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Social Preferences and Strategic Uncertainty: An Experiment on Markets and Contracts

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JEL CLASSIFICATION: C90, D86

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Abstract

This paper reports a 3-phase experiment on a stylized labor market. In the first two phases, agents face simple games, which we use to estimate subjects' social and reciprocity concerns, together with their beliefs. In the last phase, four principals, who face four teams of two agents, compete by offering agents a contract from a fixed menu. Then, each agent selects one of the available contracts (i.e. he "chooses to work" for a principal). Production is determined by the outcome of a simple effort game induced by the chosen contract. We find that (heterogeneous) social preferences are significant determinants of choices in all phases of the experiment. Since the available contracts display a trade-off between fairness and strategic uncertainty, we observe that the latter is a much stronger determinant of choices, for both principals and agents. Finally, we also see that social preferences explain, to a large extent, matching between principals and agents, since agents display a marked propensity to work for principals with similar social preferences.

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When it comes to assess the distribution of rewards within and among organizations, economists have, by and large, taken the view that *inequality is a natural consequence of disparities in ability, or simply of asymmetric information.*[1] In marked contrast, social psychologists emphasize *the deleterious effects of inequality on workers' motivations and social relations within the organization.*[2] More recently, these two stylized perspectives have moved towards less extreme viewpoints. On the one hand, many economists now accept that workers have *social* (i.e. interdependent) and/or *reciprocal* preferences, with a strong taste against inequality.[3] On the other hand, social psychologists recognize that there are situations in which inequality may be beneficial for an organization. For example, Bloom (1999) claims that, since "... greater dispersion is negatively related to the performance of those lower in the dispersion [...] and positively related of those higher in the dispersion, [...] it may be beneficial for a law firm to pay a relatively high salary to attract a top attorney or for a university to offer an endowed chair to a particularly productive scholar. In other types of organizations [...] the situation is quite different because the poor performance of a particular worker cannot be compensated for by the better performance of the other workers".

The interesting part of this latter observation, from our point of view, is that the benefits of inequality seem to be directly linked to the existence of activities which display *strategic complementarities*, which often lead to multiple equilibria.[4] This goes along the lines of Winter's (2004) model of moral hazard in teams, which shows that complementarities are not only *sufficient*, but also *necessary* for the optimal contract -the one which implements the high-effort profile as the *unique* equilibrium of the game- to yield inequality in rewards. This is because, "if agents' exertion of effort induces a positive externality on the effectiveness of other agents' effort, it is optimal to promise high rewards to some agents so as to make the others confidently believe that these highly paid agents will contribute, hence allowing the planner to save resources by offering other agents substantially less". Even though Winter's (2004) result abstracts from the existence of social preferences, it adds an additional ingredient to the debate on inequality by showing that the principal faces a trade-off between robustness and fairness considerations: *fairness can be obtained only at the expense of ro-*

[1] A simple model with hidden actions would predict that agents with the same level of ability receive unequal pay even if in equilibrium they make the same amount of effort, due to purely random variations in output. See e.g. Macho-Stadler and Pérez-Castrillo (1997), chapter 3.

[2] "Decision makers are likely to use the equity principle in employment contexts and to use the equality principle to allocate resources in social contexts in which maintaining harmony and positive relationships are the primary goals." (Jawahar, 2005).

[3] Bewley (1999) is the seminal reference offering survey evidence on the importance of equity concerns in organizations. Other papers on this topic are Blinder and Choi (1990), Bewley (1995), Agell and Lundborg (1995, 2003) and Campbell and Kamlani (1997).

[4] Many payoff functions display strategic complementarities. A well-known one is the so-called "O-ring" production function, originally proposed by Kremer (1993), which has been applied in a large number of empirical and theoretical works. Heywood and Jirjahn (2004), or Mirza and Nicoletti (2004), are recent examples of papers in very different fields which take this production function as the basis of their empirical work.

bustness to strategic uncertainty.[5] In this respect, one can only expect this trade-off to be exacerbated by the presence of (inequality-averse) distributional preferences.

The aim of this paper is precisely to test experimentally the idea that workers' (heterogeneous) social preferences are crucial in determining the contracts they are offered and choose.[6] We are also interested in the way our experimental subjects resolve the trade-off between robustness and inequality, as they can choose either *i)* contracts in which -following Winter (2004)- the all-effort profile is the unique equilibrium, but inequality is enhanced; or *ii)* contracts in which the all-effort profile is not the unique equilibrium, but inequality is mitigated. In this respect, subjects more concerned with equity (and less worried about coordination failure) may find convenient to opt for the latter alternative. Finally, since another solution to the trade-off is *sorting* (agents with similar distributional concerns work for the same firms), this will also be an important element of our experimental design.[7]

With these goals in mind, we design and perform an experiment with three phases.

1. In the first phase (P_1), subjects are matched for 24 rounds with a different partner and have to choose among four possible options involving a payoff pair -one for them, one for their matched partner- in a Dictator Game-type protocol. We use P_1 to estimate subjects' purely distributional preference parameters within the realm of Charness and Rabin's (2002, C&R hereafter) model.

2. In the second phase (P_2), subjects are again matched in pairs for 24 rounds and asked to choose among the same payoff pairs. However, this time options correspond to "contracts", as they yield a 2×2 effort game induced by Winter's (2004) technology, which subjects then have to play at a second stage. In P_2 reciprocity may play a role, since agents may condition their second-stage effort decision on their teammate's contract choice. Thus, we use P_2 to estimate subjects' C&R reciprocity parameters, together with their beliefs in the effort game.

3. Finally, in the third phase (P_3), there are 4 principals and 4 pairs ("teams") of agents.

[5] Van Huyck, Battalio and Beil (1990, 1991) are probably the best known experimental works on the effects of strategic uncertainty in coordination games. Crawford (1995) and Crawford and Haller (1990) are theoretical papers partly inspired by these experimental results. Heinemann, Nagel and Ockenfels (2008) experiments measure the extent and importance of strategic uncertainty in coordination games. López-Pintado, Ponti and Winter (2008) test directly Winter's (2004) model in the lab.

[6] Fershtman, Hvide and Weiss (2005), Rey-Biel (2008) and Kosfeld and von Siemens (2006) explore theoretically the effects of social preferences on effort and cooperation. On the experimental side, Charness (2004) shows that volition in choosing a wage has a significant effect on subsequent costly effort provision. Fehr, Klein and Schmidt (2007) show (theoretically and experimentally) that even a minority of people with concerns for fairness can alter the kind of contracts that are efficient.

[7] Cabrales, Calvó-Armengol and Pavoni (2008), Cabrales and Calvó-Armengol (2008) and Teyssier (2008) show that social preferences lead to more productive workers sorting themselves into different firms than the remaining workers. In a controlled laboratory experiment, Dohmen and Falk (2006) find that more productive workers self-select into firms with variable pay schemes. Krueger and Schkade (2007) and Bellemare and Shearer (2006) provide field evidence suggesting that sorting by preference traits is an important determinant of contract choices.

Principals offer a *contract* (a 2×2 game, such as those played in P_2) selected from a given set. The presence of several competing principals acts as a kind of menu of contracts, among which agents may sort themselves.

This three-stage experimental design (and the associated estimation strategy) is novel, and it is especially designed to solve the identification problem discussed by Manski (2002), as we use it to disentangle preference and beliefs parameters. Since in P_1 beliefs do not play any role, we use data from P_1 to estimate subjects' distributional preference parameters. Under the assumption that the latter are constant across phases, we then use data from P_2 to estimate subjects' reciprocity concerns and beliefs.[8] Our estimation of distributional parameters is carried out at the level of each individual subject participating in the experiment.[9]

Let us summarize the main results of our study.

1. *Subjects display a significant degree of heterogeneity in their decisions, and thus, in estimated preferences and beliefs.*

2. *This heterogeneity explains, to a large extent, agents' behavior.* That is, preferences and beliefs which best explain agents' behavior in P_1 and P_2, also explain well the contracts they choose among those offered by the different principals in P_3, together with their subsequent effort decision.

3. We also observe that *equality is a less important consideration than robustness*, for both principals and agents, since the egalitarian (but not robust) contract is rarely selected and, when it is selected, it very often yields the (inefficient) low effort outcome. This, in turn, implies lower profits, for both principals and agents.

4. Finally, we find that *principals and agents sort themselves according with their social preferences.* An agent's probability of selecting a contract in P_3 decreases with the distance between her estimated preferences and those of the principal for whom she ends up working for. Moreover, principals also end up offering contracts in tune with their own estimated distributional preferences.

The remainder of this paper is arranged as follows. Section 1 presents the experimental design, while in Section 2 we develop an econometric model to estimate distributional

[8] In comparison with the approach recently proposed by Bellemare *et al.* (2008), we do not rely upon hypothetical subjective probability questions to estimate beliefs. More generally, as Nyarko and Schotter (2002) acknowledge, belief elicitation has its own problems "As is true of all scoring functions, while payoffs are maximized by truthful revelation of beliefs, there are other beliefs that could be stated that are more secure [...] If subjects were risk averse, such an action might be desirable." We opted for our design because it allows us to identify cleanly the distributional preferences, separating them from belief identification, without distracting the subjects with new tasks. Given the complication of the overall design, this seemed to us a sensible strategy.

[9] Many other papers in the "social preferences" literature, such as Fehr and Schmit (1999,2003), Costa-Gomes and Zauner (2001), or Charness and Rabin (2002) only provide pooled estimates. One noticeable exception is the paper of Fisman, Kariv and Markovits (2007), which provides individual distributional preference parameters for those subjects whose behavior is sufficiently "consistent", in the sense of Afriat (1972).

preferences and beliefs. Section 3 discusses our testable hypotheses and reviews the relevant literature. Final remarks are placed in Section 4. Three Appendices provide proofs, additional statistical evidence and experimental instructions.

1 Experimental design

In what follows, we introduce the features of our experimental environment.

1.1 Sessions

Three experimental sessions were conducted at the Laboratory of Theoretical and Experimental Economics (LaTEx), of the Universidad de Alicante. A total of 72 students (24 per session) were recruited among the undergraduate population of the Universidad de Alicante -mainly, students from the Economics Department with no (or very little) prior exposure to game theory. The experimental sessions were computerized. Instructions were read aloud and we let subjects ask about any doubt they may have had.[10] In all sessions, subjects were divided into two *matching groups* of 12. Subjects from different matching groups never interact with each other throughout the session. Given this design feature, we shall read the data under the assumption that the history of each matching group (6 in total) corresponds to an independent observation.

1.2 Choice sets

Our experiment involves, for each one of the 24 rounds t constituting each phase, two subjects, 1 and 2, deciding over a choice set of four *options* $C_t = \left\{b_t^k\right\}, k = 1, ...4$, where each option constitutes a pair $b_t^k \equiv (b_{1t}^k, b_{2t}^k)$, with $b_{1t}^k \geq b_{2t}^k$ by construction. Each pair determines the payoff matrix of a simple 2×2 effort game $G(k)$. The rules of $G(k)$ are as follows. Each agent $i = 1, 2$, has to decide, simultaneously and independently, whether to make a costly effort. We denote by $\delta_i \in \{0, 1\}$ agent i's effort decision, where $\delta_i = 1(0)$ if agent i does (does not) make effort. Let also $\delta = (\delta_1, \delta_2)$ denote the agents' action profile. The monetary payoff of agent i is described by

$$\pi_{it}^k(\delta) = B + P(\delta) b_{it}^k - \delta_i c. \tag{1}$$

where

$$P(\delta) = \begin{cases} 0 \text{ if } \delta_1 + \delta_2 = 0, \\ \gamma \text{ if } \delta_1 + \delta_2 = 1, \\ 1 \text{ if } \delta_1 + \delta_2 = 2, \end{cases} \tag{2}$$

B is a benefit not depending on effort decision, and c is the cost of effort. Players receive their payoff in full if they both (independently and simultaneously) coordinate on the effort decision. In our experiment we fix $B = 40$, $c = 10$ and $\gamma = \frac{1}{4}$.

[10]The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). The complete set of instructions, translated into English, can be found in Appendix C.

The pairs $b_t^k \equiv (b_{1t}^k, b_{2t}^k)$ were drawn at random in the positive orthant, but not uniformly.

Figure 1. The experimental contract sets

In Figure 1 we report all pairs b_t^k used in the experiment. As Figure 1 clearly shows, these pairs are concentrated in two "clouds", which differ one another from the fact that, for some pair, Player 1 (the "advantaged" player within the 2-member team) receives substantially more. As we explain in detail in Appendix A, the two clouds includes pairs b_t^k which are the solutions of two different mechanisms design problems aimed at inducing both players to provide effort. The two mechanism design problems differ in that

1. under the "*w*eak effort induc*ing*" solution (*wing* hereafter) players have a strict incentive to put effort only if the other does;
2. under the "*st*rong effort induc*ing*" solution (*sting* hereafter*)* player 1's payoff is sufficiently high to provide a strict incentive to put effort independently on what player 2 does, while player 2, like in the *wing* solution, has a strict incentive to put effort only if player 1 does. This implies that, under the *sting* solution, the all-effort profile is the unique equilibrium of the induced game, while under the *wing* solution also the all-no-effort profile is an equilibrium.

Unlike Winter (2004), who focuses on Egoistic (i.e. non distributional) Preferences (EP), we solve the two mechanism design problems under a wide variety of distributional preferences analyzed by the literature. This explains the additional payoff variability within each cloud (where the larger points in each cloud identifies the corresponding EP solution).

The interested reader can find in Appendix A all the details. What is important to stress here is that our choice set provides sufficient variability in payoffs to estimate individual social preferences in Section 2.1, and that the specific variability we created (essentially, payoffs of similar magnitude for player 2, while a substantial difference in monetary prizes for player 1, depending on whether a *wing* or a *sting* solution is applied) gives some formal dress to the discussion on the trade-off between equality and robustness we proposed earlier.[11]

Depending on the round t, the choice set C_t could be made by *i)* 4 *wing* contracts generated from 4 different preference profiles; *ii)* 4 *sting* contracts generated from 4 different preference profiles; or *iii)* 2 *wing* and 2 *sting* generated by two different preference profiles.

We grouped rounds into *time intervals*. A time interval is defined as a group of three consecutive rounds (starting at 1), and indexed by p so that round $\tau_p = \{3(p-1) < t \leq 3p\}$, is part of time interval $p = 1, ..., 8$. Within each time interval τ_p, subjects experienced each and every possible situation, *i)* to *iii)* The particular sequence of three situations within each time interval was randomly generated. We did so to keep under control the time distance

[11] The fact that monetary payoffs are derived from a specific theoretical exercise -instead of simply randomly generated- has no further impact on the experimental design. Subjects were not acknowledged, at any time, on where those numbers came from: they simply had to choose, at each round, one out of four different options, with no further explanation.

between two rounds characterized by the same situation. Player position (either player 1 or player 2) was also chosen randomly, for each team and round.

1.3 Phases

Subjects played three *phases,* P_1 to P_3, of increasing complexity, for a total of 72 rounds (24 rounds per phase).

P_1. **Dictator Game (24 rounds)** In this phase we use a variant of the classic protocol of the Dictator Game. The timing for each round t and matching group is as follows:

1. At the beginning of the round, six pairs are formed at random. Within each pair, another (independent and uniformly distributed) random device determines player position (i.e. the identity of the best paid agent).
2. After each agent is informed of her player position in the pair (common to all options in C_t), she has to select her preferred choice. The monetary payoff associated to each choice corresponds to the all-effort profile payoff, $\pi_{it}^k(1,1)$.
3. Once choices are made, another independent draw fixes the identity of the *Dictator.*
4. The Dictator's choice, k, determines monetary payoffs for that pair and round.

P_2 : **Effort Game (24 rounds)** Stages 1 to 3 are identical to those of P_1. Instead of stage 4, we have

4 Subjects are asked to play the 2×2 effort game $G(k)$ described above. Subjects' action profile determines their financial reward (1).

P_3 : **The Market (24 rounds)** At the beginning of P_3, within each matching group, 4 subjects are randomly chosen to act as "Principals". Then, in each round t, these 4 principals have to select one contract within the choice set C_t to be offered to the 4 teams of agents in their matching group. We denoted by $C_t^0 \subseteq C_t$ the set of contracts offered by at least one Principal (this set may be a singleton, since contracts offered by Principals may all coincide, as it often happened in the experiment). Agents have then to choose within this subset C_t^0. Stages 2-4 are then identical to those of P_2. The payoff for the Principal is calculated as the difference between total output, $V \sim U[A, B]$, and total costs:

$$\pi_0^k(\delta) = P(\delta)(V - b_1^k - b_2^k),$$

with $A = 100$ and $B = 150$ in the experiment (i.e. $V \sim U[100, 125]$).

1.4 Monetary payoffs

All monetary payoffs in the experiment were expressed in Spanish Pesetas (1 euro is approx. 166 ptas.).[12] Subjects received 1.000 ptas. just to show up, to which they summed up all their cumulative earnings throughout the $24 \times 3 = 72$ rounds of the experiment.[13] Average earnings were about 21 euros, for an experimental session lasting for approximately 90 minutes.

1.5 Three (testable) questions

We are now in the position to specify the main objectives of our experiment.

Q1. *Is it inequality aversion or strategic uncertainty aversion?* Contracts have been calculated using two different mechanism design strategies, with rather different distributional characteristics. Two kinds of questions arise here.

Q1.1. *Which contract type* (*sting* or *wing*) *is chosen more often by principals and agents?* Evidence for this in **Remark 1**

Q1.2. *What is the role of strategic uncertainty?* That is, to which extent the (non) existence of multiple equilibria in *wing* (*sting*) affects agents' behavior in the effort game. Evidence for this in **Remarks 2** and **3**.

Q2 *Does separation emerge?* That is, is the market able to sort (principals and) agents according to their distributional and reciprocity preferences? Evidence for this in **Remarks 4** and **5**.

Q3. *Do models of social preferences work?* That is, does a model with distributional and reciprocity preferences provide a reliable framework to predict principals and agents' behavior? Evidence for this in **Remark 6**.

2 Identifying preferences and beliefs

In what follows, i and j identify our subjects matched in pairs. We assume that our subjects' preferences follow C&R, as we explain in the following

[12] It is standard practice, for all experiments run in Alicante, to use Spanish ptas. as experimental currency. The reason for this design choice is twofold. First, it mitigates integer problems, compared with other currencies (USD or Euros, for example). On the other hand, although Spanish pesetas are no longer in use (substituted by the Euro in the year 2002), Spanish people still use Pesetas to express monetary values in their everyday life. In this respect, by using a "real" (as a opposed to an artificial) currency, we avoid the problem of framing the incentive structure of the experiment using a scale (e.g. "Experimental Currency") with no cognitive content.

[13] In other papers in this area subjects are paid according to the outcome of a randomly chosen period (instead of the accumulated payoffs, as we do). Our design choice was dictated by our focus on "strategic" uncertainty, which led us to reduce other sources of uncertainty (notice that we also replaced the uncertain payoffs of the theoretical benchmark by their certainty equivalent).

Definition 1 (C&R Preferences))

$$
\begin{aligned}
u_i(\delta) &= \pi_i(\delta) &(3)\\
&\quad -(\alpha_i - \theta_i\phi_j)\max\{\pi_j(\delta)-\pi_i(\delta),0\} - (\beta_i + \theta_i\phi_j)\max\{\pi_i(\delta)-\pi_j(\delta),0\},
\end{aligned}
$$

where $\phi_j = -1$ if j "has misbehaved", and $\phi_j = 0$ otherwise (we provide an operational definition of misbehavior a little later in this Section). In words, if player j has "misbehaved", player i increases her "envy" parameter α_i (or lowers her "guilt" parameter β_i) by an amount equal to θ_i. Thus, θ_i can be interpreted as player i's sensitivity to negative reciprocity. Model (3) has the useful feature that it subsumes parameters which account for subjects' *distributional tastes* a' la Fehr and Schmidt (1999, F&S), α_i and β_i, as well as for their *tastes for reciprocity*, θ_i.

Our experimental setup seems particularly well suited to estimate both distributional *and* reciprocity concerns. With respect to the former, there are four relevant subsets of parameters, which we now describe. All these specifications do not consider reciprocal motives (i. e., it is always assumed $\theta_i = 0$), and, in this sense, define purely "distributional" preferences.

$$\text{Egoistic Preferences (EP): } \alpha_i = \beta_i = 0. \tag{4}$$

$$\text{Inequality Averse Preferences (IAP): } 0 \leq \beta_i < 1, \alpha_i \geq \beta_i. \tag{5}$$

$$\text{Status Seeking Preferences (SSP): } \alpha_i \in [0,1), \beta_i \in (-1,0], |\alpha_i| \geq |\beta_i| \tag{6}$$

$$\text{Efficiency Seeking Preferences (ESP): } \alpha_i \in (-\frac{1}{2},0], \beta_i \in [0,\frac{1}{2}), |\beta_i| \geq |\alpha_i| \tag{7}$$

Inequality averse preferences (5) were first proposed by F&S. The literature has also focused upon two alternative subsets of parameters for (3), namely SSP (Frank, 1984) and ESP (Engelmann and Strobel, 2004). The former assumes that an increase in the other player's monetary payoff is always disliked, independently of relative positions. The latter, that a reduction in her own payoff is acceptable only if it accompanied by an increase (at least of the same amount) in the other player's payoff. Even though C&R follow F&S in only considering IAP, we jointly call -with a slight abuse of notation- "C&R distributional preferences" the four types of preferences (4)-(7).

2.1 Estimating distributional preferences using P_1.

In each round t, let L_{it} be a dummy variable which is equal to 1 if subject i is the lower paid agent- and zero otherwise. Assuming that each subject i is characterized by her own parameters α_i and β_i, her utility from choosing option k at round t can be written as

$$u_{it}^k = (1-L_{it})\left[\pi_{1t}^k - \beta_i\left(\pi_{1t}^k - \pi_{2t}^k\right)\right] + L_{it}\left[\pi_{2t}^k - \alpha_i\left(\pi_{1t}^k - \pi_{2t}^k\right)\right] + \varepsilon_{it}^k.$$

According to this notation, subject i chooses option k at round t if

$$u_{it}^{k}=\max\left(u_{it}^{1},\ldots,u_{it}^{4}\right).$$

Under the assumption that the stochastic term ε_{it}^{k} is iid with an extreme value distribution, the probability that individual i chooses option k at round t is therefore

$$\begin{aligned}&\Pr\left(y_{it}=k|\pi_1(.),\pi_2(.)\right)=\\&\frac{\exp\left(\left(1-L_{it}\right)\left[\pi_{1t}^{k}-\beta_i\left(\pi_{1t}^{k}-\pi_{2t}^{k}\right)\right]+L_{it}\left[\pi_{2t}^{k}-\alpha_i\left(\pi_{1t}^{k}-\pi_{2t}^{k}\right)\right]\right)}{\sum_{k=1}^{4}\exp\left(\left(1-L_{it}\right)\left[\pi_{1t}^{k}-\beta_i\left(\pi_{1t}^{k}-\pi_{2t}^{k}\right)\right]+L_{it}\left[\pi_{2t}^{k}-\alpha_i\left(\pi_{1t}^{k}-\pi_{2t}^{k}\right)\right]\right)}.\end{aligned} \tag{8}$$

Notice that (8) allows for parameter heterogeneity across subjects. Thus, the iid assumption does not stem from neglected individual unobserved heterogeneity, and it is consistent with the random order of the four contracts in the choice set C_t.

In our estimates we do not constrain the parameters to adhere to any of the preference types (4)-(7). Our estimated couples $\left(\widehat{\alpha}_i,\widehat{\beta}_i\right)$ can therefore potentially cover all the $\mathbb{R}^2$ space. Figure A1 (in Appendix B) plots the estimated α_i and β_i of each subject participating to the experiment. In Table 1 we summarize this information by partitioning our subject pool, assigning each subject to the quadrant (Q_1 to Q_4) of the $\mathbb{R}^2$ space in which her estimated parameters are most likely to fall. At the same time, we group in an additional "EP" category those subjects whose estimated α_i and β_i are jointly not significantly different from zero (at the 10% confidence level). Subjects with IAP preferences are a subset of those included in the first quadrant ($\alpha_i>0,\beta_i>0$; 19.4% of all the subjects), the pool in Q_2 ($\alpha_i>0,\beta_i<0$; 22.2%) includes agents with SSP preferences, while those with ESP preferences fall in Q_4 ($\alpha_i<0,\beta_i>0$, 29.2%). For 19.4% of the subjects we cannot reject the null hypothesis of EP.

Table 1. Preference types of agents and principals

2.2 Estimating reciprocity and beliefs using P_2.

In P_2, after selecting their favorite option (now to be interpreted as a proper "contract", that is, a benefit profile conditional on the joint effort decision), agents are asked to play the induced effort game, $G(k)$, in which they may condition their effort decision upon the (publicly known) contract choice of their teammate.

This, in turn, implies that we can apply the full-fledged behavioral model (3) to estimate our subjects' reciprocal concerns. To do this, we need first to operationally identify what "misbehavior" means in the context of our experimental setup. In this respect, we shall use contract choice decisions by j and i in Stage 1, defined as k_j and k_i, respectively:

$$\phi_j=\begin{cases}-1\text{ if }b_i^{k_j}<b_i^{k_i},\\ \ \ 0\text{ otherwise.}\end{cases} \tag{9}$$

By (9), j misbehaves by choosing a contract k_j which assigns i a strictly lower benefit than what i would have guaranteed herself with k_i.

We can now look at agents' effort decisions in P_2 as the result of a process of expected utility maximization. Individual i will choose to make effort in STAGE 2 $\left(\delta_i^k = 1\right)$ if

$$E_{\lambda_i^k}\left[u_i^k\left(1, \delta_j^k\right) - u_i^k\left(0, \delta_j^k\right)\right] > 0, \tag{10}$$

where $E_{\lambda_i^k}[\cdot]$ indicates the expected value taken with respect to player i's beliefs on j's effort decision, λ_i^k. We parametrize λ_i^k as a logistic function of the distributional features of contract k, b_j^k and $\left(b_i^k - b_j^k\right)$, and on player i's own misbehavior in STAGE 1, ϕ_i:

$$\lambda_i^k = \frac{\exp\left(\psi_1\phi_i + \psi_2 b_j^k + \psi_3(b_i^k - b_j^k)\right)}{1 + \exp\left(\psi_1\phi_i + \psi_2 b_j^k + \psi_3(b_i^k - b_j^k)\right)}. \tag{11}$$

Our belief specification (11) allows player i to anticipate that *her own behavior in Stage 1 may affect j's willingness to put effort.* In addition, ψ_2 and ψ_3 proxy the effect associated with absolute and relative payoffs. Our specification for the reciprocity parameter θ_i in (3) allows j's behavior to affect i's effort decision differently, according to i's player position (1 *vs.* 2) and to the Dictator role. Letting $D_i = 1$ if individual i is the Dictator, and zero otherwise, we have.

$$\theta_i = \theta_1 D_i\left(1 - L_i\right) + \theta_2\left(1 - D_i\right)\left(1 - L_i\right) + \theta_3 D_i L_i + \theta_4\left(1 - D_i\right) L_i. \tag{12}$$

Assuming that the latent index on the LHS of (10) has an extreme value distribution, the probability to observe the subject i making effort given the plan k is given by

$$\begin{aligned} &\Pr\left(\delta_i^k = 1 | \left(\alpha_i, \beta_i, \theta_i\right), L_i, D_i, \left(b_1^k, b_2^k\right)\right) \\ &= \frac{\exp\left(E_{\lambda_i^k}\left[u_i^k\left(1, \delta_j^k\right)\right]\right)}{\exp\left(E_{\lambda_i^k}\left[u_i^k\left(1, \delta_j^k\right)\right]\right) + \exp\left(E_{\lambda_i^k}\left[u_i^k\left(0, \delta_j^k\right)\right]\right)}. \end{aligned} \tag{13}$$

Since we posit that distributional preferences estimated in P_1 are constant across phases, the effort decision taken in STAGE 2 of P_2 reveals individuals' subjective belief over their teammates' effort decision (λ_i^k) and their own sensitivity to reciprocity (θ_i).

Consistently, our estimation strategy is a two step procedure:

1. in P_1 we get estimates of distributional parameters, $\widehat{\alpha}_i$ and $\widehat{\beta}_i$ from (8);

2. in P_2 we estimate - via partial maximum likelihood- the parameters of λ_i^k and θ_i replacing $\widehat{\alpha}_i$ and $\widehat{\beta}_i$ in (13).

Given the two-step nature of the procedure, we use (8) to obtain $N = 150$ bootstrap estimates of (α_i, β_i) for each of the 72 subjects, and we use them to obtain a bootstrap distribution of Step 2 estimates.

Table 2 reports the estimation results, where the estimated standard errors of the parameters of λ_i^k and θ_i take into account matching group clustering.

Table 2. Estimated parameters of belief function and reciprocity.

As for our belief specification (11), we see that both coefficients associated with (relative) payoffs, ψ_2 and ψ_3, are significant, indicating that player i is expecting more effort the higher j's payoff $\left(\widehat{\psi}_2 > 0\right)$ and lower effort if her teammates is Player 2 ($\widehat{\psi}_3 < 0$ and $b_i^k - b_j^k > 0$). As for our account for reciprocity in i's beliefs, ψ_1, we find a positive coefficient, although not statistically significant. Similar considerations hold when we look at the estimates of the four coefficients for θ_i in (12) conditional on Player and Dictator positions.[14] None of them is significant, and those associated with Player 2 (1) are positive (negative).

To summarize, our estimations do not yield statistically significant reciprocity parameters for subjects' beliefs and behavior, at least conditional on the specific functional forms (11)-(13). Conditional on the estimated distributional preferences we carry from P_1, only (absolute and relative) payoffs seem to have a significant effect on how subjects form their beliefs and make their effort decisions.[15]

3 Discussion

We devote this section to provide answers to our conjectural hypotheses and discuss several methodological (as well as empirical) issues raised by our novel theoretical and experimental setting.

3.1 $Q1$. Is it inequality aversion or strategic uncertainty aversion?

We first analyze subjects' revealed preferences over the type of contract, *wing* or *sting*, to see how subjects resolved the tension between fairness and strategic uncertainty we discussed earlier, and how this depends on their individual social preferences. As explained in Section 1, in 8 out of 24 rounds of the experiment, the choice set C_t was compound by 2 *wing* and 2 *sting* contracts, built upon two pairs of distributional preferences (5)-(7). Table 3 reports the relative frequency of subjects' choices of a *sting* contract in the 8 rounds in which both types of contracts were available.

[14] In principle we could provide individual estimates for θ_i. In fact, we obtain estimates of θ_i which are significantly different from zero for only 20 out of 72 individuals, with 10 of them positive. But these results are difficult to interpret because given the number of observations available for each individual we are forced to impose that the reciprocity effect does not vary according to the player position of the individuals (that is, Dictator vs. Non Dictator and Player 1 vs. Player 2). Table 1B in Appendix B provides prima facie evidence against these assumptions, thus we prefer to present a pooled estimate for θ.

[15] It may be worth noticing at these stage that these qualitative results are robust across alternative functional specifications for both beliefs and tastes for reciprocity. Results are not reported here, but are available upon request.

Table 3. Relative frequencies of the *sting* choice in the "mixed" rounds.

Remark 1 *sting* is the most frequent choice for all players and phases.

As Table 3 shows, in all phases, *sting* is by far the most popular choice, and this is particularly true for Player 1 (who, in P_2, goes for *wing* only 7 out of 288 times). Principals also display a higher preference for *sting*, even though choice frequencies are much closer to those of the less advantaged Players 2. To assess the extent to which social preferences affect the probability of choosing a *sting* contract, we need to control for the inequality in the available choice set C_t, which varies substantially from round to round. In Appendix B we run a logit regression, whose main conclusions are:

1. The more "unequal" is the *wing* choice (i.e., the bigger are the payoff differences $b_{1t}^k - b_{2t}^k$ of the 2 *wing* contracts, relative to those of the 2 *sting* contracts in C_t), the more likely is the choice of a *sting* contract, whatever the player position. On average, a 1% increase of a "relative inequality index" between *wing* and *sting* contracts we build for this purpose induces an increase of the 29% of the probability of choosing *sting* for Player 2, and of 14% for the principals in P_3.

2. For principals, distributional parameters are not significant to explain the choice of contract type, while for Players 2 in P_2, both α and β are significant, with opposite sign.

We now discuss agents' effort decisions in P_2 and P_3. Table 6 shows that individual i's willingness to put effort is higher when she faces a *sting* contract: when we focus on P_2 we see that, with a *sting* contract, Player 1 puts effort in 92% of the cases, while the same statistic drops to 51% in the *wing* contracts. For Player 2 the corresponding figures are much lower (62% and 43%, respectively).[16] If we compare the effort decisions in P_2 and P_3 we observe that only for Player 1 in the *wing* case there is an overall reduction of the effort in P_3. (51% vs 44%).

Table 4. Relative frequencies of positive effort decisions in P_2 and P_3

Remark 2 Effort is much higher in *sting* that in *wing.*

We now look at the extent to which contract choices are able to solve the coordination problems agents face in the effort game. Table 5 shows that the relative frequencies of the all-effort efficient equilibrium are about twice larger in *sting* than in *wing* (about 60% vs 30%).

[16] This consideration notwithstanding, it may be worth to remember -see Figure 1 - that difference in effort on behalf of Player 1 could be imputed to the higher benefits she enjoys under a sting contract. On the other hand, for Player 2, absolute rewards do not vary much across contract types and higher efforts may be due, following Winter's (2004) argument, to the reduced strategic uncertainty.

Remark 3 In *wing*, the inefficient all-no-effort equilibrium pools more than 1/3 of total observations, and it is played more frequently than the efficient all-effort equilibrium.

While this frequency stays basically constant over phases and mechanisms, in *sting* the relative frequency of outcomes in which only Player 2 puts effort never exceeds 4% while, in *wing*, this frequency is 3 times bigger. Also notice that about 30% of total observations correspond to a (non-equilibrium) strategy profile in which only one agent puts effort.

Finally, if we look at the evolution of outcomes over time, we see that, for both *wing* and *sting,* the relative frequency of efficient equilibria is falling, although, in *wing*, this effect is much stronger. In addition, the frequency of the inefficient no-effort equilibria almost doubles, when we compare the first and the last 12 repetitions of each phase.

Table 5. Outcome dynamics in the effort game.

If we look at the mechanism design problem from the principal's viewpoint, our evidence yields a clear preference for the "*sting* program". Despite its being more expensive (since the sum of benefits to be distributed is higher), the difference in average team effort is sufficient to compensate the difference in cost. In addition, in the "mixed" rounds of P_3, principals offering *sting* contracts were selected by agents with a much higher frequency. This, in turn, implies that average profits for a principal when offering a *sting* contract in the "mixed" rounds was substantially higher, three times as much as the corresponding profits when offering a *wing* contract (95.4 ptas. *vs.* 30.1).

3.2 $Q2$. Does separation emerge?

One way to interpret the results of the previous section is that distributional preferences play a role to resolve the trade-off implicit in the *wing-sting* choice only for Player 2. Matters change when C_t is composed of the same contract type, either *sting* or *wing,* and therefore, differences across contracts in C_t are less pronounced. We refer to periods characterized by an homogeneous contract choice set as "non-mixed". In this case, the *wing-sting* trade-off is not an issue, and principals and agents may fine-tune their contract decisions to their individual distributional tastes. In Appendix B we show that when we focus our attention to relative inequality and relative total cost of chosen contracts by Principals and Agents (compared with the other available options in C_t), individual social preferences matter, and in the expected direction: more inequality averse Principals and Agents choose, on average, contracts in which inequality is reduced. By the same token, more inequality averse Principals go for "more expensive" contracts (i.e. contracts in which Agents' benefits are higher).

Remark 4 Distributional preferences parameters estimated in P_1 account well for agents' and principals' and observed contract choices in P_2 and P_3.

This last remark could be interpreted as an indirect evidence on sorting: for both principals and agents, distributional concerns matter when it comes to decide which contract to offer and to choose. A more direct evidence on sorting would come from the direct inspection, in P_3, of how distributional parameters explain the matching process. In other words, to properly understand sorting we need to look at the extent to which principals and agents of similar distributional tastes tend to form matches.

To do this, we estimate the probability that a principal is "chosen" by an agent in each period as a (logit) function of the (euclidean) distance -in the (α_i, β_i) space- between agents' and principals estimated distributional preferences:

$$\Pr\left(agent\ i\ chooses\ principal\ j|\left(\alpha_i,\beta_i\right),\left(\alpha_j,\beta_j\right),\boldsymbol{D}_c\right)=\frac{\exp\left(\psi\sigma_{ij}+\boldsymbol{\gamma}'\boldsymbol{D}_c\right)}{1+\exp\left(\psi\sigma_{ij}+\boldsymbol{\gamma}'\boldsymbol{D}_c\right)},$$

where $\sigma_{ij}=\sqrt{\left(\alpha_i-\alpha_j\right)^2+\left(\beta_i-\beta_j\right)^2}$ and $\boldsymbol{D}_c$ is a full set of matching group dummies. We estimate the model using only those periods in which not all the principals offer the same contract to the pool of agents. The estimated coefficient ψ is -0.336, (bootstrap and cluster adjusted std. err. 0.099), for a $p-$value of 0.001. This evidence justifies the following

Remark 5 Agents are more likely to choose a contract offered by a principal with more similar distributional preferences to her own.

3.3 *Q*3. Does the social preference model work?

To answer this question, we use data from P_3 to check whether our structural model is able to explain (and predict out-of-sample) agents' effort choices in P_3.[17] Once we provide agents with parameters on tastes for distribution (estimated in P_1), and reciprocity and beliefs about their teammate's action in the effort game (estimated in P_2), we can fully characterize the agents' effort decision *at the individual level* in P_3.

Using the evidence from P_3, each cell of Table 6 reports *a)* relative frequencies of *actual* positive effort decisions, *b)* relative frequencies of *predicted* positive effort decisions and *c)* relative frequencies of instances in which actual and predicted behavior coincide. Predicted behavior is identified by subjects' effort decision which maximizes expected utility (3) in the effort game, subject to their estimated preference parameters $(\alpha_i, \beta_i, \theta_i)$ and their subjective beliefs, λ_i^k.

Table 6. Actual and predicted behavior in Stage 2 of Phase P_3

Overall (more details in Appendix B), the model seems to frame subjects' decisions accurately, which justifies the following

[17] Our behavioral model (3) clearly provides a suitable framework to predict *agents' effort decisions*. To also predict contract choices, it would be necessary to deal seriously with several additional problems. Three of those are particularly noteworthy. First, we would need to model agents' beliefs on the probability of teammates "misbehavior" in the contract decision (and, in consequence, principals' beliefs over those beliefs). Second, we would also need a robust model of competition among principals. And finally, we would have to deal with the incomplete information about agents' (and other competing principals) preferences.

Remark 6 Estimated preferences and beliefs predict about 80% of observed agents' effort decisions.

A more indirect, but still useful, way to check for the ability of the model to account for the subjects' behavior is to look at the robustness of estimates across alternative design specifications. In this respect, two features of our experimental design looked, ex ante, particularly likely to have affected our inferences from the data.[18]

1. *In our experiment, player position assignment is the outcome of an i.i.d. draw.* We did this to be able to obtain individual estimates of *both* distributional parameters, α and β. On the other hand, one might argue that, fixing player position across the entire experiment, may yield different estimates for distributional and reciprocity parameters.[19]

2. *Players were choosing their favorite contract before being acknowledged of the identity of the Dictator.* The reason why we used this procedure (also known as the *strategy method*) was to collect observations on contract decisions for all subjects and rounds (not only in cases where a particular subject turned out to be the Dictator). However, one might argue that when using this procedure, fairness can be achieved in two ways: either by playing the "fair" equilibrium in each single round, or by playing the "unfair" equilibrium in each round (letting the random Dictator role allocation provide overall fairness). Thus, the uncertainty of not knowing whether the agent decision was binding could change agents' behavior in different directions.[20]

For these reasons, in May 2007, we run three extra sessions (i.e. 6 additional independent observations) to investigate these issues. In these new sessions we made only two modifications of the original design:

(i) We fixed the player position throughout the experience (i.e. across all 72 rounds).

(ii) We made public the identity of the Dictator *before the contract choice* (i.e. we only have observations on contract decisions on behalf of Dictators).

In what follows, we shall denote by TR_1 (TR_2), evidence coming from the original (alternative) treatment conditions. Clearly, in P_1 of TR_2, we can only estimate one distributional parameter per subject, either α (Player 2) or β (Player 1). Figure 2 shows the distributions of α_i and β_i estimated in P_1 of TR_1 and TR_2.

[18] We thank two anonymous referees to point out these two possible drawbacks of our original design.

[19] For example, inequality might be perceived as less important for the the "richest" Player 1, since she never experiences a position at the lower end of the stick (or, by the same token, inequality may be perceived as more important by the less favored Player 2).

[20] For instance, it is possible that by fixing the role of the Dictator before the choice of the contract we would observe that agents choose less often "fair" contracts (or would have a less pronounced concern for reciprocity).

Figure 2. Comparison of the distribution of α_i and β_i in TR_1 and TR_2

As Figure 2 shows, social preference parameters display very similar distributions across treatments. For the empirical distributions depicted in Figure 2, the hypothesis of equality of the means is not rejected (with t-statistics equal to 0.24, and 1.07, respectively), and the Kolmogorov-Smirnov statistics do not reject the hypotheses of equality of the distributions (with KS statistics of 0.11 and 0.15, respectively).

By contrast, effort decisions in P_2 and P_3 appear to be sensitive to treatment conditions (see Table 5B in Appendix B). Average effort levels are higher in $TR1$, when subjects interchange player positions across rounds. This evidence points to a dynamic aspect of social preferences, which our static model cannot account for.

4 Conclusion

Our experimental results show that strategic uncertainty should be an important concern for those in charge of designing organizational incentives. In our context, where strategic uncertainty conflicts with social preferences in terms of their respective recommendations on contract design, the former seems to be the primary consideration. However, we also provide evidence showing that distributional preferences are a key determinant of contracts offered and accepted, on effort levels, as well as on how markets sort different attitudes towards distributional issues into different organizations.

Our experimental environment is certainly ad-hoc in some respects.[21] Nevertheless, our results are encouraging, because a parsimonious model of individual decision making is capable of organizing consistently the evidence from a complex experimental environment. The stability of social preferences (and beliefs) across quite different environments is a positive piece of news for the research program in interdependent preferences.[22]

We conclude by discussing three possible avenues for future research.

From a theoretical standpoint, it would be interesting to solve completely the mechanism design problem under incomplete information about the social preferences of the agent. From an empirical point of view, it would be interesting to observe the effect of having agents of different productivities, which are also private information. In this way we could see how finely and in which ways "corporate culture" partitions the agents. Also, notice that, in our setup, the numbers of principals and agents exactly balance one another. Thus, the

[21] Take, for example, our decision to give to only one agent the monopolistic power to decide the ruling contract for the entire team.

[22] It is true that the literature has already discussed the ability of different models to explain quite diverse data sets. But this discussion has been done by showing that the same distribution of parameters that explains behavior in one experiment also explains behavior in a different one. Our experiments provide a more definitive test, by following subjects' choices, and showing their consistency with social preferences, across rather different tasks.

effect of more intense competition on the side of either principals or agents is an empirically interesting extension.

Finally, we also would like to check the extent to which agents' decisions (and, consequently, the estimated distributional preferences which derive from these decisions) depend on whether the choice of the optimal contract is made *before* or *after* agents' are told about their player position in the game. If agents choose the contract before knowing their relative position within the team (i.e. "under the veil of ignorance"), their decisions may also reflect individuals' attitude to risk, as well as distributional considerations. This exercise would require to collect additional information about our experimental subjects on these two complementary dimensions, measuring how these dimensions interact in the solution of the decision problem facing them in the experiment.

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	EP $\alpha{=}\beta{=}0$	Q_1 $\alpha,\beta{>}0$	Q_2 $\alpha{>}0,\beta{<}0$	Q_3 $\alpha,\beta{<}0$	Q_4 $\alpha{<}0,\beta{>}0$
Agents	11 22.9%	8 16.7%	10 20.8%	6 12.5%	13 27.1%
Principals	3 12.5%	6 25%	6 25%	1 4.3%	8 33.3%
Total	14 19.4%	14 19.4%	10 22.2%	7 9.7%	21 29.2%

Table 1: Preference types of agents and principals

Beliefs $\left(\lambda_i^k\right)$		$Coeff.$	$Std.err.$	$p-value$
	ψ_1	0.196	0.508	0.700
	ψ_2	0.015	0.009	0.084
	ψ_3	-0.114	0.038	0.003
Reciprocity (θ_i)		$Coeff.$	$Std.err.$	$p-value$
	θ_1	-0.081	0.070	0.248
	θ_2	-0.072	0.087	0.409
	θ_3	0.093	0.059	0.118
	θ_4	0.058	0.114	0.611

Table 2: Estimated parameters of beliefs function and reciprocity. Bootstrap and matching group adjusted standard errors

	P_2	P_3
Player 1	0.98	0.89
Player 2	0.68	0.76
Principals		0.75

Table 3: Relative frequencies of the *Sting* choice in the "mixed" rounds

	P_2			
	wing (339)		*sting* (525)	
	Player 1	*Player 2*	*Player 1*	*Player 2*
Non Dictator	0.52	0.39	0.93	0.55
Dictator	0.49	0.47	0.92	0.69
Total	0.51	0.43	0.92	0.62
	P_3			
	wing (222)		*sting* (354)	
	Player 1	*Player 2*	*Player 1*	*Player 2*
Non Dictator	0.47	0.42	0.90	0.63
Dictator	0.42	0.44	0.92	0.64
Total	0.44	0.43	0.91	0.64

Table 4: Relative frequencies of positive effort decisions in P_2 and P_3. Number of cases for each player type in parenthesis

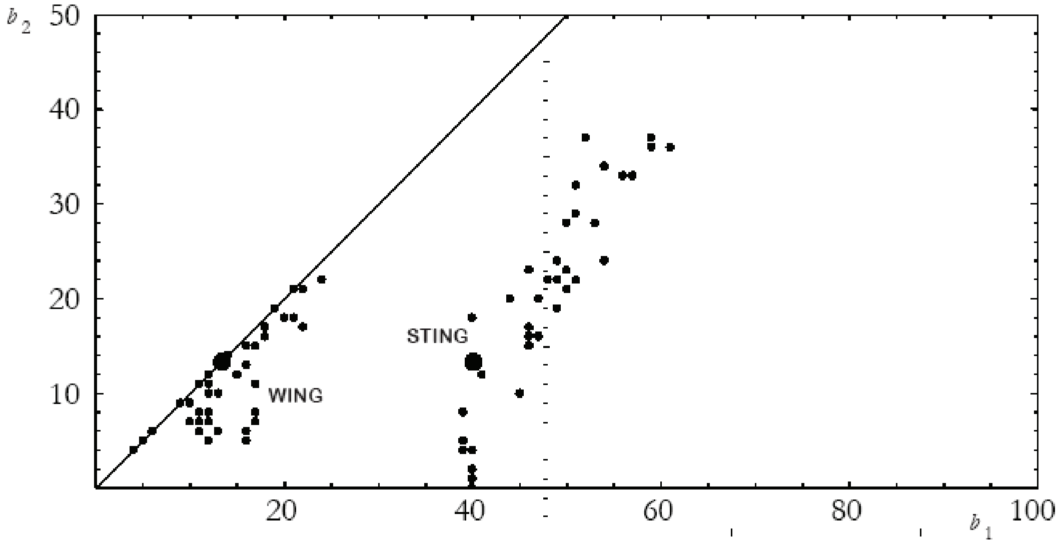

Fig. 1

	$P_2, wing$				$P_2, sting$			
	None	Pl. 1	Pl. 2	Both	None	Pl. 1	Pl. 2	Both
Rounds 1-12	44 26.2%	37 22%	24 14.3%	63 37.5%	10 3.8%	83 31.4%	8 3.0%	163 61.7%
Rounds 13-24	80 46.8%	31 18.1%	19 11.1%	41 24%	19 7.3%	90 34.5%	5 1.9%	147 56.3%
Total	124 36.6%	68 20.1%	43 12.7%	104 30.7%	29 5.5%	173 33%	13 2.5%	310 59.1%
	$P_3, wing$				$P_3, sting$			
	None	Pl. 1	Pl. 2	Both	None	Pl. 1	Pl. 2	Both
Rounds 1-12	35 30.7%	22 19.3%	15 13.2%	42 36.8%	6 3.5%	46 26.4%	7 4.0%	115 66.1%
Rounds 13-24	59 54.6%	10 9.3%	15 13.9%	24 22.2%	17 9.4%	60 33.3%	2 1.1%	101 56.1%
Total	94 42.3%	32 14.4%	30 13.5%	66 29.7%	23 6.5%	106 29.9%	9 2.5%	216 61.0%

Table 5: Outcome dynamics in the effort game. Absolute values and row percentages

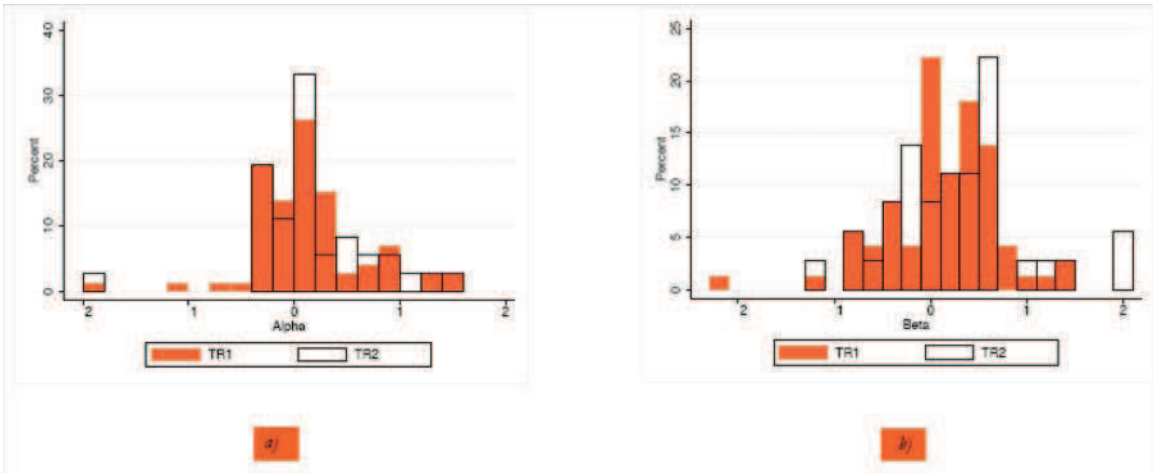

Fig. 2

	i is Player 1									
	wing contracts					*sting* contracts				
	$\phi_j = -1$ (20)	$\phi_j = 0$ (202)	$\phi_i = -1$ (23)	$\phi_i = 0$ (199)	*Total* (222)	$\phi_j = -1$ (70)	$\phi_j = 0$ (284)	$\phi_i = -1$ (64)	$\phi_i = 0$ (290)	*Total* (354)
	.15	.51	.14	.52	.47	.8	.92	.81	.91	.9
No Ditctator.	.23	.43	.14	.45	.41	.9	.95	.88	.95	.94
	.62	.83	.71	.82	.8	.7	.87	.7	.87	.84
	.14	.44	.22	.44	.42	.9	.93	.89	.93	.92
Dictator	.0	.38	.11	.38	.36	.83	.88	.84	.88	.87
	.86	.68	.89	.67	.7	.78	.82	.79	.82	.81
	.15	.47	.17	.47	.44	.86	.92	.86	.92	.91
Total	.15	.4	.13	.4	.38	.86	.92	.86	.91	.9
	.7	.74	.78	.73	.74	.74	.85	.75	.84	.82

	i is Player 2									
	wing contracts					*sting* contracts				
	$\phi_j = -1$ (23)	$\phi_j = 0$ (199)	$\phi_i = -1$ (20)	$\phi_i = 0$ (202)	*Total* (222)	$\phi_j = -1$ (64)	$\phi_j = 0$ (290)	$\phi_i = -1$ (70)	$\phi_i = 0$ (284)	*Total* (354)
	0	.46	0	.45	.42	.37	.7	.4	.7	.63
No Dictator.	.11	.38	0	.38	.35	.47	.69	.48	.7	.65
	.89	.71	1	.7	.71	.84	.77	.83	.77	.78
	.29	.47	.15	.49	.45	.35	.69	.4	.7	.64
Dictator	.07	.44	0	.44	.39	.35	.6	.43	.6	.56
	.79	.76	.85	.75	.77	.85	.75	.77	.77	.77
	.17	.46	.1	.47	.43	.36	.7	.4	.7	.64
Total	.09	.4	0	.41	.37	.42	.65	.46	.64	.61
	.83	.72	.9	.72	.74	.84	.76	.8	.77	.77

Table 6: Actual and predicted behavior in Stage 2 of P_3. For each case we report relative frequencies of actual positive effort decisions, relative frequencies of predicted positive effort decisions, and the fraction of cases for which actual and predicted effort behavior coincides. Number of cases in parenthesis.

Social Preferences and Strategic Uncertainty: an Experiment on Markets and Contracts
Appendix A: The Mechanism Design Problem

NOT FOR PUBLICATION

1 Two mechanism design problems

1.1 Production technology

Technology closely follows Winter's (2004) model of moral hazard in teams. Let $G(b)$ define the game-form associated with a given benefit profile, $b = (b_1, b_2)$. The rules rules of the game-form are the following. Each agent $i = 1, 2$, has to decide, simultaneously and independently, whether to make a costly effort. We denote by $\delta_i \in \{0, 1\}$ agent i 's effort decision, where $\delta_i = 1(0)$ if agent i does (does not) make effort. Let also $\delta = (\delta_1, \delta_2) \in \{0, 1\}^2$ denote the agents' action profile. The cost of effort c is assumed to be constant across agents. Team activity results in either success or failure. Let $P(\delta)$ define production as the probability of success as a function of the number of agents in the team who have put effort:

$$P(\delta) = \begin{cases} 0 \text{ if } \delta_1 + \delta_2 = 0, \\ \gamma \text{ if } \delta_1 + \delta_2 = 1, \\ 1 \text{ if } \delta_1 + \delta_2 = 2, \end{cases} \tag{1}$$

with $\gamma \in (0, \frac{1}{2})$.[1]

If the project fails, then all (principal and agents) receive a payoff of zero. If the project succeeds, then agent i receives a *benefit*, $b_i^k > 0$. Agent i's expected monetary profit associated to contract k is given by

$$\pi_i^k(\delta) = P(\delta)b_i^k - \delta_i c. \tag{2}$$

The expected monetary payoff for the principal is the difference between expected revenues, for a given (randomly generated) value for the project $V \sim U[A, B]$, and expected costs:

$$\pi_0^k(\delta) = P(\delta)(V - b_1^k - b_2^k).$$

[1] This is how Winter (2004) models moral hazard: agents' effort affect the overall probability of success of the project. However, since risk neutrality is assumed on agents' behalf, the fact that technology follows a random -as opposed to deterministic, as in our design- process has no impact in the solution of the mechanism design problem.

Assume a principal who wishes to design a mechanism that induces all agents to exert effort in (some) equilibrium of the game induced by $G(b)$, which we denote by $\Gamma(b)$. A mechanism is an allocation of benefits in case of success, i.e., a vector b that satisfies this property at the minimal cost for the principal. Following Winter (2004), the principal may consider mechanisms that *strongly* or *weakly* implement the desired solution, depending of how concerned he is about equilibrium multiplicity. More precisely:

Definition 1 (*sting* contracts) *The contract b is strongly effort-inducing (sting) if all Nash Equilibria (NE) of $\Gamma(b)$ entail effort by all agents with minimal benefit distribution, $b_1 + b_2$.*

Definition 2 (wing contracts) *The contract b is weakly effort-inducing (wing) if there exists at least one NE of $\Gamma(b)$ such that $\delta = (1, 1)$, with minimal benefit distribution.*

2 The solutions

By analogy with our experimental conditions (and without loss of generality), we assume $b_1 \geq b_2$. In what follows, we shall assume that both agents hold either EP (as in Winter, 2004), or IAP, SSP and ESP, respectively. We allow for heterogeneous preferences, provided they belong to the same preference class.

2.1 Solution of the mechanism design problem under the *wing* program

In the case of *wing*, the search of the optimal mechanism corresponds to the following linear program:

$$b^* \equiv (b_1^*, b_2^*) \in \arg \min_{\{b_1, b_2\}} [b_1 + b_2] \text{ sub} \tag{3}$$

$$u_1(1,1) \geq u_1(0,1) \tag{4}$$

$$u_2(1,1) \geq u_2(1,0) \tag{5}$$

$$b_1 \geq b_2 \geq 0 \tag{6}$$

Assumption (6) is wlog. To solve the problem (3)-(6), we begin by partitioning the benefit space $B = \left\{(b_1, b_2) \in \Re_+^2, b_1 \geq b_2\right\}$ in two regions, which specify the payoff ranking of each strategy profiles in $G(b)$. This partition is relevant for our problem, since it determines whether in (1,0) - player 1 exerts effort and player 2 does not - whether it is player 1 or 2 the one who experiences envy (guilt):

$$\begin{aligned} R_1 &= \left\{ b \in B : b_2 \leq b_1 - \frac{c}{\gamma} \right\}; \\ R_2 &= \left\{ b \in B : b_1 - \frac{c}{\gamma} \leq b_2 \leq b_1 \right\}. \end{aligned}$$

Let $g^1(b_1) = b_1 \left(g^2(b_1) = b_1 - \frac{c}{\gamma}\right)$ define the two linear constraints upon which our partition is built. The strategy proof is as follows. We shall solve the linear program (3)-(6) in the two regions independently (since, within each region, social utility parameters are constant for each agent and strategy profile), checking which of the two solutions minimizes the overall benefit sum $b_1 + b_2$, and determining the constraints on preferences which determine the identity of the best-paid player 1.

2.1.1 *Wing* under EP

As for the solution of *wing* under EP (i.e. with $\alpha_1 = \alpha_2 = \beta_1 = \beta_2 = 0$), the linear program (3)-(6) simplifies to the following:

$$\min b_1 + b_2$$

subject to:

$$\begin{aligned} b_1 - c &\geq \gamma b_1 \\ b_2 - c &\geq \gamma b_2 \\ b_i &\geq 0; \quad \text{with } i = 1, 2 \end{aligned}$$

In this case, the solution of the problem is problem is trivial:

$$b_1^* = b_2^* = \frac{c}{1-\gamma}.$$

2.1.2 *Wing* under IAP

As for the solution of *wing* under IAP, we need to add to the basic linear program (3)-(6) the IAP constraint.

Proposition 3 (winiIAP) *The optimal wing mechanism under IAP is as follows:*

$$b_1^* = \left(\begin{array}{c} \frac{c(-1+\alpha_2(-1+\beta_1)+2\beta_1+\gamma(-1+2\beta_1)(-1+\beta_2)-\beta_1\beta_2}{(-1+\gamma)(1+\alpha_2-\beta_1+\gamma(-1+\beta_1+\beta_2)}, \\ \frac{c(-1+\beta_1)(-1+\alpha_2-\beta_2+\gamma(-1+2\beta_2))}{(-1+\gamma)(1+\alpha_2-\beta_1+\gamma(-1+\beta_1+\beta_2)} \end{array} \right) \ \mathit{if}\ \beta_1 < \frac{1}{2}; \tag{7}$$

$$b_2^* = \left(\frac{c(1-\beta_1)}{1-\gamma}, \frac{c(1-\beta_1)}{1-\gamma} \right) \ \mathit{if}\ \beta_1 \geq \frac{1}{2}, \tag{8}$$

with $\beta_1 \leq \beta_2$.

To prove Proposition 3, some preliminary lemmas are required. Let $\hat{b}^k \equiv (\hat{b}_1^k, \hat{b}_2^k)$ define the solution of the linear program (3-6) in R_k.

Lemma 4

$$\hat{b}^1 = \left(\frac{c(1+\alpha_2)}{(1-\gamma)\gamma}, \frac{c(\gamma+\alpha_2)}{(1-\gamma)\gamma} \right) \tag{9}$$

.

Proof. In R_1, agent 1's monetary payoff, as determined by $G(b)$, is always higher (i.e. $\pi_1(\delta) \geq \pi_2(\delta)$, $\forall \delta$). This, in turn, implies that constraints (4)-(5) correspond to

$$b_1 \geq f_1^1(b_1) \equiv \frac{c(1-\beta_1)}{(1-\gamma)\beta_1} - \frac{1-\beta_1}{\beta_1} b_1; \tag{10}$$

$$b_2 \geq f_2^1(b_1) \equiv \frac{c}{1-\gamma} + \frac{\alpha_2}{1+\alpha_2} b_1. \tag{11}$$

Let x_i^k define the value of b_1 such that $f_i^k(b_1) = 0$. By the same token, let y_i^k denote the intercept of $f_i^k(b_1)$, i.e. $f_i^k(0)$. Finally, let τ_i^k denote the slope of $f_i^k(b_1)$. We then have $x_1^1 = \frac{c}{1-\gamma}$ and $x_2^1 = -\frac{c(1+\alpha_2)}{(1-\gamma)\alpha_2}$. Also notice that $0 \leq \tau_2^1 = \frac{\alpha_2}{1+\alpha_2} < 1$ and $y_2^1 = \frac{c}{1-\gamma} > 0$. This implies that $f_2^1(b_1)$ and $g^2(b_1)$ intersect in the first quadrant of the $b_1 \times b_2$ space. On the other hand, $f_1^1(b_1)$ is never binding in this case, since $\tau_1^1 = -\frac{1-\beta_1}{\beta_1} < 0$ and $x_1^1 = \frac{c}{1-\gamma} < \frac{c}{\gamma}$ since $\gamma < \frac{1}{2}$. This implies that $b_1 + b_2$ is minimized where $f_2^1(b_1)$ and $g^2(b_1)$ intersect, i.e. when $\hat{b}_1^1 = \frac{c(1+\alpha_2)}{(1-\gamma)\gamma}$ and $\hat{b}_2^1 = \frac{c(\gamma+\alpha_2)}{(1-\gamma)\gamma}$. ■

Lemma 5 *In R_2, the optimal wing contract under IAP is (7) when $\beta_1 < \frac{1}{2}$, and (8) when $\beta_1 \geq \frac{1}{2}$, with $\beta_1 < \beta_2$.*

Proof. In the case of R_2, constraints (4)-(5) correspond to

$$b_1 \geq f_1^2(b_1) \equiv \frac{c(1-\beta_1)}{(1-\gamma)\beta_1} - \frac{1-\beta_1}{\beta_1} b_1; \tag{12}$$

$$b_2 \geq f_2^2(b_1) \equiv \frac{c(1-\beta_2)}{1+\alpha_2-\gamma(1-\beta_2)} + \frac{\alpha_2+\gamma\beta_2}{1+\alpha_2-\gamma(1-\beta_2)} b_1. \tag{13}$$

This implies that $f_1^1(b_1) = f_1^2(b_1)$ (i.e. the Nash equilibrium condition for player 1 remains unchanged in both R_1 and R_2), $\tau_1^2 = -\frac{1-\beta_1}{\beta_1} < 0$ (i.e. $|\tau_1^2| > 1$ if $\beta_1 < \frac{1}{2}$), and $0 \leq \tau_2^2 = \frac{\alpha_2+\gamma\beta_2}{1+\alpha_2-\gamma(1-\beta_2)} < 1$.

We first show that $\beta_1 \leq \beta_2$. Let $\breve{\beta} = \min\{\beta_1, \beta_2\}$. If $\beta_1 > \beta_2$, then the optimal solution in R_2 would be $\hat{b}_i^1 = \hat{b}_i^2 = \frac{c(1-\breve{\beta})}{1-\gamma}$ (i.e. $\hat{b}_i^1 + \hat{b}_i^2 = 2\frac{c(1-\breve{\beta})}{1-\gamma}$). On the other hand, if $\beta_1 \leq \beta_2$, then $\hat{b}_i^1 + \hat{b}_i^2 \leq 2\frac{c(1-\breve{\beta})}{1-\gamma}$. More precisely, if $\beta_1 < \frac{1}{2}$, the optimal solution is (7), that is, the intersection between $f_1^2(b_1)$ and $f_2^2(b_1)$; if $\beta_1 \geq \frac{1}{2}$, the solution is (8), that is, the intersection between $f_1^2(b_1)$ and $g^1(b_1)$. ■

We are in the position to prove Proposition 3.

Proof. [Proof of Proposition 1]. To prove the proposition, it is sufficient to show that $\hat{b}_i^1 > \hat{b}_i^2, i = 1, 2$. To see this, remember that $f_1^1(b_1) = f_1^2(b_1)$. Also remember that $f_1^k(b_1)$ is (not) binding for both $k = 1$ and $k = 2$. If x_i^{kl} solves $f_1^k(x) = g^l(x)$, then $x_2^{12} = x_2^{22} = \frac{c(1+\alpha_2)}{\gamma(1-\gamma)}$, which, in turn, implies

$$\hat{b}_1^1 = \frac{c(1+\alpha_2)}{\gamma(1-\gamma)} > x_1^{21} = \frac{c(1-\beta_1)}{1-\gamma} \geq \hat{b}_1^2 \text{ and}$$

$$\hat{b}_2^1 = \frac{c(\gamma+\alpha_2)}{\gamma(1-\gamma)} > x_1^{21} = \frac{c(1-\beta_1)}{1-\gamma} \geq \hat{b}_2^2.$$

■

2.1.3 *Wing* with SSP

As for the solution of *wing* under SSP, we need to add to the basic linear program (3)-(6) the SSP constraint.

Proposition 6 (winiSSP) *The optimal wing mechanism under SSP is (7), with* $\beta_1 \leq \beta_2$*.*

Proof. We begin by showing that, as in the case of IAP, the optimal *wing* contract in R_1 is (9). This is because, also in this case, $f_1^1(b_1)$ is not binding, since $\tau_1^1 = -\frac{1-\beta_1}{\beta_1} > 1$ and $x_1^1 = \frac{c}{1-\gamma} < \frac{c}{\gamma}$.

On the other hand, the optimal *wing* contract in R_2 is (7), independently of the value of β_1. This is because, given $-1 < \gamma_i < 0$, both τ_1^2 and τ_2^2 are positive. Since $\tau_1^2 = -\frac{1-\beta_1}{\beta_1}$; $\left|\tau_1^2\right| > 1$ (i.e., as before, $f_1^2(b_1)$ and $f_2^2(b_1)$ intersect in the first quadrant. Also notice that, given $\beta_i < 0, i = 1, 2$, $y_1^2 = \frac{c(-1+\beta_1)}{(1-\gamma)\beta_1} < 0$. Two are the relevant cases:

1. If $\beta_1 > \beta_2$, then $f_1^2(b_1)$ and $f_2^2(b_1)$ intersect outside R_2, and the optimal solution would be $b_1 = b_2 = \frac{c(1-\breve{\beta})}{(1-\gamma)}$.
2. If $\beta_1 < \beta_2$, then the solution is (7) which overall cost is never greater than $\frac{2c1-\breve{\beta})}{(1-\gamma)}$.

We complete the proof by noticing, by analogy with the Proof of Proposition 3, that the optimal solution lies in R_2, rather than in R_1. ■

2.1.4 *Wing* with ESP

In the case of *wing* with ESP, we need to add to the basic linear program (3)-(6) the ESP constraint.

Proposition 7 (winiESP) *The optimal wing mechanism under ESP is (7), with* $\beta_1 \leq \beta_2$*.*

Proof. We begin by showing that here the optimal *wing* contract in R_1 is (9) if $|\alpha_2| < \gamma$ and $\hat{b}^1 = \left\{\frac{c}{\gamma}, 0\right\}$ if $\beta_2 \geq \gamma$. This is because, like in the previous cases, $f_1^1(b_1)$ is never binding, since $x_1^1 = \frac{c}{1-\gamma} < \frac{c}{\gamma}$ and $\tau_1^1 = -\frac{1-\beta_1}{\beta_1} < 0$. On the other hand, given that $x_2^1 = -\frac{c(1+\alpha_2)}{\alpha_2(1-\gamma)}$ and $0 \leq \tau_2^1 \leq \frac{1}{2}$, $f_2^1(b_1)$ is binding if and only if $|\alpha_2| < \gamma$ (i.e. if $x_2^1 > \frac{c}{\gamma}$).

As for R_2, we begin to notice that $\tau_1^2 = -\frac{1-\beta_1}{\beta_1} \geq -1$ (since $|\beta_1| < \frac{1}{2}$) and that $0 \leq \tau_2^2 = \frac{\alpha_2+\gamma\beta_2}{1+\alpha_2\grave{a}\gamma(1-\beta_2)} < 1$. This implies, like before, that $f_1^2(b_1)$ and $f_2^2(b_1)$ intersect in the first quadrant. The rest of the proof is identical of that of Proposition 6. ■

2.2 Solution of the mechanism design problem under the *sting* program

In the case of *sting*, the search of the optimal mechanism corresponds to the *wing* linear program (3)-(6) with an additional constraint (implementation with a unique equilibrium):

$$u_1(1,0) \geq u_1(0,0). \tag{14}$$

The constraint (14) makes, on behalf of player 1, the choice of putting effort a weakly dominant strategy.

2.2.1 *Sting* under EP

The solution of *sting* under EP is as follows (see Winter, 2004):

$$\begin{array}{l} b_1^* = \frac{c}{\gamma}, \\ b_2^* = \frac{c}{1-\gamma}. \end{array}$$

2.2.2 *Sting* under IAP

Proposition 8 *The optimal sting mechanism under IAP is*

$$\begin{cases} b_1^* = \frac{c((1+\alpha_1)(1+\alpha_2)-\gamma(1-\beta_2))}{\gamma(1+\alpha_1+\alpha_2-\gamma(1+\alpha_1-\beta_2))}, \\ b_2^* = \frac{c(1+\alpha_1)(\gamma+\alpha_2)}{\gamma(1+\alpha_1+\alpha_2-\gamma(1+\alpha_1-\beta_2))}. \end{cases} \tag{15}$$

To prove Proposition 8, we follow the same strategy as before.

Lemma 9 $\hat{b}^1 = \left(\frac{c(1+\alpha_2)}{(1-\gamma)\gamma}, \frac{c(\gamma+\alpha_2)}{(1-\gamma)\gamma}\right)$.

Proof. In R_1, the constraints for agent 1 and 2 correspond to:

$$b_1 \geq f_1^1(b_1) \quad \equiv \quad \frac{c(1-\beta_1)}{(1-\gamma)\beta_1} - \frac{1-\beta_1}{\beta_1} b_1, \tag{16}$$

$$b_1 \geq f_3^1(b_1) \quad \equiv \quad \frac{c(1-\beta_1)}{\gamma(1-\gamma)\beta_1} - \frac{1-\beta_1}{\beta_1} b_1, \tag{17}$$

$$b_2 \geq f_2^1(b_1) \quad \equiv \quad \frac{c}{1-\gamma} + \frac{\alpha_2}{1+\alpha_2} b_1, \tag{18}$$

Let x_i^{kl} solves $f_1^k(x) = g^l(x)$. We first notice that (16) is not binding. This is because (16) defines a constraint which is parallel to (17), but with a smaller intercept ($y_1^1 < y_3^1$, since $\gamma < 1$). Also notice that, in this case, (17) is not binding either. This is because, $\tau_3^1 < 0$, $\tau_2^1 > 0$, and $x_3^{12} {=} \frac{c(1-\gamma\beta_1)}{\gamma(1-\gamma)} < x_2^{12} {=} \frac{c(1+\alpha_2)}{\gamma(1-\gamma)}$.

This implies that, in R_1, $(b_1 + b_2)$ is minimized (like in *wing*) where $f_2^1(b_1)$ and $g^2(b_1)$ intersect, i.e. when $\hat{b}_1^1 = \frac{c(1+\alpha_2)}{(1-\gamma)\gamma}$ and $\hat{b}_2^1 = \frac{c(\gamma+\alpha_2)}{(1-\gamma)\gamma}$. ■

Lemma 10 *The optimal sting contract in R_2 is (15).*

Proof. R_2, the relevant constraints are as follows:

$$b_1 \geq f_1^2(b_1) \equiv \frac{c(1-\beta_1)}{(1-\gamma)\beta_1} - \frac{1-\beta_1}{\beta_1} b_1 \tag{19}$$

$$b_1 \geq f_3^2(b_1) \equiv -\frac{c(1+\alpha_1)}{\gamma\alpha_1} + \frac{1+\alpha_1}{\alpha_1} b_1 \tag{20}$$

$$b_2 \geq f_2^2(b_1) \equiv \frac{c(1-\beta_2)}{1+\alpha_2-\gamma(1-\beta_2)} - \frac{\alpha_2+\gamma\beta_2}{1+\alpha_2-\gamma(1-\beta_2)} b_1. \tag{21}$$

Notice that, by analogy with R_1, condition (19) is not binding since $\tau_1^2 < 0$, $\tau_3^2 > 0$ and $x_1^1 = \frac{c}{1-\gamma} < x_3^3 = \frac{c}{\gamma}$. Also notice that $0 < x_2^{21} = \frac{c(1-\beta_2)}{1-\gamma} < x_3^{21} = \frac{c(1+\alpha_1)}{\gamma}$ and $x_2^{22} = \frac{c(1+\alpha_2)}{\alpha(1-\gamma)} > x_3^{22} = \frac{c}{\gamma}$. This, in turn, implies that, $f_3^2(b_1)$ and $f_2^2(b_1)$ always intersect in the interior of R_2, which implies the solution.[2] ■

We are in the position to prove Proposition 8.

Proof. To close the proposition, it is sufficient to show that $\hat{b}_i^1 \geq \hat{b}_i^2, i = 1, 2$. To see this, notice that $x_2^{12} = x_2^{22} = \frac{c(1+\alpha_2)}{\gamma(1-\gamma)}$ (i.e. $f_2^2(b_1)$ and $f_2^2(b_1)$ cross exactly at the intersection with $g^2(b_1)$). Since $\tau_2^2 = \frac{\alpha_2+\gamma\beta_2}{1+\alpha_2-\gamma(1-\beta_2)} > 0$ and $\hat{b}^2$ is interior to R_2, the result follows. ■

2.2.3 *Sting* under SSP

Proposition 11 *The optimal sting mechanism under SSP is (15).*

Proof. By analogy with the IAP case, in R_1, (16) is not binding. Also notice that $\tau_3^1 = -\frac{1-\beta_1}{\beta_1} > \tau_2^1 = \frac{\alpha_2}{1+a_2} > 0$. Two are the relevant cases:

1. if $\alpha_2 \geq -\gamma\beta_1$,(i.e. if $x_3^{12} = \frac{c(1-\gamma\beta_1)}{\gamma(1-\gamma)} \leq x_2^{12} = \frac{c(1+\alpha_2)}{\gamma(1-\gamma)}$), then (20) is not binding, and the optimal solution is the intersection between $f_2^1(b_1)$ and $g_3(b_1)$, that is, $\hat{b}^1 = \left(\frac{c(1+\alpha_2)}{\gamma(1-\gamma)}, \frac{c(\gamma+\alpha_2)}{\gamma(1-\gamma)}\right)$;
2. if $\alpha_2 < -\gamma\beta_1$, then the optimal solution is the intersection between $f_2^1(b_1)$ and $f_3^1(b_1)$, that is, .

$$\hat{b}^1 = \left(\frac{c(1+\alpha_2)(1-\beta_1(1+\gamma))}{\gamma(1-\gamma)(1+\alpha_2-\beta_1)}, \frac{c(\alpha_2+\gamma(1+\alpha_2))(1-\beta_1)}{\gamma(1-\gamma)(1+\alpha_2-\beta_1)}\right).$$

As for R_2, the optimal *sting* contract is, again, (15). This is because, by analogy with the IAP case, conditions (19) and $g^2(b_1)$ are not binding. Also notice that $x_2^{22} = \frac{c(1+\gamma_2)}{\gamma(1-\gamma)} > 0$ and $0 \leq \tau_2^2 = \frac{\alpha_2+\gamma\beta_2}{1+\alpha_2-\gamma(1-\beta_2)} < 1$. This, in turn, implies that, in $R_2, (b_1 + b_2)$ is minimized where $f_3^2(b_1)$ and $f_2^2(b_1)$ intersect, which implies the solution. ■

[2] As it turns out, unlike the *wini* case, the search for the appropriate conditions on preferences to identify player 1 has no (algebraically manageable) closed-form solution, but it has to be evaluated numerically (as we did in the calibration of our experimental conditions).

2.2.4 *Sting* under ESP

Proposition 12 *The optimal sting mechanism under ESP is (15).*

Proof. By analogy with the previous cases, in R_1, (16) is not binding. Also notice that, in this case, (19) is not binding either, since $\tau_2^1 < 0$ and $x_2^{12} = \frac{c(1+a_2)}{\gamma(1-\gamma)} < \frac{c}{\gamma}$. Since ESP imply $\gamma_1 \leq \frac{1}{2}$, the unique solution in this case is $\hat{b}^1 = \left(\frac{c}{\gamma(1-\gamma)}, 0\right)$. As for R_2, we first notice that, given that $|\beta_1| \leq \frac{1}{2}, \tau_3^2 > 1$. Since ESP also imply $|\alpha_2| < \gamma$ (i.e. $x_2^2 > \frac{c}{\gamma}$), then the optimal solution is the intersection between $f_2^1(b_1)$ and $g_3(b_1)$, that is, (15). ■

Social Preferences and Strategic Uncertainty: an Experiment on Markets and Contracts
Appendix B: Additional Experimental Evidence

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1 Distribution of the social preference parameters α and β.

In Figure 1 we plot the estimated α_i and β_i of each member of our subject pool.

Figure 1. Estimating individual social preferences

Figure 1 is composed of two graphs:

1. In Figure 1*a)* each subject corresponds to a point in the (α_i, β_i) space, where we highlight the regions corresponding to the taxonomy. As Figure 1*a)* makes clear, our subjects display significant heterogeneity in their distributional preferences. Moreover, in many cases, the constraints on absolute values (in particular, in the case of IAP) are violated. This is the reason why, in what follows, we shall refer to the corresponding quadrant in Figure 1*a)* to identify each distributional preference type. In this respect, the majority of subjects falls in the first quadrant (i.e. in the IAP case), followed by SSP and ESP. Finally, 10% of agents in our subject pool display both α_i and β_i negative (a case not covered by the theoretical literature on these matters).

2. Figure 1*b)* reports, together with each estimated (α_i, β_i) pair (as in Figure 1a), the corresponding 95% confidence intervals associated to each individual estimated parameter. As Figure 1*b*) shows, we have now many subjects whose estimated distributional preferences fall, with nonnegligible probability, in more than one region. Moreover, for some of them (about 20% of our subject pool), we cannot reject (at the 5% confidence level) the null hypothesis of egoistic preferences.

2 Reciprocity and contract choice

Table 1 reports the relative frequencies of positive effort decisions in P_2, conditional on subjects' behavior in Stage 1.

Table 1. Relative frequencies of positive effort decisions in P_2

Table 1 shows that in about 35% $(= (118 + 181) / (339 + 525))$ of the cases the contracts chosen by Player 1 are less favorable to Player 2 than the one actually chosen by Player 2, that is in 35% of the cases Player 1 misbehaves ($\phi_i = -1$). This percentage is almost constant across contract types. On the other side, Player 1 observes her teammate to misbehave ($\phi_j = -1$) in 30% (=193/339) of the cases if the played plan is a *wing* and in 38% (=202/525) of the cases if it is a *sting*. Actions following misbehavior are heterogeneous: in a *wing* plan i's effort following j's misbehavior is typically lower than after correct behavior.[1] In a *sting* contract, however, only the non Dictator Player 2 effort is significantly lower after j's misbehavior. In Table 1 we also track i's willingness to make effort *following their own (mis)behavior*, ϕ_i. Also in this case, misbehavior yields lower effort profiles with the *wing* plans and - as before - with the *sting* plans a reaction appears only for Player 2 when she is not the Dictator.

It would be wrong to draw immediate conclusions from the descriptive statistics in the previous paragraph. In table 1 differences in effort are only related to misbehavior, but this does not control for other factors -such as absolute and relative payoffs of the contract being played, or the contingent choice set available in the particular round, C_t. A more comprehensive analysis can only be done by estimating a model in which we can control for all those factors (and their subtle interplay).

3 Determinants of *sting/wing* choice

We construct a measure of inequality associated to each contract $\overline{k}$ in C_t, which measures the relative inequality induced by contract $\overline{k}$, in comparison with the other available options in C_t :

$$\sigma_{\overline{k}} = \frac{\left(b_1^{\overline{k}} - b_2^{\overline{k}}\right) - \min_k \left[b_1^k - b_2^k\right]}{\max_k \left[b_1^k - b_2^k\right] - \min_k \left[b_1^k - b_2^k\right]}, k = 1, ..., 4. \tag{1}$$

By (1), $\sigma_{\overline{k}} \in [0, 1]$, i.e. we normalize the inequality each contract implies with respect to the choice set C_t. We thus define $\omega_t = \frac{\sum_{k \in wing} \sigma_k}{\sum_{k \in sting} \sigma_k}$ as a "relative inequality index" associated with the choice of *wing* vs. a *sting* contract in C_t.We are now in the position to estimate the following logit function:

$$\Pr\left(k_{it} \in sting | \alpha_i, \beta_i, \omega_t\right) = \frac{\exp\left(\psi_0 + \psi_1\alpha_i + \psi_2\beta_i + \psi_3\omega_t\right)}{1 + \exp\left(\psi_0 + \psi_1\alpha_i + \psi_2\beta_i + \psi_3\omega_t\right)},$$

where k_{it} identifies the contract choice of individual i at round t. For Players 2 (Principals), we use observations from P_2 (P_3).[2] We do so to frame the contract choice problem over the same choice sets, C_t, since in P_3 agents' choice sets are determined by principals' decisions. In Table 2 we report the partial maximum likelihood estimates of ψ_1 to ψ_3 with bootstrap standard errors.

[1] Formal tests of mean equality conditional on player position always reject the null at $\alpha = 5\%$.

[2] Player 1 chose wing in P_2 only 7 times out of 288, so that the predicted probability is basically one.

Table 2. S*ting vs. wing* choice in the "mixed" rounds, logit regression

Notice that:

1. Estimated ψ_3 are always positive and significant: the more unequal is the *wing* choice the more likely is the choice of a *sting* contract, whatever the player role: on average, a 1% increase of the relative inequality index ω_t induces an increase of the 29% of the probability of choosing *sting* for Player 2, and of 14% for the principals in P_3. These results are maintained (both in sign and magnitude) if we use a fixed-effects logit model.

2. For principals, distributional parameters are not significant to explain the choice of contract type, while for Players 2 in P_2, both α and β are significant, with opposite sign.

4 Distributional Preferences and contract choice

We look at how principals' and agents' estimated preferences explain their contract decision, with respect to the two dimensions which are more natural for the problem at stake: *a)* the total cost of the contract ($b_1 + b_2$) and, *b)* its induced inequality ($b_1 - b_2$). By analogy with $\sigma_{\overline{k}}$, we define, for each choice set C_t, the following two variables:

$$\begin{aligned}
\tau_{\overline{k}} &= \frac{\left(b_1^{\overline{k}} + b_2^{\overline{k}}\right) - \min_k \left[b_1^k + b_2^k\right]}{\max_k \left[b_1^k + b_2^k\right] - \min_k \left[b_1^k + b_2^k\right]}, \overline{k} = 1, ..., 4, \text{ and} \qquad (2) \\
\rho_{\overline{k}} &= \frac{1 + \sigma_{\overline{k}}}{1 + \tau_{\overline{k}}}.
\end{aligned}$$

We interpret τ, as a measure of *relative efficiency* (or relative cost, from the principal's viewpoint). Consequently, $\rho_{\overline{k}}$ proxies the trade-off agents (principals) face between inequality and efficiency (total costs).

We study principals' contract decisions by regressing $\rho_{\overline{k}}$ and $\tau_{\overline{k}}$ in P_3, against subjects' distributional parameters, α_i and β_i. Given that, in both cases, the dependent variable is bounded both from above and from below (with upper and lower limits which are period dependent), we estimate the equations using a double censored tobit model:

$$y_{it} = \psi_1 \alpha_i + \psi_2 \beta_i + \psi_3 V_{it} + \psi_4' \boldsymbol{D}_t + v_{it}, \qquad (3)$$

where the dependent variable y_{it} refers, alternatively, to the corresponding $\rho_{\overline{k}}$ and $\tau_{\overline{k}}$ induced by the contract choice $\overline{k}$ made by individual i at time t, V_{it} is the randomly generated value for the principal, and $\boldsymbol{D}_t$ is a full set of period dummy variables. In Table 3 we report the partial maximum likelihood estimates of the parameters with bootstrap and cluster adjusted standard errors. We estimate the parameters separating the periods in which the contract menu includes both *sting* and *wing* contracts ("mixed" periods) from the others ("non mixed").

Table 3. Relative cost choice (τ) and inequality-total costs trade-off (ρ) for principals in P_3

First notice that Principals opt for the most expensive contract available more than 50% of the cases (the latter corresponds to the right-censored observations), and more that 2/3 of the cases in the non-mixed periods. By contrast, less than 10% go for the cheapest one. We explain this evidence by the effects of competitions among principals, and the fear of having their offered contract not chosen by any agent. Consistently with the evidence of Table 2, also notice that, in the mixed periods, principals' distributional parameters are only marginally significant in explaining the choice of $\rho_{\overline{k}}$ and $\tau_{\overline{k}}$: this is another indirect evidence of the predominance of the search for robustness we already observed for the *wing*/*sting* choice. By contrast, in the non-mixed periods, we see that both principals' distributional parameters significantly explain their preferred $\rho_{\overline{k}}$. In the natural direction: the highest the (inequality-averse) distributional concerns, the lowest the relative inequality, and the highest the relative cost for the principal.

Table 4. Inequality-inefficiency trade off (ρ) for players in P_2

As for the agents we use an equation similar to (3) - here V_{it} plays no role - to study their choice about the inequality - inefficiency trade-off ($\rho_{\overline{k}}$) in P_2. Estimation results, conditional on Player positions, are shown in Table 9: we generally find -as intuition would suggest- a (negative and significant) relation between distributional concerns and relative inequality.

5 Predicted and actual effort choices

We begin by looking at actual behavior. As Table 6 in the main text shows, the overall level of effort in P_3 is similar to the level of effort observed in P_2 (see Table 1): Player 1 puts effort in 91% of the cases of *sting* contracts where this percentage for her teammate drops to 64%; both player types put effort about 43% of the time when they face a *wing* contract. The only difference with respect to P_2 can be noticed for Player 1 with *wing* contracts (51% of effort decisions in P_2 vs 44% in P_3). There is instead a noteworthy difference about misbehavior. In fact, due to the competition among the principals who, in 80 cases out of 144 (6 matching groups $\times$24 rounds) converged to a single contract offer, the possibility to misbehave is severely reduced. The agent i observed agent j misbehaving less than 10% of the times in *wing* contracts (it was 30% in P_2) and less than 20% in *sting* contracts (it was at least 34% in P_2). Conditional on misbehavior (either $\phi_j = -1$ or $\phi_i = -1$) there are some discrepancies between the effort rates in P_2 and P_3, but these are difficult to interpret as robust evidence against the hypothesis of consistent behavior between P_2 and P_3 because of the small number of observations available.[3] As for the comparison between actual and predicted behavior, our behavioral model correctly anticipates subjects' effort decisions in P_3 in 894 out of 1152 cases (about 78%), with a slightly better predicted power in *sting* rather than *wing* (80% against 74%, respectively). As for the latter, the most likely forecast mistake (for both player positions) is to predict no effort when agents decided otherwise.

6 Additional treatments

We now compare subjects' effort decisions in P_2 in the two different treatments. By analogy with Table 6, in Table 11 we report relative frequency of effort decisions, disaggregated for contract type (*wing* or *sting*), player and dictator position.

Table 5. Relative frequencies of positive effort decisions in P_2 and P_3 of TR_3

First notice that, in TR_2, both players, *ceteris paribus*, work less (on average, almost 25% less). This effect is stronger for Player 1 in *wing* and Player 2 in *sting*. We also see that, for *wing*, there is a decrease in effort frequencies, which about 2/3 of the corresponding levels of TR_1, while for *sting* the differences in effort levels across treatments are smaller. As for reciprocity, remember that, in TR_2, we cannot measure misbehavior, given that only dictators are asked to elicit their favorite contracts (and, therefore, relative comparisons cannot be performed). This implies that we are not in the position to estimate beliefs and reciprocity parameters as we did for TR_1.

[3] Take, for example, the case of of the non Dictator Player 2, whose average effort, when $\phi_i = -1$, is (7/37=) 0.19 and (0/7=) 0, in P_2 and P_3, respectively.

	wing contracts					*sting* contracts				
	i is Player 1					i is Player 1				
	$\phi_j = -1$ (103)	$\phi_j = 0$ (236)	$\phi_i = -1$ (118)	$\phi_i = 0$ (211)	*Total* (339)	$\phi_j = -1$ (202)	$\phi_j = 0$ (323)	$\phi_i = -1$ (181)	$\phi_i = 0$ (344)	*Total* (525)
No Dict.	0.36	0.60	0.45	0.56	0.52	0.92	0.93	0.90	0.94	0.93
Dict.	0.27	0.57	0.21	0.65	0.49	0.93	0.91	0.88	0.93	0.92
Total	0.33	0.58	0.34	0.60	0.51	0.93	0.92	0.89	0.94	0.92
	i is Player 2					i is Player 2				
	$\phi_j = -1$ (118)	$\phi_j = 0$ (211)	$\phi_i = -1$ (103)	$\phi_i = 0$ (236)	*Total* (339)	$\phi_j = -1$ (181)	$\phi_j = 0$ (344)	$\phi_i = -1$ (202)	$\phi_i = 0$ (323)	*Total* (525)
No Dict.	0.21	0.50	0.19	0.46	0.39	0.31	0.69	0.31	0.72	0.55
Dict.	0.40	0.50	0.33	0.54	0.47	0.61	0.73	0.62	0.73	0.69
Total	0.31	0.50	0.28	0.50	0.43	0.44	0.71	0.45	0.72	0.62

Table 1: Relative frequency of positive effort decisions in P_2. Number of cases in Parenthesis

	P_2, *Player 2*			P_3, *Principals*		
	Coeff.	*Std.err.*	*p-val*	*Coeff.*	*Std.err.*	*p-val*
ψ_0	-0.060	0.215	0.779	0.493	0.250	0.048
ψ_1	-0864	0.338	0.011	0.329	0.276	0.234
ψ_2	0.700	0.349	0.045	0.311	0.389	0.424
ψ_3	21.248	4.919	0.000	11.979	5.269	0.023
Obs		288			192	

Table 2: *Sting* vs *Wing* choice in the "mixed" rounds, logit regression

	Mixed			Non mixed		
Dep.var.: $\tau_{\overline{k}}$	*Coeff.*	*Std.err.*	*p-value*	*Coeff.*	*Std.err.*	*p-value*
ψ_1	0.119	0.093	0.201	0.294	0.104	0.005
ψ_2	0.206	0.143	0.149	0.276	0.184	0.134
ψ_3	0.002	0.004	0.673	-0.004	0.005	0.472
Left censored		16 (8.6%)			30 (7.8%)	
Uncensored		76 (39.6%)			90 (23.4%)	
Right censored		100 (52.1%)			264 (68.8%)	
	Mixed			Non mixed		
Dep.var.: $\rho_{\overline{k}}$	*Coeff.*	*Std.err.*	*p-value*	*Coeff.*	*Std.err.*	*p-value*
ψ_1	-0.061	0.034	0.075	-0.191	0.073	0.009
ψ_2	-0.084	0.061	0.168	-0.203	0.119	0.088
ψ_3	-0.001	0.002	0.495	0.003	0.003	0.316
Left censored		85 (44.3%)			218 (56.8%)	
Uncensored		68 (35.4%)			138 (35.9%)	
Right censored		39 (20.3%)			28 (7.3%)	

Table 3: Relative cost choice (τ) and inequality - total costs trade off (ρ) for principals in P_3. All specifications include a full set of period dummies. Bootstrap and cluster adjusted standard errors

	Mixed			Non mixed		
Player 1	*Coeff.*	*Std.err.*	*p-value*	*Coeff.*	*Std.err.*	*p-value*
ψ_1	-0.030	0.015	0.048	0.070	0.064	0.272
ψ_2	-0.041	0.021	0.050	-0.381	0.114	0.001
Left censored		101 (35.1%)			313 (54.3%)	
Uncensored		139 (48.3%)			209 (36.3%)	
Right censored		48 (16.7%)			54 (9.4%)	
	Mixed			Non mixed		
Player 2	*Coeff.*	*Std.err.*	*p-value*	*Coeff.*	*Std.err.*	*p-value*
ψ_1	-0.031	0.023	0.178	-0.185	0.090	0.040
ψ_2	-0.043	0.020	0.034	-0.181	0.097	0.062
Left censored		168 (81.1%)			467 (81.1%)	
Uncensored		109 (37.8%)			97 (16.8%)	
Right censored		11 (3.8%)			12 (2.1%)	

Table 4: Inequality - inefficiency trade off (ρ) for agents in P_2. All specifications include a full set of period dummies. Bootstrap and cluster adjusted standard errors

	P_2			
	wing (359)		*sting* (505)	
	Player 1	*Player 2*	*Player 1*	*Player 2*
Non Dictator	0.34	0.27	0.77	0.42
Dictator	0.34	0.37	0.83	0.47
Total	0.34	0.32	0.80	0.44
	P_3			
	wing (233)		*sting* (343)	
	Player 1	*Player 2*	*Player 1*	*Player 2*
Non Dictator	0.25	0.31	0.82	0.48
Dictator	0.17	0.20	0.84	0.51
Total	0.21	0.25	0.83	0.49

Table 5: Relative frequencies of positive effort decisions in P_2 and P_3 of TR_2. Number of cases for each player type in parenthesis

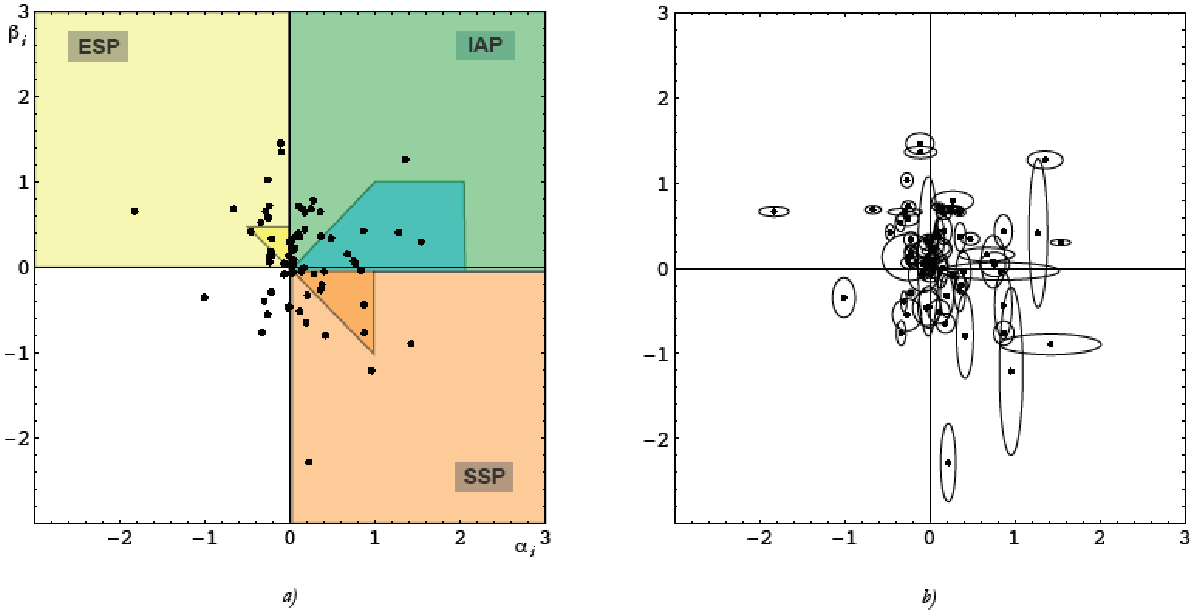

Figure 1: Distribution of estimated α and β in TR_1.

Appendix C
Experimental Instructions

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NOTE: In the experiment, the instruction for each PHASE were given only after subjects had played the previous phases.

WELCOME TO THE EXPERIMENT!

- This is an experiment to study how people make decisions. We are only interested in what people do on average.
- Please, do not think we expect a particular behavior from you. On the other hand, keep in mind that your behavior will affect the amount of money you can win.
- In what follows you will find the instructions explaining how this experiment runs and how to use the computer during the experiment.
- Please do not bother the other participants during the experiment. If you need help, raise your hand and wait in silence. We will help you as soon as possible.

THE EXPERIMENT

- In this experiment, you will play for 72 subsequent rounds. These 72 rounds are divided in 3 PHASES, and every PHASE has 24 rounds.

PHASE 1

- In each of the 24 rounds of PHASE 1, you will play with ANOTHER PLAYER in this room.
- The identity of this person will change from one round to the next. You will never know if you interacted with the OTHER PLAYER in the past, nor the OTHER PLAYER will ever know if he has interacted with you. This means your choices will always remain **anonymous**.
- At each round of PHASE 1, the computer will first randomly choose 4 different OPTIONS, that is, four monetary payoff pairs, one for you and one for the OTHER PLAYER. Every OPTION will always appear on the left of the screen.
- Then, you and the OTHER PLAYER have to choose, simultaneously, your favourite OPTION.
- Once you and the OTHER PLAYER have made your decision, the computer will randomly determine who (either you or the OTHER PLAYER) will decide the OPTION for the pair.
- We will call this player the CHOOSER of the game.
- The identity of the CHOOSER will be randomly determined in each round.
- **On average half of the times you will be the CHOOSER and half of the time the OTHER PLAYER will be the CHOOSER.**
- Thus, in each round, the monetary payoffs that both players receive will be determined by the choice of the CHOOSER.

PHASE 2

- In the following 24 rounds of PHASE 2, you will participate in a game similar to the previous one, with some modifications.
- In STAGE 1 of PHASE 2, a payoff matrix will be chosen, and in STAGE 2 of PHASE 2, each pair will face this payoff matrix, which will appear on the left of the screen.

BID	NO	YES
NO	**40,40**	**40+b1/4, 30+b2/4**
YES	**30+b1/4, 40+b2/4**	**30+b1, 30+b2**

What does this matrix mean?

- In each round, you and the OTHER PLAYER will receive an **initial endowment** of **40** pesetas.
- In each round, you and the OTHER PLAYER have to choose, simultaneously, whether to BID or NOT TO BID.
- Bidding costs 10 pesetas, not bidding does not cost anything.
- You choose the ROW, the OTHER PLAYER chooses the COLUMN.
- Every cell of the matrix (which depends on the monetary payoffs b1 and b2 and your decisions on whether or not to bid) contains two numbers.
- The first number (on the left) is what you win in this round. The second (on the right) is what the OTHER PLAYER wins in this round. There are four possibilities:

    1. If both players bid, both add to their initial endowment their ENTIRE MONETARY PAYOFF b1 or b2 (to which the 10 pesetas cost of bidding will be subtracted).
    2. If you bid, and the OTHER PLAYER does not, **both** players add to their endowment ONE FOURTH of the monetary payoff b1 or b2 (and the cost of bidding will be subtracted from you only);
    3. If the OTHER PLAYER bids, and you don't, **both** players add to their endowment ONE FOURTH of their monetary payoff b1 or b2 (and the cost of bidding will be subtracted from the OTHER PLAYER only);
    4. If nobody bids, you and the OTHER PLAYER will only obtain the 40 pesetas endowment.

PHASE 2 is composed of 2 STAGES:

- In STAGE 1, you and the OTHER PLAYER have to choose your favorite OPTION, that is, the game that you would like to play in STAGE 2.
- After you and the OTHER PLAYER have made your decision, the computer will randomly determine who (either you or the OTHER PLAYER) will be the CHOOSER of the game. That is, the OPTION selected by the CHOOSER in STAGE 1 is the one played in STAGE 2.
- Like in PHASE 1, the identity of the CHOOSER, will be randomly determined in each round.
- **On average, half of times you will be the CHOOSER and half of times the OTHER PLAYER will be the CHOOSER.**
- Once the CHOOSER has determined the option that will be played in this round, you and the other player have to choose whether TO BID or NOT TO BID and the monetary consequences of your decisions are exactly those we just explained.

SUMMING UP

- In each of the 24 rounds of PHASE 2, you will play with ANOTHER PLAYER of this room.

- In STAGE 1, you and the other player, like in PHASE 1, have to choose simultaneously your favorite OPTION.
- After you and the OTHER PLAYER have made your decisions on the OPTION, the computer will randomly determine which one of those OPTIONS is the game that you will play in STAGE 2. That is, the computer designs a CHOOSER.
- In STAGE 2 you and the OTHER PLAYER have to simultaneously DECIDE whether to bid or not to bid. The payoffs of each round depend on your initial endowment of 40 pesetas, on both your choices (to bid or not to bid), on the OPTION chosen by the CHOOSER and on the cost of bidding of 10 pesetas.
- The PAYOFF MATRIX (which will always appear on the left of your screen) sums up, in a compact form, the monetary consequences of your choices.

PHASE 3

- In the last 24 rounds of PHASE 3, you will play in a game similar to the one in PHASE 2 but with some differences.
- Within the 24 persons in this room, the computer will randomly choose two groups of 12.
- In each group of 12 people, the computer will randomly determine 8 **PLAYERS** and 4 **REFEREES.**
- The identity of PLAYERS and REFEREES is randomly determined at the beginning of PHASE 2 and it will remain the same for the rest of the experiment.

PHASE 3 has 3 STAGES.

- Like in the previous PHASES, in STAGE 1 the computer randomly selects 4 OPTIONS, (that is, 4 pairs of monetary payoffs (b1, b2) for the players.
- In addition, in STAGE 1, each REFEREE picks an OPTION within the 4 available for that round (which may be the same or different among them).
- Thus, the 4 OPTIONS selected by the four REFEREES will be proposed to the 8 PLAYERS of their group.
- In STAGE 2, the 8 PLAYERS will be randomly paired. PLAYERS will be rematched at every round.
- Then, just like in PHASE 2, each player has to select one among the 4 OPTIONS proposed by the 4 REFEREES.
- Just like in PHASE 2, the computer randomly determines which of the two OPTIONS chosen by the PLAYERS is played by the pair. That is, the computer designs a CHOOSER.
- Just like in PHASE 2, in the game, both PLAYERS have to choose simultaneously, whether TO BID or NOT TO BID.
- The monetary consequences for the players of their decision are exactly the same as in PHASE 2.

REFEREES' PAYOFF

The REFEREES' payoffs depend on

1. the OPTION they offer,
2. how many REFEREES in their group offer the same OPTION
3. how many CHOOSERS choose the same OPTION
4. Players' actions in the game.

We shall make this clearer with some examples.

CASE 1

- First, suppose that the REFEREE offered an OPTION with payoffs (b1, b2) and that only one CHOOSER has chosen this option.
- The payoff of each REFEREE depends on the positive VALUE randomly generated by the computer and that each REFEREE (and only her) knows, and, in addition, on the sum of the payoffs b1+b2 in the following way:

- if both players bid, the REFEREE wins the difference between his VALUE and the sum of the payoffs; that is, V-(b1+b2);
- if one player bids and the other does not, the REFEREE wins ONE FOURTH of the difference between his VALUE and the sum of the payoffs; that is, $\frac{V-(b1+b2)}{4}$.
- if nobody bids, the REFEREE does not win anything.

In this case, the PAYOFF MATRIX for the REFEREE would be as follows:

BID	NO	YES
NO	0	(V-(b1+b2))/4
YES	(V-(b1+b2))/4	V-(b1+b2)

CASE 2

- Suppose now that more than one CHOOSER chose the option that the REFEREE offered. Moreover, suppose moreover that this REFEREE is the only one that picked this OPTION.
- In this case, the REFEREE gets the sum of the payoffs obtained with each couple that chose her OPTION.
- The payoff with each couple will be determined as in CASE 1, taking into account if they bid, if only one bids or nobody bids.

CASE 3

- Suppose now that one or more CHOOSERS chose an option that the REFEREE offered. Moreover, suppose that more than one REFEREE picked the same OPTION. In this case, every single REFEREE that chose the same OPTION gets a payoff with the same structure as in CASE 2, but now, sharing this payoff with the other REFEREES that picked the same option.

CASE 4

- Suppose now that no couple chose the option that the REFEREE offered. In this case, her payoff for this round will be 0.

ÚLTIMOS DOCUMENTOS DE TRABAJO

2009-09: "Social Preferences and Strategic Uncertainty: An Experiment on Markets and Contracts", **Antonio Cabrales, Rafaele Miniaci,Marco Piovesan y Giovanni Ponti**.
2009-08: "Hidden Information, Bargaining Power and Efficiency: An Experiment", **Antonio Cabrales, Gary Charness y Marie Claire Villeval**.
2009-07: "Democracy and the curse of natural resources", **Antonio Cabrales y Esther Hauk**.
2009-06: "Social Interactions and Spillovers: Incentives,Segregation and Topology", **Antonio Cabrales, Antoni Calvó-Armengol e Yves Zenou**.
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