Three Stories on Influence

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Three stories on Influence

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Olivier Herlem

Les Carroz d'Arâches, August 2017

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Chapter 1

Introduction

Messire Loup vous servira,	*Sir Wolf, here, won't refuse to give*
s'il vous plaît de robe de chambre.	*His hide to cure you, as I live.*
Le Roi goûte cet avis-là:	*The king was pleased with this advice.*
On écorche, on taille, on démembre	*Flayed, jointed, served up in a trice,*
Messire Loup. Le Monarque en soupa	*Sir Wolf first wrapped the Monarch up,*
Et de sa peau s'enveloppa.	*Then furnished him whereon to sup.*

Jean de La Fontaine, *Le Lion, le Loup, et le Renard*, Livre VIII, fable 3

In literature, foxes are traditionally depicted as shrewd and wily creatures, that trick and deceive those around them. In La Fontaine's *The Crow and the Fox*, the Fox profusely compliments the Crow's voice, and steals the cheese that the credulous bird held in his beak, before he answered the praise and broke into singing. Foxes are also cunning and selfish, and behave very rationally in a way. In *The Wolf, the Fox and the Horse*, the Horse, wary of the two other animals, enjoins them to read his name off his back hooves. Circumspect, the Fox pretends to be illiterate and has the Wolf approach the Horse - and his kick - in his stead.

Foxes are not figures of power however, they obtain what they want and escape punishment not through strength or authority, but influence. They convince rather than command. Though they do not rule, they can sway their masters' decisions and bend their will to serve their own. In *The Lion, the Wolf and the Fox*, an old Lion calls on his court to bring him a cure for his old age. The Fox cautiously stays home, aware of the impossibility of the task at hand. Seeking the King's favors, the Wolf goes by his bedside and denounces the Fox's absence. Abruptly summoned, the Fox recognises the Wolf's enmity and starts appealing to the Lion. He was on a pilgrimage for the Lion's health he pleads, whereupon he learnt of a prescription to cure his ailment: flay a wolf and wear his warm skin. Heeding the advice, the Wolf is flayed and served for supper, as the Lion wraps himself in his fur.

This dissertation is also about foxes, lions and wolves. However, here they will be called decision-makers, agents, information providers, corporations, advocates, party leaders, lobbyists, interest groups or congressmen. Though they are not short fables, the following chapters each tell a different story about influence and its consequences, using economic theory and methods to discern who is the Fox or the Wolf, and who gets to keep his skin.

The second and third chapters of this book are theoretical and study, in different settings, how agents with private verifiable information can persuade a decision-maker. The fourth chapter is an empirical exercise, which shows that party leaders in the US House of Representatives have used federal funds in order to maintain voting discipline among Representatives.

Chapter 2, co-authored with Otto Swank, uses theory to analyze a practical case: pharmaceutical companies that want to bring a new drug to the market have to convince public agencies that the drug is effective and safe. How- ever, there is evidence that new drugs are sometimes approved on the basis of incomplete information. This chapter develops a simple persuasion game in which a pharmaceutical company communicates with a health agency on two aspects of a drug: effectiveness and side effects. We show that there exists an equilibrium in which a health agency may approve a drug even though the pharmaceutical company is known to conceal some information. The out- comes of this equilibrium appear to be consistent with empirical observations. We also discuss how an equilibrium with full information revelation requires the health agency to take a sceptical attitude towards all uncertain aspects of a drug.

Chapter 3 attempts to explain how organizations make decisions when they are faced with different levels of uncertainty. In this chapter, I model a persuasion game with three players: a decision-maker and two information providers. As in the previous chapter, the decision-maker is uninformed about the consequences of her decision, and relies on the information provided by interested parties. In this one however, I assume that the different aspects of the decision are heterogenous, so that the decision-maker faces an asymmetric uncertainty. The information providers act as advocates[1] and communicate on distinct aspects of the decision. I show that the asymmetric uncertainty introduces a distortionary bias in the equilibrium decision, but that more uncertainty validates this bias and alleviates its distortionary effects. I then compare the advocacy setting with two competing information providers to one where only one partisan information provider collects and sends information on all aspects of the decision. I find that welfare is higher under the advocacy system when the asymmetry is high, and reach a somwehat counterintuitive conclusion: competition among information providers that communicate on heterogenous aspects of the decision is more desirable if the asymmetry between them is high enough.

Chapter 4 is empirical and studies a somewhat more elementary tool of influence than strategic communication: quid pro quo, in the US House of Representatives. For many observers

[1] cf. Dewatripont and Tirole (1999)

in the US, earmarks - federal funds designated for local projects of US politicians - epitomize wasteful spending and corrupt politics. Others argue earmarks are critical for the legislative process because they facilitate agreements among representatives. Despite a lack of evidence supporting either side, there has been a moratorium on earmarking since 2011. Ironically, the end of earmarks provides a means to assess their effects on the legislative process. In this chapter, I exploit the introduction of the moratorium to examine the effects of earmarks on congressional voting, campaign con- tributions and spending, and electoral outcomes. I show that legislative support for the party line is tremendously sensitive to the availability of earmarks, even though earmarks represent less than a tenth of one percent of the federal budget. After ear- marks were discontinued, Representatives were much less likely to vote alongside the party leadership. I also show that, without earmarks, Representatives performed worse in ensuing elections, spent more on campaigning, and collected more money from special interests. The findings imply that because earmarks made re-election more likely, party leaders could use them to facilitate agreements on legislation. They also suggest that the discontinuation of earmarks gave special interests more influence over politicians. I conclude that earmarks are, in fact, better for the legislative process.

Chapter 2

Pieces of Truth, Pharmaceutical Companies and New Drugs

Joint work with Otto Swank

2.1 Introduction

Many countries have a health agency to control and review drugs that are brought to the market[1]. The usual procedure is that a pharmaceutical company that has developed a new drug submits an application for a marketing authorization to the responsible health agency. This application should contain evidence that the new drug is effective and safe. It is the responsibility of the company to provide this evidence. On the basis of the information supplied, the health agency then decides whether to approve the drug or not.

Since the preferences of the health agency and the pharmaceutical company are not fully aligned, we may expect that pharmaceutical companies have incentives to distort information. In a health care setting, distorting information usually means withholding information rather than forging information. The reason is that health agencies have expertise in assessing the

[1]For example, the Food and Drug Administration (FDA) in the United States and the European Medicines Agency (EMA) in the European Union.

scientific evidence that is presented to them (such as clinical trial results, chemical tests and so on.). Information is hard in the sense that it can be verified (see Dewatripont and Tirole (1999) and Beniers and Swank (2004) on the distinction between soft and hard information). Still, pharmaceutical companies can conceal information.

Milgrom and Roberts (1986) show that in a setting where a decision maker has to rely on an interested party for information and when this information is verifiable, the interested party often has incentives to reveal its information. All that is needed is that the decision maker adopt a sceptical posture. Scepticism means that if the informed party does not reveal information, then the decision maker assumes the worst. This attitude gives interested parties strong incentives to supply information. Unfortunately, Milgrom and Roberts' prediction about the revelation of information does not always come true in a health setting. On the contrary, it sometimes fails with very adverse consequences. Illustrative is the approval of Rofecoxib, an anti-inflammatory drug developed and produced by the pharmaceutical company Merck. The drug was approved by the FDA, the US health agency, in 1999, and withdrawn by Merck in 2004 over concerns that it raised the risk of cardiovascular problems. By the time Merck had taken the drug out of the market, around 80 million people had been prescribed the medicine (Topol, 2004). Ensuing litigations showed that Merck had withheld information about the risks associated with Rofecoxib from the health authorities and the medical community (Psaty and Kronmal, 2008).

Merck is not the only pharmaceutical company that has withheld information from health agencies. Turner et al. (2008) collected data on trials for antidepressants approved for marketing between 1987 and 2004. From the 38 studies that found positive results for these drug products, 37 were published. From the 36 studies that found negative results, only 3 were published. Drawing from many examples, Goldacre (2012) also argues that the pharmaceutical industry generally fails to publish all the results from clinical trials. Moreover, having a vested interest seems to matter. Bekelman et al. (2003) show that studies that are financed by pharmaceutical companies find pro-industry evidence 3.6 times more often than studies that are not.

The main objective of this chapter is to offer an explanation for why health agencies sometimes approve drugs on the basis of incomplete information. To this end, we analyze a persuasion game à la Milgrom and Roberts (1986) where the decision maker - a health agency -

faces a decision with two uncertain aspects. In this setting, a pharmaceutical company has the option to provide information about one aspect of the drug, say its effectiveness, while concealing information about the other aspect. We show that even though the health agency may know that the pharmaceutical company has concealed some information, it is under certain conditions an optimal response to approve the new drug. The implication is that optimal approval decisions cannot be guaranteed if the pharmaceutical company is able to make a case for its product. Health agencies should adopt, whenever possible, a sceptical attitude towards all relevant aspects of new drugs.

This chapter is closely related to Milgrom and Roberts (1986). We extend their model by adding another dimension of uncertainty. Sharif and Swank (2012) apply the model of Milgrom and Roberts to a lobbying setting. Much of the literature on informational lobbying uses a cheap-talk model in the spirit of Crawford and Sobel (1982). An excellent overview of this literature is Grossman and Helpmann (2001). Notably, Battaglini (2000) examines the effects of multidimensionality in a cheap-talk model. As discussed above, in our model communication is not cheap. Information can be verified. Dewatripont and Tirole (1999) analyzes a model where two parties with opposing preferences provide verifiable information about two stochastic terms. In our model, there are also two stochastic terms, but there is only one interest group, the pharmaceutical company.

2.2 The Model

Consider a pharmaceutical company (PC) that has to make a case for a new drug it has developed. A health agency (HA) makes a decision $X \in \{0, 1\}$, either granting the drug approval, $X = 1$, or rejecting it, $X = 0$. The drug has two relevant aspects, μ and ε. μ is a measure of the healing capacity of the drug for instance, and ε is a measure of its side effects. The PC knows the values of μ and ε. The HA only knows that μ and ε are uniformly distributed over the interval $[-h, h]^2$.

[2] Our results also hold with more general distributional assumptions. We choose the uniform distribution to keep computations simple.

Approval of the drug yields a payoff, $U_{HA}(X)$, to the HA equal to

$$U_{HA}(1) = p + \mu + \varepsilon \text{ with } p < 0 \tag{2.1}$$

By normalization, rejection yields a payoff equal to 0, $U_{HA}(0) = 0$. In (2.1), p is the predisposition of the HA towards approval. The assumption that $p < 0$ means that without any additional information, the HA rejects the drug. Approval of the drug yields a payoff, $U_{PC}(X)$, to the PC equal to

$$U_{PC}(1) = q + \mu + \varepsilon \text{ with } p < q < 0 \tag{2.2}$$

Again by normalization we assume that $U_{PC}(0) = 0$. q is the predisposition of the PC towards approval[3]. As $p < q$, there exist ranges of μ and ε for which the PC wants the HA to approve the drug, though it is not in the interest of the HA to approve. Finally, we assume that $-2h < p$. This assumption implies that for some values of μ and ε, the HA prefers approval to rejection. Clearly, this assumption ensures that the decision on the drug is an interesting one.

The HA relies on information provided by the PC. More specifically, we assume that the PC sends a message, m, about the stochastic terms: $m \in \{\{\mu, \varepsilon\}, \{\mu\}, \{\varepsilon\}, \varnothing\}$. $m = \{\mu, \varepsilon\}$ means that the PC reveals all its information. $m = \mu(\varepsilon)$ means that the PC reveals partial information, $\mu(\varepsilon)$. Finally, $m = \varnothing$ means that the PC does not provide any information. Following Milgrom and Roberts (1986) and Dewatripont and Tirole (1999), we assume that information is hard. The PC can withhold information, but it cannot forge it. After the HA has received m, it updates its beliefs about μ and ε, and makes a decision on X.

The timing of the game is:

1. Nature draws μ and ε. It reveals μ and ε to the PC, but not to the HA.

2. The PC sends a message to the HA.

3. The HA updates its beliefs about μ and ε, and makes a decision on X.

4. Payoffs are realized.

[3] We assume that p and q are negative for simplicity purposes. The analysis when p or q is higher than 0 is similar, but with more cases.

In the next section, we discuss three perfect Bayesian equilibria of our game. In these equilibria, the decision on X maximizes the expected payoff of the HA, given m and its beliefs about μ and ε. Moreover, anticipating the strategy of the HA and given beliefs, m maximizes the expected payoff of the PC. Lastly, whenever possible, beliefs are updated according to Bayes' rule.

In the first equilibrium, the PC does not manipulate information. As a result, the decision on X is in line with the interests of the HA. In the second equilibrium, the PC either sends a message about μ and ε, or does not send any information. Sending $m = \varnothing$ leads to approval of the drug. Finally, in the third equilibrium, the PC manipulates information by sending partial information, $m = \mu$. The strategies of the players in this third equilibrium are consistent with the observations about pharmaceutical companies and health agencies made in the introduction.

There exist other perfect Bayesian equilibria than the three we look at. An obvious one is the equilibrium in which the PC manipulates through ε instead of μ. We focus on three that are most relevant to our case. The equilibria we discuss are equilibria in straightforward threshold strategies.

2.3 Equilibria

We start with discussing an equilibrium in which the outcome of the game is always in line with the interest of the HA. We refer to this equilibrium as the informative equilibrium.

Proposition 2.1. *An equilibrium of the lobbying game exists in which the PC sends* $m = \varnothing$ *if* $p + \mu + \varepsilon < 0$*, and* $m = \{\mu, \varepsilon\}$ *if* $p + \mu + \varepsilon \geq 0$*. The HA chooses* $X = 1$ *if and only if* $m = \{\mu, \varepsilon\}$*. Out of equilibrium beliefs are:* $E(\mu + \varepsilon|\mu) < -p$ *and* $E(\mu + \varepsilon|\varepsilon) < -p$*.*[4]

A straightforward interpretation of the informative equilibrium is that the HA demands evidence on all aspects of a drug before approving it. This forces the PC to supply information about both μ and ε. As a result, the PC cannot manipulate the decision of the HA. The weakness of the informative equilibrium lies in the out of equilibrium beliefs. What does the HA believe

[4]Two variants of the informative equilibrium exist. To induce $X = 0$, the PC can send $m = \mu$ or $m = \varepsilon$ instead of $m = \varnothing$.

if the PC presents highly favorable information about μ, but no information about ε? Milgrom and Roberts (1986) point out that for an informative equilibrium to exist, a HA with a sceptical posture suffices. Then, $m = \varnothing$, $m = \mu$ and $m = \varepsilon$ mean that the PC has something to hide and the HA will reject the drug. The sceptical posture is sustainable in equilibrium because the HA can perfectly identify when the PC is hiding information. In our model, the HA knows that the PC is fully informed, and it also knows exactly what kind of information the PC holds. This allows the HA to "punish" the PC by rejecting the drug when the PC hides information. However, if there were any uncertainty about either the PC being informed, or about the existence of one of the stochastic terms, then the sceptical posture might become suboptimal for the HA. It might lead the HA to reject a the drug when it should approve it. Existence of this informative equilibrium could become problematic[5]. So a health agency needs to be able to ascertain precisely how much pharmaceutical companies know for the sceptical posture to be effective in every situation. In our model, we have implicitly assumed that the HA possesses the powers and resources to do so. If it were not the case, the HA might not be able to induce full revelation of information by the PC.

The next proposition presents an equilibrium of the game in which the outcome is always in line with the preferences of the PC. We refer to this equilibrium as the equilibrium with full manipulation.

Proposition 2.2. *Suppose $E(\mu + \varepsilon | \mu + \epsilon \geq -q) > -p$. Then, an equilibrium of the lobbying game exists in which the PC sends $m = \varnothing$ if $q + \mu + \varepsilon \geq 0$, and $m = \{\mu, \varepsilon\}$ if $q + \mu + \varepsilon < 0$. The HA chooses $X = 1$ if and only if $m = \varnothing$. Out of equilibrium beliefs are: $E(\mu + \varepsilon | \mu) < -p$ and $E(\mu + \varepsilon | \varepsilon) < -p$.*[6]

The equilibrium with full manipulation almost mirrors the informative equilibrium. Equilibrium messages have opposite meanings. From an analytical point of view the informative equilibrium and the equilibrium with full manipulation are very similar. Their existence depends on the same out of equilibrium conditions. In the context of our lobbying application,

[5] see the appendix for more details.

[6] Also two variants of the equilibrium with full manipulation exist. To induce $X = 0$, the PC can send $m = \mu$ or $m = \varepsilon$ instead of $m = \{\mu, \varepsilon\}$.

the equilibrium with full manipulation is less plausible. Procedures require that the PC makes a case for a new drug. This suggests that approval requires that at least some evidence has to be presented. What about the posture of the HA? The HA's posture is positive in case no evidence has been presented, and sceptical in case partial evidence has been presented. In our setting, a positive posture means that the HA would approve the new drug, even though information has been withheld. This positive posture is the reason why the PC can manipulate the HA. The equilibrium with full manipulation suggests that from a social point of view, the HA should not place too much trust in the PC, and that it should not give latitude to withhold information.

In the third equilibrium, the PC tries to influence the HA by sometimes supplying partial information. We refer to this equilibrium as the equilibrium with partial information provision.

Proposition 2.3. *Let $\hat{\mu} = -2p + q - h$. An equilibrium of the lobbying game exists in which the PC sends $m = \varnothing$ if $q + \mu + \varepsilon < 0$, $m = \mu$ if $q + \mu + \varepsilon \geq 0$ and $\mu \geq \hat{\mu}$, and $m = \{\mu, \varepsilon\}$ otherwise. The HA chooses $X = 0$ if $m = \varnothing$, or if $m = \{\mu, \varepsilon\}$ and $p + \mu + \varepsilon < 0$, and it chooses $X = 1$ when $m = \mu$. Out of equilibrium beliefs are: $E(\mu + \varepsilon|\varepsilon) < -p$.*[7]

In the equilibrium with partial information provision, the PC induces the HA to approve the drug by revealing μ, if μ is sufficiently high. The PC only reverts to fully revealing information with $m = \{\mu, \varepsilon\}$ if μ is low. In this case, the HA will choose $X = 1$ only if $\mu + \varepsilon > -p$. So, in case μ is sufficiently high, the outcome of the game is in line with the preferences of the PC. For small values of μ, the outcome of the game is in line with the preferences of the HA. This stands in contrast with the equilibrium presented in Proposition 2.2, where the PC always induces approval of the drug when it sends $m = \varnothing$. The strategies of both the PC and the HA presented in Proposition 2.3 are more consistent with the evidence discussed in the introduction.

[7]One variant of the equilibrium with partial information provision is one where the PC sends $m = \{\mu, \varepsilon\}$ also if $p + \mu + \varepsilon < 0$.

In practice, the effectiveness of a new drug often captures more attention than its other aspects. It is naturally the main requirement for the drug to be approved. In Proposition 2.3 the PC induces approval by advertising the potency of its new drug (μ) while withholding information about its side effects (ε), thus releasing effective but potentially harmful drugs in the market.

There exist other equilibria with partial information provision. An obvious one is the symmetric equilibrium, in which the PC sends $m = \varepsilon$ instead of $m = \mu$ if $q + \mu + \varepsilon \geq 0$ and $\varepsilon \geq \hat{\mu}$. There also exists an equilibrium in which the PC induces approval by revealing μ or ε, depending on which is higher. The analysis is similar to that in proposition 2.3, and can be found in the appendix.

In the appendix we also show that this equilibrium exists for a wider range of parameters than the equilibrium with full manipulation[8].

Note that in the equilibrium with partial information provision the posture of the HA is positive when the PC reveals μ, but the HA is sceptical when the PC reveals ε. Another interesting feature is that by revealing μ, the PC also provides information about ε. The reason is that by revealing μ, the PC signals that it wants the HA to approve the drug. Consequently, from $m = \mu$, the HA infers that $\varepsilon > -q - \mu$.

Pharmaceutical companies sometimes provide enough evidence to have drugs approved but at the same time conceal relevant information. Proposition 2.3 shows that even when the HA knows that the PC conceals information it may approve a drug. Of course, this requires that the information supplied is positive. The extent to which the PC can manipulate with providing partial information depends on its predisposition towards $X = 1$. The higher is q, the higher is $\hat{\mu}$, so the lower is the probability that with μ only the PC can induce the HA to choose $X = 1$.

Suppose that $\mu < \hat{\mu}$, $\varepsilon > \hat{\mu}$ and $\mu + \varepsilon > -q$. Can the PC induce the HA to approve the drug by sending $m = \varepsilon$? From $m = \varepsilon$, the HA likely infers that $-q - \varepsilon < \mu < \hat{\mu} = -2p + q - h$. Then, $E(\mu | m = \varepsilon) = -p - \frac{1}{2}h - \frac{1}{2}\varepsilon$. It is an optimal response of the HA to choose $X = 1$ if $p + \varepsilon + \left(-p - \frac{1}{2}h - \frac{1}{2}\varepsilon\right) > 0$, implying $\varepsilon > h$, which cannot hold by assumption. Hence, if the HA does not succeed to manipulate the HA by providing information about μ, providing instead information about ε does not help. Of course, an equilibrium with partial information provision does exist in which the PC sends $m = \varepsilon$ instead of $m = \mu$ if $q + \mu + \varepsilon \geq 0$ and $\varepsilon \geq \hat{\mu}$.

2.4 Conclusion

Pharmaceutical companies have to convince health agencies of the effectiveness and safety of the drugs they want to sell. Health agencies are responsible for protecting the public health by controling and reviewing new drugs before they are brought to the market. In this chapter we have shown that it is optimal from a public health perspective to take a sceptical attitude towards evidence presented by pharmaceutical companies. We have also shown that letting

[8]see the appendix for the proof.

pharmaceutical companies make a case for their drugs may lead to suboptimal outcomes, and we have argued that this case fitted empirical observations well.

Trial registries have been considered a potential solution to the agency problem with new drugs. Pharmaceutical companies have been encouraged to register all clinical trials they conducted, so that more information be accessible. However, most attempts to implement these registries have failed (Goldacre, 2012). Following the discussion of our results, giving pharmaceutical more trust and latitude is likely to induce them to conceal relevant information. In a public health environment, the public, the medical community and corporate interests can focus attention on the effectiveness of a drug, or divert attention from other aspects. Health agencies must withstand such pressure so that drug approval decisions not be compromised.

2.A Appendix

2.A.1 Computation of the threshold $\hat{\mu}$ in proposition 2.3.

Assume the PC sends $m = \mu$ to the HA. From this message, the HA infers that $q + \mu + \varepsilon > 0$, thus:

$$\begin{aligned} E(\mu + \varepsilon | m = \mu) &= \mu + E(\varepsilon | \varepsilon > -q - \mu) \\ &= \frac{-q + \mu + h}{2} \end{aligned}$$

The HA will then approve the drug if $p + \frac{-q+\mu+h}{2} > 0 \Leftrightarrow \mu > -2p + q - h$.

In order for the equilibrium in proposition 2.3 to exist, we need to assume that $\hat{\mu} < h \Leftrightarrow \frac{q}{2} - p < h$, otherwise a partial message would never be feasible: the threshold would be too high. We discuss existence of equilibria in footnote 9, which is detailed in this appendix further below.

2.A.2 Footnote 5: the informative equilibrium becomes more fragile when we add uncertainty.

Let us add the following assumption to our model: at the beginning of the game, the PC knows the values of μ and ε with probability γ, and with probability $1 - \gamma$ it only knows the value of μ. There is now uncertainty about whether the PC is fully informed or not. This added uncertainty reduce the range of parameter values for which the informative equilibrium exists.

Assume that the PC behaves informatively, and consider the HA's beliefs when it receives $m = \mu$.

If the HA believes that the PC only has information about μ and that it is truthfully revealing, then we have, from the HA's perspective:

$$E(\varepsilon | m = \mu) = 0$$

And the HA will approve the drug if $p + \mu > 0$. Clearly, this gives the PC incentives to deviate when it knows μ and ε, and when $-q < \mu + \varepsilon < -p$ and $p + \mu > 0$.

So the HA cannot trust the PC to behave informatively.

Now assume that the HA is sceptical (as in proposition 2.1), so that it always rejects the drug when it receives $m = \mu$. In proposition 2.1, it induces the PC to behave informatively and leads to optimal approval decisions. Here however, this may lead to suboptimal decisions, depending on parameter values.

Assume that $p > -h$, then there exist some values of μ such that $p+\mu > 0$. If the PC is only partially informed and it is revealing its information about μ when $p + \mu > 0$, the HA should approve the drug. Thus, the sceptical posture is unsustainable when $p > -h$.

Thus, the informative equilibrium would not exist when we add uncertainty and $p > -h$.

If $p < -h$, then the sceptical posture is still possible and the informative equilibrium still exists.

We presented a simple case here, but we obtain the same result when we add uncertainty about the stochastic terms, or about the PC's information.

2.A.3 Footnote 7: another equilibrium with partial information provision

There exists another form of equilibrium with partial information provision. In this equilibrium, the PC may induce the HA to approve the drug by revealing μ or ε, depending on which one is higher.

Let $\tilde{\mu} = \frac{q}{2} - p$. In this equilibrium, the PC sends $m = \varnothing$ if $q + \mu + \varepsilon < 0$; $m = \mu$ if $q + \mu + \varepsilon \geq 0$, $\mu > \varepsilon$, and $\mu \geq \tilde{\mu}$; $m = \varepsilon$ if $q + \mu + \varepsilon \geq 0$, $\mu > \varepsilon$, and $\varepsilon \geq \tilde{\mu}$; and $m = \{\mu, \varepsilon\}$ otherwise. The HA chooses $X = 0$ if $m = \varnothing$, or if $m = \{\mu, \varepsilon\}$ and $p + \mu + \varepsilon < 0$, and it chooses $X = 1$ when it receives $m = \mu$ or $m = \varepsilon$.

$\tilde{\mu}$ is derived as follows: assume that $q + \mu + \varepsilon \geq 0$, $\mu > \varepsilon$, and that the PC sends $m = \mu$. From this message, the HA infers that $\varepsilon \in [-q - \mu, \mu]$, so we have, from the HA's perspective:

$$E\left(\varepsilon | m = \mu\right) = -\frac{q}{2}$$

so that the HA will approve the drug if $p+\mu-\frac{q}{2}>0 \Leftrightarrow \mu>\frac{q}{2}-p$. The analysis is similar if $\varepsilon>\mu$ and the PC sends $m=\varepsilon$.

In order for this equilibrium to exist, we also need that $\tilde{\mu}<h \Leftrightarrow \frac{q}{2}-p<h$, which is the same condition than for the equilibrium presented in the text.

The interpretation of this equilibrium is relatively similar to the one presented in the text. Here, the PC may send information about either of the two stochastic terms. It will choose to communicate information about the better aspect of the drug, given that the information is positive enough (higher than $\tilde{\mu}$). In the equilibrium in proposition 2.3, the PC may only send information about one aspect. The notable difference here is that the PC can choose which aspect it wants to advertise by the HA, however the HA will also infer that the advertised aspect is the better one. If for instance the PC sends $m=\mu$, then the HA anticipates that $q+\mu+\varepsilon\geq 0$, and that $\varepsilon<\mu$. In order to convince the HA, μ will have to be higher than in the equilibrium in proposition 2.3: we have $\tilde{\mu}>\hat{\mu} \Leftrightarrow \frac{q}{2}-p<h$.

2.A.4 Footnote 8: the equilibrium with partial information provision exists for a wider range of parameters than the equilibrium with full manipulation.

The equilibrium with full manipulation exists if $E\left(\mu+\varepsilon|\mu+\epsilon\geq -q\right)>-p$. The equilibrium with partial information provision exists if there exists some $\mu>\hat{\mu}$ with $\mu+E\left(\varepsilon|\varepsilon>-q-\mu\right)>-p$.

So, if there exists some $\mu>\hat{\mu}$, such that $\mu+E\left(\varepsilon|\varepsilon>-q-\mu\right)>E\left(\mu+\varepsilon|\mu+\epsilon\geq -q\right)$, it means that the equilibrium with partial information provision exists for lower values of p. We show that there always exists at least one such value.

Assume $\mu=h$.

Then $\mu+E\left(\varepsilon|\varepsilon>-q-\mu\right)=h-\frac{q}{2}$

And we have $E\left(\mu+\varepsilon|\mu+\epsilon\geq -q\right)=\frac{2}{3}h-\frac{2}{3}q$

$h-\frac{q}{2}>\frac{2}{3}h-\frac{2}{3}q \Leftrightarrow 2h>-q$

which always holds.

Chapter 3

Asymmetric Persuasion

3.1 Introduction

Many decisions are made on the basis of information supplied by different parties. A buyer looking for a second-hand car may heed the advice of a salesman at a local car dealership, but also consider offers from online sellers. A judge will consider the arguments of all parties to a litigation before ruling over the case. Important decisions in central banks and corporations are often made in committees. In those instances, the individual or the organization making a decision has to consider different pieces of information received from various sources. For instance, the car seller may have very detailed information about the car engine, its fuel consumption, the tyres, the availability of spare parts, while online ads may only feature the brand of the car and its mileage. A prosecutor arguing its case before the judge may be more skilled at presenting evidence than the defense attorney. Different committee members do not necessarily have the same level of expertise on all subjects pertaining to monetary policy or corporate strategy. Furthermore, if the interests of the informed parties are not aligned with hers, the decision-maker not only has to consider the heterogenous nature of the information provided, but she also has to take into account that the informed parties may communicate strategically.

This chapter attempts to explain how individuals and organizations make decisions when they are faced with different levels of uncertainty. Consider a company that needs to decide how to allocate funds between two divisions, one with a risky project, the other with a safe one. At the board meeting, the division heads come with performance reports, business plans and forecasts to make their case in order to obtain the larger share of the budget. While the board's objective is to make the best possible decision for the company, the division heads may not share this agenda, and rather seek to obtain the best possible decision for their own division. They will then have incentives to communicate strategically. The difference in uncertainty between the two projects also matters: if the risky project turned out to be very successful, the division head might present overwhelming evidence that his project is superior. On the other hand, if the division head did not report on the project, the board could suspect that he is hiding a consequential failure, worse than any outcome of the safer project. In this chapter, I try to shed some light on the effects of such asymmetric uncertainty.

I model a persuasion game with three agents: an uninformed decision-maker, and two information providers. The decision maker must make a binary decision with uncertain consequences. Her payoffs depend on her decision and on the realizations of two random variables. The asymmetry in uncertainty is introduced with the assumption that the two variables are drawn from uniform distributions, but that one has a larger support, so that it may take more extreme values. Following Dewatripont and Tirole (1999), the two information providers act as *advocates*. Advocates have opposite preferences, and it is assumed that their payoffs are purely decision-based, so that the final decision can only be either in their favor, or against them. Furthermore, the advocates collect information and communicate on *distinct* aspects of the decision: they receive information and can send a message about only one of the two random variables. This advocay framework departs from the classic form of competition between information providers, where the agents communicate on the same aspects of the decision, and assumes instead that they communicate on separate issues. This form of organization is relatively widespread[1], and it readily applies to the company setting described above, where the division heads would not be responsible, or maybe even allowed, to report on activities outside of their own division. In line with the literature on persuasion, I assume that the agents can only send *verifiable* information. Forging information or lying is not possible, or prohibitively costly, so an informed agent can only reveal his information or hide it.

[1] Many examples can be found in Dewatripont and Tirole (1999).

The main objective of this chapter is to examine how the asymmetry in uncertainty affects the agents' communication strategies and the final decision. Competition among information providers is generally expected to increase the amount of information revealed in equilibrium, and yield more informed decisions (Milgrom and Robert (1986)). However, competition among advocates who communicate on heterogenous aspects of the decision are less clear. I first show that the asymmetry introduces a distortion: it biases the decision against the agent that can send more extreme messages. In equilibrium, both agents play a threshold strategy, i.e. they only reveal information that is likely to shift the decision in their favor and hide their information otherwise. The agent who can send more extreme messages is then also expected to hide relatively more adverse outcomes, and gets penalized by the decision maker when he does not reveal information. The second result shows that a larger degree of asymmetry increases the quality of the final decision and welfare. As the asymmetry increases, it becomes more likely that the agent that can send more extreme messages is actually hiding very adverse outcomes when he does not communicate, and the decision maker is more often right when she decides against him. In other words, more asymmetry validates the bias that it introduces in the final decision. Finally, I put the model in perspective by comparing it to one where there is only one partisan information provider collecting information and communicating on both aspects of the decision. I find that, when the asymmetry is low and when the agents are less likely to be informed ex ante, it is then more desirable to have a single agent trying to manipulate the decision maker rather than two competing advocates. When the asymmetry is high, or when the agents are very likely to be informed ex ante, the quality of the decision and welfare are higher with advocates.

I reach a somewhat counterintuitive conclusion: that competition among informed parties works better when there is more asymmetry among them. An important limitation of the model though is that it does not endogenize information collection, so that I do not examine the effects of asymmetric uncertainty on the incentives to search or produce information. This point and the relevance of the model are discussed further in the conclusion.

3.2 Related literature

This study contributes to the literature on persuasion, where interested parties try to convince an uninformed decision maker with verifiable information. A survey of the main findings from these models can be found in Milgrom (2008), and in Valsecchi (2013) who also gives a broader overview of the literature on strategic communication. With regards to previous studies on persuasion, the aim of this chapter is to provide new insights about the effects of competition between information providers. In Milgrom and Roberts (1986) for instance, competition among informed parties that have opposed interests leads to fully informed decisions. However full revelation disappears when there is uncertainty with regards to whether the informed parties are informed or not. More specifically, I draw directly upon Dewatripont and Tirole (1999) and their model of advocacy. In their paper, advocates collect verifiable information on only one of two stochastic variables. The authors show that competition among advocates generally leads to more informed decisions than a single nonpartisan information provider. They also show that when information can be concealed, the benefits of advocacy increase in the probability that the agents are informed ex ante. I extend this analysis, with a slightly more general model, where the decision maker faces an asymmetric uncertainty, represented by two different continuous stochastic variables. The main contribution of this chapter is then to show that the asymmetry induces a distortionary bias in the decision when there are two advocates, and that a single information provider can sometimes generate more welfare than advocates.

Persuasion models have also been used in a strand of literature on judicial decisions that compares the adversarial and the inquisitorial systems of litigation. In the adversarial system, an arbitrator or a judge makes a decision on the basis of evidence provided by opposing parties (for instance the plaintiff and the defendant, or the prosecutor and the defense attorney). In contrast, in the inquisitorial system, evidence is provided by a single nonpartisan agent. As in Shin (1998) and Dewatripont and Tirole (1999), the adversarial system is generally thought to be superior because competition among agents with opposed preferences generates more information disclosure than when there is only a nonpartisan agent. The findings presented in this study suggest a more nuanced argument: I show that, in the presence of asymmetry, the adversarial system may be even less efficient than a single *biased* agent, but that it remains more efficient if the asymmetry is large enough or if the advocates have a high chance of being informed ex ante.

Furthermore, this chapter adds on to previous studies on competition between informed experts, where the information setting or the players are heterogenous. Shin (1994) presents a model relatively close to the one in this chapter, where an arbitrator receives verifiable messages from a plaintiff and a defendant and decides on the amount of compensation the latter will have to pay. Both parties have an incentive to hide unfavorable information, but if one party is more likely to be informed about the true state of the world, the arbitrator will expect him to hide adverse information more often, and will be less likely to rule in his favor. I reach a different result with a similar reasoning. In the model developed below, the agents collect information and report on different issues, and it is the agent with the 'noisiest' messages who eventually gets penalized, because the decision maker expects him to hide more extreme values of his signal. Relatedly, Sharif and Swank (2012) present a model of informational lobbying with two interest groups that have different costs of information collection. They show that the interest group with the lower cost will get penalized when it does not communicate, but that the level of heterogeneity between the two interest groups does not affect the decision ex ante. In a similar way in this chapter, the amount of heterogeneity between the two aspects of the decision does not affect the decision ex ante, but it does induce a fixed constant bias against the player that can send more powerful messages. With regards to heterogeneity in the information setting, Beniers and Swank (2004) develop a model where committee members can search for either soft or hard information and show that advocacy - two agents with opposite preferences collecting hard information - yields more informed decisions when the cost collecting information is high. I do not take information collection into account, and my conclusions differ slightly, as I show that the benefits of advocacy increase when the information parties have a higher chance of being informed ex ante.

Finally, this study is related to the accounting literature on financial disclosure (see Beyer et al. (2010) for an extensive survey). The results suggests that, in a competitive environment, risky managers will communicate less often. This is rather consistent with the empirical findings in Li's (2010), who implements a lexical analysis of annual reports, and shows that reports of firms that have lower earnings are more difficult to read, and that firms with reports that are easier to read exhibit more persistent profits.

3.3 Model

I examine a persuasion game with three agents. Suppose a decision maker (DM) has to make a binary decision $X \in \{a, b\}$ with uncertain consequences η and ϕ. The optimal decision for the DM depends on the realizations of these two random variables. η and ϕ are independent. The DM can either implement project a ($X = a$) and receive payoffs $U_{DM}(X = a) = \eta + \phi$, implement project b ($X = b$), with payoffs $U_{DM}(X = b) = -(\eta + \phi)$. Thus, if the DM knew the values of η and ϕ, the optimal decision is to choose $X = a$ if $\eta + \phi$ is positive, $X = b$ if negative, and randomize between the two options when $\eta + \phi = 0$. Without loss of generality, we assume that the DM randomizes with probability $\frac{1}{2}$[2].

$$U_{DM}(X) = \begin{cases} \eta + \phi \text{ if } X = a \\ -(\eta + \phi) \text{ if } X = b \end{cases} \tag{3.1}$$

An important feature of the model is that there is some asymmetry with regards to the two dimensions of the decision. η and ϕ have the same weight in the DM's payoffs, but I assume that η is drawn from a distribution with a wider support, so that it may take more extreme values: $\eta \sim U[-\beta, \beta]$, and $\phi \sim U[\beta - 1, 1 - \beta]$, with $\beta \in \left(\frac{1}{2}, 1\right)$. I normalize $\eta + \phi \in [-1, 1]$, so that the analysis focuses on the *relative* effects of asymmetry, i.e. the effects of the difference between the two distributions, not the effects of the total amount of uncertainty.

The DM is uninformed about the realizations of η and ϕ, but she can receive information from two informed parties A and B. Another important feature of the model is that A and B are never fully informed about the consequences of the project, but rather specialize in one dimension each. A may only have information on η, and B may only have information on ϕ. At the beginning of the game, A receives a signal $s_A \in \{\eta, \emptyset\}$, B receives $s_B \in \{\phi, \emptyset\}$. This

[2]This assumption bears no significance for the analysis: any other randomization is also possible.

signal is informative, i.e. $s_i \neq \emptyset$ for $i \in \{A, B\}$, with prior probability $\rho = \Pr(s_A = \eta)$ $= \Pr(s_B = \phi)$, $\rho \in (0, 1)$.

Both parties can only send verifiable information, so that they cannot pretend to be informed if they are not, and they cannot forge the value of their signal. If their signal is informative, A sends a message $m_A \in \{\eta, \emptyset\}$ to the DM, and B sends $m_B \in \{\phi, \emptyset\}$. When informed, both parties can either disclose the value of their signal, or hide it by sending an empty message. If they do not receive an informative signal, A and B can only send an empty message $m_i = \emptyset$, $i \in \{A, B\}$. I assume that communication is free. I also assume that when A or B is indifferent between revealing the value of his signal and hiding it, they will choose to hide it and send an empty message: when they have no strict incentives to communicate, A and B will not say anything. Arguably, this assumption is relatively natural and serves as a proxy for communication costs: when they expect no gain either way, A and B would rather not communicate. Furthermore, without this assumption, there would exist infinitely many mixed-strategy equilibria, that are qualitatively similar. With it, I restrict the set of possible equilibria to a unique one where A and B play pure strategies (which also exists when the assumption is relaxed). I then focus the analysis on a relatively simpler and more natural equilibrium, without any real loss of generality.

Both parties have one-sided and opposite preferences over the DM's decision. Moreover, A and B's payoffs are purely decision-based: A receives a fixed reward $R_A(X) = R > 0$ if $X = a$, and 0 otherwise. Conversely, B receives payoffs $R_B(X) = R$ if $X = b$ and 0 otherwise.

$$R_A(X) = \begin{cases} R \text{ if } X = a \\ 0 \text{ if } X = b \end{cases} \text{ and } R_B(X) = \begin{cases} R \text{ if } X = b \\ 0 \text{ if } X = a \end{cases} \tag{3.2}$$

The timing of the game is as follows:

1. A and B receive their respective signals s_A and s_B.
2. A and B send their respective message m_A and m_B to the DM.
3. The DM updates her beliefs about η and ϕ and makes a decision on X.
4. Payoffs are realized.

The way aymmetry is introduced in the model is relatively flexible[3]. It expresses the idea that A and B communicate on heterogenous aspects of the decision. However, the asymmetry could also represent a difference in abilities between A and B: A could be more skilled at collecting information, or A could communicate 'louder' or more noisily than B. It could also be argued that the DM cares more about η than ϕ. Given that the DM is risk-neutral, it actually does not matter whether the asymmetry concerns the distributions of η and ϕ, or the DM's preferences over the two dimensions[4]. What eventually matters is the relative uncertainty between the two dimensions: in the main model, the uncertainty associated with η can have a larger impact on the DM's decision.

Following the example in the introduction, the DM would represent a board of directors and A and B two division heads. Nevertheless, the model can be applied to a variety of situations: in the context of a legal decision, the judge (DM) might be presented with different pieces evidence (η and ϕ) from the opposing parties (A and B). These pieces of evidence may not have the same relevance to the case at hand: η could be direct evidence while ϕ would be circumstancial evidence. Both η and ϕ influence the judge's choice, but if there is strong direct evidence (i.e. extreme values of η) it is enough to sway the final decision. The asymmetry can also be interpreted as a difference in abilities or resources between the two parties (A may be more skillful at presenting evidence, or better at collecting it), or even as a bias from the judge in favor of A. The model can also be applied to a organizational setting: employees that have been assigned heterogeneous tasks (A in charge of η, B in charge of ϕ) may compete for a reward by providing performance reports to the manager (DM). For the analysis of the model, I will use generic terms to refer to the game and the players.

In what follows, I look at Perfect Bayesian equilibria. This requires that A and B's communication strategies $m_A(s_A)$ and $m_B(s_B)$ are optimal given the DM's decision rule $X(m_A, m_B)$,

[3]Asymmetry in the model is represented by one distribution being a scaling of the other. A linear transform would also be possible but it would not add to the analysis. Uniform distributions were chosen for computational simplicity, but other self-replicating distributions could also be possible.

[4]We could assume that η and ϕ are drawn from the same distribution $U[-1,1]$, but that the DM cares relatively more about the value of ϕ, such that:

$$U_{DM}(X) = \begin{cases} \beta\eta + (1-\beta)\phi \text{ if } X = a \\ -(\beta\eta + (1-\beta)\phi) \text{ if } X = b \end{cases}$$

with $\beta \in \left(\frac{1}{2}, 1\right)$. The analysis of both model variants is entirely similar.

and that the DM's decision rule is optimal given her beliefs about A and B's communication strategies. Beliefs are updated using Bayes' rule. Most proofs can be found in the appendix.

3.4 Analysis

I first examine A and B's communication strategies. Then I establish the equilibrium of the game and the first results.

3.4.1 Preliminaries: threshold strategies

When informed, A and B have one alternative: either reveal or hide the value of their signal. In equilibrium, the DM will update her beliefs about the values of η and ϕ, after receiving m_A and m_B. Her optimal behavior is then to choose $X = a$ if $E(\eta|m_A) + E(\phi|m_B) > 0$[5], $X = b$ if $E(\eta|m_A) + E(\phi|m_B) < 0$ and it is assumed that she randomizes between the two choices with probability $\frac{1}{2}$ if $E(\eta|m_A) + E(\phi|m_B) = 0$. Given that A and B cannot lie about the value of their signals, then A will have an incentive to reveal only high values of η, and B only low values of ϕ, in order to shift the DM's decision in their favor.

Formally, this implies that for A and B, given the DM's decision rule, and given the other player's communication strategy, a threshold strategy is a best response. For instance, assume that A is informed and receives $s_A = \{\eta\}$. A anticipates the DM's decision rule as described above and that $E(\eta|m_A = \emptyset) + E(\phi|m_B = \emptyset) < 0$ so that the DM chooses $X = b$ when she receives two empty messages. For any strategy that B plays, i.e. for any $P \subset \{[\beta - 1, 1 - \beta], \emptyset\}$, such that, when informed, B reveals ϕ if $\phi \in P$, and hides if $\phi \notin P$, A's expected payoffs are then[6]:

[5] η and ϕ are independent, so that for the DM $E(\eta + \phi|m_A, m_B) = E(\eta|m_A) + E(\phi|m_B)$.

[6] The expected value $E(\phi|m_B = \emptyset)$ is from the DM's perspective.

$$E\left(R_A\left(X\right)\right)=\begin{cases}\left(1-\rho\right)R+\rho\Pr\left(\phi\notin P\right)R+\rho\Pr\left(\eta+\phi>0|\phi\in P\right)R\\ \text{ if } \eta>-E\left(\phi|m_B=\emptyset\right) \text{ and A reveals}\\ \\ \left(1-\rho\right)\frac{1}{2}R+\rho\Pr\left(\phi\notin P\right)\frac{1}{2}R+\rho\Pr\left(\eta+\phi>0|\phi\in P\right)R\\ \text{if } \eta=-E\left(\phi|m_B=\emptyset\right) \text{ and A reveals}\\ \\ \rho\Pr\left(\phi\in P|\eta+\phi>0\right)R\\ \text{ if } \eta<-E\left(\phi|m_B=\emptyset\right) \text{ and A reveals}\\ \\ \left(1-\rho\right)R+\rho\Pr\left(\phi\notin P\right)R+\rho\Pr\left(\phi+E\left(\eta|m_A=\emptyset\right)>0|\phi\in P\right)R\\ \text{if A hides}\end{cases} \tag{3.3}$$

A's expected payoffs when revealing are increasing in the value of η. Moreover, if η is very low, then it is optimal for A to hide his signal. Thus, for any strategy that B may play, A's best response is a threshold strategy: when informed, A reveals η if η is larger than a threshold $\bar{\eta}$, and hides his signal otherwise. The optimal value of $\bar{\eta}$ depends on A' anticipation of the DM's decision rule and B's strategy. The same analysis applies to the situation where $E\left(\eta|m_A=\emptyset\right)+E\left(\phi|m_B=\emptyset\right)<0$ and the DM chooses $X=b$ when she receives two empty messages. This applies similarly to B: for any strategy that A may play, B's best response when informed will be to reveal ϕ if ϕ is lower than a threshold $\bar{\phi}$, and hide otherwise.

Lemma 1. *In equilibrium, A and B's strategies can only be threshold strategies.*

Furthermore, the strategies 'always reveal when informed' and 'always hide' can be considered as threshold strategies where the threshold is equal to one of the bounds of the distribution. However they cannot be equilibrium strategies. For A for instance, always revealing cannot be optimal for very low values of η. Always hiding is also not tenable in equilibrium: the DM would have expectations $E\left(\eta|\emptyset\right)=0$, which would give A incentives to deviate when $\eta>0$. A similar reasoning holds for B. These strategies can then be ignored, when I solve for equilibrium.

3.4.2 Equilibrium

I now solve the model: the DM's optimal behavior is straightforward: choose $X = a$ if $E(\eta|m_A) + E(\phi|m_B) > 0$, $X = b$ if $E(\eta|m_A) + E(\phi|m_B) < 0$, and either option with probability $\frac{1}{2}$ if $E(\eta|m_A) + E(\phi|m_B) = 0$. As was shown above, when A and B anticipate this decision rule, their best response is to play a threshold strategy: when informed, A will reveal η if $\eta > \bar{\eta}$, $\bar{\eta} \in [-\beta, \beta]$; and when informed, B will reveal ϕ if $\phi < \bar{\phi}$, $\bar{\phi} \in [\beta - 1, 1 - \beta]$. In equilibrium, A and B choose their optimal thresholds $\bar{\eta}$ and $\bar{\phi}$ given the DM's decision rule, and given that the other information provider plays an optimal threshold strategy.

The DM correctly anticipates the threshold strategies in equilibrium and updates her beliefs about η and ϕ accordingly. For instance, if the DM receives $m_A = \{\eta\}$, then she knows the true value of η; if she receives $m_A = \emptyset$, then she knows that either A is uninformed, or A is informed and $\eta \leq \bar{\eta}$, and she updates her beliefs as follows:

$$\begin{aligned} E(\eta|m_A = \emptyset) &= \begin{array}{c} \Pr(s_A = \emptyset|m_A = \emptyset) E(\eta|s_A = \emptyset) \\ + \Pr(s_A \leq \eta|m_A = \emptyset) E(\eta|\eta \leq \bar{\eta}) \end{array} \\ &= \rho \frac{\bar{\eta}^2 - \beta^2}{4\beta - 2\beta\rho + 2\bar{\eta}\rho} \end{aligned} \tag{3.4}$$

Similarly, when B sends $m_B = \emptyset$:

$$\begin{aligned} E(\phi|m_B = \emptyset) &= \begin{array}{c} \Pr(s_B = \emptyset|m_B = \emptyset) E(\phi|s_B = \emptyset) \\ + \Pr\left(s_B \geq \bar{\phi}|m_B = \emptyset\right) E\left(\phi|\phi \geq \bar{\phi}\right) \end{array} \\ &= \rho \frac{\bar{\phi}^2 - (1-\beta)^2}{2(1-\beta)\rho - 4(1-\beta) + 2\bar{\phi}\rho} \end{aligned} \tag{3.5}$$

In order to describe the equilibrium mechanisms, let us consider A's decision. A anticipates the DM's decision rule and expects B to play an optimal threshold strategy. Thus, in equilibrium A knows the values of $E(\eta|m_A = \emptyset)$ and $E(\phi|m_B = \emptyset)$, and what the DM will choose when she receives two empty messages. Furthermore, A knows the ex ante probability that B is informed and for which values of ϕ B will reveal his signal or send an empty message. If A is uninformed, he can only send an empty message. If A is informed, his expected payoffs from revealing η are increasing in η (cf. (3.3)). Whether η is greater, lower or equal to $E(\phi|m_B = \emptyset)$ also matters since there is always a positive probability that B sends an empty message (if B is uninformed, or if $\phi \geq \bar{\phi}$). A's expected payoffs from hiding depend on how often B reveals values of ϕ that are lower than $E(\eta|m_A = \emptyset)$, and on what the DM chooses when she receives two empty messages. The optimal threshold $\bar{\eta}$ is then the value of η for which his expected payoffs from revealing η and his expected payoffs from hiding are equal. B's optimal threshold $\bar{\phi}$ is determined in a similar manner.

We can now establish the unique equilibrium of the game. Uniqueness is ensured by the assumption that A and B send an empty message when they are indifferent between hiding and revealing their information.

Equilibrium. There exists a unique equilibrium where:

- the DM chooses $X = a$ if $E(\eta|m_A) + E(\phi|m_B) > 0$, $X = b$ if $E(\eta|m_A) + E(\phi|m_B) < 0$, and randomizes between the two with probability $\frac{1}{2}$ if $E(\eta|m_A) + E(\phi|m_B) = 0$. In equilibrium the DM then chooses:
  - $X = a$ when $\{m_A, m_B\} = \{\eta, \emptyset\}$, or $\{m_A, m_B\} = \{\eta, \phi\}$ and $\eta + \phi > 0$.
  - $X = b$ when $\{m_A, m_B\} = \{\emptyset, \phi\}$, or $\{m_A, m_B\} = \{\eta, \phi\}$ and $\eta + \phi < 0$, or when $\{m_A, m_B\} = \{\emptyset, \emptyset\}$.
- A and B both play a threshold strategy: when informed, A reveals if $\eta > -E(\phi|m_B = \emptyset)$ and hides otherwise; when informed, B reveals if $\phi < E(\phi|m_B = \emptyset)$ and hides otherwise.
- $$E(\phi|m_B = \emptyset) = \frac{1}{\rho}(\beta - 1)\left(\rho + 2\sqrt{-\rho + 1} - 2\right) \tag{3.6}$$

When the DM receives two informative messages, i.e. $\{m_A, m_B\} = \{\eta, \phi\}$, then she can always make an informed decision. When she receives only one informative message, i.e. $\{m_A, m_B\} \in \{\{\eta, \emptyset\}, \{\emptyset, \phi\}\}$, she always decides in favor of the player who sent the informative message. The salient feature of this equilibrium however, is that the DM always choose

$X = b$ when she receives two empty messages: $E(\eta|\emptyset) + E(\phi|\emptyset) < 0$ always holds in equilibrium. There does not exist an equilibrium where, in this situation, she chooses $X = a$ or randomizes between the two options. Uniqueness of the equilibrium is ensured by the assumption that A and B remain silent when they are indifferent between revealing and hiding their signal, but relaxing that assumption does not allow for equilibria where the DM follows a different decision rule than in the equilibrium above.

The fact that the DM will favor B when both information providers remain silent is a direct consequence of asymmetry. A receives a signal drawn from a distribution with a wider support, so A's message may contain more extreme values, that can even make B's message irrelevant (when $\eta > 1 - \beta$). But given that A plays a threshold strategy, it also implies that the DM will expect A to hide more extreme values when he sends an empty message. In equilibrium then, the DM will always choose $X = b$ when A sends an empty message. Whether B reveals or sends an empty message, $X = b$ is always the best decision: B reveals if $\phi < E(\phi|m_B = \emptyset)$ and hides otherwise, and $E(\eta|m_A = \emptyset) + E(\phi|m_B = \emptyset) < 0$.

In equilibrium then, A always receives null payoffs when he sends an empty message, which affects his communication strategy. A never has a strict incentive to hide his signal. But he also has no incentive to communicate if $\eta \leq -E(\phi|m_B = \emptyset)$, in which case he will send an empty message. Only when $\eta > -E(\phi|m_B = \emptyset)$ does A have an incentive to reveal his signal. In contrast, B has an incentive to send an empty message when $\phi \geq E(\phi|m_B = \emptyset)$, since there is always a positive probability that A will send an empty message (either because he is uninformed, or because $\eta \leq -E(\phi|m_B = \emptyset)$), which would then induce the DM to choose $X = a$.

When we compare A and B's communication in equilibrium, we also see that, ex ante, B will reveal his signal more often than A:

$$\Pr(\eta > -E(\phi|m_B = \emptyset)) < \Pr(\phi < E(\phi|m_B = \emptyset)) \tag{3.7}$$

Both distributions are symmetric around 0, only the support for η is wider, which implies that $\Pr(\eta > -E(\phi|m_B = \emptyset)) < \Pr(\phi > E(\phi|m_B = \emptyset))$. Furthermore, $E(\phi|m_B = \emptyset)$ is decreasing in β (cf. (3.6)) , $\Pr(\eta > -E(\phi|m_B = \emptyset))$ is also decreasing in β.Thus, the asymmetry not only harms A'prospects when he sends an empty message, it also makes his communication relatively less effective than B's and induces him to stay silent relatively more often.

Based on the players' behavior in equilibrium, we can compute the ex ante probabilities that the DM will choose $X = a$ or $X = b$, which yields the first proposition.

Proposition 3.1. *Asymmetric uncertainty induces a fixed constant bias against the information provider that can send more extreme messages. In equilibrium, the ex ante probability that the DM chooses* $X = a$ *is* $\Pr(X = a) = \frac{1}{2}\rho$*, while* $\Pr(X = b) = 1 - \frac{1}{2}\rho$*, and the asymmetry parameter* β *does not affect the ex ante decision.*

This result may seem counterintuitive: asymmetry was introduced by assuming that one dimension of the decision, η, may matter more than the other. Yet A, who collects and provides information about η is actually penalized in equilibrium: ex ante the DM is always more likely to choose $X = b$. Instead of favoring A, the asymmetry biases the decision against him. This bias in the DM's ex ante decision is caused by the threshold strategies. The fact that η may take larger values than ϕ can be an advantage when A actually reveals his signal, but it also means that A can hide larger values when he sends an empty message. An empty message from A carries more uncertainty relatively to one from B, which the DM accounts for, leading him to always choose $X = b$ then.

This bias in the ex ante decision is also fixed and constant in the sense that it is not affected by the degree of asymmetry β. No matter how large or small β is, the DM already accounts for the asymmetry when she forms her expectations ex ante. It is not the extent of asymmetry but only its presence that shapes the DM's choice, with regards to the situations where A will be informed or not. In the latter case, A will always send an empty message, which induces the DM to choose $X = b$. This property of the DM's ex ante decision can also reformulated as follows: *conditional on A being informed*, the ex ante decision is fully neutral: $\Pr(X = a|s_A \neq \emptyset) = \frac{1}{2}$; and *conditional on A being uninformed*, the ex ante decision is fully biased towards B: $\Pr(X = a|s_A = \emptyset) = 0$.

3.4.3 Advocacy and asymmetry

In the previous section, I derived the unique equilibrium of the game and showed that the asymmetry between η and ϕ had a significant impact on the DM's decision rule in equilibrium. Now we turn to the effect of asymmetry on the quality of the DM's decision. In this section, I investigate the normative implications of the asymmetric uncertainty. I first put the model in perspective by examining its two polar cases, before looking at the effect of asymmetry on the quality of the DM's decision and on welfare.

The model actually represents a continuum of situations between two polar cases: 1) $\beta = \frac{1}{2}$, no asymmetry: η and ϕ have the same distribution and competition between A and B is completely symmetric; 2) $\beta = 1$, fully asymmetry: only η (and only A) matters. The analysis of these two cases helps to understand how the introduction of asymmetry and its value β affect a) the DM's decision rule, b) communication from A and B in equilibrium, and importantly c) the probability that the DM will make a mistake. In both cases there is a unique equilibrium. The derivations are similar to those for the main model. I present those equilibria below with the corresponding ex ante decision probabilities from the DM.

1) *Equilibrium for the symmetric case,* $\beta = \frac{1}{2}$. There exists a unique equlibrium where:

- the DM chooses $X = a$ if $E(\eta|m_A) + E(\phi|m_B) > 0$, $X = b$ if if $E(\eta|m_A) + E(\phi|m_B) < 0$, and randomizes between the two with probability $\frac{1}{2}$ if $E(\eta|m_A) + E(\phi|m_B) = 0$. Furthermore, in equilibrium the DM is always indifferent and randomizes if she receives two empty messages, i.e. $E(\eta|m_A = \emptyset) + E(\phi|m_B = \emptyset) = 0$.

- A and B both play a threshold strategy: when informed, A reveals if $\eta > E(\eta|m_B = \emptyset)$ and hides otherwise; when informed, B reveals if $\phi < E(\phi|m_B = \emptyset)$ and hides otherwise.

- The thresholds are symmetric:

$$E(\eta|m_A = \emptyset) = -E(\phi|m_B = \emptyset) = -\frac{1}{\rho}(\beta - 1)\left(\rho + 2\sqrt{-\rho + 1} - 2\right) \tag{3.8}$$

- Ex ante, the DM chooses $X = a$ and $X = b$ with equal probability: $\Pr(X = a) = \Pr(X = b) = \frac{1}{2}$

2) *Equilibrium for the fully asymmetric case,* $\beta = 1$. There exists a unique equlibrium where:

- the DM chooses $X = a$ if $E(\eta|m_A) > 0$, $X = b$ if if $E(\eta|m_A) < 0$, and randomizes between the two with probability $\frac{1}{2}$ if $E(\eta|m_A) = 0$. Furthermore, in equilibrium the DM always chooses $X = b$ when she receives an empty message, i.e. $E(\eta|m_A = \emptyset) < 0$.

- A plays a threshold strategy: when informed, A reveals if $\eta \geq 0$ and hides otherwise.

- Ex ante, the DM chooses $X = a$ with probability $\Pr(X = a) = \frac{1}{2}\rho$, and $X = b$ with probability $\Pr(X = b) = 1 - \frac{1}{2}\rho$

With regards to the DM's ex ante decision, the symmetric case ($\beta = \frac{1}{2}$) unsurprisingly yields no bias towards A or B. In the fully asymmetric case ($\beta = 1$) however, the DM's ex ante decision is similar to the main model: A is being penalized when he sends an empty message, which induces a bias against him in the DM's decision. It is also worth noting how the ex ante probabilities of choosing $X = a$ or $X = b$ are the same, whether there are two competing information providers that communicate on distinct and asymmetric aspects of the decision, or just one that communicates on one aspect.

Concerning A and B's communication in equilibrium, we can see that B will reveal his signal as often in the symmetric case as in the main model, regardless of the value of β. In the fully asymmetric case, B becomes irrelevant. A on the other hand, reveals his signal as often as B in the symmetric case, but then less and less often as the asymmetry gets larger (cf. (3.7), $\Pr(\eta > -E(\phi|m_B = \emptyset))$ is decreasing in β). This result is relatively standard: more symmetric competition between information providers induces them reveal their signal more often in equilibrium.

Up til now, we have seen how the asymmetry between η and ϕ affects the DM's choice between $X = a$ and $X = b$ in equilibrium, but not how it affects the *accuracy* of her decision. I define it here as the ex ante probability that the DM will make the correct choice, i.e. choose $X = a$ when $\eta + \phi > 0$, and $X = b$ when $\eta + \phi < 0$. In order to evaluate how accurate the DM is we can then compute the ex ante probability $P^*(miss)$ that the DM will make a mistake in equilibrium:

$$\begin{aligned} P^*(miss) &= \Pr(X = a|\eta + \phi < 0) + \Pr(X = b|\eta + \phi > 0) && (3.9) \\ &= \frac{1}{2\beta\rho}(\rho - 1)\left(4\beta + 2\rho + 4\sqrt{1-\rho} - 3\beta\rho - 4\beta\sqrt{1-\rho} - 4\right) && (3.10) \end{aligned}$$

For completeness, we can directly compute the value of $P^*(miss)$ in the symmetric case ($\beta = \frac{1}{2}$) and the fully asymmetric case ($\beta = 1$), or use the expression above. $P^*(miss)$ is continuous and decreasing in β, for $\beta \in \left[\frac{1}{2}, 1\right]$.

Furthermore, given the players' strategies in equilibrium, we can compute the ex ante welfare of the game, represented by the expected utility from the DM in equilibrium $E^*(U_{DM})$:

$$E^*(U_{DM}) = \begin{array}{c} \Pr(\{m_A, m_B\} = \{\eta, \emptyset\}) E(\eta + \phi | \{m_A, m_B\} = \{\eta, \emptyset\}) \\ + \Pr(\{m_A, m_B\} = \{\emptyset, \phi\} (-E(\eta + \phi | \{m_A, m_B\} = \{\emptyset, \phi\}))) \\ + \Pr(\{m_A, m_B\} = \{\eta, \phi\} \wedge \eta + \phi > 0) \\ E(\eta + \phi | \{m_A, m_B\} = \{\eta, \phi\} \wedge \eta + \phi > 0) \\ + \Pr(\{m_A, m_B\} = \{\eta, \phi\} \wedge \eta + \phi < 0) \\ (-E(\eta + \phi | \{m_A, m_B\} = \{\eta, \phi\} \wedge \eta + \phi < 0)) \\ + \Pr(\{m_A, m_B\} = \{\emptyset, \emptyset\} (-E(\eta + \phi | \{m_A, m_B\} = \{\emptyset, \emptyset\}))) \end{array} \quad (3.11)$$

$E^*(U_{DM})$ is also continuous and increasing in β, for $\beta \in \left[\frac{1}{2}, 1\right]$, which yields the second proposition.

Proposition 3.2. *More asymmetry leads to a less informed but more accurate decision ex ante, and to more welfare. As β becomes larger, A communicates less often, but the ex ante probability that the DM makes a mistake decreases and her expected utility increases.*

The fact that asymmetry improves the quality of the DM's decision and her expected utility even though less information is communicated is due to η and ϕ being investigated *separately.* Competition between A and B does make them reveal their signals more often than if they were the only information provider, but it also induces more mistakes when the DM receives empty messages because both of them play threshold strategies on distinct aspects of the decision. For instance, when in equilibrium A sends a message $m_A = \{\eta\}$, with $\eta \in [-E(\phi|m_B = \emptyset), 1-\beta]$ and B remains silent and sends $m_B = \emptyset$, the DM will always choose $X = a$. If B is silent because he is informed and $\phi > E(\phi|m_B = \emptyset)$, the DM is making the right choice. However if B is silent because he is uninformed, there is a positive probability that the DM is making a mistake since, ex ante, $\Pr(\phi < -\eta|\eta \in [-E(\phi|m_B = \emptyset), 1-\beta]) > 0$. A similar reasoning applies when B sends an informative message and A stays silent, and when both of them send an empty message.

The asymmetry biases the DM's decision towards B and makes her mistakes more one-sided: in expectations the DM will make a mistake in favor of B more often:

$$\Pr(X = a|\eta + \phi < 0) < \Pr(X = b|\eta + \phi > 0) \tag{3.12}$$

However, the asymmetry also reduces the size of the mistake: as β grows larger, then the probability that A is hiding a very low value of η relatively to ϕ also grows larger. In other words, a larger asymmetry increases the likelihood that the DM's bias against A is actually right. In contrast, symmetric competition between A and B, when $\beta = \frac{1}{2}$, leads to an unbiased decision in equilibrium ($\Pr(X = a) = \Pr(X = b) = \frac{1}{2}$), but it also increases the probabilities of making a mistake both in favor of A and in favor of B.Thus, the asymmetry biases the DM's decision in equilibrium, but the larger the asymmetry the more valid this bias becomes, and the more the DM's expected utility increases.

3.4.4 Advocates vs. single partisan

In this section, I ask a broader question: is advocacy a good organizational choice for the DM? One pivotal feature of the model is that information about η and ϕ are collected and communicated separately. For this reason, competition between two enfranchised agents who only collect one signal can actually be detrimental to the DM's decision, because it provides them with distinct opportunities to manipulate her. Competition does induce the agents to behave more informatively, but it also increases the chances of manipulation. I argued in Proposition 2 that the asymmetry between η and ϕ can alleviate this issue: it biases the DM's decision, but more asymmetry validates this bias and reduces the likelihood of making a mistake. When competing information providers collect information and communicate about the same aspect(s) of the decision, then competition leads to more informed and more accurate decisions. In our model however, the fact that η and ϕ are investigated separately undermines the positive effects of competition. This raises the question of whether advocacy is beneficial to the DM, or under what conditions it can be so.

Model variant with a single partisan

Alternatively, I consider a variant of the model without competition: there is only one agent, A, with one-sided preferences over the DM's decision, who collects information and communicates about both η and ϕ. In line with the main model, A receives *separate* signals $s_\eta \in \{\eta, \emptyset\}$ and $s_\phi \in \{\phi, \emptyset\}$, which are informative with prior probability $\Pr(s_\eta = \{\eta\}) = \Pr(s_\phi = \{\phi\}) = \rho$. If A is fully informed, he can decide to communicate on both η and ϕ, or just one aspect, or none at all, i.e. he can send a message $m_A \in \{\{\eta, \phi\}, \{\eta\}, \{\phi\}, \emptyset\}$. If A is partially informed, i.e. if $\{s_\eta, s_\phi\} \in \{\{\eta, \emptyset\}, \{\phi, \emptyset\}\}$, he can send a partial message $m_A = \{\eta\}$ if he only knows η, or $m_A = \{\phi\}$ if he only knows ϕ, or an empty message $m_A = \emptyset$. Finally, if A does not receive any informative signal, he can only send an empty message. The rest of the model is otherwise similar to the one above: the DM's and A's payoffs are the same, information is verifiable, and the timing of the game is similar. The main difference between this variant and the main model is that A can now use two separate signals to communicate, which augments his opportunities for manipulation. In order to induce the DM to choose $X = a$, A can either reveal both signals when $\eta + \phi > 0$ if he is fully informed, or send a partial message $m_A = \{\eta\}$ or $m_A = \{\phi\}$ if its value is high enough to convince the DM.

This variant with a single partisan does not admit an equilibrium where A always truthfully reveals his signals. Assume that the DM expects him to behave so, then she would choose $X = a$ when A reveals both signals and $\eta + \phi > 0$, but also when A reveals only one positive signal. For instance, when the DM receives $m_A = \{\eta\}$ with $\eta > 0$, she would infer that A only received an informative signal about η and choose $X = a$. But this gives A incentives to deviate when he is fully informed and $\eta + \phi < 0$ but $\eta > 0$.

This game admits three equilibria that are qualitatively similar. In these equilibria, A' communication strategy follows the same pattern: when A is fully informed, he will first try to persuade the DM to choose $X = a$ with partial messages. If partial messages fail, A will reveal both signals if $\eta + \phi \geq 0$. Otherwise, A will send an empty message. When A is partially informed, he will try to persuade the DM with a partial message, and if that is not possible he will send an empty message.

It is always optimal for A to send partial messages first when he is fully informed. If the DM expects A to reveal both signals first instead, this hampers A's capacity to manipulate the DM with partial messages when sending both signals is ineffective, or when A is only partially informed. Let us assume that, when fully informed, A reveals both signals first, then η only if sending both signals is ineffective, and then ϕ only if $m_A = \{\eta, \phi\}$ and $m_A = \{\eta, \emptyset\}$ are both ineffective. If $\eta + \phi > 0$, A is able to persuade the DM by sending $m_A = \{\eta, \phi\}$ and the DM chooses $X = a$. But if A sends a partial message $m_A = \{\eta\}$, the DM will update his beliefs as follows: either A is partially informed and has no information on ϕ, or A is fully informed and chose not to reveal both signals because $\eta + \phi < 0 \Leftrightarrow \phi < -\eta$ and:

$$E\left(\phi | m_A = \{\eta\}\right) = \frac{\rho \Pr\left(\phi < -\eta\right)}{\rho \Pr\left(\phi < -\eta\right) + (1 - \rho)} E\left(\phi | \phi < -\eta\right) \tag{3.13}$$

Sending $m_A = \{\eta\}$ makes it harder for A to manipulate the DM with partial messages then, because the DM will always consider the possibility that A is hiding low values of $\eta + \phi$. This decreases A' chances to manipulate the DM when he is fully informed but also when he is partiallly informed and can only send partial messages.

If A chooses to reveal partial signals first, this effect is mitigated: let us now assume that when he is fully informed A reveals ϕ first, then η, and only if partial messages do not succeed does he reveal both. When he is partially informed, A sends partial messages first. When A sends $m_A = \{\phi\}$, the DM cannot infer any information about η: A could be fully informed or partially informed, so that $E\left(\phi | m_A = \{\eta\}\right) = 0$. If $\eta > 0$ the DM will then choose $X = a$. So, when A is fully informed, or when he only knows the value of ϕ, A will reveal ϕ if $\phi > 0$.

When A sends $m_A = \{\eta\}$, then the DM will update her beliefs as follows: either A is partially informed and has no information about η, or A is fully informed and $\eta < 0$, so that:

$$E(\phi | m_A = \{\eta\}) = \frac{\rho \Pr(\phi < 0)}{\rho \Pr(\phi < 0) + (1 - \rho)} E(\phi | \phi < 0) \tag{3.14}$$

Solving $\eta + E(\phi | m_A = \{\eta\})$ in (3.13) and (3.14) shows that A needs higher values of η to persuade the DM when she expects him to reveal both signals first. The same analysis applies for all strategies where A sends partial messages first when he is fully informed[7]. Any strategy where A reveals both signals first when he is fully informed is thus a dominated strategy.

I describe below one equilibrium of this game, which, arguably, is best suited to make a comparison with the main model. The three equilibria are qualitatively similar, but this particular one is chosen for two reasons: 1) it exists for all parameter values whereas the two other equilibria do not, 2) A's expected payoffs are always higher in this equilibrium than in the other two. So, even if I cannot always formally discriminate between these three equilibria, the one presented below is intuitively the most relevant. Furthermore, the other two equilibria do not yield additional insights, while the results remain valid.

Equilibrium 1

- The DM chooses $X = a$ when she receives a non-empty message $m_A \in \{\{\eta, \phi\}, \{\eta\}, \{\phi\}\}$, and $X = b$ if $m_A = \emptyset$.
- A plays the following communication strategy in equilibrium:
  - When A is fully informed, he sends:
    - $m_A = \{\phi\}$ if $\phi > 0$
    - $m_A = \{\eta\}$ if $\phi \leq 0$ and $\eta > \rho \frac{1-\beta}{2\rho - 4}$
    - $m_A = \{\eta, \phi\}$ if $\phi \leq 0$, $\eta \leq \rho \frac{1-\beta}{2\rho - 4}$, and $\eta + \phi \geq 0$
    - $m_A = \emptyset$ otherwise

[7] There are three such strategies: a) the one discussed above: send η first, then ϕ; b) send ϕ first, then η; c) send the higher signal first.

- When A only knows the value of η, he sends:
    - $m_A = \{\eta\}$ if $\eta > \rho\frac{1-\beta}{2\rho-4}$
    - $m_A = \emptyset$ otherwise
- When A only knows the value of ϕ, he sends:
    - $m_A = \{\phi\}$ if $\phi > 0$
    - $m_A = \emptyset$ otherwise

Details on this equilibrium and the others can be found in the appendix. Given the players' strategies, we can compute the ex ante probability that the DM will choose $X = a$ in equilibrium:

$$\Pr(X = a) = \rho\frac{(4-\rho)(32\beta - 4\rho + 3\rho^2 - 28\beta\rho + 5\beta\rho^2)}{32\beta\rho^2 - 128\beta\rho + 128\beta} \tag{3.15}$$

This probability is increasing in β, which implies that more asymmetry increases A's capacity to manipulate the DM. Indeed, as β increases the revealing threshold $\rho\frac{1-\beta}{2\rho-4}$ for η decreases. Thus, the ex ante probability that A will send a message $m_A = \{\eta\}$[8] and induce the DM to choose $X = a$ is increasing in β. As the asymmetry grows larger, A can manipulate the DM relatively more often, with lower values of η.

We can derive from the equilibrium the ex ante probability $P^{SP}(miss)$ that the DM makes a mistake in equilibrium, and her expected utility $E^{SP}(U_{DM})$ (see Appendix). $P^{SP}(miss)$ is increasing in β, and $E^{SP}(U_{DM})$ is decreasing in β, which means that more asymmetry increases the likelihood that the DM will make mistake, and decreases welfare. Contrary to the model with advocates, asymmetry has a negative effect on the quality of the DM's decision and on welfare when there is a single partisan providing information to the DM.

Comparing the two organizations.

In order to compare the relative benefits of having two advocates or one single partisan supplying information, I look at the quality of the DM's decision and welfare across the two models.

[8] $\Pr(m_A = \{\eta\}) = \rho\Pr\left(\eta > \rho\frac{1-\beta}{2\rho-4}\right)(1-\rho+\rho\Pr(\phi \leq 0))$

Formally, I compare $P^*(miss)$ and $P^{SP}(miss)$, and $E^*(U_{DM})$ and $E^{SP}(U_{DM})$. These expressions depend on the two parameters of the model: the probability $\rho \in (0,1)$ that the information providers are informed, and the degree of asymmetry $\beta \in \left(\frac{1}{2}, 1\right)$. We have:

$$\frac{\partial P^*(miss)}{\partial \rho} < 0, \frac{\partial E^*(U_{DM})}{\partial \rho} < 0, \frac{\partial P^{SP}(miss)}{\partial \rho} > 0, \frac{\partial E^{SP}(U_{DM})}{\partial \rho} > 0 \quad (3.16)$$

$$\frac{\partial P^*(miss)}{\partial \beta} < 0, \frac{\partial E^*(U_{DM})}{\partial \beta} > 0, \frac{\partial P^{SP}(miss)}{\partial \beta} > 0, \frac{\partial E^{SP}(U_{DM})}{\partial \beta} < 0, \quad (3.17)$$

An increase in the likelihood that the information providers are informed (increase in ρ) has similar effects across the two models: it decreases the probability of mistake and increases welfare. This effect is due to the players' communication strategy in equilibrium, which follow the same logic across both models: reveal favorable information or hide and send an empty message. When ρ increases, the empty messages from the players become more informative. An empty message is then more likely to be the sign of a player hiding information, rather than the sign of a player being uninformed. Thus, as ρ increases, the DM is able to extract more information about η and ϕ, which improves the quality of her decision and welfare.

An increase in asymmetry (increase in β) has opposite effects across models. When two advocates supply information to the DM, more asymmetry decreases the probability that the DM makes a mistake and increases welfare, whereas it increases the probability that the DM makes a mistake and decreases welfare when there is a single partisan.

The third proposition determines which organization - advocacy or single partisan - performs better in terms of the quality of the DM's decision and welfare, for given values of β and ρ.

Proposition 3.3. *With regards to the quality of the DM's decision and welfare: a) If the probability ρ that the agents are informed is relatively low, advocates perform worse than a single partisan when the degree of asymmetry β is low, and better when β is high. b) If ρ is relatively high, then advocates always perform better.*

There can be a trade-off between the two models. Relatively to the first-best situation where the DM would always make informed decisions, both types of organization have negative effects on the quality of the decision and on welfare. Advocates induce a bias in the DM's decision, and a single partisan manipulates the DM's decision in his favor. However, the negative effects of advocay are decreasing in the level of asymmetry, while those caused by a single partisan increase with it. So, the degree of asymmetry between η and ϕ can either amplify or reduce the distortions present in those models. If β is low then, the bias from advocacy is more detrimental than the manipulation of a single partisan, and competition between two information providers is less desirable than having only one. As β increases, advocacy then becomes more desirable[9].

This trade-off disappears though, when the information providers have a higher chance of being informed. An increase in ρ mitigates the distortions in both models, but more so in the case of advocacy. When advocates become more informed, the benefits of competition between two information providers prevail. Then, advocacy is always more desirable than having a single partisan.

3.5 Conclusion

This chapter presents of model of advocacy where the decision maker is faced with an asymmetric uncertainty. I show that the asymmetry induces a distortionary bias in the decision, but that more asymmetry alleviates the negative effects of the bias. I also show that in the presence of asymmetry a single partisan information provider might be more efficient than advocates. Nevertheless, advocacy remains preferable when the asymmetry is large, and when the agents have a high probability of being informed ex ante.

One limitation of the model is that it does not endogenize information collection. The analysis then focuses on the effects of asymmetry on the incentives to communicate, but not on the incentives to search or collect information. However, it seems plausible that the positive effects of increasing asymmetry would still remain to a certain extent. Since the advocate that can send more extreme messages always gets zero payoffs when he sends an empty message, he would then always have a strict incentive to search for information. This could in turn increase the other player's incentives to collect information, in order to better compete with a more informed

[9]Looking at the limit cases when $\beta \to \frac{1}{2}$ and $\beta \to 1$ provides a good illustration of this trade-off: in both cases the models diverge. For $\beta \to \frac{1}{2}$ this is straightforward: we have two symmetric advocates or one single partisan. For $\beta \to 1$ though, both the models may appear to converge towards only one information provider collecting one piece of information, but that is not the case. As long as $\beta \neq 1$, a single partisan still potentially has two signals to manipulate the DM, whereas an advocate only has one.

opponent. On the other hand, endogenizing information collection might allow for a separating equilibrium where the asymmetry would discourage the player that can send less extreme messages from searching.

Another limitation of the model is that it does not look at contracts. We can compute the players' expected payoffs from the game, but since there are no communication costs or information collection costs, not much can be said about the advocates' incentives to participate in the game. Still, I do find that the expected payoffs of the player that can send the more extreme messages are relatively lower, and I also show that these expected payoffs do not depend on the level of asymmetry (see Proposition 1), which opens some avenues for reflexion.

Building on the example in the introduction, let us consider a board of directors seeking to hire division managers. Following the results of this chapter, the board understands that it is in the company's interest to hire very asymmetric managers: a safe one, and a very risky one. Assuming that the managers' earnings depend on the board's investment decision, the first proposition suggests that, if managers all ask the same wage, it would be more difficult to hire a risky manager since his expected earnings are lower. On the other hand, if managers ask for a remuneration that is correlated with their own risk, a very risky manager might be more willing to take the position with lower expected earnings but higher variance. In this situation, the board's objective would be to design contracts where the expected compensation for the risky manager is high enough so that very risky profiles have a strong incentive to participate (and increase the asymmetry), but not so much so that it would discourage safe managers (and decrease the asymmetry).

Lastly, the findings of this chapter seem to outline a commendation of simplicity in organizations: welfare is always higher when there is only one advocate and one issue to communicate on ($\beta = 1$). It is nevertheless difficult to draw any conjectures from this, as organizational constraints generally make simplicity a very elusive object.

3.A Appendix

3.A.1 Equilibrium

Here is the derivation of the equilibrium presented in section 4.2. To make the notation slightly more concise I write $E(x|m_i = \emptyset)$ as $E(x|\emptyset)$ for $x \in \{\eta, \phi\}$ and $i \in \{A, B\}$. Since η and ϕ and independent, there should be no ambiguity regarding the origin of signal: A only sends messages about η, and B only sends messages about ϕ.

The DM's decision rule

Assume that the DM expects that A plays the following threshold strategy: when informed, A sends $m_A = \{\eta\}$ if $\eta > \bar{\eta}$ and hides otherwise; and that B plays the following strategy: when informed, B sends $m_B = \{\phi\}$ if $\phi < \bar{\phi}$, and hide otherwise. Furthermore, assume that for the DM $E(\eta|\emptyset) + E(\phi|\emptyset) < 0$.

The DM's optimal strategy is then to choose $X = a$ if $E(\eta|m_A) + E(\phi|m_B) > 0$, $X = b$ if if $E(\eta|m_A) + E(\phi|m_B) < 0$, and randomizes between the two with probability $\frac{1}{2}$ if $E(\eta|m_A) + E(\phi|m_B) = 0$.

A and B anticipate the DM's decision rule in equilibrium. Their expected payoffs are then:

A's expected payoffs

$$E\left(R_A\left(X\right)\right)=\begin{cases}\left(1-\rho\right)R+\rho\Pr\left(\phi>\bar{\phi}\right)R+\rho\Pr\left(\phi\in\left[-\eta,\bar{\phi}\right]\right)R \\ \text{if } \eta>-E\left(\phi|\emptyset\right) \text{ and A reveals} \\ \\ \left(1-\rho\right)\frac{1}{2}R+\rho\Pr\left(\phi>\bar{\phi}\right)\frac{1}{2}R+\rho\Pr\left(\phi\in\left[E\left(\phi|\emptyset\right),\bar{\phi}\right]\right)R \\ \text{if } \eta=-E\left(\phi|\emptyset\right) \text{ and A reveals} \\ \\ \rho\Pr\left(\phi\in\left[-\eta,\bar{\phi}\right]\right)R \\ \text{if } \eta<-E\left(\phi|\emptyset\right) \text{ and A reveals} \\ \\ \rho\Pr\left(\phi\in\left[-E\left(\eta|\emptyset\right),\bar{\phi}\right]\right)R \\ \text{if A hides}\end{cases} \tag{3.18}$$

Assume $\eta\geq-E\left(\phi|\emptyset\right)$.
By assumption: $E\left(\eta|\emptyset\right)+E\left(\phi|\emptyset\right)<0$, so we have $-\eta<E\left(\phi|\emptyset\right)<-E\left(\eta|\emptyset\right)$.
So $\Pr\left(\phi\in\left[-\eta,\bar{\phi}\right]\right)>\Pr\left(\phi\in\left[-E\left(\eta|\emptyset\right),\bar{\phi}\right]\right)$ for all $\eta>-E\left(\phi|\emptyset\right)$.
So A always reveals when $\eta\geq-E\left(\phi|\emptyset\right)$.

Assume $\eta<-E\left(\phi|\emptyset\right)$
So we have $-\eta>E\left(\phi|\emptyset\right)$. And recall that $E\left(\phi|\emptyset\right)<-E\left(\eta|\emptyset\right)$
So if $\left[-\eta,\bar{\phi}\right]$ is empty for all $\eta<-E\left(\phi|\emptyset\right)$, then $\left[-E\left(\eta|\emptyset\right),\bar{\phi}\right]$ is also empty.

Then we have three possible optimal strategies:
1) $\left[-\eta,\bar{\phi}\right]\neq\emptyset$, and $\left[-E\left(\eta|\emptyset\right),\bar{\phi}\right]\neq\emptyset$.
Then A reveals if $\eta>E\left(\eta|\emptyset\right)$ and hides otherwise.
2) $\left[-\eta,\bar{\phi}\right]\neq\emptyset$, and $\left[-E\left(\eta|\emptyset\right),\bar{\phi}\right]=\emptyset$.
Then A has a strict incentive to reveal if $\eta>-\bar{\phi}$, and otherwise he is indifferent and hides.
3) $\left[-\eta,\bar{\phi}\right]=\emptyset$, and $\left[-E\left(\eta|\emptyset\right),\bar{\phi}\right]=\emptyset$.
Then A reveals when $\eta\geq-E\left(\phi|\emptyset\right)$, otherwise he is indifferent and hides.

B's expected payoffs

$$E\left(R_B\left(X\right)\right)=\begin{cases}\left(1-\rho\right)R+\rho\Pr\left(\eta<\bar{\eta}\right)R+\rho\Pr\left(\eta\in\left[\bar{\eta},-\phi\right]\right)R \\ \text{ if }\phi<-E\left(\eta|\emptyset\right)\text{ and B reveals} \\ \\ \left(1-\rho\right)\frac{1}{2}R+\rho\Pr\left(\eta<\bar{\eta}\right)\frac{1}{2}R+\rho\Pr\left(\eta\in\left[\bar{\eta},-\phi\right]\right)R \\ \text{if}\phi=-E\left(\eta|\emptyset\right)\text{ and B reveals} \\ \\ \rho\Pr\left(\eta\in\left[\bar{\eta},-\phi\right]\right)R \\ \text{ if }\phi>-E\left(\eta|\emptyset\right)\text{ and B reveals} \\ \\ \left(1-\rho\right)R+\rho\Pr\left(\eta<\bar{\eta}\right)R+\rho\Pr\left(\eta\in\left[\bar{\eta},-E\left(\phi|\emptyset\right)\right]\right)R \\ \text{if B hides}\end{cases} \tag{3.19}$$

Assume $\phi>-E\left(\eta|\emptyset\right)$

Recall that $E\left(\eta|\emptyset\right)+E\left(\phi|\emptyset\right)<0\Leftrightarrow E\left(\eta|\emptyset\right)<-E\left(\phi|\emptyset\right)$.

Thus $-\phi<E\left(\eta|\emptyset\right)<-E\left(\phi|\emptyset\right)$ for all $\phi>-E\left(\eta|\emptyset\right)$.

So that $\Pr\left(\eta\in\left[\bar{\eta},-\phi\right]\right)<\Pr\left(\eta\in\left[\bar{\eta},-E\left(\phi|\emptyset\right)\right]\right)$ for all $\phi>-E\left(\eta|\emptyset\right)$, so B always hides when $\phi>-E\left(\eta|\emptyset\right)$.

We have then two possible optimal strategies:

1) $\left[\bar{\eta},-\phi\right]\neq\emptyset$ and $\left[\bar{\eta},-E\left(\phi|\emptyset\right)\right]\neq\emptyset$.

Then B reveals if $\phi<E\left(\phi|\emptyset\right)$ and hides otherwise.

2) $\left[\bar{\eta},-\phi\right]\neq\emptyset$ and $\left[\bar{\eta},-E\left(\phi|\emptyset\right)\right]=\emptyset$.

Then B reveals if $\phi>-\bar{\eta}$, and B is indifferent otherwise.

I solve for the equilibrium by going through the 6 different possibilities. Only one does not lead to a contradiction: case 3) from A and 2) from B.

A and B's equilibrium strategies are then: when informed, A reveals if $\eta>\bar{\eta}$, $\bar{\eta}=-E\left(\phi|m_B=\emptyset\right)$ and hides otherwise; when informed, B reveals if $\phi<\bar{\phi}$, $\bar{\phi}=E\left(\phi|m_B=\emptyset\right)$

and hides otherwise.

We have:

$$\bar{\eta} = -\bar{\phi} = \frac{1}{\rho}(1-\beta)\left(\rho + 2\sqrt{-\rho+1} - 2\right) \tag{3.20}$$

In equilibrium, the following conditions must hold:

1) $\bar{\eta} \in [-\beta, \beta]$ and $\bar{\phi} \in [\beta - 1, 1 - \beta]$.

2) $E(\eta|\emptyset) + E(\phi|\emptyset) < 0$

Both conditions are always satisfied for $\beta \in \left[\frac{1}{2}, 1\right]$.

3.A.2 Proof of proposition 1

$\Pr(X = a)$ can be computed graphically, by representing all possible pair (η, ϕ) in a two-dimensional space, which is a rectangle of area $4\beta(1-\beta)$. $\Pr(X = a)$ is then the fraction of the space where, given A, B, and the DM's equilibrium strategies, a pair (η, ϕ) leads to the DM choosing $X = a$.

We then have:

$$\begin{aligned}\Pr(X=a) &= \left(\begin{array}{c}\rho^2 \frac{1}{4\beta}\left((\beta+\bar{\eta})\,2 + \frac{1}{2}(1-\bar{\eta})^2\right) \\ +(1-\rho)\,\rho\frac{1}{4\beta}\left((\beta+\bar{\eta})\,2\right) + (1-\rho)^2 + (1-\rho)\,\rho\end{array}\right) \\ &= \frac{1}{2}\rho\end{aligned} \tag{3.21}$$

Which we obtain by plugging in $\bar{\eta} = \frac{1}{\rho}(1-\beta)\left(\rho + 2\sqrt{-\rho+1} - 2\right)$.

By the same method we then have:

$$\Pr(X = b) = 1 - \frac{1}{2}\rho \tag{3.22}$$

3.A.3 Proof of proposition 2

$P^*(miss)$ is computed with a similar method as above.

In order to compute the value of $E^*(U_{DM})$, we need an expression for the distribution of a random variable $z = E + F$, where $E \sim U[\bar{\eta}, \beta]$, and $F \sim U\left[\beta - 1, \bar{\phi}\right]$, so that we can compute the ex ante expected value of $\eta + \phi$ when both A and B reveal their signals.

The expression for the convolution of E and F is:

$$f(z) = \begin{cases} \frac{1}{(\beta+\bar{\phi})(1-\beta+\bar{\phi})}\left(1 - \beta + \bar{\phi} + z\right) & \text{if } z \in \left[\beta - 1 - \bar{\phi}, 0\right] \\ \frac{1}{(\beta+\bar{\phi})} & \text{if } z \in [0, 2\beta - 1] \\ \frac{1}{(\beta+\bar{\phi})(1-\beta+\bar{\phi})}\left(\beta + \bar{\phi} - z\right) & \text{if } z \in \left[2\beta - 1, \beta + \bar{\phi}\right] \end{cases} \tag{3.23}$$

where $\bar{\phi} = \frac{1}{\rho}(\beta - 1)\left(\rho + 2\sqrt{-\rho + 1} - 2\right)$

Then we have:

$$\begin{aligned} E^*(U_{DM}) \quad = \quad & \Pr\left(\{m_A, m_B\} = \{\eta, \emptyset\}\right) E\left(\eta + \phi | \{m_A, m_B\} = \{\eta, \emptyset\}\right) \\ & + \Pr\left(\{m_A, m_B\} = \{\emptyset, \phi\} \left(-E\left(\eta + \phi | \{m_A, m_B\} = \{\emptyset, \phi\}\right)\right)\right) \\ & + \Pr\left(\{m_A, m_B\} = \{\eta, \phi\} \wedge \eta + \phi > 0\right) \\ & \quad E\left(\eta + \phi | \{m_A, m_B\} = \{\eta, \phi\} \wedge \eta + \phi > 0\right) \\ & + \Pr\left(\{m_A, m_B\} = \{\eta, \phi\} \wedge \eta + \phi < 0\right) \\ & \quad \left(-E\left(\eta + \phi | \{m_A, m_B\} = \{\eta, \phi\} \wedge \eta + \phi < 0\right)\right) \\ & + \Pr\left(\{m_A, m_B\} = \{\emptyset, \emptyset\} \left(-E\left(\eta + \phi | \{m_A, m_B\} = \{\emptyset, \emptyset\}\right)\right)\right) \\ = \quad & -\frac{1}{12\beta}\frac{\rho}{\beta - 1}\left(\begin{array}{c} \rho + 6\beta^2 - 6\beta^3 - 6\phi^2 - 3\beta\rho + 3\phi\rho + 6\beta\phi^2 + 3\beta^2\rho \\ -\beta^3\rho + 3\phi^2\rho + \phi^3\rho - 3\beta\phi^2\rho + 3\beta^2\phi\rho - 6\beta\phi\rho \end{array}\right) \end{aligned} \tag{3.24}$$

Plugging in the value of $\bar{\phi}$, we can then compute the derivative of $E^*(U_{DM})$ with respect to β, which is always positive.

3.A.4 Other equilibria in the single partisan model

There are two other equilibria of the game. I present them below. For both equilibria, we can compute the ex ante probability that the DM will choose $X = a$, which can be shown to be always lower than in the equilibrium presented in the main text. The main feature of this equilibrium was that when A is fully informed, he will rather send ϕ first if ϕ is high enough. In the second equilibrium presented below, A sends η first when he is fully informed and η is high enough. In the third equilibrium, A will send whichever signal is higher first when he is fully informed.

One notable difference between these equilibria and the one in the main text is that the expected payoffs from the DM are increasing in β. However, when we compare these equilibria to the advocacy model, we arrive to the same result: with regards to welfare the single partisan model fares better when ρ and β are relatively low.

Equilibrium 2

- The DM chooses $X = a$ when she receives a non-empty message $m_A \in \{\{\eta, \phi\}, \{\eta\}, \{\phi\}\}$, and $X = b$ if $m_A = \emptyset$.
- A plays the following communication strategy in equilibrium:
  - When A is fully informed, he sends:
    - $m_A = \{\eta\}$ if $\eta > 0$
    - $m_A = \{\phi\}$ if $\eta \leq 0$ and $\phi > \frac{\beta\rho}{4-2\rho}$
    - $m_A = \{\eta, \phi\}$ if $\eta \leq 0$, $\phi \leq \frac{\beta\rho}{4-2\rho}$, and $\eta + \phi \geq 0$
    - $m_A = \emptyset$ otherwise
  - When A only knows the value of η, he sends:
    - $m_A = \{\eta\}$ if $\eta > 0$
    - $m_A = \emptyset$ otherwise
  - When A only knows the value of ϕ, he sends:
    - $m_A = \{\phi\}$ if $\phi > \frac{\beta\rho}{4-2\rho}$
    - $m_A = \emptyset$ otherwise

Equilibrium 3

- The DM chooses $X = a$ when she receives a non-empty message $m_A \in \{\{\eta, \phi\}, \{\eta\}, \{\phi\}\}$, and $X = b$ if $m_A = \emptyset$.

- A plays the following communication strategy in equilibrium:

  - When A is fully informed, he sends:
    - $m_A = \{\eta\}$ if $\eta > -\frac{1}{3\rho}(\beta - 1)\left(\rho + 2\sqrt{-\rho + \rho^2 + 1} - 2\right)$ and $\eta > \phi$
    - $m_A = \{\phi\}$ if $\phi > \frac{1}{3}\frac{\beta}{\rho}\left(\rho + 2\sqrt{-\rho + \rho^2 + 1} - 2\right)$ and $\phi > \eta$
    - $m_A = \{\eta, \phi\}$ if $\eta \leq -\frac{1}{3\rho}(\beta - 1)\left(\rho + 2\sqrt{-\rho + \rho^2 + 1} - 2\right)$, $\phi \leq \frac{1}{3}\frac{\beta}{\rho}\left(\rho + 2\sqrt{-\rho + \rho^2 + 1} - 2\right)$, and $\eta + \phi \geq 0$
    - $m_A = \emptyset$ otherwise

  - When A only knows the value of η, he sends:
    - $m_A = \{\eta\}$ if $\eta > -\frac{1}{3\rho}(\beta - 1)\left(\rho + 2\sqrt{-\rho + \rho^2 + 1} - 2\right)$
    - $m_A = \emptyset$ otherwise

  - When A only knows the value of ϕ, he sends:
    - $m_A = \{\phi\}$ if $\phi > \frac{1}{3}\frac{\beta}{\rho}\left(\rho + 2\sqrt{-\rho + \rho^2 + 1} - 2\right)$
    - $m_A = \emptyset$ otherwise

3.A.5 Proof of proposition 3

$P^{SP}(miss)$ and $E^{SP}(U_{DM})$ are computed with a similar method as $P^{*}(miss)$ and $E^{*}(U_{DM})$ respectively. Below we give a rough sketch of the proof for the comparison of $P^{*}(miss)$ and $P^{SP}(miss)$. Comparing $E^{*}(U_{DM})$ and $E^{SP}(U_{DM})$ follows the same logic.

Since $\frac{\partial P^{*}(miss)}{\partial \beta} < 0$ and $\frac{\partial P^{SP}(miss)}{\partial \beta} > 0$, then $P^{*}(miss) = P^{SP}(miss)$ either has a unique solution $\tilde{\beta}$, where $P^{*}(miss) > P^{SP}(miss)$ if $\beta < \tilde{\beta}$, and $P^{*}(miss) < P^{SP}(miss)$ if $\beta > \tilde{\beta}$, or there is no solution and $P^{*}(miss)$ is always greater or always smaller than $P^{SP}(miss)$.

Solving $P^{*}(miss) = P^{SP}(miss)$ we find that there exists such a $\tilde{\beta}$, however $\tilde{\beta} \in \left[\frac{1}{2}, 1\right]$ only if ρ is below a certain threshold $\tilde{\rho}$.

Chapter 4

Earmarks

4.1 Introduction

The popular press in the US describes earmarks as ”symptoms of a broken spending system”, a ”gateway to corruption”, but also a ”political carrot” that ”produces legislation”[1]. Earmarks are legislative provisions that assign federal funds to specific projects. They are inserted into larger bills by individual members of Congress, usually for the purposes of financing local projects in their constituencies. Earmarks bypass regular allocation processes and let politicians channel money to their district with relative discretion[2]. By contrast, most other federal funds are distributed through formulas and programs over which an individual representative has only a limited influence.

Earmarking provides politicians with opportunities to fund local projects, for which they

[1] See for instance:
http://www.nbcnews.com/id/40128623/ns/politics-capitol_hill/t/earmark-dispute-splits-gop-senators/#.VGJeeTSG-jc
http://www.forbes.com/sites/rickungar/2012/12/29/why-congress-cannot-operate-without-the-bribing-power-of-earmarks/

[2] According to the official definition provided by the Office of Management and Budget: ”Earmarks are funds provided by the Congress for projects, programs, or grants where the purported congressional direction (whether in statutory text, report language, or other communication) circumvents otherwise applicable merit-based or competitive allocation processes, or specifies the location or recipient, or otherwise curtails the ability of the executive branch to manage its statutory and constitutional responsibilities pertaining to the funds allocation process.”. see http://earmarks.omb.gov/earmarks-public/

can claim direct credit by their constituents. As such, many view earmarks as instrumental for passing bills in Congress because party leaders can use them to sway the representatives' votes on legislation. However, for many others earmarking has devolved into a practice of vote-buying that epitomizes wasteful spending and pork barrel politics. Yet, in spite of receiving considerable attention in the popular press, evidence on the role of earmarks in the legislative process and on the incentives they provide is scarce. This chapter addresses these questions, providing some of the first systematic evidence on the effects of earmarks on the legislative process and on elections in the US House of Representatives.

The US House of Representatives implemented a moratorium on earmarks in 2011. In this chapter, I exploit the introduction of the moratorium to estimate the effects of earmarks on congressional voting for legislation, campaign contributions and spending, and electoral outcomes. Officially, the purpose of the moratorium was to end a spending practice that only served the politicians' interests and aggravated the public deficit, even though earmarks had never represented more than 0.05% of the total federal budget[3]. Interestingly, a year later John Boehner - the Speaker of the House of Representatives, who had advocated the moratorium, remarked on the difficulties that it had generated for legislative action (see quote)[4]. However, earmarks were effectively discontinued in 2010, one year before the moratorium. The public perception of earmarks had grown bad enough that the House leaders from both parties proposed to rein in their distribution in order to garner support for the coming elections, even though members of Congress had already submitted requests for earmarks then. Furthermore, the 2010 budget did not pass on time, which de facto prevented the distribution of earmarks that year. Although Representatives were still expecting to receive earmarks in 2010, they did not. Earmarks were not handed out later either, since the moratorium was in effect by the time Congress passed the budget.

Ironically, the end of earmarks can be used as a means to assess their effects on US Representatives and the legislative process. Using detailed data on earmarking history, I exploit the events of 2010 as an exogenous variation in earmarking and estimate the effects that the loss of earmarks had on congressional voting, electoral outcomes, campaign spending and contributions

[3] According to the detailed data on earmarks for the years 2007 to 2009.

[4] See http://transcripts.cnn.com/TRANSCRIPTS/1204/29/sotu.01.html for a transcript of the interview.

collected for the electoral campaign.

In 2007, the US Congress made it compulsory for its members to disclose their sponsorship of earmarks. This makes it possible to identify exactly which members of Congress sponsored an earmark, and the amounts of federal spending they obtained[5]. Consequently, there is detailed data on earmarks that were distributed in 2007, 2008 and 2009. In the empirical analysis, I then consider the period 2007-2010 in the US House of Representatives, and test the hypothesis that earmarks were used to gather support for the legislative agenda of the party leaders. Using roll call data, I measure the Representatives' propensity to deviate from their party legislative agenda, and estimate how much it was affected by the earmark stoppage. Furthermore, I estimate the effects of the loss of earmarks on vote shares in the elections. I also estimate the effects on the Representatives' expenditures on their electoral campaign, and on the amounts of contributions they collected to finance them.

The analysis reveals an astonishing discrepancy between the substantial impact of earmarks on the legislative process and the tiny share of the total budget they represent - less than a tenth of one percent. The results show that legislative support for the party line is tremendously sensitive to the availability of earmarks. After earmarks were discontinued, Representatives were much less likely to vote alongside their party leaders. Specifically, the loss of earmarks induced deviations from the party line to increase by at least 15 percent across all votes on legislation. With regards to the effects of earmarks on electoral outcomes, the results show that the earmark stoppage cost the Representatives about 1 percent of the votes in the subsequent elections. The results also show that, without earmarks, Representatives ran more expensive campaigns and collected significantly more money from Political Action Committees[6] (PACs), that represent special interests.

These findings imply that because earmarks made re-election more likely party leaders could use them to facilitate agreements on legislation. Accordingly, the earmark stoppage weakened party voting discipline and undermined the incumbents' electoral prospects. The findings also

[5]Prior to 2007, there was no disclosure requirements. There is data on earmarks before 2007, compiled by Citizens Against Government Waste (www.cagw.org). However it does not match earmarks with individual members of Congress, and it is probably not exhaustive.

[6]Political Action Committees (PACs) are organizations created by businesses, unions, associations, interest groups or parties for the purpose of influencing federal elections.

suggest that Representatives ran more expensive electoral campaigns in order to mitigate the electoral consequences of the earmark stoppage, and that they financed the increase in campaign expenditures by seeking additional contributions from special interests. Thus, while the moratorium has been upheld as a safeguard against particularistic politics, it may actually have given special interests more influence over politicians. I conclude that earmarks are, in fact, better for the legislative process.

The most significant contribution of this chapter relates to the literature on distributive politics[7]. This chapter provide some of the first systematic evidence on the effects of distributive policies on the legislative process. Prior empirical studies have focused on the determinants of the allocation of distributive policies (e.g. Balla et al. (2002); Knight (2008); Carrol and Kim (2010); Lazarus (2010)). However, evidence on their effects on the legislative process is very scarce. Lee (2003) and Evans (2004) have shown that representatives were more likely to vote for a bill if they have earmarks attached to it, but this evidence has several limitations. First, these studies do not identify a causal link between earmarking and the representatives' votes, so that they cannot ascertain whether earmarks were used to sway votes on the bills, or representatives attached earmarks to bills that were already assured to pass. Moreover, these studies focus on specific bills. Their results may not extend to other congressional votes, and Representatives who earmark on those bills may be different from those who do not. Additionally, these studies cannot account for the possibility that earmarks may have an effect across different congressional votes, not necessarily related to the bills that contain earmarks. This chapter offers several improvements. The events of 2010 provide a counterfactual - a world where representatives cannot earmark. The fact that Representatives did not receive any earmarks in 2010 although they expected them is exploited as an exogenous variation, that allows to estimate the causal effects of the loss of earmarks on congressional voting and on elections. Furthermore, this chapter uses the most exhaustive earmark data available and the representatives' entire voting record during the sample period. The effects of earmarks are also differentiated across the different types of congressional votes, by using various subsamples of the roll call data.

Importantly, the findings of this chapter question the predictions of the standard models on

[7]Distributive politics generally refer to the allocation of public goods and services to specific localities or groups.

distributive politics (e.g., Weingast, Shepsle and Johnsen (1981); Ferejohn and Krehbiel (1987)). Previous theoretical studies generally argue that distributive policies create a common pool problem and generate inefficient public spending. In this chapter, I show that earmarks represented a tiny share of the federal budget while creating powerful incentives for more productive lawmaking, which may actually improve efficiency in policy-making.

Within the literature on distributive politics, this chapter also adds to previous studies that examine the effects of public spending on elections. For instance, Levitt and Snyder (1997) show that increased federal spending in the House Representatives' districts increases their chances of re-election. Nevertheless, the responsibility of individual representatives for the public spending in their district is difficult to establish. Most public spending at the federal level is determined by rules and programs over which an individual representative has little influence. In comparison, the earmark data used in this chapter provides an individual measure of discretionary spending[8]. Closely related to this chapter, Strattman (2013) adopts an instrumental variable approach - using state population and the presence of Senator on the Senate Appropriations committee as instruments for earmarks - and shows that earmarks increase the chances of re-election[9]. Although it finds similar results, the analysis in this chapter uses a different approach: it employs a difference-in-differences strategy and looks at the effects of the loss of earmarks on electoral performance and campaign finance.

This chapter also contributes to the literature on the determinants of congressional voting. This literature has mainly focused on external factors of influence, such as constituents' economic interests, ideology, or special interests (e.g., Peltzman (1985); Levitt (1996); Strattman (2002); Mian, Sufi and Trebbi (2010)). A few studies have underlined the importance of logrolling, or vote-trading between the representatives (e.g., Ferejohn (1989); Strattman (1992)), but there is still little evidence showing that political factors from within Congress have a systematic influence on the legislative process. In this chapter, I show that party leaders could use

[8] There also exists evidence of the effects of electoral incentives on discretionary spending in state legislatures (see Aidt and Shvets (2012))

[9] However, Shepsle et al. (2009) have shown that the allocation of earmarks in the US Congress is influenced by electoral cycles in the House and the Senate: every two years the Senate is renewed by a third whereas all Representatives are up for reelection. The authors show that Senators seeking reelection will try to obtain more earmarks for their state, and that the House corrects for this cyclical bias. Thus, using state-based variables as instruments for earmarks may compromise the estimations.

earmarks to influence the representatives, and that they had a substantial impact on their voting behavior.

The rest of the chapter is organized as follows: Section II provides some theoretical background for the empirical analysis, Section III gives additional information on earmarks in the US House of Representatives, Section IV describes the data and the methodology, Section V presents the results, and Section VI concludes.

4.2 A simple model of policy-making

In this chapter, earmarks are identified as an important bargaining instrument within the US legislative process and the empirical analyis will show that they significantly affected the representatives' voting behavior because they provided them with electoral benefits. This section provides some theoretical background for the empirical findings with a simple model of policy-making.

Drawing from Grossman and Helpman (2001), policy-making is represented as a common agency game with three players: a politician, her party leadership, and an interest group. The politician (P) is a lawmaker and has to make a unidimensional decision p. Before she makes her decision, the party leadership (L), and the interest group (IG) try to influence her by offering campaign contributions $C(p)$ and public funds $G(p)$, respectively, that are both contingent on the policy choice p. The leadership and the interest group represent two different types of influence: one comes from within the legislative institutions, while the other represents external special interests.

The politician's objective is to maximize her chances of reelection, which are decreasing in the distance between her decision p and the policy D that would be optimal from her constituents' perspective, increasing in the amount of campaign contributions $C(p)$ that the politician collects, and increasing in the amount of public funds $G(p)$ that the politician manages to channel to her district. Her objective function is simply defined as a weighted sum of these three terms. The politician's problem then reads:

$$\max_{p} \quad U^{P} = -\left(p-D\right)^{2} + \alpha C\left(p\right) + \beta G\left(p\right) \tag{4.1}$$

The party leadership (L) has an interest in p, and tries to influence the politician's decision by offering her discretionary benefits for her district, according to the schedule $G\left(p\right)$. The optimal policy for the leadership is normalized at 0. The party leadership then designs a schedule $G\left(p\right)$ that solves :

$$\max_{G(p)} \quad U^{L} = -p^{2} - G\left(p\right) \tag{4.2}$$

The interest group (IG) also has an interest in p, and tries to influence the politician's decision by offering her campaign contributions, according to the schedule $C\left(p\right)$. The objective of the interest group is to bring p as close as possible to its optimal policy E. So, the interest group designs the optimal contribution schedule that solves:

$$\max_{C(p)} \quad U^{IG} = -\left(p-E\right)^{2} - C\left(p\right) \tag{4.3}$$

The game is in two stages and the timing is as follows: first, the party leadership and the interest group simultaneously present their schedules $G\left(p\right)$ and $C\left(p\right)$ to the politician. Then, the politician chooses p and receives $G\left(p\right)$ and $C\left(p\right)$, according the schedules that were offered in the previous stage.

The schedules $C\left(p\right)$ and $G\left(p\right)$ are assumed to be nonnegative for any value of p: the leadership and the interest group can give to the politician but they cannot take funds or contributions from her. In order to simplify the analysis, I also assume that $C\left(p\right)$ and $G\left(p\right)$ are differentiable whenever they are strictly positive (see Grossman and Helpman (2001) for more details). $C\left(p\right)$ and $G\left(p\right)$ represent promises of payments contingent on p. In this one-shot game, it is assumed that the party leadership and the interest group commit to those schedules, so that they cannot renege on the payments once the policy has been set. Likewise, the politician cannot change her choice of policy once the payments have been made. While this may seem like a strong assumption, it is motivated by the fact that commitment may arise endogenously if the game were repeated: the players would make good on their promises in order to ensure future collaborations.

Without loss of generality it is assumed that $D \geq 0$. This game is solved using backwards induction. An equilibrium consists of a policy p^*, a contribution schedule $C^*(p)$ and a public funds schedule $G^*(p)$, such that U^P, U^{IG}, and U^L are maximized.

While there exist many equilibria in this game, they all have the same unique policy outcome. Solving the game yields the following: in the second stage of the game, the politician chooses p^* in order to maximize U^P, given the schedules $G(p)$ and $C(p)$. Thus, p^* solves:

$$-2(p - D) + \alpha \frac{dG}{dp} + \beta \frac{dC}{dp} = 0 \tag{4.4}$$

Then, in the first stage of the game, the leadership and the interest group respectively choose their optimal schedules $G^*(p)$ and $C^*(p)$, so that they maximize their respective utilities when $p = p^*$. Thus, in equilibrium the optimal schedules $C^*(p)$ and $G^*(p)$ satisfy the following conditions:

$$2p^* = \frac{dG^*}{dp^*} \tag{4.5}$$

$$2(p^* - E) = \frac{dC^*}{dp^*} \tag{4.6}$$

The leadership and the interest group take the schedule of the other player as given. In equilibrium, the amounts $G^*(p^*)$ and $C^*(p^*)$ must be large enough so that the politician accepts their offers, which implies the following participation constraints:

$$C^*(p^*) \geq \max_p \left[(p - D)^2 + \alpha G^*(p)\right] - \left[(p^* - D)^2 + \alpha G^*(p^*)\right] \tag{4.7}$$

$$G^*(p^*) \geq \max_p \left[(p - D)^2 + \beta C^*(p)\right] - \left[(p^* - D)^2 + \beta C^*(p^*)\right] \tag{4.8}$$

These participation constraints always hold in equilibrium: both the leadership and the interest group give to the politician, as it would be suboptimal for them to let the other player exert influence alone. This yields the following equilibrium policy:

$$p^* = \frac{D + \beta E}{1 + \alpha + \beta} \tag{4.9}$$

There exist many equilibria which all have the same policy outcome p^*, and where the optimal schedules $G^*(p)$ and $C^*(p)$ satisfy conditions (5) and (7), and (6) and (8) respectively. Furthermore, in equilibrium, the following hold:

$$\frac{\partial p^*}{\partial G^*} = -\frac{1}{2}\left(\frac{1 + \alpha + \beta}{D + \beta E}\right) \tag{4.10}$$

$$\frac{\partial p^*}{\partial C^*} = \frac{1}{2}\left(\frac{1 + \alpha + \beta}{(1 + \alpha) E - D}\right) \tag{4.11}$$

The equilibrium policy is a weighted average of the optimal points of the three players. It is more or less biased towards the bliss point of one of the three players, according to how much the politician values the policy outcome, public funds, and campaign contributions relatively to each other. Given that there are many equilibria with the same policy outcome, the model does not allow to pin down the amounts of public funds and campaign contributions that the politician receives in equilibrium. Nevertheless, conditions (10), (11) and (12) provide some information about the behavior of the leadership and the interest group. For both the leadership and the interest group, the purpose of giving additional public funds or additional campaign contributions is always to bring the policy outcome closer to their own optimal policy. In equilibrium, their influences on the policy outcome may conflict or complement each other, depending on the relative positions of their bliss point in the policy space.

By assumption, $D \geq 0$ and the leadership's optimal policy is $p = 0$. According to conditions (10) and (11), if $E \geq \frac{D}{1+\alpha}$ then $0 \leq p^* \leq E$, $\frac{\partial p^*}{\partial G^*} \leq 0$, and $\frac{\partial p^*}{\partial C^*} \geq 0$. So, if the objectives of the interest group are more aligned with those of the politician than those of the leadership, then the equilibrium policy lies between the leadership's and the interest group's bliss points. Accordingly, public funds and campaign contributions have conflicting motives in equilibrium, as they try to draw the politician's decision in opposite directions.

If $-\frac{D}{\beta} \leq E \leq \frac{D}{1+\alpha}$ then $p^* \geq 0$ and $p^* \geq E$, $\frac{\partial p^*}{\partial G^*} \leq 0$, and $\frac{\partial p^*}{\partial C^*} \leq 0$. As the interest group becomes more aligned with the party leadership, but the equilibrium policy is still higher than both of their bliss points, then their objectives concur. Public funds and campaign contributions complement each other: they both aim at lowering the policy outcome.

Finally, if $E \leq -\frac{D}{\beta}$ then $E \leq p^* \leq 0$, $\frac{\partial p^*}{\partial G^*} \geq 0$, and $\frac{\partial p^*}{\partial C^*} \leq 0$. When the interest group grows further opposed to the politician, it pulls her decision so much that the leadership actually tries to counter the interest group's influence on the politician. In equilibrium, even though the leadership's bliss point is lower than that of the politician, it provides her with public funds in order to increase her policy decision.

In this simple model, there may be a wide variety of special interests that try to cater to the politician. However, the first two situations above where the objectives of the politician and those of the interest group are not too divergent (i.e. $E \geq \frac{D}{\beta}$) are arguably more relevant. On one hand, a politician is more likely to grant access to special interests whose preferences are somewhat aligned with hers. On the other hand, an interest group is also more likely to give contributions and support the reelection of a politician if their policy objectives concur to some extent. For instance, it is unlikely that a politician who favors family planning and pro-choice policies would seek the support of anti-abortion organizations, or that these organizations would help her get reelected.

In reference to the model, the main purpose of the empirical analysis in this chapter is to measure the effect of G on p. The first challenge is to find appropriate measures for these two variables. Measures for campaign contributions are straightforward and readily available. In this chapter, I claim that earmarks are a good measure for G. There is some evidence that the amount of federal funds flowing into a politician's district increases her chances of reelection (see Levitt and Snyder (1997)). However, earmarks are only a small subset of the federal funds that are allocated to the Representatives' district. In order for them to be a viable measure, they must have an effect on elections. The empirical analysis will show that it is the case, and thus that they were a valid bargaining instrument. With regards to policy, I will not employ a direct measure of p, but rather a measure of the distance between p and 0, in other words the distance between the politician's decisions and the party leadership's preferred policy. By looking at roll call votes, I am able to measure the Representatives' propensity to deviate from the party line with regards to policy.

In this model, the decisions on p, G, and C are interdependent, pointing at obvious endogeneity problems in the estimation of the effects of these variables on each other. In this chapter, I address the issue by exploiting an exogenous change in G: the discontinuation of earmarks in 2010. The model can then offer some predictions about the associated change in policy. In the more relevant situations, where the preferences of the interest do not diverge too strongly from those of the politician (when $E \geq -\frac{D}{\beta}$), then $\frac{\partial p^*}{\partial G^*} \leq 0$: a decrease in G should lead to an increase in p, and by extension an increase in the difference between p and 0. Thus, the discontinuation of earmarks should lead the Representatives to deviate from their leadership relatively more often. However, it will also change how the politicians respond to campaign contributions. Campaign contributions may also increase or decrease, depending on the special interests that make those contributions. In order to refine the theoretical predictions, the model is solved again, assuming $G = 0$. The equilibrium then consists of a policy $p^{\#}$ and a contribution schedule $C^{\#}(p)$ such that U^P and U^{IG} are maximized:

$$p^{\#} = \frac{D + \beta E}{1 + \beta} \tag{4.12}$$

In equilibrium, $C^{\#}(p)$ satisfies:

$$\frac{\partial p^{\#}}{\partial C^{\#}} = \frac{\beta + 1}{2(E - D)} \tag{4.13}$$

For all values of D and E in the more relevant range ($E \geq -\frac{D}{\beta}$), $p^{\#} \geq p^* \geq 0$. So, the discontinuation of earmarks should induce the Representatives to deviate from their leadership more often. Furthermore, looking at the absolute value of $\frac{\partial p^{\#}}{\partial C^{\#}}$ and $\frac{\partial p^*}{\partial C^*}$ allows to compare how much the politician responds to campaign contributions across the two equilibria, whether it is by increasing or decreasing p. For $E \geq T(\alpha, \beta, D)$ ($\frac{1}{1+\alpha}D < T(\alpha, \beta, D) < D$), then $\left|\frac{\partial p^{\#}}{\partial C^{\#}}\right| \geq \left|\frac{\partial p^*}{\partial C^*}\right|$. In other words, for a wide range of interest groups, the discontinuation of earmarks should make the politicians more sensitive to campaign contributions, and give special interests better conditions to exert influence, which might increase their incentives to contribute to electoral campaigns.

4.3 Earmarks in the House of Representatives

Earmarks are legislative provisions that are inserted into larger bills. The large majority of earmarks are in the Appropriations bills, which determine the allocation of federal spending. These bills are drafted by the Appropriations subcommittees in the House of Representatives and the Senate. They are approved within the subcommittees, and then by the full Appropriations committee, before being sent to the floors of the House and the Senate for a vote. Within those bills, earmarks specify that certains amounts of federal funds be spent on specific projects. Generally, earmarks provide funds for local projects related to the districts of their sponsors. For instance, Florida Representative Allen Boyd obtained an earmark in 2009 to fund construction and maintenance works in an agricultural station in his district.[10].

In order to place an earmark into a bill, a member of Congress submits a request at the subcommittee level. If the request is granted, the earmark is inserted into the bill, which goes further through the legislative process. The decisions to grant earmarks are generally not debated or voted within the subcommittee, and they are usually handled by each party separately. The requests are addressed to the chairs of the Appropriations subcommittees - the ”Cardinals”, or the ranking members from the minority party[11], who then choose whether to place an earmark into the bill or not. These decisions go relatively unnoticed: even though they sum up to considerable amounts, earmarks have always represented a very small share of the federal budget. For instance: around $20 billion of federal funds were allocated through earmarking in 2009, but total federal spending that year was set at $3.1 trillion.

In part due to their discretionary nature, earmarks drew suspicions of wasteful spending, and have been commonly associated with pork barrel spending. In 2007, Congress made it mandatory for its members to disclose the earmarks they sponsored, making it possible to collect detailed data on earmark sponsorship for each member of Congress. In 2010, earmarks had become a sensitive issue. With the congressional elections drawing close, in a context where the Democrats' popularity was steadily decreasing, the Democratic leadership in the House decided to stop giving earmarks allocated to for-profit organizations, hoping that it would be

[10]See http://www.washingtonwatch.com/bills/show/ED_1595.html

[11]These positions are considered to be very influential within the House of Representatives. They are usually held by more senior Representatives, which are appointed by the parties' leaderships.

received positively by the voters. However, the Republican leadership in the House quickly followed by advocating that earmarks be completely revoked, and announced that they would stop distributing earmarks altogether. These measures were taken when Representatives from both parties had already submitted requests for earmarks in that year, and they were far from being unanimously approved within the parties. Senate Democrats openly criticized their House counterparts. Two days after the Republican leadership announcements, a couple of Republican Representatives protested by ostensibly submitting new requests. In the months leading to the 2010 congressional elections, it became increasingly clear that Congress would not be able to pass the budget before the elections[12] and that the earmarks that were supposed to be included in the 2010 budget would not be distributed. Even though the House leaderships' decisions to restrict the distribution of earmarks was endogenous to the electoral context, it suddenly changed the bargaining terms of the legislative process for the individual Representatives. The fact that Republicans responded to the Democratic move against earmarks with an even stronger one accentuated the unexpected devaluation of earmarks as bargaining instruments. While the Representatives did anticipate that earmarks might be discontinued after the 2010 elections, they still expected to receive some that year. However, the US Congress' failure to pass the budget on time de facto prevented their distribution. After a large victory over the Democrats in the 2010 elections, House Republicans regained the majority and voted a moratorium on earmarks, which the President confirmed by stating that he would veto any Appropriations bill that included earmarks.

I use the data on earmarks that became available since 2007, which describe the earmarks that were placed in the Appropriations bills in 2007, 2008, and 2009. These data were compiled by Taxpayers for Common Sense[13]. So, the data cover all the earmarks passed under the 110th Congress (2007-2008). In the 111th Congress (2009-2010) however, the data cover the earmarks placed into the bills in 2009 only. No Appropriations bills were passed before the general elections in 2010, and earmarks have been under a moratorium since then.

Table 1 provides an overview of the Representatives' earmarking activity for the years 2007,

[12]Congressional elections are held in November, while the Congress is supposed to pass the budget by the end of September.

[13]www.taxpayers.org.

Table 4.1: Earmarks in the House of Representatives

	2007	2008	2009	2010
Number of earmarks				
Total	8527	7948	7529	0
sponsored by: Democrats only	4854	4530	4681	
sponsored by: Republicans only	2978	2756	2239	
sponsored by: both parties	695	642	589	
Mean (per Representative)	23.73	23.49	22.25	0
Democrats	27.08	28.01	27.04	
Republicans	19.7	18.05	18.13	
Sponsorship				
Solo earmarks	910	882	889	0
Co-sponsored with Senators	4017	3585	3372	0
Representatives without earmarks	14	52	52	435
Amount				
Total ($bn)	12.8	13.87	13.62	0
Democrats only	6.53	6.98	7.79	
Republicans only	4.12	4.27	3.64	0
both parties	2.15	2.32	2.19	
Mean value (per Representative) ($million)	47.3	63.5	58.6	0
Democrats	51	80.4	71.9	0
Republicans	42.6	42.5	39	
Mean sponsor-weighted value ($million)	17.7	19.4	22.5	0
Democrats	19.1	21.8	25.1	0
Republicans	15.9	16.5	18.6	
Total US federal expenditures ($trillion)	2.73	2.9	3.1	3.46

2008 and 2009. During the period covered by the data, a Representative sponsored (or co-sponsored), on average around $65 million worth of earmarks each year. Generally, the total number of earmarks decreased over time, while their total dollar value increased. House Democrats received more earmarks than the Republicans, most likely because they had the majority during the period covered by the data (110th and 111th Congresses) and were thus in control of the Appropriations committee. Moreover, the table shows that the vast majority of earmarks was sponsored by more than one Representative, and almost half of them were co-sponsored with Senators. Given that Representatives could request many earmarks and that their values could differ greatly, earmarking activity might not be accurately represented by the number of earmarks sponsored, or by the total dollar value. In order to get a more comprehensive overview of earmarking activity, the Table also shows the mean sponsor-weighted value of earmarks. The dollar value of each earmark is weighted by the number of sponsors. The Table then shows the average of the total weighted value per Representative. Though it remains a rough indicator (every sponsor is given the same weight), this measure suggests that earmarking activity had been increasing from 2007 to 2009.

4.4 Data and methodology

4.4.1 Data

In this chapter, I estimate the effect of earmarks on US Representatives' voting behavior, on vote shares in the elections, on campaign spending and campaign contributions. Congressional voting data and election data are collected over periods of two years, that coincide with the duration of a Representative's mandate. The unit of analysis is the individual Representative, observed over two periods: 2007-2008 and 2009-2010, which cover the 110th and the 111th Congress. The discontinuation of earmarks is used as an exogenous change in earmarking, that allows to assess the causal effet of the loss of earmarks in the 2009-2010 period.

The sample population includes the Representatives for whom there is complete data on earmarks, congressional voting and elections from 2007 to 2010. Representatives who were voted out of office in 2008, those who were newly elected in 2008, and those who did not pursue reelection in both 2008 and 2010 are excluded from the sample. There are 331 Representatives in the sample (the House sits 435 voting members), 199 Democrats and 132 Republicans. Democrats retained the majority in the House during the sample period. The composition of the sample population is discussed in more detail below.

Congressional voting and the party line

Prior studies, as well as an abundance of anecdotal evidence, have indicated that politicians are willing to trade their votes on specific bills against personal favors, benefits for their districts or eamarks. This chapter takes a more general approach using roll call data, which documents every vote cast by every Representative during the sample period. For each vote in the House, I determine the parties' official positions by looking at the votes of the party leader and the Whip. If they cast the same ballot, it is then defined as the party line on that vote. If they do not, or if they abstain, then the vote is dropped out of the sample. Maintaining the parties's voting discipline is one of the main responsibilities of the leaders and the Whips. Thus, looking at their voting record should give a good indication of whether there was an official party stance on a vote. Looking only at these two individuals also allows to define the party line loosely enough to keep a sufficient number of votes in the sample. It is then possible to measure how often each Representative deviates from her party line. The *propensity to deviate from the party line* is then defined as the percentage of a Representative's votes that were different from the party line. There are two ways in which a Representative can deviate from the party line: she can abstain, or vote against the party line. Both these deviations will be examined separately.

Arguably, roll call votes do not all have the same significance: a vote on a health care reform certainly carries more weight than a vote on inaugurating a local post office. In order to address that issue, the estimation will be conducted with a subsample of the roll call votes that only includes major legislative actions: votes on passage of a bill, votes on amendments, and votes on House Resolutions. Furthermore, I will also use two alternative definitions of the party line in order to check the robustness of the results. The first alternative definition imposes an additional restriction: both the party leader and the Whip must vote similarly, and neither the leader or the Whip from the other party should agree with them. The second alternative definition stipulates that if at least 70% of the Representatives from the same party vote similarly, this designates the party line on that vote. For future references, the first definition will be called *leadership line*, and the two alternative ones will be called *leadership line with agenda*, and *member majority line*.

Table 2 presents summary statistics for the Representatives' voting behavior and earmarking activity over the sample period. With regards to earmarking activity, rather than using the total of the gross value of the earmarks that a Representative received, the table displays statistics for the total sponsor-weighted value. For each earmark, its dollar value is divided by the number of sponsors. As it was mentioned above, this measure should give a more accurate description of earmarking activity. The analysis will use this measure in all the estimations that follow, however all the results are identical and stay fully robust when the total dollar value of earmarks is used. The table also includes statistics for members of the Appropriations committee, who had an advantage in earmarking given their direct involvement in the budget process: the Table shows that members of the Appropriations committee earmarked twice as much as the average Representative.

Notably, the average propensity to deviate is around ten percent across all measures. While this may seem relatively small, it implies that, on average, Representatives deviated from the party line on more than 150 votes in both periods. A closer look at the deviations also reveals that deviations by abstention are much more variable than by votes against the party line. Furthermore, the table shows a general decrease in the propensity to deviate from the party line in the second period. A plausible explanation for this change is the election of Barack Obama in 2008: it increased the legislative responsibilities of the Democratic majority in the House, which had to work in concert with the new Administration to pass bills and implement policies.

The statistics presented in Table 2 apply only to the sample population, which excludes Representatives who were not in office, or who did not run for reelection in both periods. Among those Representatives are those who left the House by 2008. If earmarks had any effect on the elections, the sample might then be biased. In order to address this concern, Table 3 provides

Table 4.2: Roll call data, voting behavior and earmarks - Summary statistics

	Total number of votes	Number of official leadership positions		Propensity to deviate from leadership (% of votes cast against party line)			
		Democrats	Republicans	Mean	Std. Dev.	Min	Max
2007-2008							
Leadership line							
abstention and votes against	1865	1772	1627	11.28	12.99	0	90.35
abstention				6.07	12.85	0	90.18
votes against				5.21	5	0	51.58
Leadership line - subsample (only major legislative actions)	790	741	674	12.85	14.92	0	91.9
Leadership line with agenda	1865	764	458	13.01	15.56	0	89.3
Majority member line	1865	1865	1865	10.01	12.57	0	90.08
2009-2010							
Leadership line							
abstention and votes against	1647	1537	1376	8.43	7.04	0	93.36
abstention				4.99	5.79	0	93.29
votes against				4.43	4.46	0	42.74
Leadership line - subsample (only major legislative actions)	614	572	529	9.45	8.83	0	91.96
Leadership line with agenda	1647	642	295	10.98	10.39	0	88.31
Majority member line	1647	1647	1647	6.84	6.69	0.73	93.26
Earmarks sponsor-weighted value ($million)				Mean	Std. Dev.	Min	Max
(each earmark value divided by the number of sponsors)							
Total 2007-2009				72.7	81.9	0	620
Total 2007-2009 for Appropriations Committee members				144	108	28.3	620
N=331							

Leadership line: party leader and Whip vote similarly
Leadership line with agenda: party leader and Whip vote similarly, and the opposing leader and Whip oppose or abstain
Majority member line: at least 70% of the party members vote similarly

Table 4.3: 60 Representatives who left the House before 2009

	Propensity to deviate from leadership (%)			
2007-2008	Mean	Std. Dev.	Min	Max
Leadership line	24.33	20.12	5.41	92.68
Leadership line - subsample (only major legislative actions)	26.33	19.83	3.66	93.47
Leadership line with agenda	29.93	20.62	3.71	92.57
Majority member line	18.58	19.74	1.23	88.79
	Mean	Std. Dev.	Min	Max
Earmarks weighted value ($million)	44.2	40.7	0.9	203

some information on the characteristics of the 60 Representatives who left the House by the end of the first period (2007-2008). The table shows that these Representatives had on average a much higher propensity to deviate from the party line than those included in the sample. Moreover, the table also shows that the average amount of earmarks they received is in the same range as for the Representatives in sample population. So, if anything, the sample population is biased towards Representatives who deviate less from the party line. Which means that if there actually is selection bias, it could lead to underestimating the effects of earmarks on the propensity to deviate from the party line within the sample population.

Elections and campaign finance

The discontinuation of earmarks in 2010 prevented incumbent politicians to distribute earmarks to their constituents. Given their discretionary nature, earmarks allowed politicians to allocate public funds to specific projects in their districts, and to claim direct credit for it. I then investigates the causal effect of earmarks on vote shares in the elections, and on campaign finance variables. Looking at vote shares allows to evaluate the politician electoral performance.

Table 4.4: Electoral data - Summary statistics

	Mean	Std. Dev.	Min	Max
2007-2008				
Election scores (% votes)	68.96	12.28	44.83	100
Individual contributions ($thousands)	675	463	70	2710
PACs contributions ($thousands)	664	458	3	3578
Number of PACs	201.4	95.5	13	604
Campaign spending ($thousands)	1235	760	188	5048
2009-2010				
Election scores (% votes)	63.9	12.08	36.57	100
Individual contributions ($thousands)	706	488	44	3080
PACs contributions ($thousands)	719	464	5	2876
Number of PACs	209.1	102.1	12	629
Campaign spending ($thousands)	1436	884	230	5408

N=331

Campaign spending is the amount of money that a candidate spent during electoral campaign. Campaign contributions are the amounts that the candidate collected in order to finance her campaign. Importantly, the analysis will use data on campaign contributions from Political Action Committees, which are organizations whose official purpose is to influence elections. There is an enormous variety of PACs, that can represent a wide range of special special interests, from any sort of business or industry to religious or ideological movements. Campaign contributions from PACs are an interesting measure, as they reflect the exposure of a candidate to special interests, and can be used as proxy to assess their influence on a politician.

Summary statistics on vote shares in the elections and campaign finance are reported in table 4. The 2008 elections were a victory for the Democrats, who gained 21 seats and strenghtened the majority they had obtained in the 2006 elections. The 2010 elections however, were a large Republican victory: Republicans gained 63 seats from the Democrats and won the majority back. Since the data start before the 2008 elections and keep only incumbents who ran for election in both periods, the sample population includes a majority of Democrats. This explains the decrease in average election scores in 2010, when Democrats lost the elections.

With regards to campaign finance, table 4 indicates a slight increase in contributions from one period to the other, coming from PACs contributions. However, there is a fair amount of dispersion among the Representatives in the sample: standard deviations for total, individual and PACs contributions are quite high in both periods. Notably, PACs contributions represent, on average, almost half of the total contributions[14]. Federal electoral regulations limit the amount that PACs can contribute to $5000 per candidate, which means, as the table shows, that Representatives received contributions from a very high number of PACs on average. This suggests that candidates who wish to collect a significant amount of contributions from PACs will have to be in contact with a wide variety of special interests.

Data sources

The roll call data was obtained by Voteview[15]. The congressional data used in this study were collected by Charles Stewart III and Jonathan Woon[16]. With regards to elections and campaign finance, I use data on election races, campaign spending, contributions made by individuals, contributions made by PACs, and the number of PACs that gave to a candidate. Most of the data have been compiled by the Federal Election Commission[17], and some additional data on PACs were obtained by the Center for Responsive Politics[18]. The data on the congressional districts was collected by the American Community Survey. Finally, data on earmark requests in 2008 and 2009 was collected by scraping on the WashingtonWatch website.

[14] PACs can make direct contributions, but they can also participate more or less directly in the campaign, by sponsoring ads in favor of or against a candidate for instance. PACs are expected to report the amounts spent for engaging in such activities as independent expenditures. The data on PACs contributions also include independent expenditures, as they were reported to the FEC.

[15] http://voteview.com

[16] http://web.mit.edu/17.251/www/data_page.html#2

[17] www.fec.gov

[18] www.opensecrets.org

4.4.2 Empirical specification and identification

I estimate variants of the following model:

$$Y_{it} = \alpha + \beta_0 I\left(2009 - 2010\right) + \beta_1 I\left(2009 - 2010\right) Earmarks_i + \mathbf{X}_{it}\gamma + \delta e_i + \epsilon_{it} \quad (4.14)$$

Y_{it} is the outcome variable for Representative i in period t. For the first set of estimations on voting behavior Y_{it} is the propensity to deviate from the party line. The estimations are performed on the different measures of the party described above. For the second set of estimations on elections and campaign finance, I will use five outcome variables: vote share in the elections, campaign spending, campaign contributions from individuals, campaign contributions from Political Action Committees (PACs), and the number of PACs that made a contribution.

$I\left(2009 - 2010\right)$ is an indicator variable that takes value 1 in the second period, when the discontinuation of earmarks occured. $Earmarks_i$ is the (sponsor-weighted) value of all earmarks that Representative i received from 2007 to 2009. $\mathbf{X}_{it}$ is a vector of covariates that control for time-varying characteristics of the Representatives and their districts. e_i are the fixed effects for the Representatives, which will control for many features of the politicians and their district. ϵ_{it} is the error term. Standard errors are clustered at the individual level.

β_0 estimates the baseline change in the outcome variable between 2007-2008 and 2009-2010. The causal effect of earmarks on the outcome variable is captured by the coefficient β_1. The identification strategy relies on two assumptions: 1) the discontinuation of earmarks in the second period is an exogenous change in earmarking, and 2) the unobserved changes in the outcome variable in the second period are not related to the Representatives' past earmarking activity.

With regards to the plausibility of the first assumption, the discontinuation of earmarks in 2010 was an unexpected development for the Representatives: they had already submitted requests for earmarks when the leaderships made their respective announcements to curtail their distribution, and the fact that Congress failed to pass the budget on time confirmed that no earmarks would be handed out that year.

The second assumption concerns the environment in which the discontinuation of earmarks occured during the sample period. The sample period 2007-2010 saw significant political and economic changes: Barack Obama was elected President in 2008, in a time of serious economic crisis. However, there were no significant changes within the US Congress: both the House and the Senate remained under Democratic majority during the sample period. With regards to congressional voting behavior, the specification estimates the effects of the loss of earmarks on deviations from the party line within the House of the Representatives, within each party. Even if the election of Barack Obama changed the global legislative agenda, there were no significant changes in party dynamics within Congress. The House Democratic leadership stayed the same during the sample period. In the Republican party, the only change in leadership was Rep. Eric Cantor who succeeded Rep. Roy Blunt as the House minority Whip after the 2008 elections. However, Eric Cantor had been serving as Deputy Whip for six years under Roy Blunt prior to his appointment, and he was Blunt's most logical successor.

The specification also includes a variable that controls for Tea Party membership in 2010, which was the first time that the Tea Party presented candidates for congressional elections. There is also a dummy variable controlling for membership on the Appropriations committee in the second period. Given that members of the Appropriations committee were in a more favorable position to obtain earmarks, the effects of the earmark stoppage may possibly be stronger for them. The specification also controls for electoral pressure in both periods, by including a dummy variable that takes value 1 if the Representative was engaged in a tight electoral race, defined as an election where the Representative received less than 55 percent of the votes.

Finally, the specification includes a set of time-varying variables that control for economic conditions at the district level: unemployment rate, median household income, percentage of families below the poverty line, and land area (logged). These variables should capture the effects of changing economic conditions at the district level.

Importantly, the empirical strategy uses the discontinuation of earmarks as an exogenous change in earmarking in the second period. However, politicians did receive earmarks in 2009. Since the roll call data and the electoral data are organized in periods of two years, this means that the earmark stoppage only affected half the second period. Thus, the model may actually underestimate the effects of earmarks.

4.5 Results

4.5.1 The effects of the earmark stoppage on voting behavior

Main results

Table 5 presents estimates of the effect of the discontinuation of earmarks on the Representatives' propensity to deviate from the party line, when the party line is defined as the *leadership line* (the party leader and the Whip cast the same ballot on a vote). The estimate for the baseline change in 2009-2010 is negative and significant, which implies that Representatives deviated on average less from the party line in the second period. As mentioned above, a plausible explanation for this change is the election of Barack Obama as US President in 2008. The change to a Democratic Administration most likely increased the legislative responsibilities of the House Democratic majority.

The main finding of these estimations is that the loss of earmarks caused the Representatives to deviate from the party line relatively more than before. The coefficients indicate that a standard deviation change in earmarking correspond to an increase of about 1.75 percentage points in the propensity to deviate from the party line. With respect to the politicians' voting behavior in the second period, this means that the loss of earmarks increased the average propensity to deviate by more than 15 percent, which amounts to about 30 additional votes for which the average Representatives deviated from her leadership. With regards to the nature of these deviations, the estimates for specifications (5) and (6) show that most were abstentions rather than votes against the leadership positions.

Furthermore, Representatives who sat on the Appropriations Committee were in a relatively more favorable position to obtain earmarks given their direct involvement in drafting Appropriations bills. Indeed, while the average (sponsor-weighted) value of earmarks over the 2007-2010 period is 72.7 $million, the politicians in the Appropriations committee received on average 148 $million over the same period (see Table 2). The estimates from Table 5 reveal that those politicians deviated from the party line almost twice as much as the others, once earmarks were discontinued. Together with the coefficient on the interacted earmarking variable, these results

Table 4.5: Propensity to deviate from the party line - leadership line

Deviatons from:	Leadership line - All votes					
	(1)	(2)	(3)	(4)	(5) (only abstentions)	(6) (only votes against)
2009-2010 baseline change	-1.287	-1.517***	-1.883***	-2.852	-2.195	-0.657
	(1.063)	(0.472)	(0.650)	(1.884)	(1.955)	(0.407)
Earmarks (standardized)	-0.772					
	(1.014)					
(2009-2010) interacted with Earmarks (standardized)	1.863***	1.922***	1.639***	1.730***	1.467**	0.264*
	(0.650)	(0.641)	(0.592)	(0.590)	(0.597)	(0.144)
Tight Election Race (less than 55% of the votes)	0.163		0.342	0.436	-0.230	0.666***
	(0.925)		(1.132)	(1.113)	(1.176)	(0.255)
(2009-2010) interacted with Appropriations Committee member	0.195		1.406**	1.481**	1.843***	-0.362
	(0.881)		(0.672)	(0.687)	(0.688)	(0.309)
Tea party member in 2009-2010	-0.230		-0.834	-0.699	-0.530	-0.169
	(1.087)		(2.101)	(2.201)	(2.353)	(0.325)
district unemployment	-0.0750			0.0791	0.0632	0.0160
	(0.292)			(0.800)	(0.841)	(0.133)
district median household income (logged)	2.631			-3.610	-5.112	1.502
	(3.424)			(10.69)	(10.95)	(2.749)
district percentage of families below the poverty line	0.0387			0.360	0.303	0.0572
	(0.165)			(0.525)	(0.567)	(0.0860)
district land area (logged)	0.251					
	(0.373)					
fixed effects (Representative)	no	yes	yes	yes	yes	yes
Observations	662	662	662	662	662	662
R^2	0.073	0.074	0.077	0.081	0.047	0.129

Robust standard errors in parentheses, clustered at the individual level
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4.6: The effects of earmarks on voting behavior - other measures

Deviations from:	leadership line major legislative actions			leadership line with agenda	member majority line
	(1)	(2) (only abstentions)	(3) (only votes against)	(4)	(5)
2009-2010 baseline change	-3.353	-2.865	-0.488	-2.337	-3.738**
	(2.150)	(2.289)	(0.609)	(2.278)	(1.734)
(2009-2010) interacted with Earmarks (standardized)	2.009***	1.576**	0.432*	2.068***	1.578***
	(0.682)	(0.664)	(0.230)	(0.733)	(0.533)
Tight Election Race (less than 55% of the votes)	0.139	-0.423	0.562	2.090*	1.082
	(1.309)	(1.408)	(0.387)	(1.230)	(1.091)
(2009-2010) interacted with Appropriations Committee member	2.170***	2.176***	-0.00577	1.368	0.883
	(0.810)	(0.776)	(0.464)	(0.886)	(0.685)
Tea party member in 2009-2010	-0.524	-0.506	-0.0185	-1.072	-1.735
	(2.517)	(2.714)	(0.481)	(2.827)	(1.907)
district unemployment	0.0337	0.107	-0.0733	0.139	0.355
	(0.927)	(0.993)	(0.203)	(0.899)	(0.730)
district median household income (logged)	-4.120	-5.491	1.371	-7.097	0.283
	(12.72)	(12.79)	(4.332)	(13.23)	(9.992)
district percentage of families below the poverty line	0.463	0.401	0.0622	0.369	0.407
	(0.595)	(0.650)	(0.126)	(0.528)	(0.507)
fixed effects (Representative)	yes	yes	yes	yes	yes
Observations	662	662	662	662	662
R^2	0.089	0.045	0.083	0.056	0.101

Robust standard errors in parentheses, clustered at the individual level
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

strongly suggest that earmarks were used as a bargaining instrument to buy the Representatives' votes.

Members of the newly formed Tea Party in 2009-2010 do not seem to have deviated more than other Representatives. Looking at specification (1) that does not include fixed effects, economic conditions in the districts did not have a significant impact on voting behavior, and neither did land area.

Table 6 confirms the results obtained with the *leadership line* measure. The coefficients on the earmarking variable are always positive and statistically significant, with the subsample of more important votes, and the two alternative measures of party line. The effect of earmarks appears to have been even stronger on more important legislative actions, as specifications (1), (2), and (3) indicate.

Robustness checks

In order to check the robustness of the results, I also estimate the effect of the loss of earmarks on the probability that a Representative deviates from the party line on a single vote. The following model is estimated:

$$Y_{ivt} = \alpha + \beta_0 I\left(2009 - 2010\right) + \beta_1 I\left(2009 - 2010\right) Earmarks_i + \mathbf{X}_{it}\gamma + \delta e_i + \lambda d_{iv} + \epsilon_{ivt} \quad (4.15)$$

The unit of observation is the vote of Representative i on vote v in period t. Y_{ivt} is a binary variable that takes value 1 when the Representative deviates from the party line (defined as the *leadership line*). There are then 1054357 observations in the sample. The estimation is also performed using the subsample of roll call votes that only includes major legislative actions. The variable are the same than above. Additionally, standard errors are clustered at the individual level, and at the bill level, to account for the fact that a bill may come to the floor of the House of Representatives more than once. Table 9 in the appendix provides the estimates. The results show that the earmark stoppage had a positive and statistically significant impact on the probability that a Representative deviates from her party line on a single vote, and thus confirms the validity of the findings presented above.

Another robustness check is performed using a pseudo-experimental approach. Figure 1 in the appendix plots the distribution of earmarks in the sample population. The graph shows that there is considerable variation in earmarking among the Representatives, and that a sizeable fraction received little to no earmarks. These Representatives could then be considered as a pseudo 'control group' in a natural experiment. So, the sample population is sorted into three groups of equal size, according to their earmarking activity over the period 2007-2009, prior to the stoppage. The groups are labeled LOW, MEDIUM, and HIGH. The number of groups is arbitrarily fixed at three. Using a different number of groups does not affect the results qualitatively. The sorting is done using the total weighted amount of the earmarks that Representatives received during the period 2007-2009. The total weighted amount is favored over the total (unweighted) amount, since it gives a more informative description of the politicians' earmarking, as it was discussed in the previous section. Representatives in the LOW group, those with the lowest levels of past earmarking, serve as the baseline monitoring the changes occuring in the treatment period. Arguably, these Representatives should also be the least affected by the stoppage of earmarks. The MEDIUM and HIGH groups are the pseudo 'treatment groups', which should capture the effects of the earmark stoppage on the outcome variables. The following specification is estimated:

$$Y_{it} = \alpha + I\left(2009 - 2010\right)\left(\beta_0 + \beta_1 MEDIUM + \beta_2 HIGH\right) + \mathbf{X}_{it}\gamma + \delta e_i + \epsilon_{it} \qquad (4.16)$$

The coefficient β_0 estimates the mean change in the outcome variable between the 2008 and the 2010 election cycles, for the Representatives in the LOW group, which is the baseline. β_1 and β_2 estimate "treatment effects" for the Representatives in groups MEDIUM and HIGH respectively, i.e. those with medium and high levels of earmarking activity before the earmark stoppage. For instance, β_1 estimates the average difference between the baseline and the MEDIUM group, with regards to the changes in the outcome variable in the second period.

The results are provided in table 10 in the appendix. The outcomes are in line with the previous estimations, stronger even. They indicate that Representatives who relied most on earmarks started deviating relatively more than the others when earmarks were discontinued. Again, these results also stay fully robust across all measures of party line.

4.5.2 The effects of earmarks on elections and campaign finance

Table 7 reports the effects of the earmark stoppage on vote shares in the elections. The estimates indicate that the earmark stoppage hurt the Representatives in the elections. On average, the loss of earmarks cost the Representatives almost 1% of the vote shares in the next elections. Although the coefficients are not large, they appear to be robust and statistically significant. These results imply that earmarks were helping Representatives win elections before they were discontinued.

The coefficient for the baseline change in the 2009-2010 period is very negative and very significant. This estimate reflects the large Republican victory in 2010. Democrats had had the majority in the House of Representatives since 2007, and they had won the 2008 elections, so that the sample population in this study is composed of a majority of Democrats. Members of the newly formed Tea party enjoyed considerable electoral gains in 2010. Unsuprisingly, running unopposed correlates with high electoral gains. However, being part of the Appropriations committee after the earmark stoppage does not seem to have any significant effect on the vote shares. District characteristics do not exhibit any significant effect either. However, given that there are only two data points for each control variable, it is quite likely that fixed effects capture a large share of the variations in the outcome variable.

The role of campaign contributions is a potential concern for the estimation: there is most certainly endogeneity between electoral performance and campaign contributions. Raising more money and running more expensive campaigns may improve the chances of being elected, but, at the same time, candidates who are engaged in tight electoral races would then have bigger incentives to raise contributions, which would bias the estimates. If the earmark stoppage did hurt the politicians electorally, then it also changed their incentives to raise contributions. Thus, campaign contributions raise endogeneity concerns, while they could also be a counfounding variable in the estimation. In order to address these issues, the estimation is performed with and without campaign contribution variables. The results stay consistent across the estimations.

The effects of the earmark stoppage on campaign finance are reported in Table 8. In order to give a relatively comprehensive view, four variables are considered: campaign spending, campaign contributions from individuals, campaign contributions from PACs, and the number of

Table 4.7: The effects of earmarks on vote shares in the elections

	Vote share in the elections (%votes)			
	(1)	(2)	(3)	(4)
2009-2010 baseline change	-4.766***	-5.059***	-6.412***	-6.219***
	(0.714)	(0.634)	(1.810)	(1.795)
(2009-2010) interacted with	-1.089*	-1.031*	-0.972*	-0.858*
Earmarks (standardized)	(0.621)	(0.530)	(0.520)	(0.512)
Tea party member in 2009-2010		10.33***	10.39***	10.66***
		(1.322)	(1.330)	(1.326)
Unopposed in the election		29.07***	29.13***	28.98***
		(2.472)	(2.485)	(2.396)
(2009-2010) interacted with		0.829	0.841	0.695
Appropriations Committee member		(1.557)	(1.576)	(1.526)
district unemployment			0.335	0.409
			(0.623)	(0.611)
district median			-0.000175	-0.000163
household income			(0.000195)	(0.000195)
district percentage of families			-0.0813	-0.122
below the poverty line			(0.349)	(0.348)
Campaign contributions				-0.00166
from individuals				(0.00101)
Campaign contributions				-0.00362
from Political Action Committees (PACs)				(0.00269)
fixed effects (Representative)	yes	yes	yes	yes
Observations	662	662	662	662
R^2	0.148	0.035	0.093	0.069

Robust standard errors in parentheses, clustered at the individual level
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4.8: The effects of earmarks on campaign finance

	Campaign spending (1)	Contributions from individuals (2)	Contributions from PACs (3)	Number of PACs (4)
2009-2010 baseline change	72.18	-52.41	51.90	4.523
	(141.2)	(101.5)	(42.99)	(11.02)
(2009-2010) interacted with Earmarks (standardized)	95.13*	-0.0684	31.82***	5.560**
	(54.28)	(40.39)	(10.05)	(2.431)
Tea party member in 2009-2010	144.0	295.7	-43.41	-7.696
	(246.5)	(293.2)	(29.13)	(7.696)
Tight Election Race (less than 55% of the votes)	547.1***	117.9**	60.82**	23.18***
	(107.7)	(50.27)	(28.96)	(8.117)
Unopposed in the election	-214.4	-23.46	-22.37	-3.168
	(154.3)	(84.09)	(38.47)	(11.32)
(2009-2010) interacted with Appropriations Committee member	-50.50	-33.65	-28.58	-2.376
	(121.3)	(61.49)	(28.35)	(7.286)
district unemployment	34.93	43.66	1.782	0.645
	(53.03)	(44.37)	(11.77)	(3.266)
district median household income	-0.00181	0.00755	-0.00127	-0.000491
	(0.0221)	(0.0148)	(0.00514)	(0.00129)
district percentage of families below the poverty line	-20.19	-6.857	-6.988	-1.776
	(30.51)	(22.39)	(8.137)	(2.058)
fixed effects (Representative)	yes	yes	yes	yes
Observations	662	662	662	662
R^2	0.148	0.035	0.093	0.069

Spending and contributions variables are expressed in thousands of dollars
Robust standard errors in parentheses, clustered at the individual level
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

PACs that made contributions to the Representative. The spending and contributions variables are expressed in thousands of dollars. Politicians who were involved in tight electoral races generally spent and collected more money than the others. More importantly, the estimations reveal that the discontinuation of earmarks had a positive and significant effect on campaign spending, contributions from PACs, and on the number of PACs who made a contribution. These results suggest that the loss of earmarks induced Representatives to run more expensive campaign on average. The increase in expenditures was financed with a significant increase in PACs contributions. Moreover, these additional donations were obtained by soliciting a significantly larger number of PACs.

4.6 Discussion

Once earmarks became unavailable, Representatives who had relied on earmarks started deviating from the leadership legislative agenda more often. They also lost votes in the subsequent elections, while running more expensive campaigns and collecting more contributions from PACs. As such, these findings strongly indicate that earmarks were used to maintain voting discipline within the parties. Representatives were willing to trade their votes against earmarks because earmarks were a valuable electoral instrument. Thus, the earmark stoppage weakened party discipline and generated electoral liability. This added pressure induced the affected Representatives to turn towards special interests - the PACs - in order to run more expensive campaigns, so that they could mitigate the repercussions of not being able to obtain earmarks for their districts anymore. The chapter does not investigate the consequences of the increased exposure to special interests, however the findings suggest that the earmark stoppage spurred favorable conditions for them to exert influence: while decreasing the ability of the parties' leadership to bring politicians into the fold, the discontinuation of earmarks also incentivized the legislators to seek additional financial support by special interests.

The results on voting behavior appear to be quite robust, however those on elections and campaign finance have to be considered a bit more cautiously for two reasons. First, the sample population is de facto a selection of Representatives who might potentially be stronger electoral candidates. This is especially true of the Republicans in the sample, who survived a Democratic victory in the 2008 elections. Since the selection was partly based on electoral performance in the 2008 elections[19], there could be some concerns that the results on the effects of earmarks on elections and campaign finance are biased. Nevertheless, the sample population still retains more than two thirds of the seats in the House of Representatives (331 out of 435), and thus offers a relatively wide variety of profiles. Fixed effects should also attenuate such bias, if there is any.

Second, earmarks came under stronger scrutiny after the parties' leadership announced that they would curtail the distribution of earmarks, and they received mostly negative coverage in the media. The results clearly show that the Representatives who relied on earmarks suffered electorally after the stoppage. In this chapter, I claim that the losses in vote shares can be attributed to the Representatives' inability to obtain benefits for their districts. These results and this interpretation are fully consistent with the previous findings of Strattman (2013), who found that earmarks increased the chances of reelection. Moreover, these results are also consistent with those on voting behavior. However, I cannot exclude that the debates about earmarks in 2010 may have brought bad publicity to the Representatives who had relied on them before. So, the eamark stoppage may have affected vote shares in the elections through two channels: the reduction of benefits flowing to the district for which the Representative can claim direct credit, and the bad publicity associated with her past earmarking. Given the results on voting behavior and the existing evidence, this chapter places more emphasis on the first channel, but recognizes that it may not be the only one.

4.7 Conclusion

This chapter exploits the discontinuation of earmarks in 2010 to estimate their effects on congressional voting on legislation, campaign spending and contributions, and electoral outcomes. The results show that the loss of earmarks made Representatives much less likely to support

[19]Electoral performance was not the only criterion: the Representatives who died, retired, or just left the House of Representatives between elections were also excluded from the sample.

the legislative agenda of the party leaders. They also indicate that, without earmarks, Representatives faced stronger electoral challenges, which they tried to address by running more expensive campaigns and seeking out additional campaign contributions from PACs. The analysis establishes a direct and systematic relation between electoral considerations from individual politicians and policy-making. It also provides a deeper and somewhat positive apprehension of the incentives that drive representatives' behavior. Positive, because political institutions are generally believed to create very high agency costs. However the results of this chapter show that powerful incentives can be generated from relatively cheap instruments (with regards to public spending), like earmarks did before the moratorium.

Earmarks used to be a symbol of corrupt politics. They drew heavy suspicions of wasteful public spending, allocated at the whims of politicians in power. In this chapter, I shows that earmarks were actually critical in the legislative process: they were a tool to facilitate agreements and curb the influence of special interests. Thus, while the moratorium may have stopped a questionable practice with regards to public spending, it appears to have left Congress less effective for passing legislation and more vulnerable to special interests.

4.A Appendix

Table 4.9: The effects of earmarks on the probability to deviate from the leadership on single votes

Deviations from	Leadership line (1)	Leadership line (major legislative actions) (2)
2009-2010 baseline change	-0.0402** (0.0201)	-0.0470* (0.0236)
(2009-2010) interacted with Earmarks (standardized)	0.0130*** (0.00443)	0.0151** (0.00502)
Tight Election Race (less than 55% of the votes)	0.00487 (0.0120)	0.00349 (0.0154)
(2009-2010) interacted with Appropriations Committee member	0.0147** (0.00690)	0.0210* (0.00831)
Tea party member in 2009-2010	-0.00697 (0.0221)	-0.00785 (0.0254)
district unemployment	0.000834 (0.00778)	0.000303 (0.00891)
district median household income (logged)	-0.0262 (0.104)	-0.0234 (0.123)
district percentage of families below the poverty line	0.00369 (0.00522)	0.00493 (0.00577)
fixed effects (Representatives	yes	yes
Observations	1054357	443058
R^2	0.003	0.004

Standard errors in parentheses, clustered at the individual and at the bill level
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 4.1: Distribution of earmarks in the House of Representatives, summed over 2007-2009

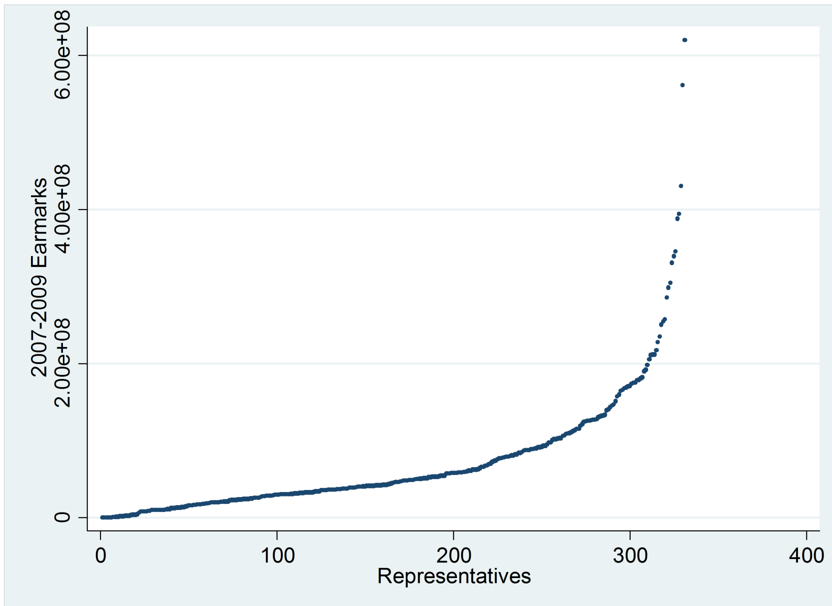

Table 4.10: The effects of earmarks on the probability to deviate from the party line - pseudo-experimental specification

Deviations from:	leadership line			leadership line major legislative actions	leadership line with agenda	member majority line
	(1)	(2) (abstentions)	(3) (votes against)	(4)	(5)	(6)
2009-2010 baseline change	-6.997***	-6.106**	-0.891*	-8.156***	-7.437**	-7.294***
	(2.393)	(2.526)	(0.460)	(2.800)	(2.947)	(2.183)
(2009-2010) interacted with MEDIUM Earmarks	3.461*	3.712*	-0.251	4.046*	4.086**	2.756
	(1.866)	(1.998)	(0.319)	(2.111)	(2.039)	(1.772)
(2009-2010) interacted with HIGH Earmarks	4.784***	4.112**	0.672**	5.705***	6.112***	4.317***
	(1.587)	(1.658)	(0.291)	(1.848)	(1.812)	(1.498)
Tight Election Race (less than 55% of the votes)	0.207	-0.456	0.663***	-0.150	1.836	0.879
	(1.167)	(1.233)	(0.252)	(1.387)	(1.260)	(1.155)
(2009-2010) interacted with Appropriations Committee member	1.011	1.589**	-0.579*	1.550**	0.590	0.385
	(0.669)	(0.676)	(0.322)	(0.760)	(0.879)	(0.657)
Tea party member in 2009-2010	-0.496	-0.368	-0.127	-0.243	-0.795	-1.548
	(2.158)	(2.313)	(0.318)	(2.469)	(2.752)	(1.882)
district unemployment	0.0717	0.0755	-0.00378	0.0672	0.122	0.332
	(0.800)	(0.845)	(0.134)	(0.925)	(0.892)	(0.736)
district median household income	-0.000223	-0.000239	0.0000159	-0.000180	-0.000349	-0.000141
	(0.000212)	(0.000216)	(0.0000490)	(0.000251)	(0.000247)	(0.000200)
district percentage of families below the poverty line	0.246	0.216	0.0308	0.366	0.224	0.283
	(0.533)	(0.566)	(0.0768)	(0.605)	(0.539)	(0.513)
fixed effects (Representatives)	yes	yes	yes	yes	yes	yes
Observations	662	662	662	662	662	662
R^2	0.096	0.060	0.146	0.106	0.076	0.113

Robust standard errors in parentheses, clustered at the individual level
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Summary

This thesis is a collection of three stories about influence. Each of them tells, in different ways, how individuals and organizations can be swayed by external agents and what consequences such influence begets. The second and third chapters of this book are theoretical and study, in different settings, how agents with private verifiable information can persuade a decision-maker. The fourth chapter is empirical and examines a somewhat more elementary instrument of influence: quid pro quo, in the US House of Representatives.

Chapter 2, co-authored with Otto Swank, uses theory to analyze a practical case: pharmaceutical companies that want to bring a new drug to the market have to convince public agencies that the drug is effective and safe. How- ever, there is evidence that new drugs are sometimes approved on the basis of incomplete information. This chapter develops a simple persuasion game in which a pharmaceutical company communicates with a health agency on two aspects of a drug: effectiveness and side effects. We show that there exists an equilibrium in which a health agency may approve a drug even though the pharmaceutical company is known to conceal some information. The out- comes of this equilibrium appear to be consistent with empirical observations. We also discuss how an equilibrium with full information revelation requires the health agency to take a sceptical attitude towards all uncertain aspects of a drug.

Chapter 3 attempts to explain how organizations make decisions when they are faced with different levels of uncertainty. In this chapter, I model a persuasion game with three players: a decision-maker and two information providers. As in the previous chapter, the decision-maker is uninformed about the consequences of her decision, and relies on the information provided by interested parties. In this one however, I assume that the different aspects of the decision are heterogenous, so that the decision-maker faces an asymmetric uncertainty. The information

providers act as advocates and communicate on distinct aspects of the decision. I show that the asymmetric uncertainty introduces a distortionary bias in the equilibrium decision, but that more uncertainty validates this bias and alleviates its distortionary effects. I then compare the advocacy setting with two competing information providers to one where only one partisan information provider collects and sends information on all aspects of the decision. I find that welfare is higher under the advocacy system when the asymmetry is high, and reach a somwehat counterintuitive conclusion: competition among information providers that communicate on heterogenous aspects of the decision is more desirable if the asymmetry between them is high enough.

Chapter 4 is an empirical study on the uses of earmarks in the US House of Representatives. For many observers in the US, earmarks - federal funds designated for local projects of US politicians - epitomize wasteful spending and corrupt politics. Others argue earmarks are critical for the legislative process because they facilitate agreements among representatives. Despite a lack of evidence supporting either side, there has been a moratorium on earmarking since 2011. Ironically, the end of earmarks provides a means to assess their effects on the legislative process. In this chapter, I exploit the introduction of the moratorium to examine the effects of earmarks on congressional voting, campaign con- tributions and spending, and electoral outcomes. I show that legislative support for the party line is tremendously sensitive to the availability of earmarks, even though earmarks represent less than a tenth of one percent of the federal budget. After earmarks were discontinued, Representatives were much less likely to vote alongside the party leadership. I also show that, without earmarks, Representatives performed worse in ensuing elections, spent more on campaigning, and collected more money from special interests. The findings imply that because earmarks made re-election more likely, party leaders could use them to facilitate agreements on legislation. They also suggest that the discontinuation of earmarks gave special interests more influence over politicians. I conclude that earmarks are, in fact, better for the legislative process.

Nederlandse samenvatting (Summary in Dutch)

Dit proefschrift, bestaande uit drie onderzoek hoofdstukken, heeft als overkoepelend onderwerp: invloed. Het tweede en derde hoofdstuk van dit proefschrift zijn theoretisch en bestuderen, in verschillende instellingen, hoe actoren met verifieerbare privé informatie een beleidsmakers kunnen overtuigen. Het vierde hoofdstuk is een empirische hoofdstuk, waarin blijkt dat partijleiders in het Amerikaanse Huis van Afgevaardigden federale fondsen hebben gebruikt om het stem gedrag onder de vertegenwoordigers te disciplineren.

Het tweede hoofdstuk van dit proefschrift, in samenwerking met Otto Swank, maakt gebruik van theorie om een praktische casus te analyseren: Farmaceutische bedrijven moeten overheidsinstanties overtuigen dat een nieuw geneesmiddel effectief en veilig is voordat zij het op de markt brengen. Er is bewijs dat nieuwe medicijnen soms worden goedgekeurd op basis van onvolledige informatie. In dit hoofdstuk wordt een simpel overtuigingsmodel ontwikkeld waarin een farmaceutisch bedrijf communiceert met een zorgautoriteit op twee aspecten van een geneesmiddel: effectiviteit en bijwerkingen. We laten zien dat er een evenwicht bestaat waarin een zorgautoriteit een geneesmiddel wel zal goedkeuren met de wetenschap dat het farmaceutische bedrijf informatie verbergt. De uitkomsten van dit evenwicht blijken consistent te zijn met empirische waarnemingen. We laten ook zien hoe in een evenwicht met volledige informatie verstrekking de zorgautoriteit een sceptische houding moet aannemen tegenover alle onzekere aspecten van een medicijnen.

Het derde hoofdstuk probeert uit te leggen hoe organisaties beslissingen nemen wanneer

ze geconfronteerd worden met verschillende niveaus van onzekerheid. In dit hoofdstuk modeleer ik een overtuigingsmodel met drie spelers: een beleidsmaker en twee geinformateerde actoren. Zoals in het vorige hoofdstuk is de beleidsmaker niet geïnformeerd over de gevolgen van haar beslissing en berust daardoor op de verstrekte informatie van de belanghebbenden geïnformeerde actoren. In dit model veronderstel ik echter dat de verschillende aspecten van de beslissing heterogeen zijn, zodat de beleidsmaker met een asymmetrische onzekerheid geconfronteerd wordt. De informatieverstrekkers fungeren als *vertegenwoordiger* (Dewatripont en Tirole (1999)) en communiceren over verschillende aspecten van de beslissing. Ik laat zien dat de asymmetrische onzekerheid een verstorende werking in het evenwichtsbesluit introduceert, maar dat bij een toename in de onzekerheid deze verstorende werking minder welvaart verlagend is. Ik vergelijk vervolgens het model met twee concurrerende informatieverstrekkers met een model waar slechts één partijdige informatieverstrekker informatie verzamelt en verstuurt over alle aspecten van de beslissing. Ik vind dat de welvaart hoger is onder het concurrerende systeem wanneer de asymmetrie hoog is en ik kom tot de counterintuïtieve conclusie: De concurrentie tussen informatieverstrekkers die communiceren over heterogene aspecten van de beslissing is meer wenselijk als de asymmetrie tussen hen hoog genoeg is.

Het vierde hoofdstuk is een empirisch studie van het gebruik van ”earmarks” in het Amerikaanse Huis van Afgevaardigden. Voor veel waarnemers in de VS worden ”earmarks” - federale fondsen aangewezen voor lokale projecten van Amerikaanse politici - gezien als de belichaming van geld verspilling en corrupte politiek. Anderen zien het belang van ”earmarks”, doordat zij het wetgevingsproces tussen vertegenwoordigers vergemakkelijken. Ondanks het gebrek aan bewijsmateriaal aan beide zijden is er een opschorting van de ”earmarks” sinds het oordeel van 2011. Ironisch genoeg biedt het einde van de ”earmarks” een manier om te beoordelen wat het effect is op het wetgevingsproces. In dit artikel exploiteer ik de opschorting om de effecten van ”earmarks” op congress stemmingen, campagne bijdragen en uitgaven en verkiezingsuitkomsten te onderzoeken. Ik toon aan dat wetgevende steun voor de partij enorm gevoelig is voor de beschikbaarheid van ”earmarks”. Dit effect is ondanks het feit dat ”earmarks” slechts een tiende van een procent deel uitmaken van het federale budget. Na de opschorting van de ”earmarks”, is de kans kleiner dat vertegenwoordigers de zelfde stem uitbrengen als de partij-leider. Ik laat ook zien dat zonder earmarks de vertegenwoordigers slechter presteren in de daaropvolgende verkiezingen, meer uitgeven aan campagne voering en meer geld ophalen bij lobby groepen. De bevindingen impliceren dat, omdat de ”earmarks” de kans op herverkiezing vergroten, partij leiders de ”earmarks” kunnen gebruiken om afspraken over wetgeving te vergemakkelijken. De resultaten suggereren ook dat lobby groepen meer invloed konden uitoefenen op politici na de stopzetting van de ”earmarks”. Ik concluderen uit mijn resultaten dat ”earmarks” beter zijn voor het wetgevingsproces.

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