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Social Preferences and Strategic Uncertainty
An Experiment on Markets and Contracts

Antonio Cabrales, Raffaele Miniaci,
Marco Piovesan and Giovanni Ponti

Social Preferences and Strategic Uncertainty: an Experiment on Markets and Contracts*

Antonio Cabrales

Universidad Carlos III de Madrid

Raffaele Miniaci

Università di Brescia

Marco Piovesan

University of Copenaghen

Giovanni Ponti[†]

Universidad de Alicante

and Università di Ferrara

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Abstract

This paper reports experimental evidence on a stylized labor market. The experiment is designed as a sequence of three phases. In the first two phases, P_1 and P_2, agents face simple games, which we use to estimate subjects' social and reciprocity concerns, together with their beliefs. In the last phase, P_3, 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.

I. Preliminaries

Social scientists from various disciplines have been interested for a long time in understanding the distribution of rewards -monetary, or otherwise- within and among firms and organizations. This interest is far from being purely academic. As Blau and Kahn (1996) argue: "Labor earnings are by far the most important component of income for individuals who are employed; hence, in the absence of any compensatory government policies, low living standards in market economies will be associated with low labor incomes. More generally, labor market inequality is a major determinant of disparities in living standards." Decision makers at organizations choose who is going to receive how much, as well as when and why this should be so. Consequently, "organizations affect inequality by influencing how jobs are defined, how rewards are attached to positions, how people are matched to these jobs, and how workers determine whether they have been treated fairly" (Baron and Pfeffer, 1994).

Economists have, by and large, taken the view that *inequality is a natural consequence of disparities in ability, or simply of asymmetric information.* A simple model with hidden actions would predict that agents with the same level of ability receive unequal pay even if they make, in equilibrium, the same amount of effort, due to purely random variations in output.[1] Even more extremely, Lazear (1995, p.26) claims that "many, including myself, believe that most motivation is produced not by an absolute reward but by compensation that is based on relative comparison." He refers to tournament theory, which asserts that firms motivate workers to exert effort by offering a fixed (and sizable) differential in wages, for even minimally different final performance.

In marked contrast, social psychologists emphasize *the deleterious effects of inequality on workers' motivations and social relations within the organization*, claiming that "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).

More recently, these two stylized positions have become more nuanced, and the perspec-

tives have moved towards less extreme, and more complementary, viewpoints. For example, there has been a surge of survey and experimental evidence in economics showing that workers have *social* (i.e. interdependent) and/or *reciprocal* preferences, with a strong taste against inequality.[2] Thus, even a self-interested manager should take this into account when constructing her pay packages and may moderate the use of incentive pay and other forms of unequal payoffs. On the other hand, researchers in social psychology and organizational behavior 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-fire fighting and rescue squads, theatrical casts, manufacturing teams, and hotel customer service staffs, for example- 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, and the outstanding performance of one person is unlikely to influence organizational outcomes over the long term if the performance of others is lacking". The interesting part of this observation, from the point of view of an economist, is that the benefits of inequality seem to be directly linked to the intrinsic characteristics of the production technology. More precisely, the conditions under which inequality is likely to be "beneficial" strongly depend on the existence of activities which display *strategic complementarities*. These activities are such that the profitability of an action increases when others are also taking it. This situation normally leads to multiple equilibria. Thus, any institutional device to align agents' expectations about others' -call it, along with Kreps (1990), *corporate culture*- can be thought as a key to the success of organizations.[3]

As it turns out, strategic complementarities are the key ingredient with which Winter (2004) justifies the existence of inequity within an organization. In his model, a principal has to design the optimal contract for a team of ex-ante identical agents. A contract specifies

a profile of monetary rewards, one for each agent, if the team is successful in the assigned "project". Technology is such that agents can increase the probability of success of the project by performing -independently and simultaneously- a costly action. This probability only depends on the number of agents who put effort, and not on their identity.[4] Under these conditions, he is able to show that complementarities are not only *sufficient*, but also *necessary* for the optimal solution (that is, the contract which implements the high-effort efficient equilibrium as a *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".[5] 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 robustness to strategic uncertainty.* 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. We are also interested in the way our experimental subjects resolve the trade-off between robustness and inequality: they can choose either contracts in which the all-effort profile is the unique equilibrium, but inequality is enhanced, or contracts in which the all-effort profile is not the unique equilibrium, but inequality is mitigated. In this respect, individuals 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.

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

1. In the first phase (P_1), subjects are randomly matched in pairs and play a sequence of Dictator Games in which they have to choose among four options, each of which corresponds to a monetary payoff pair (one for them, one for their teammate). The choice set, *which changes at every round*, corresponds to the (all-effort) equilibrium payoffs of the games they will face later in the following two phases. We use P_1 to estimate the subjects' purely distributional preference parameters within the realm of Charness and Rabin's (2002, C&R hereafter) model.[6]

2. In the second phase (P_2), subjects are, once again, randomly matched in pairs and are first asked to choose among four options (within the same choice set and sequencing as in P_1). This choice induces a simple 2x2 game which subjects have to play at a subsequent stage. This second stage corresponds to the effort game induced by Winter's (2004) technology, given the option (i.e. the *contract)* chosen at the first stage. Since in P_2 reciprocity may play a role -as agents could condition their effort decision to their teammate's (publicly observed) contract choice- we use the second stage of P_2 to estimate subjects' C&R reciprocity parameters, together with their beliefs in the effort game.

3. In the third phase (P_3), there are 4 principals and 4 pairs ("teams") of agents. Principals offer a *contract* (a 2×2 game, such as those played in P_2) selected from a given set. We expect, and then corroborate in the data, that 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), which is related to the difficulty to disentangle preference and beliefs parameters when the experiment produces only observations on game outcomes which result from the interaction between subjects' preferences and beliefs. As in P_1 (our Dictator Game) beliefs do not play

any role, we use data from P_1 to estimate subjects' distributional preference parameters, which we assume determine, together with reciprocity concerns and beliefs, subjects' choices in P_2. Under the assumption that distributional preference parameters are constant across phases, data from P_2 convey useful information to estimate subjects' reciprocity and beliefs.[7] Moreover, to the best of our knowledge, this is the first paper in which *the estimation of distributional parameters is carried out at the level of each individual subject participating in the experiment*.[8]

Let us summarize the main observations 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, typically also explain the contracts they choose among those offered by the different principals in P_3, together with their subsequent effort decision. Around 80% of total observations in P_3 are consistent with the estimated preferences and beliefs of the concerned agents.

3. We also observe that *equality is a less important consideration than robustness*. The egalitarian (but not robust) contract is rarely selected, by both principals and agents and, when it is selected, it very often yields the 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 given contract in P_3 decreases with the distance (in the parameter space) between her estimated preferences and those of the principal for whom she ends up working. Moreover, we also see that, not only the agents, but also principals end up offering contracts (which we like to view as stylized "corporate cultures") more in tune with their own estimated distributional preferences.

The remainder of this paper is arranged as follows. In Section 2, we briefly review the emerging literature which deals with strategic uncertainty, contracting and market competition in the presence of social preferences. Section 3 describes the game-form (or mechanism) that subjects play in the lab and the mechanism design problem facing the principal. In Section 4 we describe the experimental design and procedures. In Section 5 we develop an econometric model in which principals and agents' distributional preferences and beliefs are estimated in phases P_1 and P_2 respectively. Section 6 discusses the testable questions arising from the theory. Final remarks and guidelines for future research are placed in Section 7, followed by an appendix containing proofs and the experimental instructions.

II.   Related literature

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 (2006) is a more recent experimental work designed to measure the extent and importance of strategic uncertainty in coordination games. The only other experimental work dealing directly with the effect of strategic uncertainty on contract choices that we know of is that of López-Pintado, Ponti and Winter (2008), who test directly Winter's (2004) model in the lab.

The economic literature on social preferences in economics is, to a large extent, a response to the vast experimental evidence challenging the standard hypothesis of "selfishness".[9] A variety of models were devised to explain these observations.[10] It would be too difficult to discuss all the models, so we refer to the excellent surveys of Fehr and Schmidt (2000) and Sobel (2005).

There has been some theoretical work on the consequences of social preferences for labor markets. Frank's (1984) seminal contribution shows that wages may depart from the value of marginal productivity if workers care high enough about relative payoffs. Fershtman, Hvide

and Weiss (2005) explore the effects of status on effort. They show that firms hire groups of workers of heterogeneous productivities. They also show that wages may differ across the economy for equally productive workers, and that the quest for status may increase total output. Cabrales, Calvó-Armengol and Pavoni (2008) and Cabrales and Calvó-Armengol (2008) study (respectively) long-term and static contracts in the presence of social preferences and competition. One of the main implications of both studies is that workers will sort themselves into different firms according to their levels of ability. In this respect, their results are consistent with the field evidence, as well as with the experimental results reported in this paper. Rey-Biel (2005) shows that the threat of inequity in pay after bad performance can actually induce effort at a lower cost to the principal than without social preferences. Kosfeld and von Siemens (2006) show that different levels of worker cooperation can be the result of competition in the labor market if workers have heterogeneous social preferences and these preferences are private information. Teyssier (2007) proves the existence of a separating equilibrium that explains the coexistence of multiple payment schemes in firms. In her model, inequity averse agents are attracted by a revenue-sharing scheme in which joint production is equally distributed, whereas selfish agents prefers tournaments. If the market is perfectly flexible, this separating equilibrium induces a high effort level for both types of agents.

On the experimental side, one of the first applications of social preferences in the lab is Charness (2004), who shows that volition in choosing a wage has a significant effect on subsequent costly effort provision, implying that reciprocity is important in experimental labor markets. Erikson and Villeval (2004) find that other-regarding preferences affect contractual choices and the sorting effect of performance pay schemes. This suggests that efficiency wages may be an explanation for the scarcity of variable pay schemes. Their data also exhibit more sorting in terms of employees' degree of reciprocity than in terms of skill level. Fehr, Klein and Schmidt (2007) show (both theoretically and experimentally) that the presence of even a minority of people with concerns for fairness can alter in an important way the kind

8

of contracts that are efficient.

Finally, let us briefly review some empirical evidence on sorting in labor markets. Dohmen and Falk (2006) study the impact of incentives on worker self-selection in a controlled laboratory experiment. They find that output is much higher in variable (as opposed to fixed) pay schemes, such as piece rate, tournament, or revenue sharing. Moreover this difference is largely driven by productivity sorting: on average, the more productive a worker is, the more likely she self-selects into the variable pay scheme. Krueger and Schkade (2007) report a positive and statistically significant relationship between a worker's tendency to interact with others while not working and the relative frequency of work-related interactions on the worker's job. They interpret this pattern as an evidence of sorting: more extroverted workers tend to accepts jobs that require greater social interaction. Bellemare and Shearer (2006) run a field experiment to measure the risk preferences of a sample of workers (within a real firm) who are paid incentive contracts and face substantial daily income risk. They find that workers are risk tolerant, and the high level of risk tolerance suggests that both sorting and transaction costs are important determinants of contract choices when workers have heterogeneous preferences.

III.   The game

The economic environment we reproduce in the most complicated part of the experiment (phase 3, P_3) has the following features. Within each round t,

1. At STAGE 0, Nature moves first, fixing the choice set $C_t = \{b^k\}$, $k = 1, ..., 4,$, where $b^k = (b_1^k, b_2^k)$ defines *a contract*. By construction, $b_1^k \geq b_2^k$, $\forall k$ (i.e. 1 denotes the identity of the best paid agent, constant across all contracts in C_t). Then, 4 principals (indexed as Player 0) choose, simultaneously and independently, which contract they want to offer for that round;

2. At STAGE 1, 8 agents are randomly paired in 4 *teams*, with player position (either agent

1, or agent 2) determined randomly. Each agent has to choose her favorite contract within the set $C_t^0 \subseteq C_t$ of contracts offered by (at least one of the) principals. Once contracts have been chosen by agents, another random draw selects which agent is the *Dictator* in the choice of the contract, that is, the agent whose choice determines the ruling contract $b \in C_t^0$ for the pair.

3. At STAGE 2 production takes place and payoffs are distributed, according to a simple effort game-form $G(b)$ induced by the contract b selected by the Dictator in STAGE 1. The rules of $G(b)$ 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 $\delta = (\delta_1, \delta_2) \in \{0, 1\}^2$ 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:

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

with $\gamma \in (0, \frac{1}{2})$.[11]

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

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

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

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

A. The mechanism design problem

We are now in the position to characterize the mechanism design problem upon which we constructed the (optimal) contracts which are available -to the principals and agents- in the experiment.

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.

In this respect, two alternatives routes are possible. Following Winter (2004), the principal may consider only mechanisms that *strongly* implement the desired solution, in the sense of the following

Definition 1 (Strong INI mechanisms). *We say that the mechanism b is strongly investment-inducing (sting) if all Nash Equilibria (NE) of $\Gamma(b)$ entail effort by all agents with minimal benefit distribution.*

If the principal is not particularly worried about the strategic uncertainty induced by the presence of multiple equilibria (precisely, by the existence on an equilibrium in which both agents do not make effort), he may opt for the following (cheaper) alternative, satisfying the following

Definition 2 (Weak INI mechanisms). *We say that the mechanism b is weakly investment-inducing (wing) if there exists at least a NE of $\Gamma(b)$ such that $\delta = (1, 1)$, with minimal benefit distribution.*

11

In Appendix A we solve the mechanism design problems associated with both Definitions 1 and 2, under a wide range of alternative agents' distributional preferences (see Section V. for details).

IV. Experimental design

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

A. 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.[12] 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.[13]

B. Treatment

In all sessions, subjects played three *phases,* P_1 to P_3, of increasing complexity, for a total of 72 rounds (24 rounds per phase). This was done to gradually introduce subjects to the strategic complexity of the market environment and to estimate, in P_1 and P_2, subjects' preferences and beliefs.

In any given phase, matching group and round, team composition was randomly determined. Within each phase and for each round t, the choice set $C_t = \{b^k\}$, $k = 1, ...4$, where $b^k \equiv (b_1^k, b_2^k)$, was drawn at random, but not uniformly.

- Each contract b^k in the set C_t is the optimal solution of one mechanism design problem, either *wing* or *sting*, for some given and commonly known randomly generated preference profile.[14]

- Depending on the round t, the choice set C_t could be composed of

    1. 4 *wing* contracts generated from 4 different preference profiles;

    2. 4 *sting* contracts generated from 4 different preference profiles;

    3. 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, 1. 2. or 3. The particular sequence of three situations within each time interval was randomly generated. We did so to keep under control the time distance 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.

We now describe in detail the specific features of each phase, P_1, P_2 and P_3.

P_1 : ***Dictator Game (24 rounds).***—We use the classic protocol of the Dictator Game, to collect our subjects distributional preferences without any interference with any strategic consideration. In P_1, the timing for each round 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.

2. Then, each agent, having been informed of her player position in the pair (common to all contracts), selects her favorite contract within C_t, the pool of 4 options available for that round.

3. Once choices are made, another independent draw fixes the identity of the *Dictator* (for that couple and round). Let $\hat{k}$ denote the ruling contract (for that couple and round) corresponding to the Dictator's choice.

4. Monetary consequences are as follows $\pi_i = b_i^{\hat{k}} - c$ (i.e. subjects receive the corresponding equilibrium payoffs of the induced effort game $G(b^{\hat{k}})$).

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

4.1 Subjects play the effort game $G(b^{\hat{k}})$.

4.2 Agents' monetary payoffs are distributed according to the payoff function (2).

P_3 : **The Market (24 rounds).**—This is the phase we described in the introduction, that is, the full-fledged matching market. At the beginning of P_3, within each matching group, 4 subjects are randomly chosen to play as principals throughout the phase. Then, in each round t, these 4 principals have to select one contract C_t to offer to the 4 teams 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 the principals may all coincide, as it often happened in the experiment). Agents have then to choose within this subset C_t^0. Phases 2-4.2 are then identical to P_2.

C. Payoffs

In phase P_2 and P_3 subjects always received, as monetary reward, their expected payoff, given the strategy profile selected in the effort game $G(b)$. This was to make the experimental environment closer to the model's assumption of risk neutrality.

14

All monetary payoffs in the experiment were expressed in Spanish Pesetas (1 euro is approx. 166 ptas.).[15] Subjects received 1.000 ptas. just to show up. Monetary payoffs in the experiment (in ptas.) were calculated by fixing $c = 10$, $\gamma = \frac{1}{4}$, $A = 100$ and $B = 125$ (i.e. $V \sim U[100, 125]$). Average earnings were about 21 euros, for an experimental session lasting for approximately 90 minutes.

D.   Three (testable) questions from the theory

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

Q1. *Is it inequality aversion or strategic uncertainty aversion?* Remember that optimal contracts have been calculated by using two different mechanism design strategies (denoted by *sting* and *wing* in Definitions 1-2), with rather different strategic and 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 8.

   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 9 and 10.

Q2 *Does separation emerge?* In other words, is the market able to sort (principals and) agents according to their distributional and reciprocity preferences? Evidence for this in Remark 12.

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 Remarks 11 and 13.

V.   Estimating social preferences

In this Section, we shall first set up an econometric model by which we directly estimate subjects' preferences. In what follows, i and j identify our subjects matched in pairs according to the experimental protocol described in Section IV.. We assume that our subjects' preferences are defined by a slight modification of the one proposed by C&R, as follows.

Definition 3 (C&R Preferences)**.**

$$(3) \quad u_i(\delta) \;=\; \pi_i(\delta)$$
$$-(\alpha_i - \theta_i\phi_j)\max\left\{\pi_j(\delta) - \pi_i(\delta), 0\right\} - (\beta_i + \theta_i\phi_j)\max\left\{\pi_i(\delta) - \pi_j(\delta), 0\right\},$$

where $\phi_j = -1$ if j "has misbehaved", and $\phi_j = 0$ otherwise. 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 F&S (α_i and β_i) as well as for their *tastes for reciprocity*, θ_i.

As we shall explain later, our experimental setup is particularly well suited to estimate both distributional and reciprocity concerns. With respect to the former, there are four particularly important subsets of parameters, which we now describe.

Definition 4 (Egoistic Preferences (EP))**.**

$$(4) \qquad\qquad\qquad\qquad\qquad \alpha_i = \beta_i = 0.$$

Definition 5 (Inequality Aversion Preferences (IAP))**.**

$$(5) \qquad\qquad\qquad\qquad 0 \leq \beta_i < 1, \alpha_i \geq \beta_i.$$

Distributional preferences with constraints as in equation (5) were first proposed by F&S. F&S do not consider reciprocal motives (that is, it is assumed $\theta_i = 0$, and, in this sense,

preferences are purely distributional). In addition, following Loewenstein *et al.* (1989), F&S also impose to the model conditions (5), by which guilt (β_i) is bounded above by 1 and envy (α_i) cannot be lower than guilt.

The literature has also focused upon two alternative subsets of parameters for (3), which also neglect reciprocal motives by fixing $\theta_i = 0$, namely "status seeking" (SSP, see Frank, 1984) and "efficiency-seeking" (ESP, see Engelmann and Strobel, 2004) preferences. 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.

Definition 6 (Status-Seeking Preferences (SSP))**.**

$$(6) \qquad\qquad \alpha_i \in [0,1), \beta_i \in (-1,0], |\alpha_i| \geq |\beta_i|$$

Definition 7 (Efficiency-Seeking Preferences (ESP))**.**

$$(7) \qquad\qquad \alpha_i \in (-\frac{1}{2},0], \beta_i \in [0,\frac{1}{2}), |\beta_i| \geq |\alpha_i|$$

Even though C&R follow F&S in only considering IAP preferences, we jointly call -with a slight abuse of notation- "C&R distributional preferences" the four types of preferences described above: EP, IAP, SSP and ESP). This four specifications are defined as "distributional", in that the parameter measuring reciprocity, θ_i, is taken to be zero for all four types.

A. *Estimating distributional preferences using P_1.*

As we already noticed, in our Dictator Game (P_1), agents receive the (all effort) equilibrium payoff (2) corresponding to the option selected by the Dictator. Given that the identity of the Dictator is randomly determined for each round and pair, this seems the ideal

situation to estimate pure distributional preferences, since there appears to be no issue of reciprocity.

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 contract 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 contract k at round t if

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

(remember that 4 contracts are available in each round). Under the assumption that the stochastic term ε_{it}^k is iid with an extreme value distribution, the probability that individual i chooses the contract k at round t is therefore

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

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 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 different graphs:

1. In Figure 1*a)* each subject corresponds to a point in the (α_i, β_i) space, where we high-

light the regions corresponding to the taxonomy we proposed in Section V.. As Figure 1a) 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 1a) 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 1b) 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 1b) 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.

Table 1 summarizes our results on subjects' preference heterogeneity by partitioning our subject pool, assigning each subject to the quadrant (Q_1 to Q_4) of Figure 1 in which their 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). Following this approach, Table 1 assigns each experimental subject (principals and agents) to the corresponding "distributional preference type".

Table 1. Preference types of agents and principals

As for many subjects falling in quadrant Q_1 (i.e. the IAP region) in Figure 1, the estimated α_i and β_i are in fact not significantly different than zero, the biggest group in Table 1 is that of Q_4 (i.e. ESP: 29.17% of the total), followed by Q_2 (SSP: 22.22%).

B. Estimating reciprocity and beliefs using P_2.

Our P_1 is a simple Dictator Game game in which, by choosing a "contract", subjects enforce (provided they are selected as Dictators) a particular benefit profile for the team. By contrast, in P_2, after selecting their favorite contract, they are then asked to play the induced effort game, where they may (if they wish) condition their effort decision upon the contract choice of they teammate (which is made public before they have to make their effort decision). For subjects with pure distributional preferences this feature of the experimental design of P_2, is irrelevant. This is because, once the game is set, the identity of the Dictator and foregone payoffs associated to contracts which have not been selected do not affect monetary outcomes in the effort game. This is not true if subjects are also concerned with reciprocity.

In recent years there has been substantial experimental evidence supporting the claim that reciprocal motives cannot be fully captured by the "reduced form" of purely distributional preferences.[16] Paradigmatic is Falk *et al.*'s (2003) experimental evidence where, in a reduced Ultimatum Game in which the Proposer has only two possible options, the responders' reaction does not only depend on current material payoffs, but also on the payoffs that would have been available if the Proposer would have chosen otherwise.

Prompted by these finding, we now proceed to estimate our subjects' reciprocal concerns within the realm of C&R's model (3). 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, denoted as k_j and k_i, respectively, which are publicly observed before fixing the identity of the Dictator:

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

By (9), j misbehaves by choosing a contract k_j which assigns i a strictly lower benefit

20

than what i would have guaranteed herself with k_i.

With this specification for reciprocity in mind, Table 2 reports the relative frequencies of positive effort decisions in P_2, conditional on subjects' behavior in STAGE 1.

Table 2. Relative frequencies of positive effort decisions in P_2

Table 2 shows that in about 35% $\left(= (118 + 181) / (339 + 525)\right)$ 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.[17] In a *sting* contract, however, only the non Dictator Player 2 effort is significantly lower after j's misbehavior. In Table 2 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 2 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).

With this purpose in mind, we 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

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

where $E_{\lambda_i^k} \left[\cdot \right]$ indicates the expected value taken with respect to the beliefs of player i on j's effort choice under the ruling contract, 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:

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

Consistently with the descriptive evidence of Table 2, 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 player position and the type of contract (either *wing* or *sting*) being played. Our specification for the reciprocity parameter θ_i in (3) -again, consistently with Table 2- 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:

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

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

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

Assuming that distributional preferences estimated in P_1 are constant across phases (i.e.

that we can use each subject's (α_i, β_i) pair to parameterize her distributional tastes), 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: we first estimate (α_i, β_i) from P_1 where beliefs and reciprocity do not play any role, in the second step we estimates - via partial maximum likelihood- the parameters of λ_i^k and θ_i replacing $\left(\widehat{\alpha}_i, \widehat{\beta}_i\right)$ in (13). Given the two-step nature of the procedure, we use P_1 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 the second step estimates. The reported estimated standard errors of the parameters of λ_i^k and θ_i take also into account matching group clustering.

Table 3. Estimated parameters of belief function and reciprocity.

Table 3 reports the estimation results. 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 (and expect) 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.[18] 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.[19]

VI.   Testable questions

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.

A.   *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 in Section 1, and how this depends on their individual social preferences. As explained in Section IV., in 8 out of 24 rounds of the experiment, agents and principals had to choose between two optimal *wing* and two optimal *sting* contracts. Table 4 reports the relative frequency of subjects' choices of a *sting* contract in the 8 rounds in which both types of contracts were available.

Table 4. Relative frequencies of the *sting* choice in the "mixed" rounds.

Remark 8. *sting is the most frequent choice for all players and phases.*

As Table 4 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. In order to assess the extent to which social preferences affect the probability of choosing a *sting* (instead of a *wing*) contract, we need to control for the inequality in the available contract choice set C_t, which varies substantially from period to period. To do this, we construct a variable associated to each contract $\bar{k}$ in C_t, which measures the relative inequality induced by contract $\overline{k}$, in comparison with the other available options in C_t :

$$(14) \qquad \sigma_{\bar{k}} = \frac{\left(b_1^{\bar{k}} - b_2^{\bar{k}}\right) - \min_k \left[b_1^k - b_2^k\right]}{\max_k \left[b_1^k - b_2^k\right] - \min_k \left[b_1^k - b_2^k\right]}, k = 1, ..., 4.$$

By (14), $\sigma_{\bar{k}} \in [0,1]$, 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).[20] 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 5 we report the partial maximum likelihood estimates of ψ_1 to ψ_3 with bootstrap standard errors.

Table 5. 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

25

sign.

Table 6. Relative frequencies of positive effort decisions in P_2 and P_3

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 (the better paid) puts effort in 92% of the cases, while the same statistic drops to 51% in the *wing* contracts; for the Player 2 the corresponding figures are much lower (62% and 43%).[21] 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%).

Remark 9. *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 7 shows that the relative frequencies of the efficient equilibrium (the one in which both players put effort) are about twice larger in *sting* than in *wing* (about 60% vs 30%).

Remark 10. *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 equilibrium.*

Also notice that about 30% of total observations correspond to a (non-equilibrium) strategy profile in which only one agent puts effort. While this frequency stays basically constant over phases and mechanisms, it is quite remarkable that the identity of the working agent crucially depends on the mechanism being played (either *wing* or *sting*): in *sting* the relative frequency of outcomes in which only Player 2 puts effort never exceeds 4% while, in *wing*, this frequency is three times bigger. This is probably due to the strategic uncertainty created by the existence of multiple equilibria in *wing* (strategic uncertainty which affects both agents). 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 7. Outcome dynamics in the effort game.

To summarize, 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).

B.   *Q*2. *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 shall 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. To test this conjecture, 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 then define, for each choice set C_t, the following two variables:

$$(15) \qquad \tau_{\overline{k}} = \frac{\left(b_1^{\overline{k}} + b_2^{\overline{k}}\right) - \min_k \left[b_1^k + b_2^k\right]}{\max_k \left[b_1^k + b_2^k\right] - \min_k \left[b_1^k + b_2^k\right]}, \overline{k} = 1, ..., 4, \text{ and}$$

$$\rho_{\overline{k}} = \frac{1 + \sigma_{\overline{k}}}{1 + \tau_{\overline{k}}}.$$

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:

$$(16) \qquad y_{it} = \psi_1 \alpha_i + \psi_2 \beta_i + \psi_3 V_{it} + \psi_4' \boldsymbol{D}_t + v_{it},$$

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 8 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 8. 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 5, 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 9. Inequality-inefficiency trade off (ρ) for players in P_2

As for the agents we use an equation similar to (16) - 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. These considerations justify the following.

Remark 11. *Distributional preferences parameters estimated in P_1 account well for agents' (principals') and observed contract choices in P_2 (P_3).*

This last remark could be interpreted as an indirect evidence on sorting: for both principals and agents, horizontal distributional concerns matter when they have to decide on the contracts to offer and to choose. In this respect, contract selection is crucial for understanding sorting. More direct evidence on sorting should 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:

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

where $\sigma_{ij} = \sqrt{(\alpha_i - \alpha_j)^2 + (\beta_i - \beta_j)^2}$ 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 12. *Agents are more likely to choose a contract offered by a principal with more similar distributional preferences to her own.*

C. *Q3. Does the social preference model work?*

One direct way to answer this question is through the use of data from P_3 (our stylized matching market) to check whether our structural model (and the corresponding estimation strategy using the evidence from P_1 and P_2) is able to explain (and predict out-of-sample) agents' effort choices in P_3.[22] Once we provide agents with parameters on tastes for distribution (in P_1) and reciprocity, and beliefs about their teammate's action in the effort game (in P_2), we can fully characterize the agents' effort decision *at the individual level* in P_3.

Using the evidence from P_3 with the same layout of Table 2, each cell of Table 10 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 evaluated by (8).

Table 10. Actual and predicted behavior in Stage 2 of Phase P_3

We begin by looking at actual behavior. As Table 10 shows, the overall level of effort in P_3 is similar to the level of effort observed in P_2 (see Table 2): 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.[23] 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. Overall, the model seems to frame subjects' decisions accurately, which justifies the following

Remark 13. *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.

Two features of our experimental design looked, ex ante, particularly likely to have affected our inferences from the data.[24]

1. *In our experiment, player position assignment was 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. 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).

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 and let 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. 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).

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). As in TR_1, the Dictator role was assigned randomly within each pair (i.e. subjects were selected as Dictators approximately 50% of the times).

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.

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).

Table 11. Relative frequencies of positive effort decisions

in P_2 and P_3 of TR_3

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. 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

33

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 as in (9), since 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.

To summarize: we were not able to detect significant differences across treatments at the level of contract decisions (in P_1), but the effort choices in P_2 and P_3 appear to be sensitive to treatment conditions. They are higher when subjects interchange player positions across rounds. This evidence points to a dynamic aspect of social preferences, which our static model cannot account for.

VII.   Conclusion

Our experimental results show that strategic uncertainty should be an important concern for those in charge of designing organizational incentives. In fact, in our context, where strategic uncertainty conflicts with social preferences in terms of their respective recommendations on contract design, the primary consideration appears to be strategic uncertainty. However, this does not mean that social preferences do not matter for contract design, in that 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 organizational cultures.

Our experimental environment is certainly ad-hoc in some respects.[25] Nevertheless, our experimental results are encouraging, because a parsimonious model of individual decision making is capable of organizing consistently the evidence from a complex experimental environment. In this respect, the model of social preferences we choose seems to pass our "empirical examination". Given that principals face a more complex strategic environment, since they compete with other principals to attract agents, the stability of social preferences

(and beliefs) across quite different environments is a positive piece of news for the research program in interdependent preferences. It is true that the literature has already discussed the ability of different models to explain quite diverse data sets.[26] But, to the best of our knowledge, this discussion has been done by showing that the same distribution of parameters that explains behavior in experiment A, also explains behavior in experiment B with a different subject pool. While this is suggestive, it does not go far enough. Since individuals in experiments A and B are different, it is possible that a subject that appeared to be highly fair-minded in experiment A, would have given the opposite appearance had she participated in experiment B.[27] Our experiments provide a more definitive test, by following subjects' choices (with particular reference to principals' decisions), and showing their consistency with social preferences, across rather different tasks.

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. The menus of contracts available to agents, possibly through the market via firms with different "corporate cultures" as in our experiment, could have a theoretically interesting structure.

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 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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Appendix A

VIII.   Solving Stage 2

By analogy with our experimental conditions (and without loss of generality), we assume $b_1 \geq b_2$. in what follows, we shall solve

A.   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:

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

(18) $$u_1(1,1) \geq u_1(0,1)$$

(19) $$u_2(1,1) \geq u_2(1,0)$$

(20) $$b_1 \geq b_2 \geq 0$$

Assumption (20) is wlog. To solve the problem (17-20), 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):

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

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 par-

tition is built. The strategy proof is as follows. We shall solve the linear program (17-20) 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.

Wing under EPs.—As for the solution of *wing* under EPs (i.e. with $\alpha_1 = \alpha_2 = \beta_1 = \beta_2 = 0$), the linear program (17-20) simplifies to the following:

$$\min b_1 + b_2$$

subject to:

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

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

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

Wing under IAPs.—As for the solution of *wing* under IAPs, we need to add to the basic linear program (17-20) the IAPs constraint (5).

Proposition 14 (winiIAP). *The optimal* wing *mechanism under IAPs is as follows:*

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

$$
(22) \qquad b_2^* = \left(\frac{c(1-\beta_1)}{1-\gamma}, \frac{c(1-\beta_1)}{1-\gamma} \right) \quad if\ \beta_1 \geq \frac{1}{2},
$$

with $\beta_1 \leq \beta_2$.

To prove Proposition 14, some preliminary lemmas are required. Let $\hat{b}^k \equiv (\hat{b}^k_1, \hat{b}^k_2)$ define the solution of the linear program (17-20) in R_k.

Lemma 15.

$$(23) \qquad \hat{b}^1 = \left(\frac{c(1+\alpha_2)}{(1-\gamma)\gamma}, \frac{c(\gamma+\alpha_2)}{(1-\gamma)\gamma} \right)$$

.

Proof. In R_1, 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 (18-19) correspond to

$$(24) \qquad b_1 \geq f^1_1(b_1) \quad \equiv \quad \frac{c(1-\beta_1)}{(1-\gamma)\beta_1} - \frac{1-\beta_1}{\beta_1}b_1;$$

$$(25) \qquad b_2 \geq f^1_2(b_1) \quad \equiv \quad \frac{c}{1-\gamma} + \frac{\alpha_2}{1+\alpha_2}b_1.$$

Let x^k_i define the value of b_1 such that $f^k_i(b_1) = 0$. By the same token, let y^k_i denote the intercept of $f^k_i(b_1)$, i.e. $f^k_i(0)$. Finally, let τ^k_i denote the slope of $f^k_i(b_1)$. We then have $x^1_1 = \frac{c}{1-\gamma}$ and $x^1_2 = -\frac{c(1+\alpha_2)}{(1-\gamma)\alpha_2}$. Also notice that $0 \leq \tau^1_2 = \frac{\alpha_2}{1+\alpha_2} < 1$ and $y^1_2 = \frac{c}{1-\gamma} > 0$. This implies that $f^1_2(b_1)$ 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 $f^1_2(b_1)$ and $g^2(b_1)$ intersect, i.e. when $\hat{b}^1_1 = \frac{c(1+\alpha_2)}{(1-\gamma)\gamma}$ and $\hat{b}^1_2 = \frac{c(\gamma+\alpha_2)}{(1-\gamma)\gamma}$.

Lemma 16. *In R_2, the optimal wing contract under IAPs is (21) when $\beta_1 < \frac{1}{2}$, and (22) when $\beta_1 \geq \frac{1}{2}$, with $\beta_1 < \beta_2$.*

Proof. In the case of R_2, constraints (18-19) correspond to

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

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

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 $\check{\beta} = \min\{\beta_1, \beta_2\}$. If $\beta_1 > \beta_2$, then the optimal solution in R_2 would be $\hat{b}_i^1 = \hat{b}_i^2 = \frac{c(1-\check{\beta})}{1-\gamma}$ (i.e. $\hat{b}_i^1 + \hat{b}_i^2 = 2\frac{c(1-\check{\beta})}{1-\gamma}$). On the other hand, if $\beta_1 \leq \beta_2$, then $\hat{b}_i^1 + \hat{b}_i^2 \leq 2\frac{c(1-\check{\beta})}{1-\gamma}$. More precisely, if $\beta_1 < \frac{1}{2}$, the optimal solution is (21), 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 (22), that is, the intersection between $f_1^2(b_1)$ and $g^1(b_1)$.

We are in the position to prove Proposition 14.

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

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

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

Wing with SSPs.—As for the solution of *wing* under SSPs, we need to add to the basic linear program (17-20) the SSPs constraint (6).

Proposition 17 (winiSSP)**.** *The optimal wing mechanism under SSPs is (21), with $\beta_1 \leq \beta_2$.*

Proof. We begin by showing that, as in the case of IAPs, the optimal *wing* contract in R_1 is (23). 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 (21), 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 $\tau_1^2 = -\frac{1-\beta_1}{\beta_1}$; $|\tau_1^2| > 1$ (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 $b_1 = b_2 = \frac{c(1-\check{\beta})}{(1-\gamma)}$.

2. If $\beta_1 < \beta_2$, then the solution is (21) which overall cost is never greater than $\frac{2c1-\check{\beta})}{(1-\gamma)}$.

We complete the proof by noticing, by analogy with the Proof of Proposition 14, that the optimal solution lies in R_2, rather than in R_1.

Wing with ESPs.—In the case of *wing* with ESPs, we need to add to the basic linear program (17-20) the ESPs constraint (7).

Proposition 18 (winiESP)**.** *The optimal wing mechanism under ESPs is (21), with $\beta_1 \leq \beta_2$.*

Proof. We begin by showing that here the optimal *wing* contract in R_1 is (23) 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 17.

B. 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 (17-20) with an additional constraint (implementation with a unique equilibrium):

$$(28) \qquad\qquad u_1(1,0) \geq u_1(0,0).$$

The constraint (28) makes, on behalf of player 1, the choice of putting effort a weakly dominant strategy.

Sting under EPs.—The solution of *sting* under EPs is as follows (see Winter 60):

$$b_1^* = \tfrac{c}{\gamma},$$

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

Sting under IAPs.—

Proposition 19. *The optimal sting mechanism under IAPs is*

$$(29) \qquad \begin{cases} b_1^* = \frac{c((1+\alpha_1)(1+\alpha_2)-\gamma(1-\beta_2))}{\gamma(1+\alpha_1+\alpha_2-\gamma(1+\alpha_1-\beta_2))}, \\ b_2^* = \frac{c(1+\alpha_1)(\gamma+\alpha_2)}{\gamma(1+\alpha_1+\alpha_2-\gamma(1+\alpha_1-\beta_2))}. \end{cases}$$

To prove Proposition 19, we follow the same strategy as before.

Lemma 20. $\hat{b}^1 = \left(\frac{c(1+\alpha_2)}{(1-\gamma)\gamma}, \frac{c(\gamma+\alpha_2)}{(1-\gamma)\gamma} \right).$

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

$$(30) \qquad b_1 \geq f_1^1(b_1) \quad \equiv \quad \frac{c(1-\beta_1)}{(1-\gamma)\beta_1} - \frac{1-\beta_1}{\beta_1}b_1,$$

$$(31) \qquad b_1 \geq f_3^1(b_1) \quad \equiv \quad \frac{c(1-\beta_1)}{\gamma(1-\gamma)\beta_1} - \frac{1-\beta_1}{\beta_1}b_1,$$

$$(32) \qquad b_2 \geq f_2^1(b_1) \quad \equiv \quad \frac{c}{1-\gamma} + \frac{\alpha_2}{1+\alpha_2}b_1,$$

Let x_i^{kl} solves $f_1^k(x) = g^l(x)$. We first notice that (30) is not binding. This is because (30) defines a constraint which is parallel to (31), but with a smaller intercept ($y_1^1 < y_3^1$, since $\gamma < 1$). Also notice that, in this case, (31) 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 21. *The optimal sting contract in R_2 is (29).*

Proof. R_2, the relevant constraints are as follows:

$$(33) \qquad b_1 \geq f_1^2(b_1) \quad \equiv \quad \frac{c(1-\beta_1)}{(1-\gamma)\beta_1} - \frac{1-\beta_1}{\beta_1}b_1$$

$$(34) \qquad b_1 \geq f_3^2(b_1) \quad \equiv \quad -\frac{c(1+\alpha_1)}{\gamma\alpha_1} + \frac{1+\alpha_1}{\alpha_1}b_1$$

$$(35) \qquad b_2 \geq f_2^2(b_1) \quad \equiv \quad \frac{c(1-\beta_2)}{1+\alpha_2-\gamma(1-\beta_2)} - \frac{\alpha_2+\gamma\beta_2}{1+\alpha_2-\gamma(1-\beta_2)}b_1.$$

Notice that, by analogy with R_1, condition (33) 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.[28]

We are in the position to prove Proposition 19.

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.

Sting under SSPs.—

Proposition 22. *The optimal sting mechanism under SSPs is (29).*

Proof. By analogy with the IAP case, in R_1, (30) 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 (34) 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, (29). This is because, by analogy with the IAP case, conditions (33) 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.

Sting under ESPs.—

Proposition 23. *The optimal sting mechanism under ESPs is (29).*

Proof. By analogy with the previous cases, in R_1, (30) is not binding. Also notice that, in this case, (33) 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, by (7), $\gamma_1 \leq \frac{1}{2}$, 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, by (7),$|\alpha_2| < \gamma$ (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, (29).

C.   The contract space

Figure A1 provides a graphic sketch of the solutions of the two mechanism design problems, *wing* and *sting,* under the assumptions that both agents share the same "preference type", either IAP, or SSP or ESP, although they may differ in their individual parameters (α_s, β_s), provided they belong to the corresponding preference set. The (rather tedious) details of the $2 \times 3 = 6$ proofs are reported in Appendix A.

Figure A1. Optimal contracts

The two big circles of Figure 2 correspond to the optimal contracts, *wing* and *sting,* when both players hold EPs, whereas the small circles correspond to the contracts actually used in the experiment. Notice that some points lie outside the feasible regions defining the optimal contract space for each preference type: this is because, in some periods, the optimal contracts were derived in the case of subjects' heterogeneous preference types and, therefore, their characterization was not covered by any of our propositions, and was evaluated numerically (see Section *Treatments* below for further details).

As Figure A1 shows, *wing* and *sting* optimal contracts cover two disjoint regions of the $b_1 \times b_2$ contract space: *sting* contracts differ from *wing*, essentially, for the fact that player 1 is paid substantially more (while player 2 benefits are more similar across mechanisms). This is because, as we shall explain in Appendix A, in *sting,* player 1's benefit needs to be high enough to make the effort decision a weakly dominant strategy. We also notice that the "*sting* cloud" is somehow more dispersed.

Appendix B
Experimental Instructions

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 one round after the other. 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, first the computer will 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 favorite 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 to a game similar to the previous one, with some modifications.
- In PHASE 2, each pair will face a payoffs matrix that appears 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 sum to the initial endowment their ENTIRE MONETARY PAYOFF b1 or b2 (to which it will be subtracted the cost of bidding of 10 pesetas).
    2. If you bid, and the OTHER PLAYER does not, **both** sum to their endowment ONE FOURTH of the monetary payoff b1 or b2 (and the cost of bidding will be subtracted to you only);
    3. If the OTHER PLAYER bids, and you don't, **both** sum to their endowment ONE FOURTH of their monetary payoff b1 or b2 (and the cost of bidding will be subtracted to the OTHER PLAYER only);
    4. If nobody bids, you and the OTHER PLAYER will only gain the endowment of 40 pesetas.

PHASE 2 is compound 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 that 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.
- 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 STAGE 1, have to choose simultaneously your favorite OPTION.

- After that you and the OTHER PLAYER have made your decisions, the CHOOSER will determine the game that you will play in STAGE 2.
- 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 (that it 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 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 (that could 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. Like before, agents will be rematched at every round.
- Then, just like in STAGE 2, each player has to select one among the 4 OPTIONS proposed by the 4 REFEREES.
- Just like in PHASE 2, the (randomly selected) CHOOSER will determine the game to be played by the pair.
- 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 STAGE 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 win 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 win ONE FOURTH of the difference between his VALUE and the sum of the payoffs; that is, $\dfrac{V-(b1+b2)}{4}$
- if nobody bids, the REFEREE does not win anything.

In this case, the PAYOFF MATRIX of the REFEREE, will be as follows:

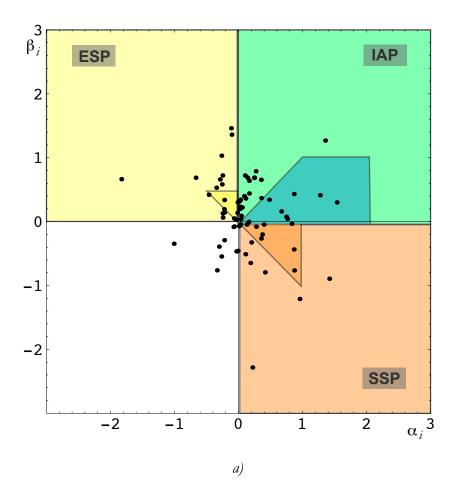| BID	NO	YES
NO	0	(V-(b1+b2))/4
YES	(V-(b1+b2))/4	V-(b1+b2)

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 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.
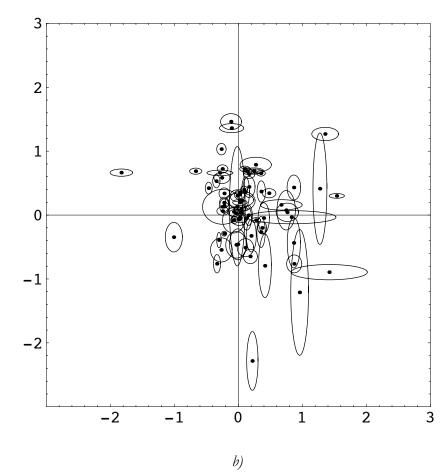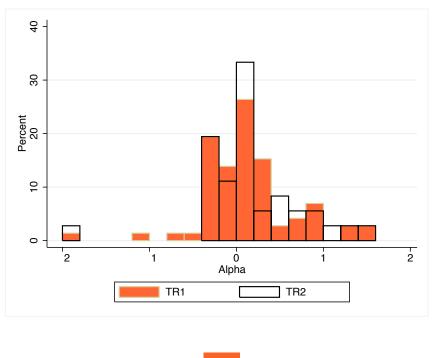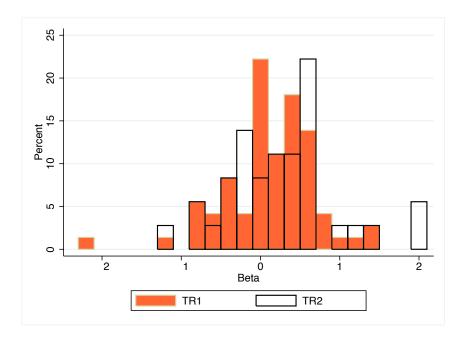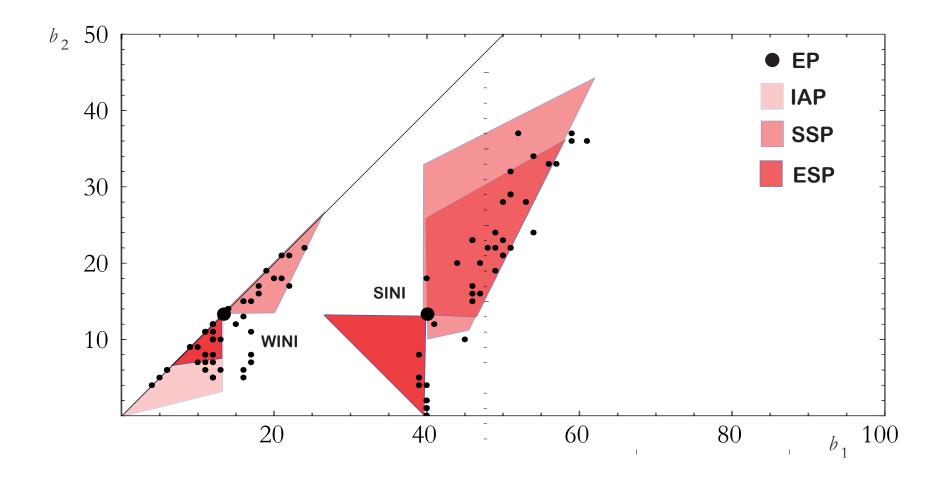
a)

b)

Fig. 1

Fig. 2

Fig. A1

	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

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

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 3: 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 4: Relative frequencies of the *Sting* choice in the "mixed" rounds

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

| | 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 6: Relative frequencies of positive effort decisions in P_2 and P_3. Number of cases for each player type in parenthesis

| | $P_2, wing$ | | | | $P_2, sting$ | | | |
	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 7: Outcome dynamics in the effort game. Absolute values and row percentages

Dep.var.:$\tau_{\overline{k}}$	Mixed			Non mixed		
	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%)		
Dep.var.:$\rho_{\overline{k}}$	Mixed			Non mixed		
	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 8: 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 9: 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

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)
No Ditctator.	.15	.51	.14	.52	.47	.8	.92	.81	.91	.9
	.23	.43	.14	.45	.41	.9	.95	.88	.95	.94
	.62	.83	.71	.82	.8	.7	.87	.7	.87	.84
Dictator	.14	.44	.22	.44	.42	.9	.93	.89	.93	.92
	.0	.38	.11	.38	.36	.83	.88	.84	.88	.87
	.86	.68	.89	.67	.7	.78	.82	.79	.82	.81
Total	.15	.47	.17	.47	.44	.86	.92	.86	.92	.91
	.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)
No Dictator.	0	.46	0	.45	.42	.37	.7	.4	.7	.63
	.11	.38	0	.38	.35	.47	.69	.48	.7	.65
	.89	.71	1	.7	.71	.84	.77	.83	.77	.78
Dictator	.29	.47	.15	.49	.45	.35	.69	.4	.7	.64
	.07	.44	0	.44	.39	.35	.6	.43	.6	.56
	.79	.76	.85	.75	.77	.85	.75	.77	.77	.77
Total	.17	.46	.1	.47	.43	.36	.7	.4	.7	.64
	.09	.4	0	.41	.37	.42	.65	.46	.64	.61
	.83	.72	.9	.72	.74	.84	.76	.8	.77	.77

Table 10: 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.

| | 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 11: Relative frequencies of positive effort decisions in P_2 and P_3 of TR_2. Number of cases for each player type in parenthesis