Project selection and competitive cheap talk: an experimental study*

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Abstract

When agents with private information compete for resources from a principal and are biased towards their own favored projects (e.g., a CEO decides which division manager's project to fund) an agency problem arises. However, possible future interaction can mitigate this problem even without reputational concerns, since an agent who induces acceptance of a low-valued project today consumes resources that crowd out even better opportunities that may arrive in the future. Using the theoretical model from Schmidbauer (*Games & Economic Behavior*, 2017), we devise experiments to address this organizational environment. Specifically, we study the incentives of competing agents to strategically communicate about their own favored project's value (high or low) to an uninformed decision maker when new projects arrive over time. After observing all advice from agents, the decision maker decides which project to adopt, if any. If no project is adopted subjects enter the next period with new independently drawn projects and continue indefinitely until one project is adopted. We hypothesize that truth telling is easier to support the larger is the benefit from a high-quality project or the less likely it is to occur, but harder to support as agent competition grows. Our findings are broadly consistent with these hypotheses.

Keywords: cheap talk, multiple senders, competition

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1 Introduction

A decision maker often consults many agents over time before taking an action. For example, the division managers of a company may report to the CEO about the profitability of projects available to them, while lobbyists may provide information to a politician about the benefit of various interventions or spending policies. In each case the decision maker likely faces a budget constraint and so cannot adopt all of the projects or interventions reported on, but only some subset. In addition, the decision maker may be at an information disadvantage. An agency problem then arises when those who report to the decision maker are biased, such as when a division manager wants funding directed to his/her division regardless of how profitably it can be used, or when a lobbyist wants his own pet project adopted even when its social return is low. Thus a decision maker who is concerned only with funding the best projects irrespective of their source may expect inflated reports from agents in a static setting. However, possible future interaction can mitigate this problem even without reputational concerns, since an agent (division manager, lobbyist) who induces acceptance of a low-valued project today consumes resources that crowd out even better opportunities that may arrive in the future.

Using the theoretical model from Schmidbauer (2017), we devise experiments to address this organizational environment. Specifically, we study the incentives of competing agents to strategically communicate about their own favored project's value to a decision-making principal when new projects arrive over time. Agents privately observe the independently realized value of their own project (which are initially taken to be High or Low quality) and recommend their project for adoption or not. Agents cannot observe the quality of each other's projects, the idea being that in modern organizations information is often compartmentalized within highly specialized divisions.[1] After observing all advice from agents, the principal decides

[1]For example, the operations department may know the benefit that would accrue from buying a

which single project to adopt, if any. If no project is adopted subjects enter the next period with new independently drawn projects and continue indefinitely until one project is adopted. The principal and adopted project's agent benefit symmetrically from the outcome of the project, whereas an agent whose project is not adopted receives no benefit at all.

Under what conditions will agents report their information truthfully? An agent who knows his/her project is low quality but successfully lies and induces its acceptance only gets a small benefit (since the project is of low quality), though this outcome is better for him/her than a competing agent's project being selected. On the other hand, reporting truthfully ensures rejection in this period but leaves open the possibility that a high quality project will be available next period and is accepted then. If the payoff from a High quality project is sufficiently high, or the probability of a High quality project is sufficiently low (so that pre-emption by a competing agent in the current period is unlikely), an agent with a Low quality project will prefer to truthfully reveal his/her information. Thus to some extent agents internalize the allocative distortions from lying even absent reputational concerns. It is also predicted theoretically that as the number of agents competing increases the incentive to truthfully report when the project is Low decreases.

When allowing a Medium state to also exist the potential communication strategies supportable in equilibrium become richer. It is shown that in *any* equilibrium agents use a threshold strategy, recommending acceptance only if their true type is above the threshold and otherwise recommending rejection. In the two-state case this was trivially true but with three states more interesting possibilities arise. For example, there may exist an equilibrium in which agents with a Low project truthfully

machine to further automate production, while the marketing department might know the increase in sales that would occur from a particular advertising campaign, yet neither knows the benefit from the other department's project. In the lobbying context, an environmental lobbyist may know the benefit from a cap on carbon emissions but not the effect of safety improvements to an interstate highway, while the converse is true for a transportation lobbyist.

report that while agents with a Medium or High project both pool on the message "High." Depending on model parameters we could instead see agents with both Low and Medium projects inducing rejection while agents with a High project truthfully reporting this and inducing acceptance.

Our findings are of relevance to practitioners. Information problems are prevalent within organizations and have implications for the optimal organization design. By validating our theoretical predictions with experiments we provide new evidence that organizations may benefit from reducing their core functions (in the model, the number of agents with their own area of expertise), and illustrate one key detriment to organizational size and complexity. In such cases, market exchange and contractual arrangements with external agents to provide some of these tasks will limit the incentive misalignment faced by firms.

The theoretical model is one of a few 'competitive cheap talk' models found in the literature. Li, Rantakari, & Yang (2016) started this literature stream with their one-period model in which two agents with additive and/or multiplicative bias compete via cheap talk for the funding of a single project. Li (2016) extended that model to a dynamic setting where the principal consults a single agent in each period and must alternate between two agents over time with some known probability. In the present paper all $n \geq 2$ agents compete in a multi-period setting and do not internalize any benefit when a competitor's project is adopted (Schmidbauer 2017 and Schmidbauer 2019; see also Rantakari 2018).

This paper also relates to the project selection literature more generally. In Bonatti & Rantakari (2016), Friebel & Raith (2010) and Rantakari (2016) costly effort can be exerted which probabilistically increases the value of the project to the principal. Rantakari (2013) allows the principal to publicly commit ex-ante to a decision mechanism when agents have an unknown bias. In Moldovanu & Shi (2013) new projects keep arriving until one is unanimously agreed upon, while in Armstrong &

Vickers (2010) the principal can delegate but is not aware of all the projects available to the agent. Finally, the accounting and finance literatures contain capital budgeting models (Harris & Raviv 1996, 1998, 2005; Stein 1997), most of which contain a single agent with private information about the optimal scale of a project and who prefers a larger size than the principal. With commitment power it is shown the principal may engage in capital rationing or the use of a higher hurdle rate than his cost of funds (Antle & Eppen 1985, Berkovitch & Israel 2004, Marino & Matsusaka 2005).

2 Design and predictions

2.1 Theory

Model with two states

There are $n+1$ players: n managers and a decision-maker (the "boss"). Each manager i has access to a single project whose profitability θ_i is \$$l$ with probability $r > 0$ and \$$h$ otherwise, where $0 \leq l < h$. Manager i privately observes the value of θ_i; neither the boss nor manager $j \neq i$ observe it. It is common knowledge that all realizations are independent and identically distributed across managers.

After observing θ_i, each manager simultaneously sends a message $m \in M = \{\text{High}, \text{Low}\}$ to the boss. Next, the boss decides which single project to accept, if any. Projects are assumed to be indivisible and so this decision as respects each manager's project is binary. If no projects are accepted, the players proceed to the next period in which new i.i.d. draws are available. Thus all realizations are independent across managers and time. The game continues indefinitely until a single project is adopted, and we assume that previously rejected projects cannot be brought back. Payoffs in the stage game are as follows:

$$U_{Boss} = \begin{cases} \theta_i & \text{if the manager } i\text{'s project is adopted} \\ \$0 & \text{if no project was adopted} \end{cases}$$

$$U_{Manager\ i} = \begin{cases} \theta_i & \text{if } i\text{'s project is adopted} \\ \$0 & \text{otherwise} \end{cases}$$

Players are expected utility maximizers.[2] Thus the boss prefers to accept the project with the highest θ irrespective of which manager generated it, while each manager only prefers his own project is accepted. In particular, manager i internalizes no benefit at all if manager j's project is adopted, $i \neq j$.

Equilibrium selection

It is well known that in communication games a plethora of equilibria exist. For example, in the present model there is always a babbling equilibrium in which the boss randomly selects a project to immediately adopt and all managers always report their projects are High. Below we give the necessary and sufficient conditions such that a non-babbling equilibrium exists, and when such an equilibrium exists we select it since an equilibrium with meaningful communication is arguably focal.[3] Another source of multiple equilibria arises from the fact that two equilibria can be outcome equivalent yet differ with respect to the specific messages used to induce any outcome.[4] Since we believe equilibria in which the literal meaning of a message corresponds to its equilibrium meaning are more intuitive, we restrict attention to these in our

[2]We specify risk-neutrality for analytical convenience. In the appendix we show that if managers are risk-averse the equilibrium structure remains qualitatively unchaged but that incentives must be "sharper" to induce a manager to truthfully report bad news.

[3]Furthermore, it can easily be shown that any non-babbling equilibrium Pareto dominates a babbling equilibrium.

[4]For example, a fully separating equilibrium in which l reports Low and h reports High is outcome equivalent to an equilibrium in which l reports High and h reports Low, since the true state is learned by the boss in either case.

analysis. In the event that the equilibrium meaning of a message cannot be directly mapped to a literal meaning of a message $m \in M$, we will provide justification for the equilibrium we select.We further assume that any off the equilibrium path message is interpreted to have its literal meaning. So, for example, in the babbling equilibrium in which all managers report High, an off the path report of Low induces the belief $Pr(\theta = l) = 1$. Finally, in Schmidbauer (2017) it is shown asymmetric as well as non-stationary equilibria may exist. Owing to the difficulty subjects likely would have coordinating on such equilibria, we select equilibria that are symmetric and stationary. That is, we select equilibria in which each manager uses the same reporting function in each period and when the boss is indifferent between accepting some agents' projects he uniformly mixes between them.

Theoretical predictions in the two state model

We proceed by finding conditions under which managers will truthfully reveal their information. First, a definition.

Definition 1 *A manager's strategy is truth-telling if type l sends message Low while type h sends message High. An equilibrium is truth-telling if each manager uses a truth-telling strategy.*

It can be seen that in an equilibrium in which all managers use a truth-telling strategy, the boss's best response is to reject when receiving the Low and accept when receiving the High message. Since the boss is indifferent between any managers that report High it is a best response to randomly pick a project to adopt from those who so reported. By our assumption that the boss treats managers symmetrically it follows that a truth-telling equilibrium must be of the form just described.

We now look for a truth-telling equilibrium. In Schmidbauer (2017) the state θ is a continuous variable on a closed connected set $A \subseteq \mathbb{R}_+$, with $\min A = 0$. Although a continuum of states exists it is shown at most two meaningful messages will be employed in equilibrium: one that recommends acceptance and one that induces rejection. This fact motivates our subsequent three state analysis, though for now with two states such an equilibrium property trivially holds. In Schmidbauer (2017), a symmetric equilibrium entails each manager sending the "accept" message if and only if his project exceeds the symmetric threshold t, which must satisfy

$$t = \frac{\delta F(t)^{n-1}}{1 - \delta F(t)^{n}} \int_{t}^{\infty} \theta dF(\theta), \tag{1}$$

where F is the cumulative distribution function of θ, n is the number of managers, and $\delta \in (0,1)$ is the time discounting factor. In equilibrium the threshold type is indifferent to continuing or stopping, the payoffs to which are proportional to the right and left hand sides of line (1), respectively. In our setting to ensure a truth-telling equilibrium exists it suffices to check that the low type weakly prefers to continue (i.e., to report Low knowing this will induce rejection), since the high type would never have incentive to misrepresent itself as low. That is, we conjecture the threshold value as l and can replace the integral with a sum over all those types strictly exceeding l, which in the present case this consists of merely h. Letting $\delta = 1$, the condition becomes

$$\begin{aligned}
l \leq & \left(\frac{F(l)^{n-1}}{1-F(l)^{n}}\right)(1-r)h \qquad \Longleftrightarrow \\
l \leq & \left(\frac{r^{n-1}}{(1-r)\sum_{j=0}^{n-1} r^{j}}\right)(1-r)h \Longleftrightarrow \\
0 \leq & \frac{hr^{n-1}}{\sum_{j=0}^{n-1} r^{j}} - l \equiv IC_1(l,h,r,n), \qquad (2)
\end{aligned}$$

where we use that $F(l) = r$ in the conjectured equilibrium. In summary, line (2) gives the necessary and sufficient condition such that truth-telling is an equilibrium, and the larger is IC_1 the stronger is the incentive of the low type to truthfully reveal he is low.

Proposition 1 *A truth-telling equilibrium exists if and only if $IC_1(l, h, r, n) \geq 0$. The strength of the incentive the low type has to report truthfully, IC_1, is increasing in h and r while decreasing in l and n.*

Proof Existence follows from the discussion above. The results on h and l are immediate. The result on n follows since the numerator decreases and the denominator increases in n. Finally for r, using the quotient rule it must be shown that

$$(n-1)r^{n-2}\sum_{j=0}^{n-1} r^j \quad > \quad r^{n-1}\frac{d}{dr}\left(\sum_{j=0}^{n-1} r^j\right) \iff$$

$$(n-1)\sum_{j=0}^{n-1} r^j \quad > \quad r\sum_{j=0}^{n-2}(j+1)r^j = \sum_{i=1}^{n-1} ir^i,$$

which holds since $n-1 \geq i$ for all $i \in \{1, ..., n-1\}$. ■

Model with three states and theoretical predictions

We now add a third state to the model. Let each manager i's project have profitability θ_i, which is \$$l$ with probability r_1, \$$m$ with probability r_2, and \$$h$ with probability r_3, where $r_i > 0$, $\sum_{i=1}^{3} r_i = 1$, and $0 \leq l < m < h$. After observing θ_i, each manager simultaneously sends a message $m \in M = \{\text{High, Medium, Low}\}$ to the boss. All other aspects of the model remain unchanged.

We now explore how the existence of a medium state and message affects the reporting strategies of the managers. As would be expected from the intuition developed in the two state case, we will show that in any non-babbling equilibrium the Low message induces rejection while the High message induces acceptance (or a uniform mixing over all those who send this message to decide which is accepted).

More interesting is the Medium message. We will show that although the m type may induce acceptance in an equilibrium the Medium message never will.

The threshold structure of the equilibrium carries over from the two state case. In particular, all types above a threshold value will send a message inducing acceptance while those below send a message inducing rejection. We therefore have three distinct equilibria to contend with:

1. *Only h induces acceptance* (truth-telling). Type h sends the High message which is accepted while types l and m send a message inducing rejection. Given our assumption that when multiple equilibria exist we select the one whose messages' equilibrium meaning matches their literal meaning, we specify that type l reports Low while m reports Medium.

2. *Both m and h induce acceptance* (partial pooling). Since type m wishes to induce acceptance it must pool with type h so that both report High.[5] If m instead truthfully reported Medium this would be rejected in favor of accepting a High report if one is immediately available or waiting for a High report if it is not. Thus m and h are pooled. Finally, the type l prefers rejection and so sends the Low message.

3. *l, m, and h induce acceptance* (babbling). In the babbling equilibrium, all types report the High message and one is randomly selected for acceptance in the first period.

We proceed by finding the conditions that support each of these equilibria. Consider first the truth-telling equilibrium. Type m must prefer rejection to inducing

[5] In the partially pooling equilibrium the message that induces acceptance cannot be directly mapped to its literal meaning since two types send it. We therefore select the equilibrium with message function "In each period, if l then report Low and otherwise High."

acceptance now, a condition exactly analogous to that found in line (2):

$$0 \leq \frac{h(1-r_3)^{n-1}}{\sum_{j=0}^{n-1}(1-r_3)^j} - m \equiv IC_2(m, h, r_3, n) \tag{3}$$

We note that since $l < m$ line (3) is also sufficient to show type l prefers rejection to acceptance. For this reason l does not appear in IC_2, which measures the strength of the incentive to follow the equilibrium by m, the type with the greatest incentive to deviate. Finally, the only probability that directly appears in line (3) is r_3, which is consistent with the fact that $Pr(\theta = h) = r_3 = 1 - r_1 - r_2$ alone determines how likely a message inducing rejection will lead to continuation of the game.

Now consider an equilibrium in which both m and h induce acceptance while l prefers rejection. Adapting line (1) gives:

$$l \leq \left(\frac{F(l)^{n-1}}{1-F(l)^n}\right) \sum_{\theta > l} \theta Pr(\theta) \iff$$

$$0 \leq \frac{(mr_2 + hr_3)r_1^{n-1}}{1-r_1^n} - l \equiv IC_3(l, m, h, r_1, r_2, r_3, n). \tag{4}$$

Note that for the partial pooling case comparative statics on any r_i require specification of how r_j, $j \neq i$ changes as well, since $r_1 + r_2 + r_3 = 1$. One particular case of interest is when the l-type becomes more likely but the conditional probability of higher types does not change. This leads to our last proposition.

Proposition 2

1. *A truth-telling equilibrium exists if and only if* $IC_2(m, h, r_1, r_2, n) \geq 0$*. The incentives supporting this equilibrium are decreasing in* r_3*,* m *and* n *while increasing in* h*.*

2. *A partially-pooling equilibrium exists if and only if* $IC_3(l, m, h, r_1, r_2, r_3, n) \geq 0$*. The incentives supporting this equilibrium are decreasing in* l *and* n *while*

increasing in m, h and r_1 such that $Pr(\theta = m \mid \theta \neq l)$ and $Pr(\theta = h \mid \theta \neq l)$ are constant.

Proof Both existence results follow from the discussion above and arguments made in Schmidbauer (2017). The comparative statics on IC_2 follow by the same arguments in the proof of Proposition 1. For IC_3, the comparative statics with respect to l, m, h, and n are obvious. For r_1,

$$\begin{aligned}
IC_3(l, m, h, r_1, r_2, r_3, n) &= \frac{\big(mr_2 + hr_3\big)r_1^{n-1}}{1 - r_1^n} - l \\
&= \frac{\big(mr_2 + hr_3\big)r_1^{n-1}}{(1 - r_1)\sum_{j=0}^{n-1} r_1^j} - l \\
&= \left[m\left(\frac{r_2}{1 - r_1}\right) + h\left(\frac{r_3}{1 - r_1}\right)\right]\frac{r_1^{n-1}}{\sum_{j=0}^{n-1} r_1^j} - l.
\end{aligned}$$

The statement follows since $\frac{r_2}{1-r_1} = Pr(\theta = m \mid \theta \neq l)$ and $\frac{r_3}{1-r_1} = Pr(\theta = h \mid \theta \neq l)$ are constant in r_1 by hypothesis, while $\frac{r_1^{n-1}}{\sum_{j=0}^{n-1} r_1^j}$ is increasing in r_1 by the proof of Proposition 1. ■

When neither line (3) nor (4) is satisfied, only a babbling equilibrium exists. While there are parameters that support both a fully separating and partially pooling equilibrium, in our design we will avoid this unnecessary complexity by selecting parameters such that a unique non-babbling equilibrium exists.

2.2 Experimental Design

We conducted all sessions in the xs/fs laboratory at Florida State University. Each session involves between 18 and 24 subjects, which gives us a total of 414 participants. Sessions were programmed in the experimental software z-Tree (Fischbacher, 2007) and subject recruitment was done through ORSEE (Greiner, 2015). Sessions last on average for 45 minutes, with mean earnings of $15 per subject.

In each session, subjects are divided into groups of three (two-agent treatments) or four (three-agent treatments). Each group consists of one subject in the role of Manager and two or three in the role of Agent, with roles fixed throughout the session. Groups played a project-selection task one time, with the session concluding after all managers selected a project for their group.

2.2.1 Project Selection Task

In the task, agents each receive a project with privately known quality, High or Low. These projects are assigned by an iid random draw for each agent, with probability r of receiving a High quality project. The probability of receiving a Low project will therefore be $1 - r$ (Subjects were informed of all parameter values at the start of the session). Once agents see their project, they each send a private binary message to the manager, recommending either that their project be chosen or that it be declined. The manager views both messages and then chooses either project or declines both. If both projects are declined, the period will "reset," with agents receiving new projects and repeating the process. The task will conclude after a project has been accepted, or after twenty unsuccessful attempts. The payoffs from a High project are \$$h$ for both the manager and selected agent, and\$$l$ each for a Low project. The agent whose project is not selected will earn 0 ECU. A period that ends if the manager declines twenty pairs of projects leaves all group members with 0 ECU.

Once all triads have concluded the task, the session will conclude with a brief demographic questionnaire and measures for honesty and risk preference. The honesty measure is the electronic dice task used in Goerg et al (2019), modified from **?**, in which participants report the position of a red "x" that appears briefly and randomly near one of six die faces numbered one through six. The risk aversion measure is the lossless version from Eckel & Grossman (2008). Earnings from the project selection task are combined with earnings from the post-experiment measures.

2.2.2 Treatments and Hypotheses

We conduct nine treatments using this environment, each designed to test the model's predictions. The parameters for each treatment are summarized in Table 1, which also reports the agent's IC for each treatment. In the first three treatments, we vary the value of r, while keeping the values for $\$h$ and $\$l$ at \$10 and \$2. In the next set of treatments, we raise $\$l$ to examine how higher low outcomes influence willingness to deviate from truthful advice. Following this, we systematically explore treatments that either add an extra agent or add a third possible outcome, preserving direct comparisons to multiple other treatments.

Table 1: Treatment Overview

Treatment	r	\$h	\$m	\$l	Agents	IC_{agent}
Varying r						
r90	.90	10	-	2	2	2.74
r75	.75	10	-	2	2	2.29
r60	.60	10	-	2	2	1.75
Varying $\$l$						
r10-L3.5	.90	10	-	3.50	2	1.24
r10-L5	.90	10	-	5	2	-0.26
Three Agents						
r10-3B	.90	10	-	2	3	0.99
r10-3B-L3.5	.90	10	-	3.50	3	-0.51
Three States						
r10-3S-M3.7	..8,.1	10	3.70	2	2	1.04 (1.03)
r10-3S-M6	.8,.1	10	6	2	2	-1.26 (1.56)

Recall that truth telling is supported in equilibrium whenever the IC is positive. Therefore, we expect to see truthful reporting in the three treatments that vary r, though the degree of truth-telling should fall as r rises.

When we vary $\$l$, we predict truthful reports in only the L3.5 treatment, though even here we expect to see lower levels of truthful reporting than the original r10 data.

Adding a third agent again allows us to make several comparisons, both between the two 3B treatments and between each of them and their corresponding two-agent treatment. Specifically, raising $\$l$ in the 3B treatments removes incentive compatibility. Also note the difference in incentive compatitibility between r10-3B and r10, as well as r10-3B-L3.5 and r10-L3.5.

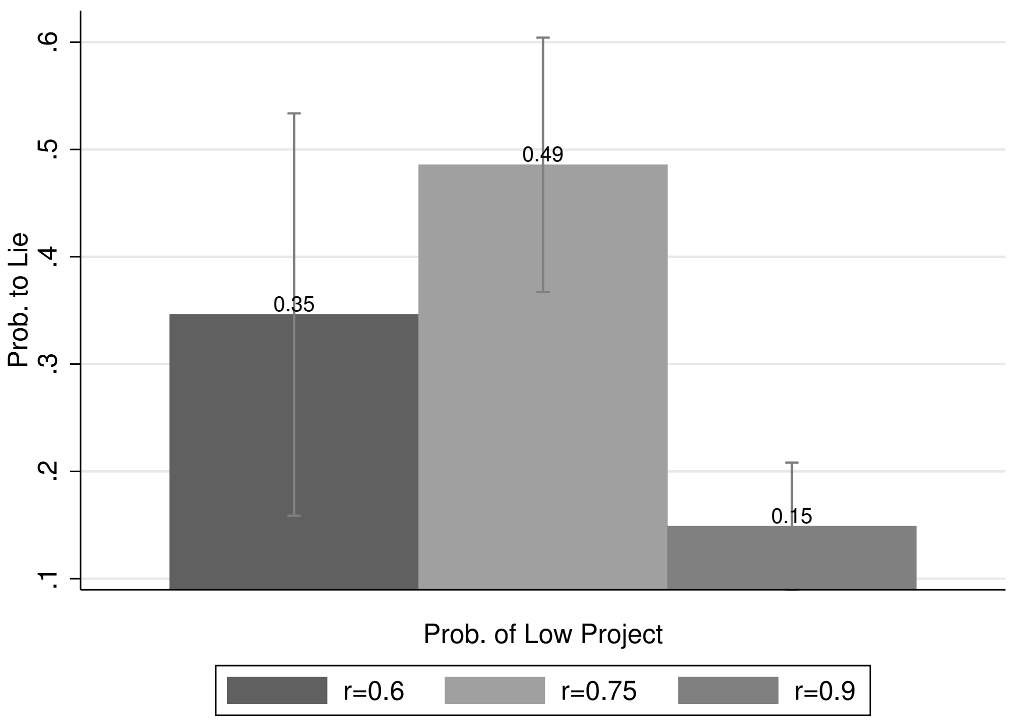
Finally, we introduce two treatments that include an intermediate state, m. Here we report the IC value for perfect truth-telling, with the IC for our partial-pooling equilibrium in parentheses. When the middle value is at \$3.70, we see similar IC values to r10-3B and r10-L3.5. However, raising the value of $\$m$ to \$6 we can only support a prediction for the partial pooling.

3 Results

3.1 Varying r

We find no significant differences on the behavior of the agents in the 0.6 and 0.75 treatments. However, the percentage of lies in the 0.9 treatment is statistically lower than the in the other two treatments in line with the predictions of the model. The t-test p-value on the differences on means between 0.6 and 0.75 = 0.226. The t-test p-value on the differences of means between 0.6 and 0.9 = 0.0159. The t-test p-value on the differences on mean between 0.75 and 0.9 = 0.0000. Similar results are obtained if we take in account all project realizations. Results are confirmed on the logit specification in Table 2.

Figure 1: Percentage of Lies: Low project State



Notes. The figure plots the percentage of lies when the agents receive a realization of a low project. In these cases, we have a value of the high project equal to 10, 2 participants, 2 states and a probability to receive a low project equal to 0.9. Our objective is to analyze how the different values of the payoffs of the low project impact the probability to lie.

Table 2: Probabitlity to Lie: Logit Regressions

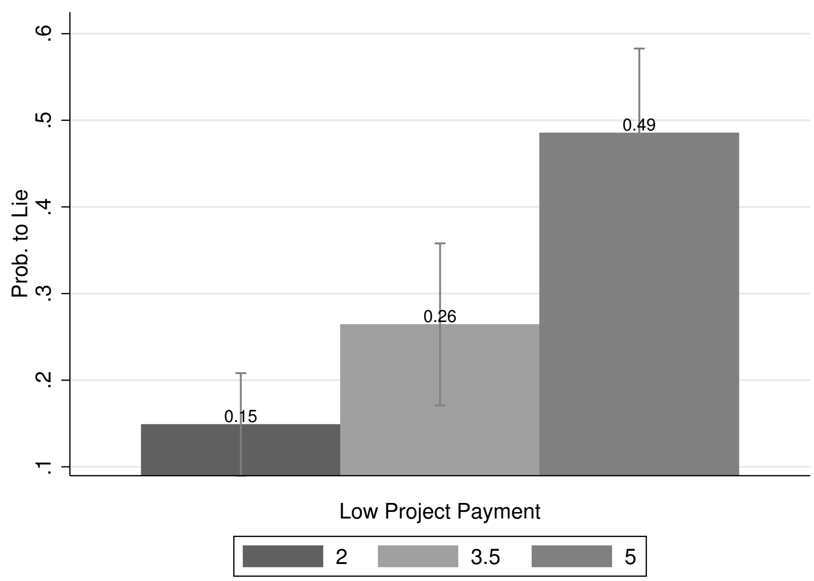
	Varying r		Varying l		Varying Number of Agents	
	model 1	model 2	model 3	model 4	model 5	model 6
$r = 0.6$	1.1070**	1.1070				
	(0.4763)	(0.6957)				
$r = 0.75$	1.6858***	1.6858***				
	(0.3371)	(0.4891)				
$r = 3.5$			0.7196**	0.7196		
			(0.3397)	(0.6175)		
$r = 5$			1.6847***	1.6847***		
			(0.3084)	(0.4545)		
3 *Agents*					0.7816**	0.7816*
					(0.3310)	(0.4720)
Constant	-1.7430***	-1.7430***	-1.7430***	-1.7430***	-1.7430***	-1.7430***
	(0.2370)	(0.3957)	(0.2369)	(0.3958)	(0.2370)	(0.3974)
Observations	237	237	331	331	235	235

Notes. (* p-value<0.1; ** p-value<0.05; *** p-value<0.01) Logit regressions specifications. The dependent variable is the probability to lie. The treatment with a probability to obtain a low project of 0.9 and payment value for the low project equal to 2 and for the high project equal to 10 is the comparison group. Odd columns use robust standard errors while even columns clustered the error terms at the triad level in each session.

3.2 Varying l

Increments in the payment of the low project significantly increases the probability to lie. It is significant when we move from 3 to 3.5 and from 3.5 to 5. The t-test p-value on the differences on means between 2 and 3.5 = 0.0320. The t-test p-value on the differences of means between 2 and 5 = 0.0000. The t-test p-value on the differences on mean between 3.5 and 5 = 0.0017. Comparing these results with the previous ones, it suggest that agents find easier to react accordingly to the model predictions when the treatment is related to payments than to probabilities. We are going to explore in more detail this issue when we use the measures risk aversion, dishonesty and agents characteristics. Similar results are obtained if we take into account all project realizations. Results are confirmed on the logit specification in Table 2.

Figure 2: Percentage of Lies: Low project State

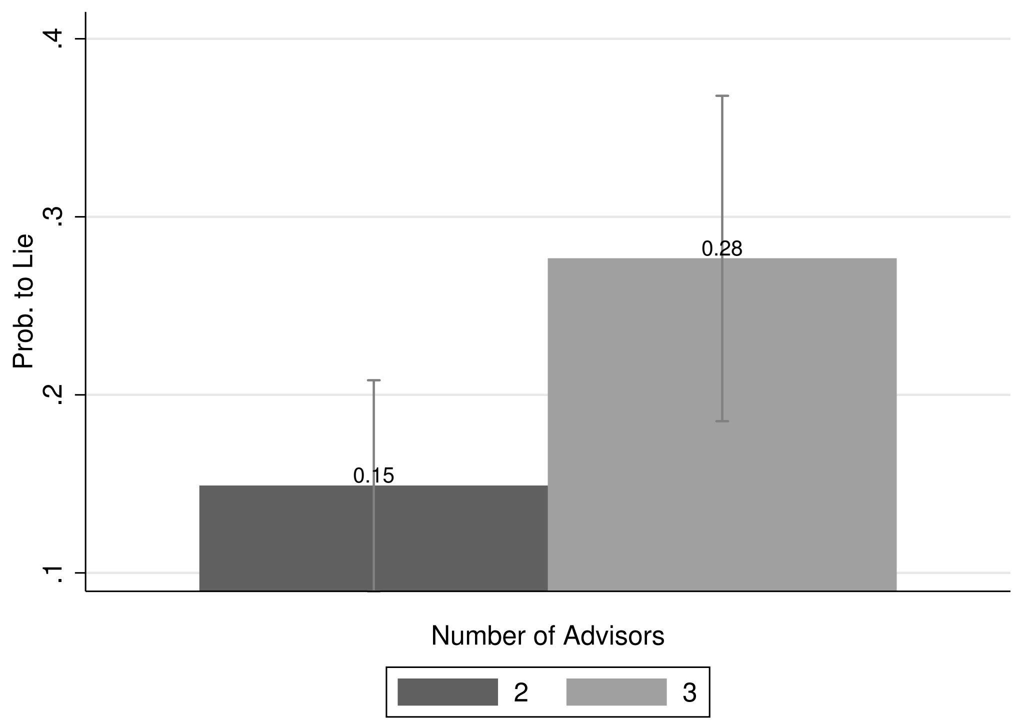


Notes. The figure plots the percentage of lies when the agents receive a realization of a low project. In these cases, we have a value of the low project equal to 2, a value of a high project equal to 10, 2 participants and 2 states. Our objective is to analyze how the different values of the probability to receive a low project realization change the behavior of the agents.

3.3 Varying number of agents

When the number of agents increases, the probability to lie increases too. The next figure use the value of the low payment equal to 2. We are replicating the same experiment with the payment of 3.5, but we have not finished to run the all the sessions. The t-test p-value on the differences on means between 2 and 3 = 0.0164. Similar results are obtained if we take in account all project realizations. Results are confirmed on the logit specification in Table 2.

Figure 3: Percentage of Lies: Low project State

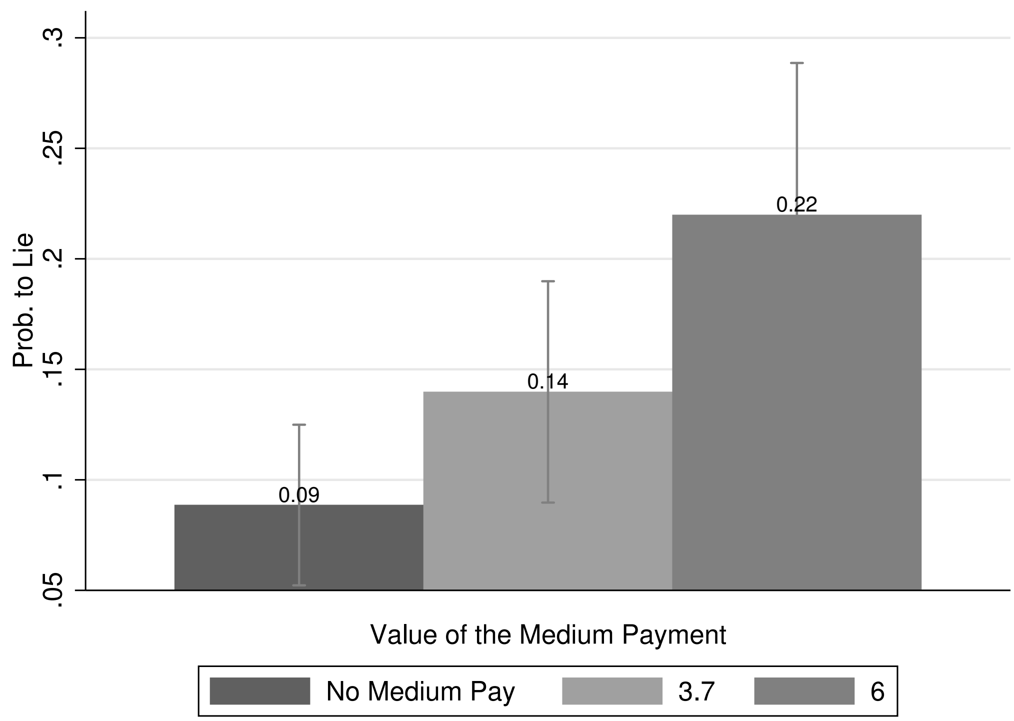


Notes. The figure plots the percentage of lies when the agents receive a realization of a low project. In these cases, we have a value of the low project equal to 2, a value of a high project equal to 10, a probability to receive a low project of 0.9 and 2 states. Our objective is to analyze how the number of advisors change the behavior of the agents.

3.4 Varying number of states

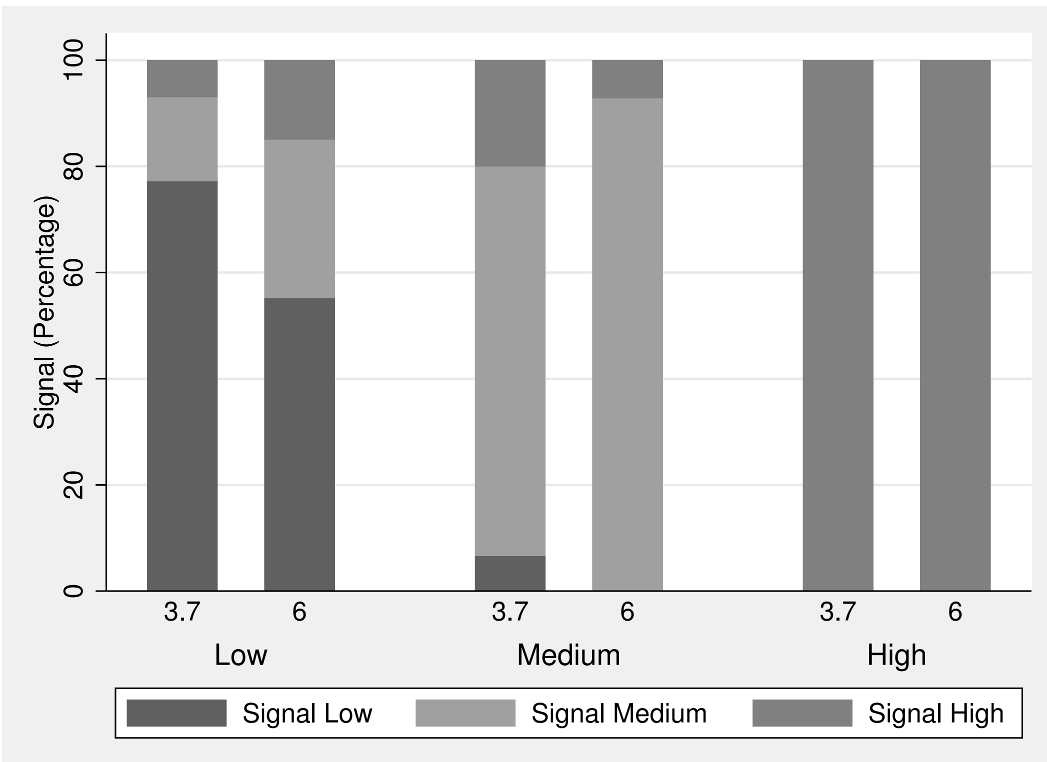
There is an increment of the probability to lie when the number of states increases. All those differences are statistically significant. For Figure 4: t-test p-value on the differences on means between 0 and 3.7 = 0.0969. The t-test p-value on the differences on means between 0 and 6 = 0.0003. The t-test p-value on the differences on means between 3.7 and 6 = 0.0590. The model predicts that when the medium payment increases, the amount of truth-telling decreases. Figure 5 suggest this is happening. On the other hand, the model predicts that the number of pooling equilibria should increase. It does not seem to happen. We can expand the analysis with the measures of risk aversion and dishonesty. It is also important to highlight that the number of medium and high reported signals in the medium treatment with a payment 6 are significantly higher than in the treatment with a payment of 3.7 (p-value for medium signal: 0.0303 ; and p-value for the high signal: 0935). There are not significant differences on the reported signals when the agents receive a medium value project.

Figure 4: Percentage of Lies: Low project State



Notes. The figure plots the percentage of lies when the agents receive a realization of a low project. In these cases, we have a value of the low project equal to 2, a value of a high project equal to 10, 2 participants and 3 states. The probability to receive a low project equal to 0.8, while the probability to receive a medium or high project is 0.1. Our objective is to analyze how the different values of the payment in the medium state change the behavior of the agents. Also, as a point of comparison we use the sessions of two states with no medium payment and a probability to receive a low value project of 0.9.

Figure 5: Signal Reported by State



Notes. The figure plots the percentage of signals reported by the agents when they received a low, medium or high value projects. In these cases, we have a value of the low project equal to 2, a value of a high project equal to 10, 2 participants and 3 states. The probability to receive a low project equal to 0.8, while the probability to receive a medium or high project is 0.1. Our objective is to analyze how the different reported signals changes when the medium payment increases.

4 Conclusion

In this paper we experimentally investigate a model of communication between informed players and an uninformed decision maker when the informed players compete for resources over time. We find evidence broadly consistent with the theoretical predictions of Schmidbauer (2017).

5 Appendix

Discussion of risk aversion

We now confirm that the sign of the comparative statics in Propositions 1 and 2 remain unchanged when managers are risk-averse but the incentive supporting the equilibrium is weaker in that the incentive for a type to falsely report High is stronger. Let utility over wealth w be given by $u(w)$, with $u' > 0$, $u'' < 0$ and $u(0) = 0$. Thus the consumer is risk-averse. Define $A(t) \equiv \sum_{i=0}^{n-1} \binom{n-1}{i} \frac{F(t)^{n-1-i}[1-F(t)]^i}{1+i}$, the probability a manager's recommended project is accepted when all other managers use threshold t. This probability depends on how many other managers recommend acceptance, where each project is accepted with equal probability if more than one is recommended. We now rederive the conditions in lines (2), (3), and (4), omitting terms that result in the focal manager's project being rejected in favor of another's project since $u(0) = 0$.

First, we rederive the result from line (2):

$$\begin{aligned} A(l)u(l) &\leq F(l)^{n-1}\big(A(l)(1-r)u(h) + F(l)^n(A(l)(1-r)u(h) + ...)\big) \\ &= F(l)^{n-1}\sum_{j=0}^{\infty}(F(l)^n)^j A(l)(1-r)u(h) \\ &= \left(\frac{F(l)^{n-1}}{1-F(l)^n}\right) A(l)(1-r)u(h) \end{aligned}$$

Canceling $A(l)$ from each side and performing the same algebraic manipulations leading up to line (2) gives

$$0 \leq \frac{u(h)r^{n-1}}{\sum_{j=0}^{n-1} r^j} - u(l) \equiv IC_1'(l, h, r, n). \tag{5}$$

Since $u' > 0$, it is immediate that the signs of all comparative statics on IC_1' equal that on IC_1. We now show that the incentive to comply with the equilibrium strategy is weaker given risk aversion than risk neutrality in the following sense.

Proposition 3 *Whenever a risk neutral manager is indifferent to defecting a risk averse manager strictly prefers to defect.*

Proof From line (2) we have the identity

$$l + IC_1 = \frac{hr^{n-1}}{\sum_{j=0}^{n-1} r^j}.$$

That is, a risk neutral player would be indifferent between receiving h with some probability and receiving $l + IC_1$ for sure. But then for a risk averse player

$$u\left(l + IC_1\right) = u\left(\frac{hr^{n-1}}{\sum_{j=0}^{n-1} r^j}\right) > \left(\frac{r^{n-1}}{\sum_{j=0}^{n-1} r^j}\right) u(h),$$

where the right hand side of the inequality is the expected utility from sending the High message (see line (5)), which is less than the utility from receiving $l + IC_1$ for sure.

Similar calculations show that lines (3) and (4) can be rederived, respectively, as

$$0 \leq \frac{u(h)(1 - r_3)^{n-1}}{\sum_{j=0}^{n-1}(1 - r_3)^j} - u(m) \equiv IC_2'(m, h, r_3, n) \tag{6}$$

$$0 \leq \frac{(u(m)r_2 + u(h)r_3)r_1^{n-1}}{1 - r_1^n} - u(l) \equiv IC_3'(l, m, h, r_1, r_2, r_3, n). \tag{7}$$

By similar arguments we conclude the signs of the comparative statics in Proposition

2 remain unchanged while the incentive to comply with the equilibrium strategy is weaker given risk aversion in the sense just described. ■

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