is the share who answered (i), excluding those who answered (v). Data for the x-axis are from the 2007-2009 Worlds of Journalism Study survey of journalists. The x-axis is the average rating on a 1 (strongly disagree) to 5 (strongly agree) scale of the statement "I always make clear which side in a dispute has the better position." Sample is restricted to OECD countries.

Figure 5: Vaccine coverage in the UK following Wakefield's announcement



Note: Data are from the World Health Organization Immunization Surveillance database (World Health Organization 2010). The "MMR" series shows the share of the target population immunized with a measles-containing vaccine as of the given year. The "DPT" series shows the share of the target population immunized with the third dose of the diptheria toxoid, tetanus toxoid, and pertussis vaccine as of the given year. The target population is defined as those who, in the given year, reach the age by which they are recommended to be immunized.

Proofs

Proof of Proposition 7

I complete the proof of existence by showing that an equilibrium in which the parties invest when $\sigma = \frac{1}{2}$ and mix when $\sigma \in \{0,1\}$ exists if and only if $\left(1-\frac{1}{2}\lambda\right)\left(\frac{1}{2}-\varepsilon(\lambda)\right) \geq \overline{c} \geq \left(1-\frac{1}{2}\lambda\right)\left(\gamma-\frac{1}{2}\right)$.

Let ρ be the probability that party j invests when $\sigma = 1-j$. Then by Bayes' Rule there exists continuous function $f()$ such that $a(1) = f(\lambda,\rho) = 1-a(0)$. It is straightforward to show that $f(\lambda,0) = 1-\varepsilon(\lambda)$, $f(\lambda,1) = \gamma$, and that $f(\lambda,\rho)$ is strictly decreasing in ρ.

Indifference by the parties when $\sigma \in \{0,1\}$ requires that $\left(1-\frac{1}{2}\lambda\right)\left(f(\lambda,\rho)-\frac{1}{2}\right) = \overline{c}$. There exists a unique ρ that solves this equation if and only if $\left(1-\frac{1}{2}\lambda\right)\left(\frac{1}{2}-\varepsilon(\lambda)\right) \geq \overline{c} \geq \left(1-\frac{1}{2}\lambda\right)\left(\gamma-\frac{1}{2}\right)$. Indifference when $\sigma \in \{0,1\}$ implies that the parties are willing to invest when $\sigma = \frac{1}{2}$ because $\underline{c} < \overline{c}$.

Proof of Proposition 8

Proposition 7 establishes that if $\overline{c} \geq \frac{1}{2}$ or $\underline{c} \geq \gamma - \frac{1}{2}$ the equilibria are robustly informative. Here I show that if $\overline{c} < \frac{1}{2}$ and $\underline{c} < \gamma - \frac{1}{2}$ then the equilibria are not robustly informative. I do this by establishing that for λ sufficiently small there is a unique equilibrium, and by showing that this equilibrium becomes arbitrarily uninformative as $\lambda \to 0$.

Pick $\overline{c} < \frac{1}{2}$ and $\underline{c} < \gamma - \frac{1}{2}$. Define λ' and λ'' so that $\underline{c} = \left(1-\lambda'\right)\left(\gamma-\frac{1}{2}\right)$ and $\overline{c} = \left(1-\frac{\lambda''}{2}\right)\left(\frac{1}{2}-\varepsilon(\lambda'')\right)$. If no such λ'' exists, then define $\lambda'' = 1$. Choose $\lambda \in (0, \min\{\lambda', \lambda''\})$ and suppose that the unopinionated journalist calls the opposition.

In any equilibrium, both parties invest with positive probability. Consider party 0. Because the party is weakly more likely to invest when $\sigma = \frac{1}{2}$ than when $\sigma = 1$, Bayes' Rule implies that $a(1) \geq \gamma$. If party 0 does not invest at all then Bayes' Rule implies that $a\left(\frac{1}{2}\right) \leq \frac{1}{2}$. Because $\underline{c} < (1-\lambda)\left(\gamma-\frac{1}{2}\right) \leq (1-\lambda)\left(a(1)-a\left(\frac{1}{2}\right)\right)$, it follows that party 0 invests with positive probability when $\sigma = \frac{1}{2}$ regardless of the behavior of the opinionated journalist. The same argument applies to party 1.

There can be no equilibrium in which both parties mix when $\sigma = \frac{1}{2}$. In such an equilibrium $\left(1-\frac{1}{2}\lambda\right)\left(a\left(\frac{1}{2}\right)-a(0)\right) = \underline{c} = \left(1-\frac{1}{2}\lambda\right)\left(a(1)-a\left(\frac{1}{2}\right)\right)$, but because $a(1) \geq \gamma$ and $a(0) \leq 1-\gamma$ and $\underline{c} \leq (1-\lambda)\left(\gamma-\frac{1}{2}\right) < \left(1-\frac{1}{2}\lambda\right)\left(\gamma-\frac{1}{2}\right)$ there exists no $a\left(\frac{1}{2}\right)$ that supports this condition for both parties.

A similar argument shows that there can be no equilibrium in which one party invests with certainty when $\sigma = \frac{1}{2}$ and the other party mixes when $\sigma = \frac{1}{2}$.

Therefore in any equilibrium both parties invest with certainty when $\sigma = \frac{1}{2}$. Letting $\rho(0)$ and $\rho(1)$ be the investment probabilities of the two parties when $\sigma = 1$ and $\sigma = 0$, respectively, it is possible to show that $a(1) = f(\lambda,\rho(0))$ and $a(0) = 1-f(\lambda,\rho(1))$ where $f()$ is defined in the proof of proposition 7. Conditions on $f()$ and $\overline{c}$ then imply that $\rho(0),\rho(1) > 0$. Together with the observation that $a\left(\frac{1}{2}\right) \lesseqgtr \frac{1}{2} \iff \rho(0) \lesseqgtr \rho(1)$ these conditions also imply that $\rho(0) = \rho(1)$.

If $\overline{c} < \left(\gamma-\frac{1}{2}\right)$ then for λ sufficiently small the unique equilibrium has $\rho(0) = \rho(1) = 1$. Otherwise for λ sufficiently small the unique equilibrium has $\rho(0) = \rho(1) = \rho^* \in (0,1)$. Because $\lim_{\lambda\to 0} f(\lambda,\rho') = 1$ for all ρ', $\lim_{\lambda\to 0}\rho^* = 1$. In either case, the limit of the voter's expected loss as $\lambda \to 0$ is $\frac{1}{4}$.

Proof of Claim on Robustness to a Richer Message Space

Proposition 7 shows that a full investment equilibrium exists in the baseline game if and only if $\overline{c} \leq \left(1-\frac{1}{2}\lambda\right)\left(\gamma-\frac{1}{2}\right)$. It is therefore sufficient to show that if $\overline{c} \leq \left(1-\frac{1}{2}\lambda\right)\left(\gamma-\frac{1}{2}\right)$ then an equilibrium of the alternative game exists in which the unopinionated journalist reports $m = \frac{1}{2}$ and the parties always invest.

Towards a proof suppose that the parties always invest, and that when the journalist has a choice of report, the unopinionated journalist always reports $m = \frac{1}{2}$ and the opinionated journalist reports $m = (s, 1-s)$

when she agrees with s and $m = \frac{1}{2}$ otherwise. Then $a\left(\frac{1}{2}\right) = \frac{1}{2}$, $a(1,0) = \gamma = 1 - a(0,1)$, $\hat{\lambda}(s, 1-s) = 1$, and $\hat{\lambda}\left(\frac{1}{2}\right) < \lambda$. Specify off-equilibrium beliefs so that beliefs at $m = s$ are identical to those at $m = (s, 1-s)$.

The opinionated journalist does not wish to deviate as her stipulated strategy is optimal to persuade the voter of her desired position. The unopinionated journalist does not wish to deviate as doing so would convince the voter she is opinionated. Party 0 wishes to play her stipulated strategy as long as $\overline{c} \leq \frac{1}{2}\lambda(a(1) - a(1,0)) + \frac{1}{2}\lambda\left(a(1) - a\left(\frac{1}{2}\right)\right) + (1-\lambda)\left(a(1) - a\left(\frac{1}{2}\right)\right)$, which holds if $\overline{c} \leq \left(1 - \frac{1}{2}\lambda\right)\left(\gamma - \frac{1}{2}\right)$. Party 1's incentives are analogous.