# Reputation, Cheap-Talk and Delegation

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*Abstract*: A decision maker is contemplating an action whose outcome is state dependent. She has a 'prior' over the states of the world and before choosing an action, she can consult an 'expert'. We model the communication game between the decision maker and the expert as a 'cheap-talk' game. Expert quality however is heterogenous. Some can obtain informative signals while the others can not. Since an expert known to be informed earns a rent in the future, uninformed experts would like to disguise as informed. We show that such concern for future reputation imposes severe constraints on the possibility of beneficial communication. Decision makers who can benefit from such communication are characterized in terms of the relevant parameters which include the prior of the decision makers and the cost of mistaken decisions. Next we address the issue of delegation. The questions that we ask are which decision makers choose to delegate, and to whom they delegate. In situations involving public goods, we characterize the decision makers who will strictly prefer to delegate, and show that when delegation occurs, the delegate is necessarily more *extreme* than the original decision maker in terms of her prior.

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# 1 Introduction

Those who are very sure need not care for a second opinion. Their posteriors after getting an expert opinion may not induce them to act any differently than without the advice. Only those with more moderate priors can at all gain from an expert's advice. Their posteriors after the advice prompt them to act differently and might increase their expected payoff. For these moderates however the problem changes if the population of experts contain some quacks as well. If the expert happens to be a quack, the advice itself will be influenced by the opinion-seeker's predisposition or prior. The latter has to take this into account. This will leave a smaller group of agents who would act any differently with the advice than without. But then, because the expert may play up to her client's predisposition, these remaining agents face an interesting option. Does it pay Jack to send Jill, who has a different prior, to talk to the expert?

Our model sets up an agent contemplating actions with state-contingent payoffs. She has a prior belief about the probability of the states and can hire an expert to update her priors before the action. Experts come from a population of informed as well as uninformed ones and are concerned about their reputation. Two related questions are posed: (1) Can we characterize the agents who would at all gain from an expert's advice? and (2) If the outcomes are public goods, when, if at all, is it better for an agent to assign the task of playing with experts to another agent? We first formalize an 'informative' equilibrium for the game between an agent and an expert. Informally, it is an equilibrium where a 'good' expert reports her information truthfully, and the decision maker uses it profitably. Profitable use means being able to improve payoffs by acting differently with the expert's input. The analysis then partitions the set of all agents into those who can sustain an informative equilibrium and those who can not. We also explore the effect on this partitioning of the cost of choosing a wrong action, the quality of experts' signals and the proportion of informed experts in the population.

The issue of delegation is then examined assuming that the outcomes are public goods. Arranging agents who can gain from advice in the order of their priors, we show that all but those with the highest and the lowest priors can gain by delegating to another person in the set. Those at one or the other extreme of the set will be the best choice for delegation by others.

The context in which the first question is asked is fairly general: it involves contingent action with noisy information inputs. The context for the second question is more restricted: the outcomes are public goods for the set of all decision makers. Examples of the first context are straightforward. Consider a group of farmers who have varied prior expectations that they have underground water in their property. But it can not be known for sure without actually drilling a well, which thus has a contingent payoff. They can consult a hydrologist at some cost. They know, firstly, that hydrological advice is based on noisy signals, and secondly not all hydrologists are qualified. We try to answer our first question by analyzing the information game between an arbitrary farmer and an expert whose type is not known. In this game farmers who are too sure either way would not be able to sustain an informative equilibrium. We can characterize the set of farmers who can use expert advice in terms of the cost of unwarranted drilling and other relevant parameters. This part of the analysis develops a structure which is then used for the second question, where the outcomes are public goods. To continue with the same example, suppose the farmers are planning a community well in their village. Everyone would equally benefit from the well if drilling is successful. They also equally share the cost. The priors about the existence of groundwater however are different for different farmers. Is it immaterial who consults the hydrologist? If not, who is the best person to do so? Similar decision problems arise in corporate boards, local governments and community levels, wherever the outcome of the actions are public goods for the members of the decision making group.

In early literature on information games, eg. Sobel [16], Bénabou and Laroque [2], 'good' experts were *assumed* to always tell the truth. By contrast, if experts behave strategically so that signals are endogenous, there can be an adverse effect. The problem was first raised by Hölmstrom and Ricart i Costa [8], and has been subsequently modelled in a number of contexts, eg. Scharfstein and Stein [14], Hölmstrom [7]. Our model also focuses on this adverse effect, but the problem and the model structure are quite different. Our paper is perhaps closest to Morris [11] who models an expert with a stake in the policy choice. In repeated games, she develops an instrumental concern for reputation to be able to influence policy in future. The concern of that paper is about the resulting effect on policy choice, which is the focus of our paper too. Morris, however, does not discuss the possibility of delegation.

Outcomes for a model with our preoccupations are expected to be influenced by two basic elements of the structure. The first is the payoff function for experts through which we introduce their concern for reputation. In our model an expert's payoff is a function of the probability of being rehired or revisited. Concern for reputation arises directly from this payoff. Uninformed experts would not like to be exposed nor would an informed expert want to be mistaken for an uninformed one. An informative equilibrium in this situation, when it exists, will have specific features that we utilize for the possibility of delegation. The second aspect of the structure is that while one of the actions would reveal the true state through observed ex-post payoffs, the other does not give information about the states. Natural context for the model is when the set of actions contain the *status quo.* The assumption that the *status quo* is uninformative can create significant effects on policy choice, see for example Fernandez and Rodrik[5]. In our model it creates a strategic tendency for the uninformed expert to recommend the *status quo*. The informative equilibrium is a configuration that holds this tendency of the uninformed expert in check. If both actions could subsequently reveal the state, no informative equilibrium would exist in our model structure.

The rest of the paper is organized as follows. Section 2 describes the overall model. To develop the intuition of the model, in Section 3 we first present a simpler model where the expert's type is known. There we characterize the set of agents who can benefit from the expert's advice. Section 4 then develops the main model with experts of both types. We show (Propositions 1 and 2) that an informative equilibrium, if it exists, is unique. In the presence of uninformed experts the possibility of useful information flow declines, and we characterize the set of decision makers who can benefit from an expert in this situation (Proposition 3). Section 5 analyzes the possibility of delegation. We show that (1) the set of decision makers who may delegate is identical to the set of decision makers who benefit from experts' advice; and (2) agents with only two possible priors would ever be entrusted with delegation (Proposition 4). We further establish an interesting result arising from the possibility of delegation that the probability of reform may sometimes increase when the *ex-ante* cost of reform increases (Proposition 5). In section 6 we outline a slightly different model where agents are differentiated by utility functions and not priors. We show that the difference in the signals received by different agents can create the possibility of delegation in that structure too. Finally Section 7 discusses the model's robustness properties.

## 2 The Environment

A decision maker has state-contingent payoffs from two alternative actions $a_0$ and $a_1$. There are two states 0 and 1. With action $a_1$, the payoff to the decision maker is 1 if the state is 1, while this payoff is $-\lambda$, $\lambda > 0$, if the true state is 0. With action $a_0$ in place however, the payoff to the decision maker is identical across the states. Without loss of generality, we normalize this payoff to 0. In contexts involving policy choice, action $a_0$ can be thought of as the *status-quo* which can be broken by the policy $a_1$. We denote by $p$ the prior assessment of the decision maker that the state of the world is 1.

Before choosing an action, the decision maker can consult an expert. The task of the expert is to gather information about the state and convey it to the decision maker. There are two types of experts in the population: type I and II. Type I experts receives a noisy signal $s \in \{s_0, s_1\}$. The probability of getting the signal $s_i$ when the state is $i$ is given by $1 \geq q > 1/2$. These signals are thus informative of the states. Type II experts do not receive any informative signals. One way to justify this assumption is to postulate a cost of collecting information that differs across the expert types. The dichotomy of uninformed and informed experts can then be interpreted as the latter having a relatively small cost of obtaining signals while the former has a prohibitively high cost. In section 7.4 we indicate how we can obtain a lower bound on the range of costs for which type II experts will remain uninformed in any equilibrium. From now on we will refer to type I experts as informed and others as uninformed. We use $p_E$ to denote the prior of an expert that the state is 1. Finally let $r$ be the proportion of informed experts in the population, $0 < r < 1$.

The interaction between the expert and the decision maker is modelled as a cheap talk game in which the expert sends a message $m$ from a finite set of messages $M$. The decision maker does not observe whether the expert is informed, i.e, received a signal or not. Upon receiving a message, the decision maker updates her prior $p$ and uses the posterior assessment to choose an action $a \in \{a_0, a_1\}$. Payoffs are then realized. For the decision maker, the payoff depends on her action choices and the realized state as specified earlier. The payoff to the expert consists of two components. The first is a fixed wage (which is normalized to 0) while the second represents the reputational rent she earns in future[1]. We capture this reputational rent by postulating the existence of a second period where the decision maker can decide to rehire this expert. If hired, the expert earns $V_1$ while her payoff is $V_2$ otherwise. Let $V = V_1 - V_2 > 0$ which we interpret as the reputational rent. The decision regarding the next period hiring can not be contracted upon in the beginning of period 1 and will be decided at the end of the first period. We assume that this decision is based on the decision maker's posterior belief about the expert's type. Let $\hat{r}$ denote the belief of the decision maker that expert she faces is informed[2]. Given $\hat{r}$, the decision maker then decides whether to keep the expert or fire her. We postulate a simple decision rule: if $\hat{r} > r$, the expert is kept with probability 1 while if $\hat{r} < r$ the expert is fired with probability 1. When $\hat{r} = r$, however, the decision maker keeps the expert with probability $\pi \in [0, 1]$. We assume that experts care only about being re-hired and thus follow the objective of maximizing the probability of re-employment[3].

The presence of a hiring decision in the second period is only for analytical convenience. Alternatively, we could posit that $\hat{r}$ becomes common

[1] We can easily allow state contingent contracts for the current period's remuneration. See section 7.3

[2] This updating depends both on the message $m$ sent by the expert and the subsequent events. With action $a_1$, the state of the world will be inferred accurately while the decision maker will use this information in updating her beliefs. However no such knowledge is available if the choice was $a_0$ and the updating rule in this case can only condition on the original message sent by the expert.

[3] In section 7.2 we indicate how our results generalize if experts' payoffs also depend on the choice of the actions.

knowledge at the end of period 1 and the expert's second period market wage depends positively on $\hat{r}$. Qualitatively similar results can be obtained in this alternative formulation as long as long term contracts on experts' future market wages are precluded.

## 3 Communication when the expert's type is known

The central question of the model is how a decision maker can use experts to provide meaningful inputs into her decision making. In common sense terms, expert's services can be said to contribute to the decision making process if the decision maker chooses the action $a_1$ when the expert sees the signal $s_1$ and chooses $a_0$ otherwise. To obtain some intuition for the incomplete information game where the decision maker is unsure of the expert's type, it is instructive to first analyze a scenario where the expert's type is known. Since there is no room for beneficial communication when the expert is uninformed, assume that the decision maker knows she faces an informed expert. Assume further that the expert has reported her signals truthfully. How and when can a decision maker with an arbitrary $p$ use such an information?

If $\tilde{p}$ is the posterior of the decision maker that the state is 1, then she chooses $a_1$ if and only if $\tilde{p} - (1-\tilde{p})\lambda \geq 0$, or equivalently if $\tilde{p} \geq \lambda/(1+\lambda)$. Hence the expert's information is useful if the posterior of the decision maker is at least $\lambda/(1+\lambda)$ when the signal received is $s_1$, and it does not exceed $\lambda/(1+\lambda)$ when the signal received is $s_0$.

Denote by $\triangle^i(p)$, $i = 0, 1$, the probability that the decision maker assigns to the event that the expert receives the signal $s_i, i = 0, 1$. Clearly

$$\triangle^1(p) = pq + (1-p)(1-q) \quad \text{and} \quad \triangle^0(p) = p(1-q) + (1-p)q$$

Thus when the decision maker knows that the realized signal is $s_i$, her posteriors that the state is 1 are given respectively by

$$p^1(p) = \frac{pq}{\triangle^1(p)} \quad \text{and} \quad p^0(p) = \frac{p(1-q)}{\triangle^0(p)}$$

For the expert's information to be useful, we must have

$$p^1(p) \geq \lambda/(1+\lambda) \geq p^0(p).$$

Let $p_*$ and $p^*$ satisfy

$$p^1(p_*) = \lambda/(1+\lambda) = p^0(p^*)$$

It is easy to check that $p_*$ and $p^*$ exist and are unique. Further, $p^* > p_*$.

We conclude that an expert's service will be useful to a decision maker with prior $p$ if and only if $p \in P \equiv (p_*, p^*)$.

If $E^U(p)$ is the decision maker's payoff when she does not consult the expert, then

$$E^U(p) = 0 \quad \text{if} \quad p < \lambda/(1+\lambda)$$
$$E^U(p) = p - \lambda(1-p) \quad \text{if} \quad p > \lambda/(1+\lambda)$$

Let $E^I(p)$ denote the expected payoff of a decision maker with prior $p \in P$ if she consults an expert. Clearly,

$$E^I(p) = qp - \lambda(1-p)(1-q).$$

From the earlier discussion, it follows that $E^I(p) > E^U(p)$ if and only if $p \in P$.

**Remark 1** $p_*$ decreases and $p^*$ increases in $q$ and as $q \to 1$, $p_* \to 0$ and $p^* \to 1$. Thus as the signal quality of the expert becomes perfect ($q \to 1$), all decision makers will benefit from using the expert's advice.

## 4 Communication when types are unknown

In this section, we characterize the set of Bayesian-Nash equilibria of the game between an expert and a decision maker. It is well known that cheap-talk games typically have multiple equilibria. The same is true here as well. We are however interested in an equilibrium outcome where the decision maker is strictly better off using the services of an expert. In such an equilibrium, the messages must convey information to the decision maker regarding the state of the world and thus her choice of action should depend (in a non trivial way) on the message she receives. Such an equilibrium, if it exists, will be referred to as an *informative* equilibrium.

To gain some insights about the structure of an *informative* equilibrium, we first observe that in any such equilibrium, the set of messages that are sent by the uninformed expert must coincide with the set of messages that are sent by the informed ones. Second, given any signal realization, since the informed expert will only randomize between two distinct messages if each of them yields the same expected payoff, without any loss of generality, we can restrict our attention to equilibria where only two messages are sent. Call them $m_1$ and $m_0$. Given $m_i$, let $h_i$ be the probability that action $a_1$ is chosen. Since the decision maker is strictly better off using the expert's service, it must be that $h_1 \neq h_0$. Further if $h_1 \geq h_0$, then either $h_1 = 1$ or $h_0 = 0$. Thus it follows that the informed expert must send in the message $m_1$ when the signal is $s_1$ and the message $m_0$ otherwise. Finally, the uninformed expert needs to randomize over the two messages such that the posterior of the decision maker with either of the messages is exactly $r$. Formally, we record the properties of an *informative* equilibrium in Proposition 1.

**Proposition 1** In any *informative* equilibrium, there exists message $m_1$ and $m_0$ such that

(a) An informed expert sends message $m_i$ if and only if her signal is $s_i$.

(b) An uninformed expert sends the message $m_0$ with probability $\triangle^0(p) = p(1-q) + q(1-p)$ and sends $m_1$ with the remaining probability.

(c) With the message $m_i$, the decision maker must choose $a_i$ with probability 1.

(d) With message $m_0$ and action choice $a_0$, the expert is re-hired with probability $\pi = p_E$. With message $m_1$ and action choice $a_1$, the expert is rehired with probability 1 (resp. probability 0) if the state of the world turns out to be 1 (resp. state 0)[4].

*Proof*: See Appendix.

Given the strategies of the experts, on getting the messages $m_i$ the posteriors of the decision maker that the state is 1 are

$$\tilde{p}^1 = \frac{p[rq + (1-r)\triangle^1]}{\triangle^1} \quad \text{and} \quad \tilde{p}^0 = \frac{p[r(1-q) + (1-r)\triangle^0]}{\triangle^0},$$

where $\triangle^i$ are as defined in the previous section. It follows from Proposition 1(c) that in an *informative equilibrium* $\tilde{p}^1 > \lambda/(1+\lambda) > \tilde{p}^0$. Let $\underline{p}$ and $\overline{p}$ satisfy

$$\tilde{p}^1(\underline{p}) = \lambda/(1+\lambda) = \tilde{p}^0(\overline{p})$$

**Observation 1** For $1 > q > 0$, $\underline{p}, \overline{p}$ exist and are unique. Further $\overline{p} > \lambda/(1+\lambda) > \underline{p}$.

Define $P^*$ as $P^* \equiv (\underline{p}, \overline{p})$

**Proposition 2** The game between a decision maker with prior $p$ and an the expert admits of an *informative* equilibrium if and only if $p \in P^*$.

*Proof*: See Appendix.

**Remark 2** For the decision makers on the boundary of $P^*$, i.e, $p \in \{\underline{p}, \overline{p}\}$, the strategies given in Proposition 1 also constitute an equilibrium of the communication game. However there are also other equilibria. It is possible to show that for any $h \in [0,1]$, there is an equilibrium outcome, where (i) if the decision maker is $\underline{p}$, she chooses $a_0$ with probability 1 with message $m_0$ but chooses $a_1$ with probability $h$ with message $m_1$; while (ii) if the decision maker is $\overline{p}$, she chooses $a_1$ with probability 1 with message $m_1$ but chooses $a_0$ with probability $(1-h)$ with message $m_0$. These equilibria however are not *informative* in that the decision makers $\underline{p}$ (or $\overline{p}$) are not strictly better off using an expert's advice. We will see in the next section

[4]In any such *informative* equilibrium, the expert's prior only determines the rehiring decision probabilities of the expert and has no effect on the equilibrium choice of actions.

that while these decision makers do not themselves benefit from communication, they play a very important role when we consider the possibility of delegation.

To calculate the expected payoff to the decision maker in an *informative* equilibrium, break it up into two components. The first component is what she receives if she was facing an informed expert and the second component is her payoff when the expert is uninformed. Since along an equilibrium, the informed expert reports her signal 'truthfully', the payoff to the decision maker when she faces the informed expert is $E^I(p)$.

With the uninformed expert, however, action $a_1$ will be chosen with probability $\triangle^1(p)$ and action $a_0$ with the remaining probability. Thus the expected payoff of the decision maker when she faces the uninformed expert is $\triangle^1(p)E^U(p)$.

Since the population has $r$ proportion of informed experts, the expected payoff to a decision maker $p \in P^*$ in any *informative* equilibrium is given by

$$E^*(p) \equiv rE^I(p) + (1-r)\triangle^1(p)E^U(p) \quad (1)$$

It is obvious that $E^*(p) > E^U(p)$ whenever $p \in P^*$.

What is the relationship of $P^*$ to $P$ [5].

**Proposition 3** $P^* \subset P$.

The intuition for this proposition is straightforward. Since $q > 1/2$, we have $q > pq + (1-p)(1-q)$ and thus the presence of an uninformed expert has the effect of reducing the quality $q$ of the signal received by expert 1. The proposition thus is an immediate consequence of Remark 1.

# 5 Delegation

In this section we assume that the outcomes of choosing $a_i, i = 0, 1$ are both public goods. Because in the informative equilibrium of the information game, agents with different priors choose $a_0$ and $a_1$ with different probabilities, it is natural to ask whether a decision maker could increase her *ex ante* payoff by delegating the responsibility of consulting an expert and the choice of action to some other decision maker. Any such delegate is assumed to be identical to the original decision maker in every respect except possibly for her initial prior on the states of the world. If an agent $p$ delegates to another agent and the delegate chooses $a_1$, the payoff to both $p$ and the delegate are 1 in state 1, and $-\lambda$ in state 0; and if the delegate chooses $a_0$, both have a pay off of 0. Further, once the delegate is employed, the original decision

[5] $P$, recall, is the set of priors that would have used the service of an expert in the absence of any incomplete information.

maker has no further control - the choice of actions as well as the re-hiring decision will be made by the delegate in place.

As we have already discussed, an example of contexts where such delegation is meaningful is the voting problem. The election issue is if the government should introduce a reform package or continue with the *status quo*. The success of the reform depends on the state of the world. Assume that the payoff from reform, both successful and failed, and *status quo* are uniform across agents, but their priors are different. The elected leader will use her office of experts and finally decide between reform or *status quo*. If the median voter wins, the probability of her choosing the two policies would depend on the informative equilibrium in the game between her and the expert(s). The probabilities could be different if another agent was elected. Can the *ex ante* pay off of the median voter be higher if she votes some one other than herself as the leader? In decision making bodies smaller than an electorate such problems perhaps appear more often. Consider a committee of the defense ministry planning a raid. An unsuccessful raid is costly. Members have equal payoffs in success, failure and *status quo*, but the parameters crucial to the success are not fully known. Members have different priors. One who will be put up in charge has to take the final decision using spying agencies' information. Supposing some members can sustain an informative equilibrium playing against information sources, they will generally realize a different probability mix of raiding and not raiding after the information input. Some members can increase their *ex ante* payoff by delegating to another member.

To analyze the outcome of the delegation game formally, we will assume that whenever the delegate's prior is in $P^*$, an *informative* equilibrium obtains, and thus the delegate's payoff corresponds to $E^*(p)$ as given in equation (1). Further if the delegate's prior is either $\underline{p}$ or $\overline{p}$, we select the equilibrium (see discussion in Remark 2) that gives the highest payoff to the original decision maker.

The questions that we ask now are (i) which decision makers choose to delegate, and (ii) who are the chosen delegates?

If $H$ is the set of decision makers that delegate and $D$ the set of those delegated upon, the following proposition provides a simple answer to these two questions.

**Proposition 4**

(a) $H = P^*$

(b) $D = \{\underline{p}, \overline{p}\}$.

(c) For $p \in P^*$, if $p < \lambda/(1+\lambda)$ then $p$ delegates to $\underline{p}$, and if $p > \lambda/(1+\lambda)$, then $p$ delegates to $\overline{p}$.

*Proof.* See Appendix.

Proposition 4 shows that the entire set $P^*$ will find it optimal to use a delegate and it is the end points of $P^*$ that act as delegates. The proposition also shows that if an agent is predisposed to action $a_1$ ie $p > \lambda/(1+\lambda)$, then she would gain by electing an agent who is more predisposed to $a_1$ than herself. Likewise if she is predisposed towards $a_0$, then she should elect one who is more oriented to $a_0$. The intuition for this result is as follows. Consider a decision maker with prior greater than $\lambda/(1+\lambda)$. If she could not consult an expert, her optimal action is $a_1$. Therefore her optimal action is still $a_1$ when she is faced with an uninformed expert. Now recall that in equilibrium, the uninformed expert sends the message $m_1$ with probability $1-p(1-q)+q(1-p)$ when she faces the decision maker $p$. Higher values of $p$ leads to a higher probability that the message $m_1$ is sent by the uninformed expert. Since the original decision maker will prefer that $a_1$ be chosen when the expert she faces is uninformed, she will like to increase the probability that message $m_1$ is sent by the uninformed expert. The way she can do it is to put in a delegate who has a higher initial prior than her own. Note however that it does not help to elect arbitrarily extreme candidates since by Proposition 2, an *informative* equilibrium can not be sustained with a delegate with prior above $\overline{p}$. Thus the optimal choice for a decision maker with $p > \lambda/(1+\lambda)$, $p \in P^*$, is to choose the delegate $\overline{p}$. An analogous intuitive argument explains why a decision maker who is initially pre-disposed to action $a_0$ should choose the delegate $\underline{p}$.

It may be of interest to explore the effect of $\lambda$ and $r$[6] on the incentives of a decision maker for delegation and its effect on the action choices.

First consider the effect of increasing $r$, the proportion of informed experts in the population. It is easy to check that $\underline{p}$ decreases in $r$ while $\overline{p}$ increases in $r$. Thus when $r$ increases, more decision makers will find it profitable to consult an expert. How does this affect the probability of action $a_1$ being chosen when the true state is 1? From Proposition 1, we know that when $p \in P^*$, this probability is $rq + (1-r)\triangle^1(p)$. Since $q > \triangle^1(p)$, it follows that with increased $r$, it is more likely that the right action $a_1$ will be chosen when the state is 1. With delegation possibilities however, this result may indeed reverse for a range of decision makers. To see how this could happen, observe from Proposition 4 that if $p \in H$ and $p < \lambda/(1+\lambda)$, then $p$ will delegate to $\underline{p}$. Thus for all such priors, the probability that action $a_1$ is chosen in state 1 is given by $rq + (1-r)\triangle^1(\underline{p})$. Keeping $\underline{p}$ fixed, this probability will increase if $r$ increases. However $\underline{p}$ is not going to stay fixed. An increase in $r$ decreases $\underline{p}$ and thus $\triangle^1(\underline{p})$ will go down. It is thus entirely possible (for small values of $r$) that an increase in the proportion of informed experts leads to an eventual decrease in the probability that action

[6]Comparative statics of changing $q$ and $r$ are similar.

$a_1$ is chosen when the true state is 1.

About the effect of $\lambda$, the *ex-ante* cost of action $a_1$, it is easy to see that both $\underline{p}$ and $\overline{p}$ increase with $\lambda$. Thus with an increase in $\lambda$, some decision makers ($p$ close to $\underline{p}$) will no longer be able to invoke an *informative* equilibrium and consequently will be content with choosing action $a_0$. On the other hand, there will also be a new group of decision makers ($p$ higher than $\overline{p}$ but close to it) who will now be able to profitably use the expert's recommendation. Since these decision makers were previously choosing action $a_1$ with probability 1, a higher cost of $\lambda$ will reduce their probability of taking action $a_1$. For the rest of the decision makers (who continue to use the expert's service), the probability of action $a_1$ in equilibrium is unaltered. Thus in the absence of delegation, an increased cost of action $a_1$ can not lead to an increased probability that action $a_1$ is chosen.

This intuitive result however does not necessarily hold when we allow for delegation possibilities. To see why this happens, given $\lambda$, let $g(p, \lambda)$ denote the probability that the action $a_1$ is chosen when the state is 1 and the decision maker is $p \in P^*$. From Proposition 4, we know that if $p < \lambda/(1+\lambda)$, $p$ will use the delegate $\underline{p}$ and thus $g(p, \lambda) = rq + (1-r)\triangle^1(\underline{p})$ and for $p > \lambda/(1+\lambda)$, $g(p, \lambda) = rq + (1-r)\triangle^1(\overline{p})$. Since both $\underline{p}$ and $\overline{p}$ increase with $\lambda$ it follows that there will be a range of priors in $P^*$ for which the probability of action $a_1$ can indeed go up when the cost of that action goes up.

We summarize the above discussion in the following Proposition.

**Proposition 5** There exists a range of priors in $P^*$ for which the probability of action $a_1$ can decrease with an increase in $r$ while increasing with increased $\lambda$.

The proof follows immediately from the earlier discussion and therefore omitted.

# 6 Identical Priors

We have assumed that the *ex ante* distribution of priors is common knowledge. Although aware that it goes against what Aumann termed the Harsanyi doctrine, we feel that this assumption provides a natural environment for the problems we wanted to mdel. Banerjee and Somanathan [1], Piketty [12] and Piketty and Spector [13] are recent papers which assume that agents are aware of their different priors.

Difference in expected payoffs reflects different utility functions and/or difference in priors. Although our context motivated us to use the difference of priors, it is easy to think of examples where the other assumption is more natural. In this section we argue that with some change in the structure, the possibility of delegation can be shown to exist in a model where agents have identical priors but vary in terms of utility functions.

Assume as before that there are two states 0 and 1 and let $p$ now denote the probability that the state is 1. Unlike before, we assume that $p$ is the same across all agents. Assume also that the action $a_1$ yields a payoff of 1 in state 1 and a loss of $\lambda$ in state 0. With action $a_0$, payoff to a decision maker is $\bar{u}$ where $\bar{u}$ is distributed over some interval $[u_1, u_2]$. Finally, we assume that a decision maker has access to a third action $a_m$ which corresponds to a 'moderate' policy. This policy results in a gain of $m$, $1 > m > 0$ if the true state is 1 while results in a loss of $m\lambda$ if the state is 0. We simplify by assuming that the type 1 expert has access to a signal that informs him of the exact state of the world, i.e, $q = 1$. The analysis of the cheap talk game with the expert and the decision maker yields a result analogous to that of Proposition 1. It is possible to show that in any *informative* equilibrium an expert of type 1 recommends action $a_1$ (i.e sends the message $m_1$) if and only if she receives the signal $s_1$. The uninformed expert sends in $m_1$ with probability $p$. The decision maker chooses $a_1$ if the message is $m_1$ and chooses $a_0$ otherwise. To support such an equilibrium, however, it is necessary that the decision maker chooses $a_0$ when she receives the message $m_0$. Given $q = 1$, the posterior of the decision maker (when she receives $m_0$) that the state is 1 is $p(1-r)$. Thus, for the decision maker to choose $a_0$, it is necessary that $\bar{u} < m[p(1-r)(1+\lambda)-\lambda]$. If this condition is not satisfied, the decision maker will not choose $a_0$ and this will destroy the possibility of achieving an *informative* equilibrium. Thus if the original decision maker is too averse to the *status quo* action $a_0$, i.e, has a very low $\bar{u}$, then this decision maker will be unable to use the services of an expert since the cheap talk game will not support an *informative equilibrium.* It is possible then that the decision maker will be better off delegating the decision making to a delegate with a high value of $\bar{u}$ who can achieve an *informative* equilibrium in the cheap talk game. To see this possibility, consider the following example.

Let $r = 1/2$, $p = 2/3$, $\lambda = -5$, $m = 1/2$ and let the original decision maker's $\bar{u}$ equals $-2$. With $q = 1$, $p(1-r) = 1/3$ and thus without delegation, this decision maker will choose $a_m$ in the cheap talk game even when she receives the message $m_0$. Consequently with such a decision maker, experts are of no use. The unique equilibrium outcome will have the decision maker choosing action $a_m$ resulting in a pay off of $-3/2$.

With the possibility of delegation however things can be improved. Consider a decision maker with $\bar{u}$ satisfying $0 > \bar{u} > -3/2$. With such a decision maker, there exists the possibility of obtaining the *informative* equilibrium. In such an equilibrium, action $a_1$ will be chosen when message $m_1$ is sent and action $a_0$ chosen otherwise. The expected payoff to the original decision maker from such an equilibrium is $1/2[p+(1-p)\bar{u}+p^2+(1-p)\bar{u}-p(1-p)\lambda] = -2/3 > -3/2$.

# 7 Discussion

The possibility of delegation in this paper arises from the fact that in the equilibrium of the information game, agents with different priors will realize different probabilities of the action mix. It is therefore crucial that the information game admits of informative equilibria for a non-empty subset of decision makers. Hence it is important to ask which elements of the model structure are crucial for the existence of such equilibria. One such element is the informative potential of the actions. In our model the choice of the *status-quo* does not give rise to information about the true state of the world and hence does not help revise the posterior about the expert's type. $a_0$ thus is not just another action but is qualitatively different from $a_1$. This assumption is a natural choice for the contexts we have discussed. But we should point out that difference in the informative potential of policies creates significant effects in models of policy choice (see for example Fernandez and Rodrik[4]) and it is a crucial assumption for our model. Suppose both action choices eventually led to information about the soundness of the expert's advice. In such a case, it is possible to show that the information game does not admit of an *informative* equilibrium for any $p$. The information game in that case would produce equilibria where no decision maker can elicit information and each is best off acting by herself.

Other structural elements of the model are not crucial for our results. Below we discuss robustness properties in relation to the other elements.

## 7.1 Costly Signalling

We have allowed only costless communication strategies in the communication game between the expert and the decision maker. If experts could send costly signals (like 'burning money'), could not an informed expert distinguish herself from uninformed ones? To analyze that possibility, assume that an informed expert, after receiving the signal $s_1$, decides to 'burn' $C$ where $C$ satisfies $p_E V < C < V$. Seeing this costly signal, the decision maker should believe that she faces an informed expert, and thus may be willing to choose action $a_1$. This however can not be an equilibrium of the signalling game. Along the equilibrium path if the action choice $a_1$ proves to be a mistake, i.e, the state of the world was actually zero, the decision maker will ascribe this to the imperfectness of the signal received by the expert. The posterior that she faces an informed expert will continue to remain at 1 and the expert will be rehired with probability 1. But in that case the uninformed expert would choose to 'burn' $C$ as well. Since $C < V$, this will be a profitable deviation. Thus allowing for costly signalling will not change any of the results of the information game. We can show that if an *informative* equilibrium exists, then Proposition 1 is true with or without the use of costly signals. The uninformed expert will still randomize the messages with probabilities undistinguishable from an informed expert's. In equilibrium the only difference will be in the probability of rehiring. The equilibrium probability of actions and the expected payoff to a decision maker of prior $p$ will continue to be characterized by Proposition 2.

### 7.2 Experts' Payoffs

We assumed that an expert cares only about getting rehired. She has no concern for the actual choice of action. Would the results change if she also had a stake in the choice? Assume that an expert's payoff function is $\pi V + w[p_E(1 + \lambda) - \lambda]$, where $\pi$ is the probability of rehire and $w$ is a positive constant. Assume for simplicity that $q = 1$. Now observe that since $w > 0$, an informed expert does not have any incentive to deviate from the strategy of sending message $m_i$ when the signal is $s_i$. Further if an *informative* equilibrium exists, then it must be that the uninformed expert sends message $m_i$ according to the probabilities given in Proposition 1. So the issue is whether an *informative* equilibrium will obtain or not. The payoff to the uninformed expert by sending message $m_1$ is $p_E V + w[p_E(1+\lambda) - \lambda]$ while she gets $\pi V$ if she sends $m_0$ where $\pi$ is the probability of rehire given the message $m_0$. It follows that if $w$ is not too large, there would exist a $\pi^*$, $0 < \pi^* < 1$ such that $p_E V + w[p_E(1 + \lambda) - \lambda] = \pi^* V$. Thus for $w > 0$ but not too large, Proposition 1, parts (a)-(c) will continue to hold.[7] For $w$ large however there may not exist $\pi^*$ that will make the uninformed expert indifferent between sending the two messages. In such cases an *informative* equilibrium will fail to exist.

### 7.3 State Contingent Contracts

We assumed that experts are paid a fixed amount, independent of the action choice and the outcome. We now investigate how our results may be affected if it were possible to write contracts with state contingent payments. We will however maintain the assumption that a decision maker can not write a contract that relates to the future hiring decision of an expert. In this setting then, a contract is a 3-tuple $(w_0, w_1^1, w_1^0)$. The expert is paid $w_0$ if action $a_0$ is chosen and $w_1^i$ in state $i$ if action $a_1$ is chosen. Assuming limited liability, these payments are non-negative. Assume that the decision maker's prior is such that she prefers to choose action $a_0$ when facing an uninformed expert, while she would choose action $a_1$ if facing an informed expert with the signal $s_1$. Can the decision maker design a contract with the following features (i) the informed expert will send messages that reveal the true signal; (ii) the uninformed expert sends a message that separates her from the informed type? The answer is yes. But to achieve such a

[7] What will change however is the probability of rehiring of the experts.

separation, the contract $(w_0, w_1^1, w_1^0)$ must satisfy

$$w_0 \geq V + p_E(w_1^1 - w_1^0) + w_1^0 \quad (2)^8$$

This separation however is costly for the decision maker. To calculate the expected cost of the decision maker, observe that with probability 1, the uninformed expert has to be paid $w_0 = V$ while if the expert is informed, the action $a_0$ will be chosen with probability $(1-p)$[9]when $w_0$ needs to be paid to the informed expert. Thus the expected cost to the decision maker is $[r(1-p)+(1-r)]w_0$. Given that $w_1^i \geq 0$, the minimum value of $w_0$ for which equation (2) can be satisfied is $V$. Thus the costs to the decision maker of using this state contingent contract is at least $[r(1-p)+(1-r)]V$. What is the benefit to the decision maker of using such a scheme? Since without the state contingent contract, $a_1$ will be chosen when facing the uninformed expert with probability $p$ (see Proposition 1), net gain of using the state contingent contract is $(1-r)p(\lambda - p(1+\lambda)$. Thus using the contingent contract will be dominated whenever $[r(1-p)+(1-r)]V > (1-r)p(\lambda - p(1+\lambda)$[10]. Therefore in all such instances, the decision maker will be better off using a non contingent wage contract as analyzed in the paper and our results will hold.

## 7.4 Costs of Information

In this section we briefly describe how our results generalize if we allow for Type II experts to acquire information but at a cost $c$. Assume as before that experts are paid a fixed wage in the first period and face a prospect of getting $V$ in the next period. To simplify exposition, assume further that $q = 1$. Assume now that an *informative* equilibrium exists where both types of experts gather information and report their signals truthfully. The decision maker's posterior after any message/ action must assign probability $r$ that the expert is of type I. Let $\alpha$ be the probability that the expert is hired after the action $a_0$ and let $\beta^i, i = 0, 1$ be the probability of rehire given action $a_1$ and the realized state $i$. Now if the expert of type II does not gather any information, she can assure herself a payoff of $max\{\alpha V, p_E\beta^1 V + (1-p_E)\beta^0 V\}$. Thus spending $c$ to gather information will be incentive compatible if and only if

$$p_E\beta^1 V + (1-p_E)\alpha V - c \geq max\{\alpha V, p_E\beta^1 V + (1-p_E)\beta^0 V\} \quad (3)$$

Note that if equation (3) holds for some values of $(\alpha, \beta^1, \beta^0)$, then (3) also holds when $\beta^0 = 0, \beta^1 = 1$ and $\alpha = p_E$. Using (3), we then conclude that an

[8]Note that the uninformed expert will forgo all reputational rent once she separates herself from the informed types and that explains why there is no term involving $V$ on the left hand side of the equation.

[9]Recall that we are assuming $q = 1$

[10]Note that this inequality hold for any values of $V$ and $\lambda$ as long as $r$ is close to 1.

informative equilibrium where type II experts gather information will exist if and only if $p_E(1-p_E)V > c$. Since $p_E(1-p_E)$ is maximized at $p_E = 1/2$, we thus conclude that if $c$, the cost of obtaining information is greater than $V/4$, the expert of type II will never be informed in any equilibrium, and our analysis applies.

# 8 Appendix

**Proof of Proposition 1** Without loss of generality, we restrict our attention to two message $\{m_0, m_1\}$ (see the discussion preceding Proposition 1). Given that the equilibrium is *informative*, it must be that both messages are sent with positive probabilities along an equilibrium path. Let $h_i$ be the probability that action $a_1$ is chosen given the message $m_i, i = 0, 1$. Let $h_1 \geq h_0$. Since the equilibrium strictly benefits the decision maker, it must be that $h_1 > h_0$.

We first argue that the uninformed expert's strategy must assign positive probabilities to both messages. Otherwise, after the message $m$ which is sent only by the informed type, the decision maker must assign probability 1 to the event that she faces an informed expert. Such an expert will be re-hired with probability 1 resulting in a payoff of $V$ to the informed expert. If the informed expert has to send the other message $m'$, then that message must also give her $V$. However the posterior of the decision maker that she faces an informed type must be strictly less than $r$ on getting $m'$ and consequently the payoff from $m'$ must be less than $V$. Thus the informed expert will not send both messages, contradicting the hypothesis that an *informative* equilibrium obtains. Hence the uninformed expert must send both messages with positive probability, ie. she must be indifferent between sending any of these messages. Further, if action $a_1$ is chosen and the state is 1, the decision maker must assign $\hat{r} > r$ that she faces an informed expert and the expert will be re-hired with probability 1 in such a case. On the other hand, if the state is 0, then the expert must be fired. Consequently, the uninformed expert's payoff if action $a_1$ is chosen is $p_E V$. Thus the payoff to her from $a_0$ must also be $p_E V$.

Since the $q > 1/2$, the posterior of an informed expert after obtaining a signal must differ from her original prior and consequently, the informed expert, for any signal realization will never randomize over the messages. Since $h_1 > h_0$, she will thus send $m_1$ with probability 1 when she observes $s_1$ while sending $m_0$ when her signal is $s_0$.

Let $r(m_0, t)$ be the posterior of the decision maker that she faces an informed expert when she receives the message $m_0$, given that an informed expert sends $m_i$ when she receives the signal $s_i$ and the uninformed expert sends $m_0$ with probability $t$. Clearly

$$r(m_0, t) = \frac{r\triangle^0(p)}{r\triangle^0(p) + (1-r)t}$$

Since after message $m_0$, $a_0$ is chosen with positive probability and the uninformed expert's payoff is $p_E V$, the expert must be rehired with probability $p_E$. But for this to happen, we must have $r(m_0, t) = r$. This however is possible if and only $t = \triangle^0(p)$.

We now check that the strategy used by the decision maker is optimal. Given the strategies of the experts, if message $m_i$ is sent, the posterior of the decision maker that she faces an informed expert is exactly equal to $r$. Since choice of $a_0$ does not lead to any further information, it is clearly optimal for the decision maker to choose $\pi = p_E$. However after the choice of $a_1$ (following the message $m_1$), the decision maker's posterior will be greater than $r$ if and only if the state realized is 1. Hence the strategy of the decision maker that calls for rehiring the expert with probability 1 (resp. probability 0) after the choice of $a_1$ and the realization of the state 1 (resp. 0) is also optimal. ■

**Proof of Proposition 2.** Assume first that an *informative* equilibrium exists. From Proposition 1 (c), it follows that the decision maker must choose action $a_i$, $i = 1, 0$ with probability 1 when she receives the message $m_i$, $i = 1, 0$. Thus $\tilde{p}^1 \geq \lambda/(1+\lambda) \geq \tilde{p}^0$. Since $\tilde{p}^1$ and $\tilde{p}^0$ are increasing functions of $p$, we then have $\underline{p} \leq p \leq \overline{p}$.

We now show that when $p \in [\underline{p}, \overline{p}]$, the strategies given in Proposition 1 can indeed be supported as an equilibrium.

Fix the decision maker's strategy as in Proposition 1. Consider the uninformed expert. Given a message, if action $a_1$ is chosen, then the expert will be rehired with probability 1 if the state is 1 while she will be fired otherwise. This gives an expected payoff of $p_E V$ to the uninformed expert. On the other hand, choice of $a_0$ results in the expert being retained with probability $p_E$, yielding a payoff of $p_E V$. Thus the uninformed expert's strategy of mixing the two messages is optimal.

Consider an informed expert. Let $p_E(s_i)$ be her posterior that the state is $i$ given signal $s_i$. Since $q > 1/2$, $p_E(s_1) > p_E > p_E(s_0)$. Thus the strategy of expert 1 of sending $m_i$ with probability 1 on observing $s_i$ is optimal and this results in a payoff strictly greater than $p_E V$.

To check for the optimality of the decision maker's strategy, consider $p \in [\underline{p}, \overline{p}]$. Clearly her posterior that the state is 1 is at least $\lambda/(1+\lambda)$ when she receives $m_1$ while her posterior is no more than $\lambda/(1+\lambda)$ when she receives $m_0$. These inequalities are strict whenever $p$ is in the interior of $P^*$. Hence the action choice of the decision maker is optimal. The proof that the decision maker's rehiring decision is optimal follows very similar lines to that of Proposition 1.

**Proof of Proposition 4** We first show that if $p \notin P^*$, then $p$ will not delegate.

Consider any $p < \underline{p}$. If she were to delegate, the delegate's prior must be at least $\underline{p}$ (Proposition 2). Now in the *informative* equilibrium that obtains with the decision maker with prior $\underline{p}$ and the expert, $p^1(\underline{p}) = \lambda/(1+\lambda)$ and thus the choice of action $a_1$ will result in a zero payoff to decision maker $\underline{p}$. Hence for any $p < \underline{p}$ such a choice will result in a negative payoff. These decision makers are thus better off just choosing action $a_0$.

Now consider any $p > \overline{p}$. For her to profitably delegate, the delegate must have a prior no higher than $\overline{p}$. In the *informative* equilibrium with $\overline{p}$, the decision maker's posterior after receiving the message $m_0$ is exactly $\lambda/(1+\lambda)$ which makes her indifferent between action $a_0$ and $a_1$. However any decision maker with a higher prior will strictly prefer that the action $a_1$ be chosen in such cases. Consequently, all such decision makers are better off not using either the delegates or the experts and choosing action $a_1$.

We now prove that if $p \in P^*$ and $p < \lambda/(1+\lambda)$, then $p$ will delegate her decision to $\underline{p}$. Since $p < \lambda/(1+\lambda)$, the decision maker's payoff can be increased if in the *informative* equilibrium, the uninformed expert is persuaded to send the message $m_0$ with a higher probability. Since the uninformed expert sends the message $m_0$ with probability $\triangle^0(p) = p(1-q) + q(1-p)$ and $\triangle^0(p)$ decreases with $p$ ( $q > 1/2$), the decision maker's payoff will be maximized by choosing a delegate with the lowest prior that is consistent with supporting an *informative* equilibrium. Hence any $p < \lambda/(1+\lambda)$ will delegate her decision to $\underline{p}$. An analogous argument establishes that if $p > \lambda/(1+\lambda)$ and $p \in H$, then $p$ will delegate to $\overline{p}$. ∎

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