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Merchants of Doubt: Corporate Political Influence when Expert Credibility is Uncertain*

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Abstract

A key role of science-based non-governmental organizations (NGOs) is to communicate scientific knowledge to policymakers. However, recent evidence has emerged showing that industry-backed groups often attempt to undermine the credibility of such NGOs and weaken their ability to influence policy. To investigate the mechanisms by which a firm can profitably create doubt about scientific information, we use a signaling model of interest-group lobbying in which the policymaker has fixed costs of taking action. We explore two mechanisms for the creation of doubt. The first involves using Bayesian persuasion to imply that the NGO may be a radical extremist whose lobbying is not credible. The second involves the creation of a think tank which can offer its own testimony on scientific matters. We show the firm prefers that the think tank does not act as a credible moderate, but instead sometimes takes radical, non-credible, positions. We identify conditions under which each mechanism is preferred by the firm.

Keywords: NGOs, Public Politics, Lobbying
JEL Codes: D72, D82, L31, Q58

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1 Introduction

Political action to regulate externalities and protect public health depends crucially on scientific knowledge. However, public doubts about the credibility of scientific experts may undermine political support for regulation. Indeed, Oreskes and Conway (2010) present a series of in-depth case studies showing how business groups whose profits were threatened by regulation sowed doubt about the scientific basis for action. They cover cases involving the regulation of tobacco, acid rain, the hole in the ozone layer, and climate change. Their central contribution is to detail how business interests attempted to block or delay legislation, even though the weight of scientific evidence was against them. In each case, the strategies involved creating uncertainty about the scientific case for regulation by undermining the credibility of scientists and science-based non-governmental organizations (NGOs). In fact, a 1969 memo by a tobacco industry executive explained that "Doubt is our product since it is the best means of competing with the 'body of fact' that exists in the minds of the general public." (Oreskes and Conway, 2010, p. 34).

One common strategy is to attack the character of scientific experts, accusing them of a political bias that makes their recommendations untrustworthy. Even if there is no evidence to support such an attack, bold assertions may be enough to create sufficient doubt to damage a scientist's reputation. One victim of such attacks was Ben Santer, recipient of a 1998 MacArthur Foundation "genius" grant and lead author of Chapter 8 of the Second Assessment Report issued by the Intergovernmental Panel on Climate Change (IPCC). Santer was the target of a 1996 Op-Ed piece in the *Wall Street Journal* that accused him of making changes to the IPCC report to "deceive policy makers and the public." (Oreskes and Conway, 2010, p. 3). The charges were false—he had simply edited the chapter in response to review comments from fellow scientists—but that did not stop Frederick Seitz, chairman of the George C. Marshall Institute, from making them. Seitz, then 85 years old, had had an illustrious career in materials science and solid state physicis. Upon his retirement in 1979, he became a consultant for the tobacco industry and later the fossil fuel industry, arguing against regulation of second-hand smoke and global warming. Although Santer and 40 other climate scientists wrote a sharp rebuttal to the *Journal*, the newspaper edited the rebuttal heavily and deleted the names of the other 40 signatories, making it appear to be a self-serving response by Santer alone. The ensuing public war of words was too complicated for most members of the public to parse, and could easily be seen as just another debate between "two sides," each with their own equally valid views. Doubt had been sown.

A second common strategy is for a "think tank" to put forward competing scientific "experts" whose opinions are opposed to those of the scientists calling for policy action. For example, in 1989 the Marshall Institute issued a "white paper" on global warming that argued any warming was caused by solar activity, not greenhouse gas emissions. Although the paper was not written by climate scientists and had not been subjected to peer review, the Institute contacted the White House and was invited to present the report to members of the Council of Economic Advisers, the Office of Management and Budget, and other high-level executive branch entities. This outreach effort was remarkably effective and "had a big impact, stopping the positive momentum that had been building in the Bush administration." (Oreskes and Conway, 2010, p. 186). This was hardly the only example of counter-lobbying by industry funded think tanks. Indeed, Jacques et al. (2008) study 141 English-language books that adopt a sceptical stance on environmental

issues and find that 92% of them are associated with conservative think tanks. Dunlap and Jacques (2013) study books denying climate change in particular, and find that at least 90% of them do not undergo peer review. One of the key funders of climate denial efforts was ExxonMobil, which has given over $20 million to sow doubt about global warming to a wide array of think tanks, with the biggest recipient being the Competitive Enterprise Institute with $2 million of ExxonMobil support (Hoggan and Littlemore, 2009, p. 82). After its support for climate denialists was exposed publicly by Greenpeace, ExxonMobil cut off funding to the Competitive Enterprise Institute, though it nevertheless continued to donate over $2 million to other denialists in 2007 (Hoggan and Littlemore, 2009, p. 84).[1]

We develop a model that extends the literature on special-interest lobbying (Grossman and Helpman, 2001; Bennedsen and Feldmann, 2006; Dahm and Porteiro, 2008) to explore the impact of the aforementioned tactics on the public policy process. We identify conditions under which the creation of doubt can weaken regulatory policy or block its passage altogether. Since a firm that faces increased costs from regulation is typically not a credible source of information, it may need to resort to covert tactics to influence public policy. We consider two such tactics for the creation of doubt, both motivated by recent literature on the role of business in the policy process. The first tactic involves attempting to undermine the credibility of the NGO by providing information that suggests it is a highly biased extremist group. This tactic does not require providing credible scientific information about the state of the world itself; it merely requires smearing the reputation of the NGO. This is a common tactic for groups opposed to action on climate change. A second mechanism involves the creation of a new "think tank" that can provide information about the state of the world that is contrary to that provided by the NGO. This is a tactic that has become increasingly common since Anthony Fisher created the Atlas Network in 1981 with the intention "to litter the world with free-market think tanks." (Djelic, 2014). This paper explores the conditions under which each tactic can be effectively employed, and when each is preferred by a firm threatened by regulation.

This paper is part of a growing body of work on how firms respond to regulatory threats. One strand of work shows that firms may preempt regulatory threats by engaging in self-regulation to mitigate the problem of concern, and that under full information this can be socially beneficial (Segerson and Miceli, 1998; Maxwell, Lyon and Hackett, 2000; Fleckinger and Glachant, 2011). Related research studies the possibility that NGOs may campaign against a firm even after the regulatory process has been settled in the firm's favor (Daubanes and Rochet, 2016). Another strand of work explores the persuasive mechanisms firms can use to deflect regulatory pressures and influence public debate. One approach is to influence the underlying preferences of the public through indirect lobbying (Yu, 2005; Prieur and Zou, 2016). An alternative approach is to influence the beliefs of stakeholders, without changing preferences. One technique of this sort is to disclose large amounts of low-quality information that is difficult for stakeholders to evaluate (Sinclair-Desgagné and Gozlan, 2003). This technique may allow poor corporate performers to pool with

[1] The most established of these think tanks, such as the American Enterprise Institute, were founded before the second World War, and another group, including the Cato Institute and the Heritage Foundation, had their origins in the 1970s (Jones, 2014, p. 134). They were part of a concerted effort to promote free markets and stave off regulation that was funded by conservative business figures such as Joseph Coors, Charles Koch, and Richard Mellon Scaife (Jones, 2014, p. 169). Since the founding of the Atlas Economic Research Foundation in 1981, the number of free market think tanks has grown rapidly and now tops 400 (Djelic, 2014). The role of think tanks in politics is understudied and merits more academic investigation.

good performers, but is less viable when a stakeholder is skeptical or worried about an issue, and has the technical capacity to evaluate firms' reports. A variant of this technique is to spend money to generate and publicize biased scientific findings, in the presence of scientific uncertainty, in order to take advantage of citizens' misperceptions (Bramoullé and Orset, 2015). A second technique is to create front groups, also known as "astroturf lobbying" groups to influence public policy (Lyon and Maxwell, 2004; Cho et al., 2011; Walker, 2014). These groups pose as authentic grassroots networks of citizens opposed to policy on a particular issue, but are really artificial campaigns orchestrated by public relations professionals and made possible by covert funding from corporations with vested interests. However, this technique cannot be used to silence an existing "green" NGO, and is used instead to bolster a "brown" group. A third technique is greenwashing, which commonly involves the selective disclosure of positive information about a firm's environmental performance while neglecting to mention negative information (Lyon and Maxwell, 2011). However, this technique may not be sensible for firms with very dirty track records, as they face too great a risk of being called out and punished by NGOs suspicious of their claims, or for firms with very clean track records, who may prefer to simply remain silent. It also creates the risk of being "tweetjacked," that is, having the firm's message turned against it on social media by activists (Lyon and Montgomery, 2013).[2]

Our contribution is three-fold, and stands at the intersection of the literatures on regulatory preemption and on influencing beliefs. First, we extend the Grossman-Helpman (2001) model of lobbying to incorporate fixed costs of formulating and implementing policy. Contrary to Martimort and Semenov (2008), we assume that the policymaker is unbiased but that the magnitude of the ideological bias of the interest groups may be unknown. Second, we show how Bayesian persuasion can be used not just to persuade decision makers about the state of the world, as in Kamenica and Gentzkow (2011), but also to persuade decision makers about the credibility of other players who are offering information. Third, we characterize when firms prefer to create biased think tanks rather than using Bayesian persuasion, and demonstrate that such think tanks have incentives to act as possible radicals instead of credible moderates.

The remainder of the paper is structured as follows. Section 2 presents the basic model and analyzes the informational role of lobbying by an NGO whose bias is common knowledge. Section 3 extends this to the case of an NGO whose bias is unknown to other players. Section 4 introduces the firm and its role in the creation of doubt about the NGO's credibility. Section 5 studies the creation of an "think tank" by the firm in order to oppose the NGO's position. Section 6 offers conclusions.

[2] There is also a large literature in management on the deceptive practices firms use to fend off pressures for change from social movements and public policy (Lyon and Montgomery, 2015). For example, firms may engage in "decoupling" the form of the organization from its performance, e.g. by creating an office of Equal Opportunity and Human Resources and giving it formal but not real authority (Dobbin and Sutton, 1998). Alternatively, firms may engage in "symbolic management," e.g., joining voluntary programs for environmental improvement without actually improving their performance (Delmas and Montes-Sancho, 2010).

2 Policy Making and Lobbying by a Moderate NGO with Known Bias

There is a social issue whose severity is as yet unknown, and may turn out to have either a high impact or a low impact on society. (For clarity, we henceforth refer to the issue as an "environmental" issue, but the case studies in Oreskes and Conway (2010) clearly show that the same mechanisms arise for health or other social issues.) The state of the world is θ_i $i \in \{L, H\}$, which takes on the value θ_L with probability $1-q$ and θ_H with probability q. The expected state of the world is then $\overline{\theta} = q\theta_H + (1-q)\theta_L$. Legislation of stringency p may be passed to ameliorate the losses from the environmental harm. There are three actors: a policy maker (PM, who represents the median voter, and whom we thus indicate with a subscript M) and an environmental NGO (whom we will indicate with a subscript E for ENGO)—each of whom seeks to minimize the difference between the policy and their own ideal point—and a firm, which seeks to minimize policy stringency.

The PM's gross utility is

$$U_M(p, \theta) = -(p - \theta)^2.$$

Thus, it prefers to set $p = \theta$. In addition to its gross utility from a particular policy, the PM may also have a fixed cost F of undertaking the effort to create a policy. This will turn out to have important effects on the firm's strategy in later sections.

The notion that it is costly to introduce a policy is an intuitive one. Legislators are typically time-constrained and under-staffed (Drutman, 2015). In the United States, legislators spend as much as half of their time simply raising funds for the next electoral campaign (Roemer, 2015). Indeed, it is common for legislators to vote on complex bills without even having read through their contents, because they simply do not have time to read everything they vote on. Thus, devoting the time and effort to introduce a piece of legislation carries with it substantial opportunity costs. Regulatory actions carry with them perhaps even larger costs. In the United States, legislative procedures require that regulators follow a detailed set of steps before issuing a regulation, including putting forward a Notice of Proposed Rulemaking (NOPR), allowing interested parties to comment on the NOPR, and making detailed responses to all substantive comments received (McCubbins, Noll and Weingast, 1987). In addition, Executive Order 12866 requires that if a regulation is expected to impose substantial costs on industry ($100 million or more), then regulators must conduct a Regulatory Impact Analysis that demonstrates to the Office of Management and Budget that the benefits of the rule exceed the costs.[3] Thus, the costs of imposing any new regulation are quite substantial, both in terms of time and in terms of real agency resources (Viscusi, Vernon and Harrington, 1998, pp. 321-322.) Not surprisingly, then, numerous papers in the literature have assumed there is a cost of proposing new policies (Glazer and McMillan 1990; Glazer and McMillan 1992; Maxwell, Lyon and Hackett 2000), and we follow in this tradition. To the best of our knowledge, however, prior work using the interest-group signaling model (e.g., Grossman and Helpman, 2001) has ignored this aspect of the political arena.

The NGO's gross utility is

$$U_E(p, \theta, \delta) = -(p - \theta - \delta)^2$$

[3]For details, see https://www.whitehouse.gov/sites/default/files/omb/assets/OMB/circulars/a004/a-4_FAQ.pdf.

where δ is a measure of the NGO's ideological position or bias. Its preferred policy is then equal to $\theta + \delta$. The NGO may be either a "moderate" with bias $\delta < \overline{\delta}$ or a "radical" with bias $\delta > \overline{\delta}$ (this threshold being defined by the characteristics of the problem, as described below). Regardless, whatever its bias, the NGO always prefers a more stringent policy than does the PM, that is, $\delta > 0$.

The firm's objective function is quite different from that of the other players, as it simply wants to minimize the policy burden that it faces (Lyon and Maxwell, 2004). Its payoff function is thus

$$\Pi = -cp^2.$$

The game of public politics involves a series of stages:

1. The NGO learns the state of the world θ.
2. The firm can either send a signal about the bias of the NGO or create a Think Tank that can send a signal about the state of the world.
3. The NGO (and the Think Tank, if it exists) can lobby the PM, and the PM updates its beliefs.
4. The PM decides whether to incur the fixed cost F of going through a policymaking process, and if so it makes a policy decision p and the game ends.

We solve these stages in reverse chronological order. In sections 2 and 3 we suppress stage 2 in order to establish baseline results against which the introduction of this stage in section 4 can be assessed. Our basic model is very similar to that of Grossman and Helpman (2001) except that we assume the policymaker here has a fixed cost F of formulating and implementing policy.

2.1 Policy Making

The policymaker's utility will depend upon its state of information and its fixed costs of taking action. We use the notation E to indicate the expectations operator.

2.1.1 Perfectly Informed Policy

If the PM learns the underlying state of the world θ before choosing a policy, then it will choose a policy p to

$$\max_p -(p-\theta)^2 - F.$$

Thus, if the PM is informed and chooses to set a policy, it simply chooses $p_i = \theta_i$, for $i \in \{L, H\}$. Its utility is then $U_M = -F$.

Alternatively, if the gain from setting a policy is too small, the PM may choose not to act. If it opts not to act in state i, its utility is $-(\theta_i)^2$. Thus, the PM acts in both states if $F < F_L \equiv (p_L)^2$, never acts if $F > F_H \equiv (p_H)^2$, and acts if and only if the state is high if $F \in (F_L, F_H)$. The relevant ranges of F are illustrated in Figure 1.

[Insert Figure 1 about here]

2.1.2 Uninformed Policy

If the PM takes action without any additional information about the state of the world, it sets

$$Ep = \overline{\theta}$$

and obtains expected utility

$$EU_M^{UI} = -(1-q)q(\theta_H - \theta_L)^2 - F.$$

Thus it is worthwhile for the PM to take action if $EU_M^{UI} > EU_M^{NP}$ or

$$F < F_q \equiv \overline{\theta}^2. \tag{1}$$

2.1.3 No Policy

If the PM implements no policy at all, its expected utility is

$$EU_M^{NP} = -(1-q)(\theta_L)^2 - q(\theta_H)^2.$$

2.2 Lobbying by the NGO

Assume the NGO has a bias of δ that is common knowledge. The NGO must weigh the costs and benefits of lobbying to inform the PM. The NGO's exogenous cost of lobbying the agency is L. (The influence of this lobbying cost in defining moderate and radical NGOs is explained further below.) Clearly if $F > F_H$ and the PM never acts, then there is no reason for the NGO to lobby, so it is only of interest to consider cases where $F < F_L$ and $F \in (F_L, F_H)$.

2.2.1 Policy Maker Always Acts ($F < F_L$)

If $F < F_L$, then the PM acts in both states of the world. If the NGO does not engage in lobbying, then it obtains the gross expected payoff for the case of action by an uninformed PM, namely

$$EU_E^{UI} = -(1-q)(\theta_L + \delta)^2 - q(\theta_H + \delta)^2.$$

If the NGO does lobby, an informative equilibrium exists if the cost of lobbying is such that the NGO will only desire to lobby in one state of the world, and not in the other (Grossman and Helpman, 2001). Lobbying then serves as a costly signal that informs the PM.

If the state is θ_H and the NGO does not lobby, the PM will infer that the state is θ_L and set the policy p_L giving the NGO utility of

$$\begin{aligned} -(p_L - \theta_H - \delta)^2 &= -(\theta_L - \theta_H - \delta)^2 \\ &= -(\theta_H - \theta_L)^2 - 2(\theta_H - \theta_L)\delta - \delta. \end{aligned}$$

If the state is θ_H and the NGO does lobby, the PM believes the state is θ_H and sets $p_H = \theta_H$, so the NGO obtains utility of

$$-\delta^2 - L.$$

In the informative equilibrium, the NGO prefers to lobby in state H if

$$\delta > \underline{\delta} \equiv \frac{L}{2(\theta_H - \theta_L)} - \frac{(\theta_H - \theta_L)}{2}.$$

The exogenous lobbying cost being L, an NGO chooses to lobby if its bias δ is at least equal to this threshold $\underline{\delta}$. By assumption, $L > (\theta_H - \theta_L)^2$ so that $\underline{\delta} > 0$.

A similar calculation can be done when the state is θ_L. The NGO will choose not to lobby in the state θ_L if

$$\delta < \overline{\delta} \equiv \frac{L}{2(\theta_H - \theta_L)} + \frac{(\theta_H - \theta_L)}{2}.$$

Thus there is a range of bias for the NGO $\delta \in (\underline{\delta}, \overline{\delta})$ such that the NGO will lobby if and only if the state is θ_H, and in this case the PM is fully informed by the NGO's lobbying. This implies that if the NGO has a bias $\delta > \overline{\delta}$ then it will lobby in both states of the world and hence it will not be credible to the PM. An NGO with bias of $\delta < \underline{\delta}$ will never find it worthwhile to lobby, and hence is also uninformative. We will refer to an NGO whose lobbying is informative as a "moderate" and an NGO whose lobbying is uninformative as a "radical."

2.2.2 Policy Maker Only Acts when the State is High ($F \in (F_L, F_H)$)

Consider now the case where the PM finds it worthwhile to take action if and only if the state is θ_H. If the state is θ_H but the NGO does not lobby, the PM will infer that the state is θ_L and choose to take no action, giving the NGO utility of

$$-(\theta_H + \delta)^2.$$

If the PM believes the NGO, then if the state is θ_H and the NGO does lobby, the PM sets $p_H = \theta_H$ and the NGO obtains utility of

$$-\delta^2 - L.$$

Thus, the NGO prefers to lobby in state H if $-\delta^2 - L > -(\theta_H + \delta)^2$, or

$$\delta > \underline{\underline{\delta}} \equiv \frac{L}{2\theta_H} + \frac{\theta_H}{2} - \theta_H.$$

If the state is θ_L and the NGO does not lobby, the PM will infer that the state is θ_L and choose to take no action, giving the NGO utility of

$$-(\theta_L + \delta)^2.$$

In an informative equilibrium, if the state is θ_L and the NGO does lobby, the PM sets $p_H = \theta_H$ and the NGO obtains utility of

$$-(\theta_H - \theta_L - \delta)^2 - L.$$

The NGO prefers not to lobby in state θ_L if $-(\theta_L + \delta)^2 > -(\theta_H - \theta_L - \delta)^2 - L$ or

$$\delta < \overline{\overline{\delta}} \equiv \frac{L}{2\theta_H} + \frac{\theta_H}{2} - \theta_L.$$

Thus, the NGO will lobby informatively if

$$\delta \in (\frac{L}{2\theta_H} + \frac{\theta_H}{2} - \theta_H, \frac{L}{2\theta_H} + \frac{\theta_H}{2} - \theta_L). \tag{2}$$

Some algebra shows that $\underline{\underline{\delta}} < \underline{\delta}$ if

$$\frac{L}{2\theta_H} + \frac{\theta_H}{2} - \theta_H < \frac{L}{2(\theta_H - \theta_L)} - \frac{(\theta_H - \theta_L)}{2},$$

which reduces to

$$-L < \theta_H.$$

This is always true because $L > 0$. Intuitively, the NGO now has even greater incentive to lobby when the state is high because the alternative (no policy) is worse than the wrong policy (p_L).

Some algebra shows that $\overline{\overline{\delta}} < \overline{\delta}$ if

$$\frac{L}{2\theta_H} + \frac{(\theta_H - \theta_L)}{2} - \frac{\theta_L}{2} < \frac{L}{2(\theta_H - \theta_L)} + \frac{(\theta_H - \theta_L)}{2},$$

which simplifies to

$$-L < (\theta_H - \theta_L)\theta_H.$$

This is always true. Hence, $\overline{\overline{\delta}} < \overline{\delta}$ and for the NGO to be a "moderate" in this case is a slightly different requirement than that in the previous section. Thus, an NGO that would behave as a moderate when $F < F_L$ might behave as a radical when $F \in (F_L, F_H)$. A moderate NGO in the latter case must have a bias $\delta \in (\underline{\underline{\delta}}, \overline{\overline{\delta}})$.

3 Policy Making and Lobbying by an NGO with Unknown Bias

Suppose now the PM is unsure whether the NGO is entirely reliable, that is, whether it might be a "radical" with an extreme bias rather than a "moderate" with a smaller bias. For simplicity, we model this by assuming that δ takes one of two values. With probability ζ, the NGO's bias takes on the value $\delta = R > \overline{\delta}$, which is so large that the NGO always has incentives to lobby regardless of the state (the NGO is a "radical"). With probability $1 - \zeta$, the NGO's bias takes on the value $\delta = M \in (\underline{\delta}, \overline{\overline{\delta}})$, so that the NGO lobbies if and only if the state is θ_H (the NGO is a "moderate"). Note that these values reflect our analysis from section 2.2, and ensure that our definitions of radical and moderate NGOs apply regardless of the level of F.[4] Facing this uncertainty, the PM may not be able to rely upon the NGO as a means of learning the underlying state of the world θ before choosing a policy. Below we treat each range of PM fixed costs separately.

[4] Another modeling option would be to assume that the bias of the NGO is unknown but that its distribution is common knowledge, e.g. δ is distributed uniformly on $(\underline{\delta}, \Delta)$ with $\Delta > \overline{\delta}$. Under this assumption, any NGO would lobby when $\theta = \theta_H$ whatever the level of the fixed cost of policymaking. When $F < F_L$, the NGO would be a radical if it had a bias of $\delta > \overline{\delta}$, which implies the NGO would always lobby regardless of the state, or would be a moderate if its bias were $\delta < \overline{\delta}$. Then the NGO would be a radical with probability $\zeta = (\Delta - \overline{\delta})/(\Delta - \underline{\delta})$. When $F \in (F_L, F_H)$, the NGO would be a radical if $\delta > \overline{\overline{\delta}}$, or would be a moderate if its bias were $\delta < \overline{\overline{\delta}}$. Then the NGO would be a radical with probability $\zeta = (\Delta - \overline{\overline{\delta}})/(\Delta - \underline{\delta})$. This approach adds no additional insight, but is more cumbersome, so we have opted for the simpler one presented in the text.

3.1 Policy Maker Always Acts ($F < F_L$)

Conditional upon observing the NGO lobby, the PM updates its belief that the state is actually high. The unconditional probability that the NGO lobbies is

$$\Pr(\text{NGO appears}) = q + (1-q)\ \zeta.$$

The probability that the NGO does not lobby is

$$1 - \Pr(\text{NGO appears}) = 1 - q - (1-q)\ \zeta = (1-q)(1-\ \zeta).$$

Using Bayes' Rule, the PM's updated belief ρ is

$$\rho = \Pr(\theta = \theta_H\ |\text{NGO appears}) = \frac{q}{q + (1-q)\ \zeta}. \tag{3}$$

Note that $\rho > q$ because $\zeta \in (0,1)$, so NGO lobbying still leads the PM to increase its belief that the state is high, although it does not believe the state is high with certainty. With this updated belief, if the PM implements a policy conditional on observing that the NGO lobbies, it will set

$$p_\rho = \rho\theta_H + (1-\rho)\theta_L = \rho p_H + (1-\rho)p_L. \tag{4}$$

If the NGO does not lobby, the PM can still infer with certainty that the state is L, so it sets

$$p_L = \theta_L.$$

Given the above, the expected policy when the NGO's bias is unknown is

$$Ep = [q + (1-q)\ \zeta][\rho p_H + (1-\rho)p_L] + [(1-q)(1-\ \zeta)][p_L] = \overline{\theta}.$$

Thus, uncertainty about the NGO's bias does not change the expected policy.

3.2 Policy Maker Only Acts when the State is High ($F \in (F_L, F_H)$)

Consider now the case where F is intermediate in value, so that the PM does not act if the state is θ_L. If the state is θ_H but the NGO does not lobby, the PM will infer that the NGO is a moderate and the state is θ_L, but because of its fixed costs it will choose to take no action, giving the moderate NGO utility of

$$-(\theta_H +\ \delta)^2.$$

If the state is θ_H and the NGO does lobby, the PM will set p_ρ as defined in (4), and the moderate NGO will obtain utility of

$$-(p_\rho - \theta_H -\ \delta)^2 - L.$$

Thus, the NGO prefers to lobby in state H if $-(p_\rho - \theta_H - \delta)^2 - L > -(0 - \theta_H - \delta)^2$, or

$$\delta > \frac{p_\rho}{2} - \theta_H + \frac{L}{2p_\rho}.$$

If the state is θ_L, and the NGO lobbies, claiming the state is high, and the PM believes the NGO, then the PM sets p_ρ and the NGO gets

$$-(p_\rho - \theta_L - \ \delta)^2 - L.$$

If the NGO does not lobby, then the PM sets $p = 0$ and the NGO gets

$$-(-\theta_L - \ \delta)^2.$$

The NGO will choose not to lobby in state L if

$$\delta < \frac{p_\rho}{2} + \frac{L}{2p_\rho} - \theta_L.$$

Thus, an NGO with bias δ will lobby informatively if

$$\delta \in (\frac{p_\rho}{2} + \frac{L}{2p_\rho} - \theta_H, \frac{p_\rho}{2} + \frac{L}{2p_\rho} - \theta_L).$$

By definition, then, a moderate NGO must have a bias in this range. By comparison with (2), it is easy to see that the above condition converges to the condition for informative lobbying when the NGO's bias is known. Thus, as long as ρ is close to one, which means that ζ is small, the NGO will still lobby informatively as long as the probability it is a radical is small.

When the NGO lobbies, the PM updates its belief to $\rho = q/(q + (1-q)\ \zeta)$ and the PM's expected utility of taking an imperfectly informed policy is

$$EU_M^{IP} = -(1-\rho)\rho(p_H - p_L)^2 - F.$$

Alternatively, the PM could opt to take no action and obtain

$$EU_M^{NP} = -(1-\rho)(p_L)^2 - \rho(p_H)^2.$$

Thus, when the NGO lobbies, the PM acts if

$$EU_M^{IP} - EU_M^{NP} = (\rho p_H + (1-\rho)p_L)^2 - F > 0. \tag{5}$$

Lemma 1 *If the policy maker is uncertain of the NGO's bias, it takes action only if ζ is such that its posterior belief ρ regarding the state of the world is*

$$\rho > \rho^{NP} = \frac{\sqrt{F} - p_L}{(p_H - p_L)}. \tag{6}$$

Proof. The expression $EU_M^{IP} - EU_M^{NP} = (\rho p_H + (1-\rho)p_L)^2 - F > 0$ can be solved using the quadratic formula to obtain the expression for ρ^{NP}. ■

The parameter value ρ^{NP} will be critical in the firm's choice of doubt-creation strategy in section 4. For any level of F, if the firm can create enough doubt to push the PM's probability that the state is high below ρ^{NP} then it can forestall legislative action. Using equation (5), for a given ζ, and the corresponding value of ρ, we can define a level of fixed cost F_ρ such that the PM is just indifferent between propagating a policy and not taking action at all. This F_ρ is simply

$$F_\rho = (\rho p_H + (1-\rho)p_L)^2 = (p_\rho)^2. \tag{7}$$

4 The Firm and the Creation of Doubt

We turn now to the possibility of strategic creation of doubt by the firm. We first examine whether the firm's expected profits increase when there is doubt about whether the NGO is a credible source of information. We then explore a method the firm can use to increase such doubt.

4.1 The Benefit for the Firm of Uncertainty about the NGO's Bias

Does the firm benefit from uncertainty about the NGO's type? As shown above, such uncertainty does not change the expected value of policy. However, if $F < F_L$, and the PM always acts, then the firm faces a tradeoff when there is a possibility that the NGO may be a non-credible radical. On one hand, it is less likely to obtain the less-stringent policy p_L, which occurs with probability $(1-q)(1-\zeta) < (1-q)$. On the other hand, it never obtains the worst policy, p_H, and instead obtains $p_\rho < p_H$ when the NGO lobbies. Thus, it is not intuitively obvious whether the firm gains from uncertainty about the NGO's bias.

Expected profits with imperfectly informed policy are

$$E\Pi^{IP} = -c(1-\frac{q}{\rho})p_L^2 - c(\frac{q}{\rho})(\rho p_H + (1-\rho)p_L)^2.$$

It is straightforward to determine the firm's preferences regarding doubt about the NGO's bias when $F < F_L$.

Proposition 2 *When $F < F_L$, so the PM always takes action, the firm benefits from an increase in the probability that the NGO is a radical.*

Proof. Differentiating the firm's expected profits yields

$$\frac{\partial E\Pi^{IP}}{\partial \rho} = -cq(p_L^2 + p_H^2 - p_L p_H) < 0.$$

Thus, expected profits are strictly decreasing in ρ, which in turn in strictly decreasing in ζ. ■

The proposition shows that expected profits increase as the probability that the NGO might be a radical increases. This result is expressed graphically in Figure 2. As the figure shows, the firm's payoff function is concave in p, making it behave as if it is risk-averse in policy. The firm's expected profits are initially located at a point along the chord from $\Pi(p_L)$ to $\Pi(p_H)$, but uncertainty about the NGO's type causes expected profits to shift upwards onto the chord from $\Pi(p_L)$ to $\Pi(p_\rho)$. Whether this is profitable depends upon which point on the new chord is relevant. However, the Proposition shows that the reduced chance of obtaining the lenient policy p_L is more than offset by the reduction in the stringent policy from p_H to p_ρ. In Figure 2, the firm's expected profits with the noisy NGO can be located precisely on the chord from $\Pi(p_L)$ to $\Pi(p_\rho)$ because we know that Ep does not change as a result of doubt about the NGO's bias. Thus, as the figure reveals, the creation of doubt about the NGO is profitable for the firm when the policymaker always takes action. It would be even more profitable if the PM were to choose a policy without any information at all about the state of the world. Whether the creation of doubt is profitable when the policymaker has fixed costs of taking action is the question to which we now turn.

[Insert Figure 2 about here]

4.2 Bayesian Persuasion and the Creation of Doubt

How can the firm create doubts about the NGO's bias? Given the firm's payoff function, it cannot credibly engage in cheap talk simply asserting that the NGO is a radical—the firm has an incentive to claim the NGO is radical regardless of whether it is true. If Exxon attacks scientists for being radical, few policymakers or members of the public will grant this much credence. If the firm can produce even some minimal amount of evidence, however, it has a much better chance of being believed. Suppose the firm can fund an "investigation" into the bias of the NGO, one that needs not necessarily be neutral or objective, but one that the firm commits to make public. As long as the investigation meets the minimal requirement of Bayes plausibility, namely that the expected posterior distribution over the NGO's bias is equal to the prior distribution, then the firm may be able to engage in Bayesian persuasion (Kamenica and Gentzkow, 2011). Formally, Bayesian persuasion implies that the firm's investigation sends a signal y and the firm can choose the probability distribution over the signal in any way that is consistent with Bayesian rationality on the part of the PM. That is, the expected posterior held by the PM after observing the signal cannot be greater than ζ. For simplicity, let the signal be binary, so that either $y = M$ (for moderate) or $y = R$ (for radical). The firm can choose any probability distribution over these signals that is consistent with Bayes plausibility. Our model differs from Kamenica and Gentzkow (2011) in that we have two signals, one sent by the firm (regarding the NGO's credibility), and then a second signal sent by the NGO (regarding the state of the world), whereas Kamenica and Gentzkow (2011) deal only with a single signal about the state of the world.

Formally, let $\mu_y(\delta = R|y)$ be the posterior belief of the PM that the NGO is a radical, conditional on the firm's signal y. For notational simplicity, we will write $\mu_y = \mu_y(\delta = R|y)$. Let $\pi(y|\ \delta)$ be the probability of getting the signal y when the true state is δ. For notational simplicity, we will write the probability of getting the signal that the NGO is a radical, conditional on the NGO's true bias being $x \in \{R, M\}$, as $\pi_x = \pi(R|\ \delta = x)$. Let λ be the probability of getting the signal $y = R$ and $1 - \lambda$ be the probability that $y = M$. Then

$$\lambda = \pi(R|\ \delta = R)\zeta\ + \pi(R|\ \delta = M)(1 -\ \zeta) = \pi_R\ \zeta + \pi_M(1 -\ \zeta) \tag{8}$$

$$1 - \lambda = \pi(M|\ \delta = R)\ \zeta + \pi(M|\ \delta = M)(1 -\ \zeta) = (1 - \pi_R)\ \zeta + (1 - \pi_M)(1 -\ \zeta).$$

Bayesian updating requires that for signal realization $y = M$, the PM's posterior belief about the NGO's bias is

$$\mu_M(\delta = R|y = M) = \frac{\pi(M|\ \delta = R)\ \zeta}{1 - \lambda} = \frac{(1 - \pi_R)\ \zeta}{(1 - \pi_R)\ \zeta + (1 - \pi_M)(1 -\ \zeta)}, \tag{9}$$

and for realization $y = R$ it is

$$\mu_R(\delta = R|y = R) = \frac{\pi(R|\ \delta = R)\ \zeta}{\lambda} = \frac{\pi_R\ \zeta}{\pi_R\ \zeta + \pi_M(1 -\ \zeta)}. \tag{10}$$

Bayes plausibility requires that the expected posterior distribution over the NGO's bias is equal to the prior distribution, that is

$$\mu_R\lambda + \mu_M(1 - \lambda) =\ \zeta. \tag{11}$$

4.2.1 An Example

An example may help to clarify the notion of Bayesian persuasion. Suppose that the PM has a prior belief that there is a 10% chance the NGO is a radical, so $\zeta = 0.1$. The firm structures its investigation by choosing π_R and π_M, knowing that the PM will update its beliefs according to Bayes' Rule. Perhaps the firm hires a hacker to break into the emails of a prominent climate scientist and then interprets the results in the most negative possible light.[5] Note that Bayes plausibility means it is pointless for the firm to choose an investigation that will always says the NGO is a radical, no matter what. Such an investigation would imply that $\pi_R = \pi_M = 1$, that $\lambda = 1$, and that $\mu_M = 0$ and $\mu_R = \zeta$. Hence it would have no impact on the PM's beliefs, as the PM will always receive the signal that the NGO is a radical and will not update its beliefs a bit. However, suppose the firm "rigs" its investigation so that if the NGO really is a moderate, the investigation says "moderate" with 50% probability and "radical" with 50% probability (that is, $\pi_M = 0.5$), while if the NGO really is a radical the investigation always says "radical" (that is, $\pi_R = 1.0$). This means the investigation says the NGO is a radical with probability $\lambda = 0.1 * 1.0 + 0.9 * 0.5 = .55$, even though there is only a 10% chance the NGO really is a radical. The PM sees that the investigation is rigged, so if receives the signal that the NGO is a radical, it only updates its belief to

$$\mu_R = \frac{1.0 * 0.1}{.55} = 0.1818.$$

If the PM receives the signal that the NGO is a moderate, it updates its belief to

$$\mu_M = \frac{0}{.45} = 0.$$

In other words, if the signal ever says the NGO is a moderate, the PM can be sure this is true. Finally, Bayes plausibility is satisfied because

$$.1818 * .55 + 0 * .45 = 0.1.$$

Thus, the firm is free to concoct a highly biased investigation, and the PM pays attention to the signal produced, but the PM is not fooled by the investigation. Nevertheless, the biased investigation may be useful to the firm if the PM makes a policy choice that is more favorable to the firm when the signal says the NGO is a radical.

4.2.2 The Policymaker's Inferences

The PM now receives two signals, first a signal from the firm about the NGO's bias, and then a signal from the NGO about the state of the world. There are four possible pairs of signals that the PM can receive:

1. "Radical" and "High": The firm's signal indicates the NGO is a radical, and the NGO lobbies. This occurs with joint probability $\lambda[\mu_R + (1 - \mu_R)q]$.

2. "Radical" and "Low": The firm's signal indicates the NGO is a radical, and the NGO does not lobby. This occurs with joint probability $\lambda(1 - \mu_R)(1 - q)$.

[5] This was essentially the case of the so-called "Climategate" scandal, although it has never been established who directed the hack. https://en.wikipedia.org/wiki/Climatic_Research_Unit_email_controversy#Public_opinion_and_political_fallout

3. "Moderate" and "High": The firm's signal indicates the NGO is a moderate, and the NGO lobbies. This occurs with joint probability $(1-\lambda)q$.

4. "Moderate" and "Low": The firm's signal indicates the NGO is a moderate, and the NGO does not lobby. This occurs with joint probability $(1-\lambda)(1-q)$.

Denote the PM's posterior belief that the state of the world is high, based on both signals, by ω_{yz} where $y \in \{R, M\}$ is the firm's signal and $z \in \{L, H\}$ is the NGO's signal. Given a posterior ω, the PM's optimal policy is to set

$$p_\omega = \omega\theta_H + (1-\omega)\theta_L. \tag{12}$$

Without the firm's signal, the PM would set policy based on (4), so $p_\omega \leq p_\rho$ if and only if $\omega \leq \rho$.

What should the PM believe for each pair of signals? One immediate observation is that if the state is high or the NGO is a radical, then the NGO will lobby and claim the state is high. Thus, the only situation in which the NGO fails to lobby is when the NGO is a moderate and the state really is low. In this case, the NGO's lobbying signal is dispositive, and trumps the firm's signal. Therefore

$$\omega_{RL} = \omega_{ML} = 0.$$

If the NGO fails to lobby, then the PM can be sure the state is low, and assuming it is worthwhile to take action, set p_L.

Now consider the PM's posterior in the other two cases. If the firm's signal indicates the NGO is a radical, and the NGO lobbies, then the PM infers

$$\omega_{RH} = \Pr(\theta = \theta_H \,|\, \text{“}R\text{” and NGO lobbies}) = \frac{\Pr(\text{“}R\text{” and Lobby}|\, \theta = \theta_H)\Pr(\theta_H)}{\Pr(\text{“}R\text{” and Lobby})}.$$

The probability the firm's signal says "R" is λ, and conditional upon this signal the PM believes the probability the NGO will lobby is now $\mu_R+(1-\mu_R)q$. Thus the joint probability of "R" and Lobby is $\lambda[\mu_R+(1-\mu_R)q]$. The probability of state θ_H is simply q. Finally, conditional on $\theta = \theta_H$, the NGO lobbies with probability 1 and the signal still occurs with probability λ, so the conditional joint probability is simply λ. Thus

$$\omega_{RH} = \frac{\lambda q}{\lambda[\mu_R + (1-\mu_R)q]} = \frac{q}{q + (1-q)\mu_R}. \tag{13}$$

If the firm's signal indicates the NGO is a moderate, and the NGO lobbies, then the PM infers

$$\omega_{MH} = \Pr(\theta = \theta_H \,|\, \text{“}M\text{” and NGO lobbies}) = \frac{\Pr(\text{“}M\text{” and Lobby}|\theta = \theta_H)\Pr(\theta_H)}{\Pr(\text{“}M\text{” and Lobby})}. \tag{14}$$

The probability the firm's signal says "M" is $1-\lambda$, and conditional upon this signal the PM believes the probability the NGO will lobby is now $\mu_M + (1-\mu_M)q$. Thus the joint probability of "M" and Lobby is $(1-\lambda)[\mu_M + (1-\mu_M)q]$. The probability of state θ_H is simply q. Finally, conditional on $\theta = \theta_H$, the NGO lobbies with probability 1 and the signal still occurs with probability $1-\lambda$, so the conditional joint probability is simply $1-\lambda$. Thus

$$\omega_{MH} = \frac{(1-\lambda)q}{(1-\lambda)[\mu_M + (1-\mu_M)q]} = \frac{q}{q + (1-q)\mu_M}.$$

The firm's expected profits with Bayesian persuasion are

$$E\Pi^{BP} = -[1-\lambda\mu_R](1-q)(cp_L^2) - \lambda[q + (1-q)\mu_R](cp_{\omega_{RH}}^2) - (1-\lambda)q(cp_{\omega_{MH}}^2). \tag{15}$$

4.3 The Firm's Optimal Signal as a Function of the Policymaker's Fixed Costs

The optimal signal for the firm will depend upon the policymaker's fixed costs of taking action. It is clear that if $F > F_H$, then the PM never acts and Bayesian persuasion is unnecessary. Consider then the firm's optimal signal when $F < F_H$. The following proposition provides a helpful step in establishing the firm's optimal signal.

Proposition 3 *Whenever the PM sets $p = p_H$, it is optimal for the firm to send a signal that ensures $\omega_{yH} = 1$.*

Proof. Suppose $\delta = R$, so the NGO will lobby regardless of the state. If the firm signals R, the PM believes ω_{RH} and sets

$$p_{\omega_{RH}} = \omega_{RH}\theta_H + (1 - \omega_{RH})\theta_L, \tag{16}$$

and if the firm signals M, the PM sets

$$p_{\omega_{MH}} = \omega_{MH}\theta_H + (1 - \omega_{MH})\theta_L. \tag{17}$$

Thus the expected policy is

$$(1 - \pi_R)p_{\omega_{MH}} + \ \pi_R p_{\omega_{RH}}.$$

So as long as $\omega_{MH} > \omega_{RH}$, the firm strictly prefers to send the signal R, which means it wants to increase the weight on $p_{\omega_{RH}}$ by increasing π_R. Otherwise the firm could strictly reduce the probability of getting $p_{\omega_{MH}}$and also decrease ω_{RH}, which weakens the policy in the event that the PM gets the signal R. From (13), (14), (16) and (17), we see that if $\mu_M < \mu_R$ then it is optimal for the firm to send the signal R with probability $\pi_R = 1$. From (10) and (9), it is easy to show that $\mu_M < \mu_R$ if $\pi_M/(1 - \pi_M) < \pi_R/(1 - \pi_R)$. Clearly if $\pi_R = 1$ then this condition holds, and hence it is an optimal response for the firm. ■

This is an intuitive outcome. It shows that if the NGO really is a radical, then the firm always sends the signal that the NGO is indeed a radical. To send any other signal would encourage the PM to set a more stringent policy when the NGO lobbies, which is contrary to the firm's interests. This result allows us to establish the following.

Proposition 4 *If $F < F_L$, then Bayesian persuasion is not profitable.*

Proof. The firm's expected profits are

$$E\Pi^{BP} = -[1 - \lambda\mu_R](1 - q)(cp_L^2) - \lambda[q + (1 - q)\mu_R](cp_{\omega_{RH}}^2) - (1 - \lambda)q(cp_{\omega_{MH}}^2).$$

Proposition 3 implies $\pi_R = 1$, so $\mu_M = 0$, $\omega_{MH} = 1$ and $p_{\omega_{MH}} = p_H$. Thus the only remaining question is the optimal value of π_M for the firm. After substituting in $p_{\omega_{MH}} = p_H$, some rather tedious algebra shows that

$$\frac{dE\Pi^{BP}}{d\pi_M} = \frac{c(1 - q)^2\zeta^2 q(1 - \ \zeta)(p_L - p_H)^2}{(\zeta + q\pi_M(1 - \ \zeta))^2} > 0$$

and

$$\frac{d^2E\Pi^{BP}}{d\pi_M^2} = \frac{-2c(1-q)^2\zeta^2 q(1-\ \zeta)(p_L-p_H)^2 q(1-\ \zeta)}{(\zeta+q\pi_M(1-\ \zeta))^3} < 0.$$

Expected profits are concave in π_M and reach a maximum at $\pi_M = 1$. Thus when the NGO is a moderate, the firm says the NGO is a radical with certainty. And when the NGO is a radical, the firm says it is a radical with certainty. Thus the firm's optimal signal is to always say the NGO is a radical, which adds zero value to the firm's profits because this is completely uninformative. Thus there is no point in engaging in Bayesian persuasion. ■

This result is consistent with Kamenica and Gentzkow's (2011) lobbying example, in which when the lobbyist and the policymaker have divergent preferences, the lobbyist derives no benefit from Bayesian persuasion. In light of Proposition 4, the remainder of this section focuses on the case where $F \in (F_L, F_H)$. In this case, the PM takes no action when the state is known to be low, and the firm's expected profits become

$$E\Pi^{BP} = -\lambda[q+(1-q)\mu_R](cp^2_{\omega_{RH}}) - (1-\lambda)q(cp^2_{\omega_{MH}}).$$

Of course, if $\omega_{yH} < \rho^{NP}$ for $y \in \{M, H\}$ then the PM does not act, effectively setting $p_{\omega_{yH}} = 0$. We can rewrite expected profits in terms of π_R and π_M. If $\omega_{RH} > \rho^{NP}$ and $\omega_{MH} \geq \rho^{NP}$ then the firm earns

$$\begin{aligned} E\Pi^{BP} \quad = \quad & -(\pi_R\ \zeta + \pi_M(1-\ \zeta))[q+(1-q)\pi_R\ \zeta]c(\omega_{RH}\theta_H + (1-\omega_{RH})\theta_L)^2 \\ & -((1-\pi_R)\ \zeta + (1-\pi_M)(1-\ \zeta))qc(\omega_{MH}\theta_H + (1-\omega_{MH})\theta_L)^2 \end{aligned}$$

and because we know $\pi_R = 1$ and $\omega_{MH} = 1$, this simplifies to

$$\begin{aligned} E\Pi^{BP} \quad = \quad & -(\ \zeta + \pi_M(1-\ \zeta))[q+(1-q)\ \zeta]c(\omega_{RH}\theta_H + (1-\omega_{RH})\theta_L)^2 \\ & -((1-\pi_M)(1-\ \zeta))qc{\theta_H}^2. \end{aligned} \tag{18}$$

Similarly, if $\omega_{RH} \leq \rho^{NP}$ and $\omega_{MH} \geq \rho^{NP}$ then the firm gets

$$E\Pi^{BP} = -(1-\lambda)q(cp^2_{\omega_{MH}}) = -((1-\pi_R)\ \zeta + (1-\pi_M)(1-\ \zeta))qc(\omega_{MH}\theta_H + (1-\omega_{MH})\theta_L)^2$$

which simplifies to

$$E\Pi^{BP} = -((1-\pi_M)(1-\zeta))qc{\theta_H}^2. \tag{19}$$

We see immediately that the second term in (18) is formally identical to (19), even though π_M in (19) is lower than in (18) because they are obtained for different ω_{RH}. But at the limit, when $\omega_{RH} \to \rho^{NP}$ in (18), this term takes the same value, and the first term of (18) is always negative and decreasing in ω_{RH}, so it is strictly worse to have $\omega_{RH} > \rho^{NP}$. Therefore the firm wants to set $\omega_{RH} \leq \rho^{NP}$. To achieve this, it is sufficient to set $\omega_{RH} = \rho^{NP}$, which implies

$$\omega_{RH} = \frac{q}{[q+(1-q)\mu_R]} = \rho^{NP} = \frac{\sqrt{F}-\theta_L}{(\theta_H-\theta_L)}.$$

This requires

$$\mu_R = \frac{q(1-\rho^{NP})}{(1-q)\rho^{NP}}.$$

Substituting this into (10) and solving for π_M, and then substituting in for ρ^{NP} yields

$$\pi_M = \frac{\zeta}{(1-\zeta)q}\frac{\sqrt{F} - qp_H - (1-q)p_L}{p_H - \sqrt{F}}.$$

Thus, recalling the definition of F_ρ from (7), we have demonstrated by construction the following proposition.

Proposition 5 *If $F \in (F_L, F_\rho]$, then the firm's optimal signal is $\pi_M = \zeta(\sqrt{F} - qp_H - (1-q)p_L)/((1-\zeta)q(p_H - \sqrt{F}))$ and $\pi_R = 1$.*

Intuitively, the firm chooses a signal that does not distort the NGO's type when it is truly a radical, but sends a noisy signal when the NGO is truly a moderate, thereby increasing the PM's doubt about the credibility of the NGO. However, it is constrained in doing so by the requirement of Bayes plausibility, that is, the expected posterior belief that the NGO is a radical is exactly equal to the prior belief that the NGO is a radical. Recall that the expected posterior belief is

$$\mu_R\lambda + \mu_M(1-\lambda) = \zeta.$$

The optimal signal implies $\lambda = \zeta + \pi_M(1-\zeta) > \zeta$, $\mu_M = 0$ and

$$\mu_R = \frac{\zeta}{\zeta + \pi_M(1-\zeta)} < 1.$$

It is immediately obvious that these conditions satisfy the requirement of Bayes plausibility. If the firm simply sent a completely truthful signal, then $\pi_M = 0$, and $\lambda = \zeta$. Relative to this, the optimal signal increases the frequency of the signal that the NGO is a radical, but reduces the PM's confidence that the NGO really is a radical when it receives the signal. This tradeoff is worthwhile because the firm merely has to create sufficient doubt about the NGO's credibility to induce the PM to eschew taking action when the NGO lobbies but the PM has received the signal that the NGO is a radical.

Sending the signal is profitable by construction as long as the PM would take the action p_ρ when its belief is ζ, that is, when $F \in (F_L, F_\rho]$. The key requirement is that the fixed costs of taking action are large enough that the PM can be persuaded not to take action if doubt about the NGO's credibility is great enough.

The increase in profits from Bayesian persuasion is illustrated in Figure 3. Without Bayesian persuasion, the PM sets p_ρ when the NGO lobbies, and does not set a policy when the NGO does not lobby; expected profits are shown in the Figure. With Bayesian persuasion, the PM has enough doubt about the NGO that if the firm's "investigation" says the NGO is a radical and the NGO subsequently lobbies, then the PM does not bother setting a policy. If the NGO fails to lobby, of course, the PM still takes no policy action. Only if the "investigation" says the NGO is a moderate and the NGO subsequently lobbies, does the PM set a policy, and in this case it sets the toughest possible policy, p_H. The firm is consciously taking a chance of receiving the worst possible payoff, which occurs when policy is set at p_H. However, the risk of obtaining this policy is more than offset by the increased likelihood of receiving no policy at all, which is accomplished by shifting the PM's posterior distribution over θ so that it places a greater weight on ω^{NP}. This is shown in the Figure by the fact that expected profits with Bayesian persuasion are higher than without it.

[Insert Figure 3 about here]

This result differs sharply from Kamenica and Gentzkow's (2011) lobbying example, in which the lobbyist never benefits from the use of Bayesian persuasion. Of course, their lobbyist is trying to directly influence the PM, while our firm is trying to indireclty influence the PM by creating doubt about the NGO's signal, but that is not the fundamental reason for the difference in results, as Proposition 4 above shows. Rather, it is the presence of fixed costs of implementing policy that create the difference. These costs enable Bayesian persuasion to dissuade the PM from taking action unless she is certain that the state is high.

5 Creating A Think Tank with Unknown Bias

The previous section has shown that creating doubt via Bayesian persuasion can be an important tool for information management, but it is only viable when there is a fixed cost to creating policy, and when that fixed cost resides within a certain range. Thus, a firm wishing to create doubt may need to have other tools at its disposal, especially if F is small. One option is the creation of a "think tank" (TT) that claims to be "pro-business" or "brown" but whose bias is not known with certainty to the PM. This uncertainty may be because the think tank is new, and does not yet have a track record against which it can be assessed, or may be because it employs a variety of people whose apparent biases differ. (Recall that Proposition 2 has already shown that the firm does not want the PM to have full information, and hence does not want to create a TT that is a fully credible moderate.) To focus attention on cases where Bayesian persuasion may not be feasible, we assume that $F = 0$ when studying the impact of a brown TT.

The TT can have two possible degrees of bias. It may be a radical "brown" with probability γ, or a moderate brown with probability $1 - \gamma$. As with our analysis of the green NGO, a radical group cannot credibly convey its information to the decisionmaker, but the moderate group can do so.[6]

If the TT is a radical brown, then it will always lobby and claim that the state is θ_L, regardless of the value of θ it observes. However, from the PM's perspective, when the TT lobbies, the TT might be a radical brown or it might be a moderate brown that in fact observed θ_L. In contrast, if the TT observes the state is $\theta = \theta_H$, and thus does not lobby, the PM can be sure the state is θ_H.

5.1 The Decision Maker's Updated Beliefs

The PM now receives two signals about the state of the world. Each lobbyist observes the true state perfectly, but the PM is unsure of their biases so is uncertain what to infer when lobbying occurs.

If the state is actually high, both the radical green NGO and the moderate green NGO will lobby and claim the state is θ_H. A moderate brown TT will not lobby, but a radical brown TT will lobby and claim the state is θ_L. Thus, there are two possibilities: both players lobby, or only the NGO lobbies. The former happens with probability γ and the latter happens with probability $1 - \gamma$.

[6] The analysis of the range of lobbying costs for which the moderate TT can credibly lobby closely parallels that for the NGO, so we do not present it here.

Likewise, if the state is actually low, both the radical brown TT and the moderate brown TT will lobby and claim the state is θ_L. A moderate green NGO will not lobby, but a radical green NGO will lobby and claim the state is θ_H. Thus, there are two possibilities: both players lobby or only the TT lobbies. The former happens with probability ζ and the latter happens with probability $1-\zeta$.

Note that there is never a state of the world in which neither party lobbies. There are three possible things the PM may observe:

1. TT lobbies and NGO lobbies. Conditional on the state being low, this happens with probability ζ. Conditional on the state being high, this occurs with probability γ. Thus, the total probability that both players lobby is $(1-q)\zeta + q\gamma$. When both players lobby the PM infers

$$\omega = \Pr(\theta = \theta_H \,|\text{Both players appear}\,) = \frac{\gamma q}{(1-q)\zeta + q\gamma}.$$

   Given this updated belief, the PM's optimal policy is to set

$$p_\omega = \omega\theta_H + (1-\omega)\theta_L.$$

   Without the TT, when the NGO lobbies the PM sets policy

$$p_\rho = \rho\theta_H + (1-\rho)\theta_L.$$

   Note that $\rho > \omega$ if

$$\frac{q}{q + (1-q)\zeta} > \frac{\gamma q}{(1-q)\zeta + q\gamma},$$

   which reduces to $\zeta q\,(1-\gamma)\,(1-q) > 0$. This is always weakly true, and it is strictly true if $0 < \gamma < 1$ and $0 < \zeta < 1$. Thus $\rho > \omega$ and hence $p_\omega < p_\rho$.

2. TT lobbies and NGO does not lobby. This can only happen if the state is low. Conditional on the state being low, the NGO does not lobby with probability $1-\zeta$. The total probability of this case is $(1-q)(1-\zeta)$. If the PM observes this case, he can infer with certainty that the state is low.

3. TT does not lobby and NGO does lobby. This can only happen if the state is high. Conditional on the state being high, the TT does not lobby with probability $1-\gamma$. The total probability of this case is $q(1-\gamma)$. If the PM observes this case, he can infer with certainty that the state is high.

The PM's expected utility is now

$$EU_M^{TT} = -\zeta\gamma q \frac{1-q}{(1-q)\zeta + q\gamma}(\theta_H - \theta_L)^2.$$

Setting policy with the NGO and the TT is more attractive to the PM than hearing from a single noisy NGO if $EU_M^{TT} > EU_M^{IP}$. Some algebra shows this is equivalent to

$$\frac{\gamma}{(1-q)\zeta + q\gamma} < \frac{1}{q + (1-q)\zeta}.$$

Since $\gamma < 1$ it is straightforward to show this is always true, so the PM prefers two noisy signals to just one, and strictly prefers two if $\zeta > 0$. Simply put, having two signals creates more information than a single

signal. In particular, it is now possible in some situations for the PM to infer with certainty that the state is high, which was impossible with a single noisy green NGO.

How does the expected policy compare when the PM is uncertain? The existence of the TT has two effects. First, it makes it more likely the PM will set the correct policy. Second, when the PM is uncertain, he sets a weaker policy than he would have otherwise (We have shown that $p_\rho > p_\omega$). Note that the expected policy (Ep^{TT}) with a noisy NGO and a noisy TT is

$$\begin{aligned} Ep^{TT} &= q(1-\gamma)p_H + (1-q)(1-\zeta)p_L + [1-q(1-\gamma)-(1-q)(1-\zeta)]\bar{p}_\omega \\ &= (1-q)\theta_L + q\theta_H. \end{aligned}$$

Thus $Ep^{TT} = \overline{\theta}$, and the addition of the TT does not change the expected policy. We have now demonstrated the following proposition.

Proposition 6 *The creation of a noisy Think Tank in addition to a noisy NGO does not change the expected policy, but it increases the expected welfare of the policy maker.*

The firm, of course, is interested in expected profits. Expected profits with an uninformed PM are

$$E\Pi^{UI} = -c\overline{\theta}^2.$$

Expected profits with imperfectly informed policy resulting from lobbying by a single noisy NGO are

$$E\Pi^{IP} = [(1-q)(1-\zeta)](-cp_L^2) + [q+(1-q)\zeta](-cp_\rho^2).$$

Expected profits with lobbying by the noisy NGO and the noisy TT are

$$E\Pi^{TT} = -q(1-\gamma)cp_H^2 - (1-q)(1-\zeta)cp_L^2 - [1-q(1-\gamma)-(1-q)(1-\zeta)]\,cp_\omega^2.$$

We can now show the following.

Proposition 7 *The firm earns higher expected profits when the think tank exists.*

Proof. Some algebraic manipulation shows that

$$E\Pi^{TT} - E\Pi^{IP} = q\left(\gamma\left(1-\omega\right) - (1-\rho)\right)\left(\theta_H - \theta_L\right)^2 \geq 0,$$

which is strictly true if $0 < \gamma < 1$ and $0 < \zeta < 1$. ■

This proposition (which parallels Proposition 4) shows that the firm prefers to have the TT exist, instead of having only the noisy green NGO. Figure 4 illustrates this result graphically. The shaded region represents the set of expected profits that are possible with any weighted averages of p_L, p_H, and p_ω. However, as we saw above, the expected policy $Ep = \overline{\theta}$ is not changed by the addition of the Think Tank, and yet expected profits are increased. Thus, the range of possible outcomes from having both the Think Tank and the noisy NGO is the dark line segment indicated on the figure.

[Insert Figure 4 about here]

Since ω and ρ are functions of the underlying variables γ and ζ, we can write

$$E\Pi^{TT} - E\Pi^{IP} = q\frac{\gamma\,(1-\gamma)\,q(1-q)\zeta}{((1-q)\zeta+q\gamma)\,(q+(1-q)\zeta)}(\theta_H-\theta_L)^2 \geq 0. \tag{20}$$

We can see immediately that the value of the think tank for the firm is only positive when there is a positive probability ζ that the NGO is a radical. (Otherwise the NGO would be completely informative and there would be no need for the PM to pay any attention to the Think Tank.) The second derivative of (20) is

$$\frac{\partial^2[E\Pi^{TT} - E\Pi^{IP}]}{\partial\gamma^2} = -2\zeta^2 q\frac{(1-q)^2}{((1-q)\zeta+q\gamma)^3} \leq 0,$$

so the benefit of the TT to the firm is concave in γ. If the firm can select a mixed strategy for the TT, and choose the probability with which it acts as a radical, its first-order condition is

$$-\zeta q\frac{1-q}{(\zeta+q(1-\zeta))\,(\zeta-\zeta q+\gamma q)^2}\left(\zeta(2\gamma-1)(1-q)+\gamma^2 q\right) = 0.$$

Thus, the value of the TT to the firm is maximized when

$$\gamma = \frac{1}{q}\left(\sqrt{\zeta^2\,(1-q)^2+q(1-q)\zeta}-\zeta(1-q)\right) \geq 0.$$

If, for example, $q = 1/2$, then the optimal γ for the firm is given by $\sqrt{\zeta^2+\zeta}-\zeta$, which is plotted below in Figure 5 (the thin solid curve in black). For beliefs $q < 1/2$, it is more valuable for the TT to be considered a radical (red dashed curves lying above the solid line), while for $q > 1/2$, it is less valuable for the TT to be considered a radical (green dashed curves lying below the solid line).

[Insert Figure 5 about here]

Thus, when the PM is uncertain about the true bias of the NGO, it is profitable for the firm to create a TT—even when $F = 0$—and the firm does not want the TT to be perceived as a moderate that can always be trusted to reveal the true state of the world. Instead, the firm prefers the TT to take a mixed strategy, acting as a moderate the majority of the time and as a radical a significant minority of the time. (It can be shown that as q goes to zero, the firm prefers the TT to act as a radical exactly half the time.) Note that for a given ζ, there exists a unique value of $q = (1-2\zeta)/(1-\zeta)$, which is decreasing in ζ, such that $\gamma = \zeta$ (shown by the intersection of the different curves with the 45-degree line). Then $\gamma > \zeta$ for all $q < (1-2\zeta)/(1-\zeta)$ and $\gamma < \zeta$ for all $q > (1-2\zeta)/(1-\zeta)$. Thus, the firm prefers the TT to be perceived as more likely than the NGO to be radical when q is small, but prefers the TT to be perceived as less likely than the NGO to be radical when q is large.

We have seen that the TT is valuable to the firm even when $F = 0$, in which case Bayesian persuasion in not feasible. If $F \in (F_L, F_\rho]$, both strategies are feasible, but it not obvious which is preferred by the firm without further analysis. If $F \in (F_\rho, F_H)$, then even without Bayesian persuasion, the PM will not act unless it is sure the state is high, and this never occurs with the noisy NGO. So there is no point creating the TT, since the PM is effectively blocked from action even with one noisy NGO. Of course, if $F > F_H$, the PM never acts, and the firm need take no action since it faces no legislative threat. The only case that merits further investigation is when $F \in (F_L, F_\rho]$, to which we now turn.

5.2 Think Tank vs. Bayesian Persuasion

Suppose $F \in (F_L, F_\rho]$, so that both Bayesian persuasion and the TT are effective means of creating doubt. Expected profits with the Think Tank are

$$E\Pi^{TT} = -q(1-\gamma)cp_H^2 - [1 - q(1-\gamma) - (1-q)(1-\zeta)]\, cp_\omega^2.$$

where

$$\omega = \frac{\gamma q}{(1-q)\zeta + q\gamma}$$

and hence

$$\bar{p}_\omega = \frac{\gamma q}{(1-q)\zeta + q\gamma} p_H + (1 - \frac{\gamma q}{(1-q)\zeta + q\gamma}) p_L.$$

Substituting in and applying some algebra reveals that we can rewrite

$$E\Pi^{TT} = -c\left(\frac{\gamma q + q(1-\gamma)(1-q)\zeta}{(1-q)\zeta + q\gamma} p_H^2 + \frac{(1-q)^2\zeta^2}{(1-q)\zeta + q\gamma} p_L^2 + 2\frac{\gamma q(1-q)\zeta}{(1-q)\zeta + q\gamma} p_H p_L\right).$$

With Bayesian persuasion, the firm's expected profits are

$$E\Pi^{BP} = -(1-\pi_M)(1-\zeta)qcp_H^2,$$

where

$$\pi_M = \frac{\zeta}{(1-\zeta)q} \frac{\sqrt{F} - qp_H - (1-q)p_L}{p_H - \sqrt{F}}.$$

Some algebraic manipulation shows that $E\Pi^{BP} > E\Pi^{TT}$ if

$$F > \underline{F} \equiv \left(\frac{\gamma p_H^2 q + (1-q)\zeta p_H p_L}{p_H(\zeta(1-q) + 2\gamma q) + \zeta p_L(1-q)}\right)^2.$$

Of course, this must be less than F_ρ in order for BP to ever be preferred on this range. We characterize the firm's preferred strategy as a function of F in the next proposition.

Proposition 8 *Suppose that $F \in (F_L, F_\rho]$. (a) If $\omega < p_L^2/(p_H - p_L)^2$, then $\underline{F} < F_L$ and BP is preferred to creating a TT. (b) If $\omega > p_L^2/(p_H - p_L)^2$, then $\underline{F} \in (F_L, F_\rho)$ and the TT is preferred for $F \in (F_L, \underline{F}]$ but BP is preferred for $F \in (\underline{F}, F_\rho]$.*

Proof. (a) Since $\sqrt{F_L} = p_L$, then $\sqrt{\underline{F}} < \sqrt{F_L}$ if

$$\frac{\gamma p_H^2 q + (1-q)\ \zeta p_H p_L}{p_H(\ \zeta(1-q) + 2\gamma q) + \ \zeta p_L(1-q)} < p_L.$$

Some algebra shows that this condition reduces to

$$\omega < \frac{p_L^2}{(p_H - p_L)^2}.$$

Thus because $F \in (F_L, F_\rho]$, BP is more profitable than a TT if $\omega < p_L^2/(p_H - p_L)^2$. (b) If $\omega > p_L^2/(p_H - p_L)^2$, then $\underline{F} > F_L$ and the TT is more profitable than BP for $F \in (F_L, \underline{F}]$. However, (7) implies that

$$\sqrt{F_\rho} = \frac{qp_H + p_L(1-q)\zeta}{q + (1-q)\zeta}.$$

Then $\sqrt{\underline{F}} < \sqrt{F_\rho}$ if

$$\frac{qp_H + p_L(1-q)\ \zeta}{q + (1-q)\ \zeta} - \frac{\gamma p_H^2 q + (1-q)\zeta p_H p_L}{p_H(\zeta(1-q) + 2\gamma q) + \zeta p_L(1-q)} > 0.$$

This reduces to

$$\left(\gamma q p_H + (1-q)\ \zeta p_L\right)^2 > 0,$$

which is always true. Thus, $\underline{F} < F_\rho$, and BP is preferred on this range. ■

The proposition shows that the PM's fixed costs of action have important implications for the firm's optimal strategy of doubt creation. As mentioned earlier, if $F < F_L$ then Bayesian persuasion is impossible and the firm prefers to create a Think Tank. When $F \in (F_L, F_\rho]$, however, either strategy may be preferred, depending on how the NGO and the TT are perceived by the PM, and on q and the gap between θ_H and θ_L. Intuitively, the condition $\omega < p_L^2/(p_H - p_L)^2$ will hold (and BP is preferred) if $p_H - p_L$ is sufficiently small or ω is sufficiently small. The former occurs if $\theta_H - \theta_L$ is small, that is, if there is little difference between the high state and the low state. The latter occurs when γ is sufficiently small, that is, when the TT is considered unlikely to be a radical. If $\gamma = \zeta$, so that the NGO and the TT are perceived as equally likely to be extremists, then $\omega = q$ and BP will be preferred if q is sufficiently small. Of course, if $F > F_\rho$, then the firm does not need to invest in either Bayesian persuasion or a Think Tank.

6 Conclusions

In this article, we have extended a workhorse model of political decision-making to incorporate the policymaker's fixed costs of taking action, and shown how the creation of doubt can be profitable for a firm under these circumstances. In this model, the decision-maker is uncertain of the state of the world, and relies on information from an expert (which we have referred to as a non-governmental organization, or NGO) to shape its decisions. We considered two strategies the firm can use. First, the firm can create doubt about the credibility of the NGO. This raises the firm's expected profits but at the expense of social welfare, as it reduces the expected utility of the policymaker. However, this strategy is only viable when the policymaker has fixed costs of taking action that fall into a certain range. Second, the firm can create a "brown" think tank that serves as a lobbyist, but whose bias is not known with certainty by the PM. This also increases the firm's profits, but it raises the expected utility of the policymaker, relative to the case of a single noisy NGO. Thus from a social perspective, the think tank is preferable to Bayesian persuasion. Nevertheless, when both strategies are feasible, the firm prefers Bayesian persuasion to a Think Tank that is perceived as likely to be moderate.

There are many related ideas that are worthy of further research. It would be of interest to explore the nature of competition between two different types of green NGO in more detail. It would also be worthwhile to study further the possibility that legislation does not pass, and that multiple NGOs then have the opportunity to engage in private politics along the lines of Baron (2010). This would allow for analysis of the conditions under which the NGO prefers public politics to private politics, and vice versa. There is

also a need to embed NGO strategic choices about lobbying within a model of competition between groups for membership and funding, such as that of Heyes and Martin (2016).

The parallels between the strategies identified here and the use of "astroturf" lobbying groups are striking and worthy of further study. Lyon and Maxwell (2004) present a theory of astroturf groups in which firms covertly fund grassroots lobbying groups in order to influence legislative decisions in their favor. This strategy implicitly creates doubt about whether grassroots groups are legitimate or simply fronts for corporate interests. The strategy examined in the present paper involves doubt about a lobbyist's objectives rather than its funding sources, as emphasized by Leitzinger and Terlaak (2013). Interestingly, Leitzinger (2014) uses uncertainty on the two dimensions of funding and objectives to classify a wide range of corporate non-market strategies ranging from greenwash to astroturf to corporate social responsibilty to think tanks. A formal model integrating both types of uncertainty might be a valuable contribution to extending non-market strategy research.

Think tanks are in particular need of more research. Their numbers have increased rapidly in the last 20 years (Djelic, 2014), but their impacts on policy and their use as part of corporate non-market strategy are only beginning to be studied. Barley (2010) notes that during the 1970s and 1980s the number of new conservative think tanks created was more than twice the number of new liberal think tanks. As explained by Jones (2014), this growth in conservative think tanks was part of a larger ideological movement commonly referred to as neoliberalism, which placed great importance on the value of unregulated free markets. Consistent with our analysis, Barley (2010, p. 792) points out that "the newcomers were less likely than their predecessors to seek reputations for unbiased objective analysis." If it is valuable for such think tanks to be publicly unclear about their political bias, as we find, how exactly should they go about creating such doubt? One natural approach is to employ a mix of "fellows," some of whom have solid academic credentials and others of whom are simply advocates for certain political positions. This is exactly what Barley (2010, p. 792) observes: "Like the older think tanks, the newcomers employed researchers to conduct studies and write articles and monographs, but they were less likely to write books or publish in established scholarly journals." Given the growing importance of think tanks, more theoretical and empirical research into their role in society seems highly worthwhile.

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Figure 1: Policy Maker Fixed Costs when NGO has Known Bias

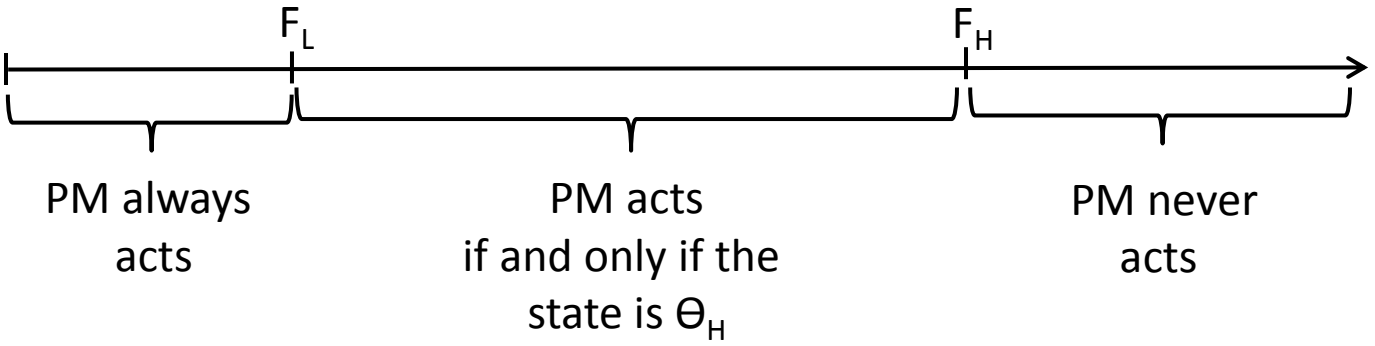

Figure 2: Expected Profits with Different Information Levels when F=0

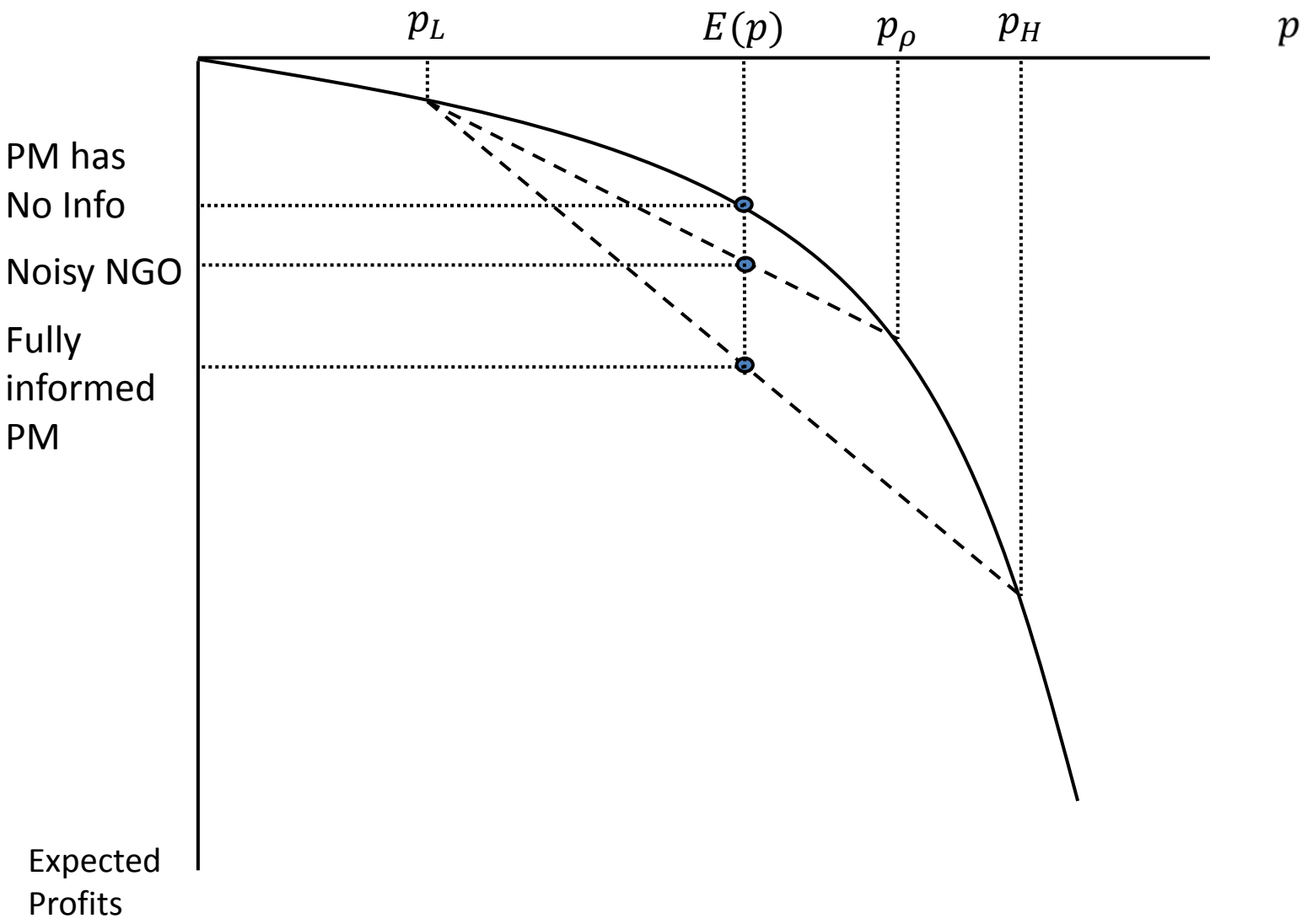

Figure 3: Expected Profits with Bayesian Persuasion when $F>F_L$

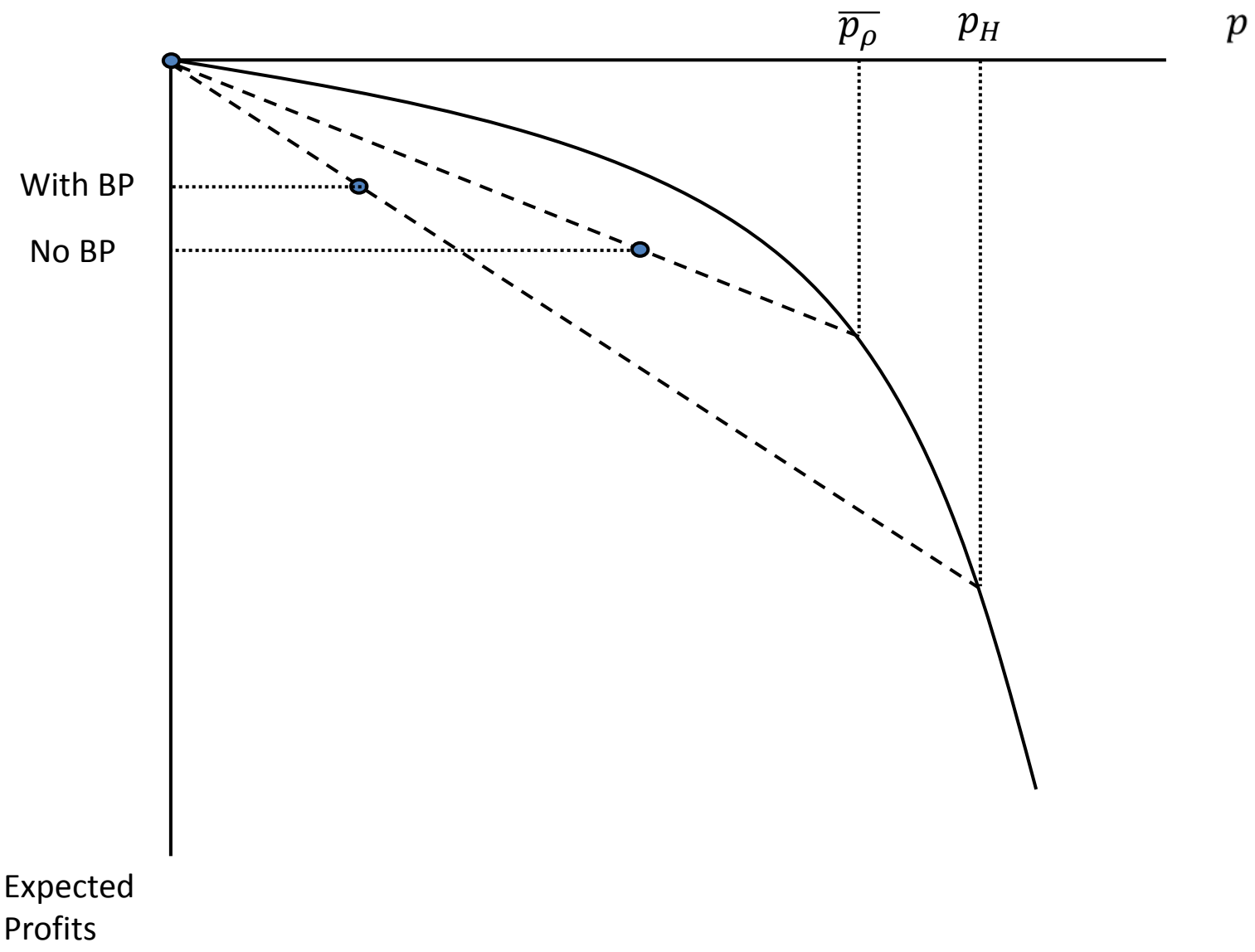

Figure 4: Expected Profits with Noisy NGO & Think Tank when F=0

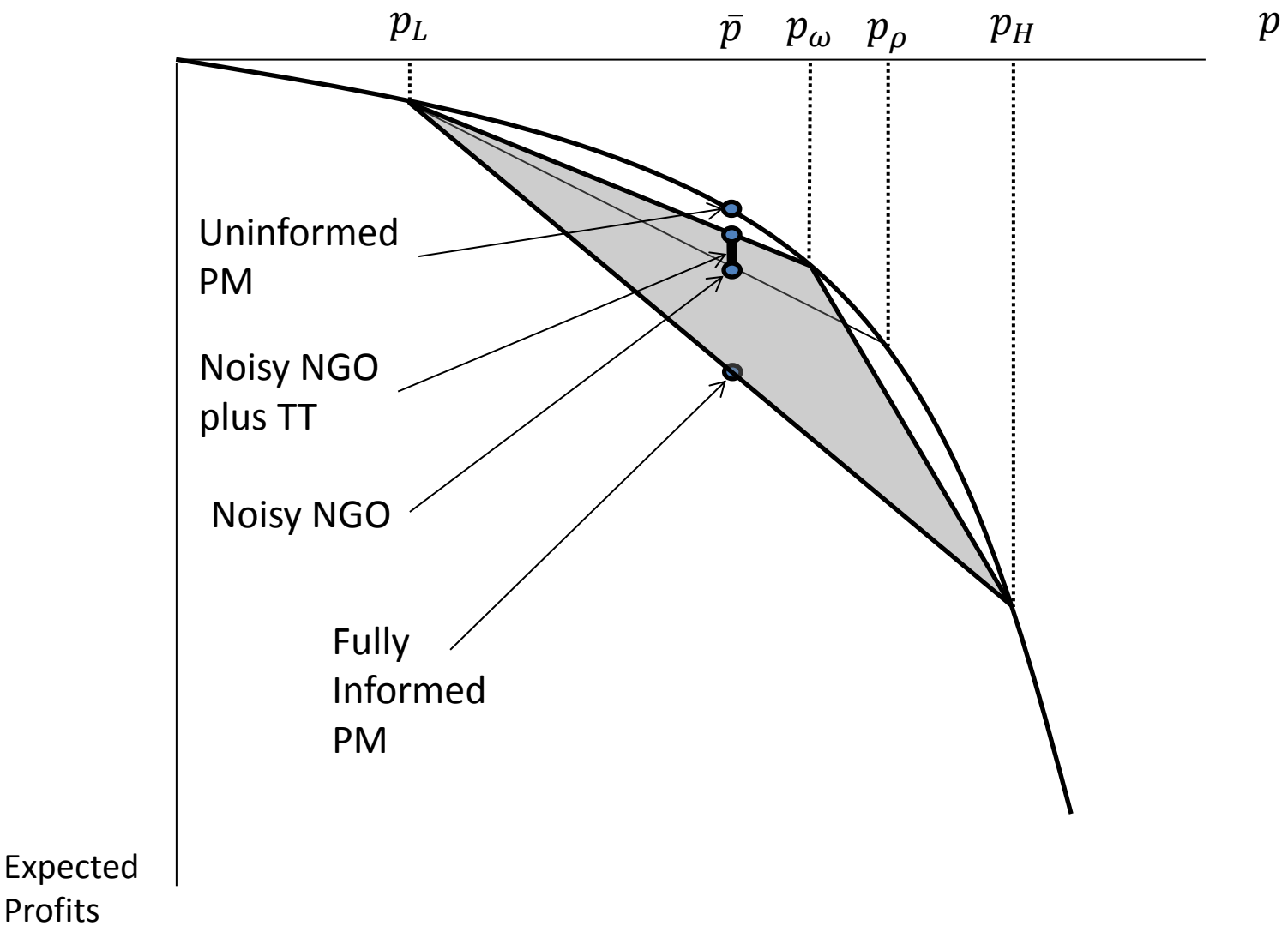

Figure 5: Preferred bias perception for the Firm