An Experiment on Markets and Contracts: Do Social Preferences Determine Corporate Culture?*

Antonio Cabrales
Universitat Pompeu Fabra

Raffaele Miniaci
Università di Brescia

Marco Piovesan
Università di Padova

Giovanni Ponti†
Universidad de Alicante
and Università di Ferrara

KEYWORDS: Social Preferences, Team Incentives, Mechanism Design, Experimental Economics
JEL CLASSIFICATION: C90, D86

*VERY PRELIMINARY AND INCOMPLETE. Please do not quote. We are grateful to Ricardo Martinez for stimulating comments and suggestions. Usual disclaimers apply. Financial support from MCyT (BEC2001-0980), the Generalitat Valenciana and the Instituto Valenciano de Investigaciones Económicas (IVIE) is gratefully acknowledged.

†Corresponding author. Departamento de Fundamentos del Análisis Económico - Universidad de Alicante - 03071 Alicante - SPAIN - Voice:++34965903619 - Fax: ++ 34965903898 - e-mail:giuba@merlin.fae.ua.es.

An Experiment on Markets and Contracts:
Do Social Preferences Determine Corporate Culture?

Abstract

This paper reports experimental evidence on a stylized labor market in which agents are assumed to hold social (i.e. interdependent) preferences a' la Fehr and Schmidt [20]. The experiment is designed as a sequence of three treatments. In the last treatments, principals compete by selecting a contract from a fixed menu, each contract being the optimal solution of the mechanism design problem the principals face for a given social preference parametrization. Agents, randomly matched in pairs, select one of the available contracts (i.e. "choose to work" for a principal). Production is determined by the outcome of a simple effort game induced by the chosen contract. In the previous two treatments, we estimate individual social utility parameters and beliefs by various techniques. We find that social preferences are significant determinants of the matching process between labor supply and demand in the market stage, as well as agents' effort decision.

1 Introduction

Contract theory applied to personnel economics (both in its moral hazard and adverse selection/screening versions) predicts that there should be a substantial amount of inequality of pay within organizations. But the evidence on this is disappointing. Baker, Jensen and Murphy (1988) say: "Evidence from research on compensation plans indicates that explicit financial rewards in the form of transitory performance-based bonuses seldom account for an important part of a workers compensation." Screening models also perform badly in this respect. Very few companies offer explicit or implicit menus of contracts from which the workers can choose, one of the more robust implications of such kinds of models. The recent literature on fairness in game theory and experimental economics (see e.g. the surveys of Fehr-Schmidt [22] and Sobel [28]) has provided one way to explain these facts. Namely, workers have interdependent preferences and dislike earning less than their peers. 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. This explanation is an important advance, but it is incomplete, as it cannot account well, in its simplest form, for a couple of additional empirical observations. First, there is ample evidence of large inter-firm wage differentials (Card and di Nardo [13]). Second, the experimental evidence that showed convincingly the existence of interdependent preferences, also showed clearly that individuals differed widely in the way in which their preferences depended on the outcomes of others. It turns out that the two phenomena can be related. Cabrales and Calvó-Armengol [12] show theoretically that if workers care about the pay of others but only if they work in close locations, then the workers of different abilities will sort into firms at different locations. For similar reasons, one would expect that more inequality averse workers would also sort into different companies. One could, in fact, claim that this kind of sorting is a concrete way to capture the concept of "corporate culture" which, despite its importance in the management literature, has often eluded economic theory.[1]

The aim of this paper is precisely to test experimentally the idea that workers have heterogeneous social preferences, that these matter for the

[1] Kreps (1990) has made the case that corporate culture serves the purpose of aligning expectations in organizations. See also Crémer (1993) and Lazear (1995) on other perspectives of corporate culture as shared expectations or information.

contracts they are offered and choose and for the way they sort into different firms. With this aim in mind we design and perform an experiment on a stylized model of a labor market in which there are 4 principals and 8 agents. Principals compete by offering a *contract* from a set of available ones. A contract specifies a pair of monetary rewards (one for each agent) if the two agents are successful in the *project* to which they are assigned. Technology is as 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 exert effort (and not on their identity). This technology, which we borrow from Winter [30], is interesting for a couple of reasons related with our motivating idea. First of all, *individual effort is not contractible* (in this sense, benefits are only conditional on the success of the project, and not on each individual effort decision). This mirrors a feature of many real-life situations, and also makes the inter-personal comparisons more focal for the experimental subjects. Second, in this environment, as Winter [30] shows, implementing the high effort level as a unique equilibrium of the game would require substantially unequal payoffs among ex-ante identical agents. Thus, this is an ideal situation to see the trade-offs between technical efficiency and fairness considerations. Fairness would require equality, technical efficiency would require inequality. Heterogeneity in preferences would provide one natural way out of this dilemma, as by sorting themselves between companies according to their preferences, agents could minimize this tension.

The main finding in our paper is that this sorting of agents and principals between contracts is indeed what happens. In order to explain how this happens we need to describe is some more detail the set of contracts from which the principal can choose. Given our setup, the theoretical problem is complex. Since "social preferences" are unlikely to be known, the principal would have to offer a menu of contracts to each pair of agents. This menu would give them incentives to perform and at the same time should respect their social preferences as much as possible. Such complication seems to us both counterfactual, and too hard to implement in the lab. Instead, we provide the principals with a set of available contracts. Each one of those contracts would be optimal if it were common knowledge that the agents had preferences as in Fehr and Schmidt's ([20]) with some particular parameter values. We expect, and then corroborate in the data, that the presence of several competing principals acts as a kind of menu of contracts between which the agents sort themselves. Indeed, not only the agents, the principals themselves can sort out into "corporate cultures" more in tune with their personalities.

In designing these contracts, we solve a mechanism design problem that has interesting (and novel) features in and of itself. In particular, we solve a model similar to Rey's [24] model, which we enrich in two (realistic) directions. First, we consider the moral hazard problem implicit in Winter's [30] technology (who, on the other hand, does not consider interdependent preferences). Second, we remove the assumption that agents are identical (with respect to their interdependent preferences).[2] In this respect, this paper contains some results which show that not only social preferences matter for the optimal contract, but that also their distribution and the choice of the solution concept are important.

Before subjects face the experimental treatment we just described (TR_3), they had to play two propedeutical treatments in which we gradually get them accustomed to the experimental conditions of the full-fledged model and we estimate individual social utility parameters and beliefs. Precisely:

1. In the first treatment (TR_1), each agent plays a sequence of Dictator Games in which she has to choose a benefit pair (one for her, one for her teammate) among four possibilities. The choice set, which changes at every round, corresponds to the equilibrium payoffs of four optimal contracts. We use this stage to estimate individual distributional preference parameters within the realm of Fehr and Schmidt's [20] parametrization.

2. In the second treatment (TR_2), the agents are, once again, required to choose a contract (within the same choice set and sequencing as in TR_1) However, they now have to play the induced effort game, which determines round monetary payoffs. We use this stage to estimate subjects' beliefs in the effort game as a polynomial function of the benefit pair corresponding to the ruling contract.

Our experiment yields the following conclusions. First, in choosing their preferred contract in TR_1, subjects display a significant degree of heterogeneity in their decisions (which, in turn, translates into heterogeneity in their estimated distributional preferences). This heterogeneity explains to

[2] Lopez-Pintado et al. [26] provide experimental evidence for Winter's [30] model.

a large extent the agents' behavior in the last treatment. That is, the preference which best explain an agents' behavior in TR_1 typically also explains the contract she chooses among those offered by the different principal in TR_3. So agents sort to firms according to their social preferences. Interestingly, the subjects who act as principals also offer the contracts most consistent with the preference we estimated for them in TR_1. In other words, social preferences turn out to be significant determinants of the matching process between supply and demand in the market stage: different "corporate cultures" (in our context, different contract types) emerge and co-exist, and sort principals *and* agents with respect to their distributional preferences. This is good for the efficiency reasons mentioned above and, in addition, it mitigates strategic uncertainty in situations with multiple equilibria.

More precisely, around 80% of total observations in TR_3 are consistent with the estimated preferences (in TR_1) and beliefs (in TR_2) of the concerned agents. Given that principals face a more complex strategic environment, since they compete with other principals to attract agents, this stability across quite different environments is an encouraging 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 (see e.g. Fehr and Schmidt [22]). But, to 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.
While this is suggestive, it does not go far enough. Since subjects 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. This kind of observation, by the way, would not necessarily mean that the subjects preferences shifted from one experiment to the other. It would also be consistent with a misspecification of the model for preferences. Our experiments provide a more definitive test, by following subjects choices, and their consistency with Fehr-Schmidt preferences, across quite different tasks.

One additional contribution of our experiment is concerned with the literature on "horizontal" distributional preferences (e.g. Rey-Biel [24]). This literature typically abstracts away the problem of modelling distributional preferences for the principals (simply assuming that they have none and, therefore, they maximize their own expected material payoffs). By the same token, this literature also does not model “vertical” distributional concerns in the agents' utility function.[3] In relation to this, we are able to see to which extent the same model (horizontal distributional preferences + estimated beliefs) we build for agents is capable of explaining the principals' behavior.

1.1 Sneak preview

Consider the following hypothetical situation (TR_1, Round 12, Figure 0a). You are asked to choose among four different options, which would imply a monetary prize (expressed in Spanish pesetas, 1 euro=166 ptas. approx.) for you ("TU PAGO") and another monetary prize ("SU PAGO") for an unidentified (real) subject in the room. You know that also this subject has to make the same decision. Once you have both made your choices through your computer terminals, a fair coin will decide the ruling option for the pair.

Figure 0. The experimental protocol

What would you choose? Notice that the four options yield rather diverse distributional consequences. Precisely, you may consider option A and option D somehow "dominated" by option B and C respectively , but what to choose between C and D? Also notice that, for all four options, your payoff is never smaller than that of your anonymous teammate (i.e. her payoff is never bigger than yours). Whatever your decision, you can easily accept the fact that our choice may not coincide with hers (since, if you were wearing her shoes, you may well go for a different option).

Consider now another hypothetical situation (TR_2, Round 12, Figure 0b). Just as before, also in this case you have to choose between four options. The difference now is that each option yields a simple (effort) game, whose outcome determines how much of your prize you (and your teammate) eventually get. Precisely, in the game both of you have to decide whether to pay 10 ptas. or not under the ruling option (as in Figure 0c). If you both pay, you will receive the prize in its full amount (once the

[3] Our design discloses all information on principals' behavior and profits to the agents. But agents are not informed of the project's value, or the choice set (i.e. the alternative contracts that the principals *have not* chosen).

10 ptas. has been subtracted); if only one pays, both receive 25% of the corresponding prize (to which 10 ptas. has to be subtracted to the paying subject only); if nobody pays, nobody receives anything.

What would you choose now? If you had chosen option B before (notice that all monetary payoffs coincide with those of the previous situation, once 30 ptas. have been subtracted), you may now consider option C more appealing (since your chances to get the full prize now also depend on your teammate decision to pay).

Finally, consider the following situation (TR_3, Round 12). You now form a group of 12 (anonymous) individuals, 4 of which, just like yourself, have to choose an option to be offered to the other 8 who, randomly matched in pairs, just like before, have (simultaneously and independently) to pick up the option they like best. For each pair that selects the option you proposed, you will receive a fixed prize (104 ptas., in this particular case), provided they both decide to pay in the game; if only one pays, you only receive 1/4 of your prize; if nobody pays, you receive nothing. In all circumstances, their monetary rewards (in full if they both pay, or 25% of them, if only one does) come out of your pocket.

What would you choose now? How much do feel your situation has changed, now that you are the residual claimant of the 104 ptas., once prizes have been distributed (and face the competitions of other 3 subjects in the room)?

We are now in the position to anticipate a small piece of our experimental evidence, which refers to the identical hypothetical situations we have just described. In TR_1, as intuition would suggest, options B and C were the most popular among our subject pool of 72 subjects, attracting 32 (26) out of the 36 subjects who, (un)like yourself, were taking their decision from the (un)advantaged position of being the receiver of the bigger prize. In both cases, option C was more popular among those 36 favored subjects (13 went for B, 19 for C), while, for those who were looking the same choice upside down, the preference for C was less pronounced (14 against 12).

As for TR_2, again C was the modal choice for both groups of subjects, but now the preference for C was stronger in the least advantaged group (out of 36 subjects, 18 went for C and only 10 for B). Finally, in TR_3, among the 24 subjects who played as principals, 12 (6) opted for option C (B). Not surprisingly, the choice of the ruling contract had also consequences on agents' decisions in the effort game: under option B (C) the relative frequency of paying agents was 47% (64%).

The above evidence show that our subjects, confronted with the same situation under three different perspectives, display rather diverse distributional preferences across the experimental timeline. The next question is: *can we provide a consistent framework for their decisions?* Surprisingly enough, out of the 12 principals that opted for the most egalitarian option C in TR_3, 8 (7) had been made expressed the same preference in TR_2 (TR_1). Despite the rather drastic shift in the incentive structure, the preference for an egalitarian split appears, for this particular piece of evidence, to carry through the various experimental conditions.

1.2 Things to come

The remainder of this paper is arranged as follows. In Section 2, we set up the theoretical model from which the available contracts are derived and we solve it. We do this under two specifications of the solution concept at the core of the mechanism design problem. In Section 3 we describe the experimental design and procedures, while Sections 4 and 5 we report the experimental results. Section 4 contains some descriptive statistics on principals and agents' contract and effort decisions, while in Section 5 we develop an econometric model in which principals and agents' distributional preferences and beliefs are estimated in treatments TR_1 and TR_2 respectively. This information is finally used in TR_3 to study the full-fledged market behavior. Final remarks and guidelines for future research are placed in Section 6, followed by an Appendix containing proofs and experimental instructions.

2 The model

We economic environment we reproduced in the lab has the following features. Within each period t,

1. At STAGE 0, Nature moves first, fixing the choice set $C_t = \left\{b^k\right\}, k = 1, ..., 4,$, 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 to all contracts in C_t). Then, 4 principals choose, simultaneously and independently, which contract they want to offer for that period.

2. At Stage 1, 8 agents are randomly paired, with player position (i.e. benefit ranking) determined by another random draw. Each agent has to choose her favorite contract within the set $C_t^0 \subseteq C_t$ of contracts offered by the principals. Once contracts have been chosen by the agents, an independent draw selects who 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 selected by the Dictator. The rules of $G(b)$ are as follows. Each agent i has to decide, simultaneously and independently, whether to invest towards the performance of her activity. We denote by $\delta_i \in \{0,1\}$ agent i's effort decision, where $\delta_i = 1$ (0) if agent i does (not) put effort. The cost of effort in the model is c and is assumed to be constant across agents. Team activity results in either success or failure. Let $P(\nu)$ define production as the probability of success as a function of the number of agents in the team who have put effort, $\nu \equiv \delta_1 + \delta_2$:

$$P(\nu) = \begin{cases} 0 \text{ if } \nu = 0 \\ \alpha \text{ if } \nu = 1 \\ 1 \text{ if } \nu = 2. \end{cases} \tag{1}$$

   with $\alpha \in (0, \frac{1}{2})$.[4]

If the project fails, then all agents (principal and agents) receive a payoff of zero. If the project succeeds, then agent i receives a *benefit*, $b_i > 0$. Thus agents' benefits are conditional only on the project's realization and not on individual effort decisions. We shall further assume that both principal and agents are risk-neutral. Let $\delta = (\delta_1, \delta_2) \in \{0,1\}^2$ denote the action combination taken by the agents. Then, agent i's expected monetary profit is given by

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

The expected monetary payoff for the principal (indexed as Player 0) is determined by the difference between expected revenues, for a given

[4]This corresponding to an "increasing return technology", according to Winter's [30] terminology.

(randomly generated) value for the project $V \sim U[1, 1+\mu], \mu > 0$, and expected costs:

$$\pi_0(\nu) = P(\nu)(V - b_1 - b_2).$$

2.1 Agents' (interdependent) preferences

Denote by $G(b)$ the game-form induced by the vector of benefits $b = (b_1, b_2)$. As for agents' preferences, we assume that behavior can be explained by the following:

Definition 1 (FS Preferences) *According to FSP, agents' preferences are as follows:*

$$u_i(\delta) = \pi_i(\delta) - \beta_i \max(\pi_j(\delta) - \pi_i(\delta), 0) - \gamma_i \max(\pi_i(\delta) - \pi_j(\delta), 0). \quad (3)$$

In what follows, we shall focus on four parametrizations of (3), that we shall employ to analyze the experimental evidence.

Definition 2 (Egoistic Preferences (EP)) *According to EP,* $\beta_i = \gamma_i = 0$.

Definition 3 (Inequality Aversion Preferences (IAP)) *According to IAPs, (i)* $\beta_i \geq \gamma_i$ *and (ii)* $0 \leq \gamma_i < 1$.

Following Bazerman *et al.* [4], Fehr and Schmidt [20] impose to the model conditions (i)-(ii) which can be rephrased as follows. By condition (i), β_i (i.e. the parameter that measures *envy),* cannot be lower than γ_i (i.e. the parameter that measures *guilt*). On the other hand, by condition (ii), guilt is bounded above by 1.

The literature has also focused upon two alternative parametrizations of (3), as follows.

Definition 4 (Status-Seeking Preferences (SSP)) *According to SSP,* $\beta_i \in [0, 1)$ *and* $\gamma_i \in [0, -1)$, *with* $|\beta_i| \geq |\gamma_i|$.

Finally, we also consider

Definition 5 (Efficiency-Seeking Preferences (ESP)) *According to ESP,* $\beta_i \in [-\frac{1}{2}, 0)$, *and* $\gamma_i \in [0, \frac{1}{2})$, *with* $|\gamma_i| \geq |\beta_i|$.

2.2 The implementation problem

We are now in the position to specify the implementation problem from which we derive the contracts which are available to the principal. Assume a principal 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 [30], the principal may consider only benefits that *strongly* implement the desired solution, in following sense:

Definition 6 (Strong INI mechanisms) *We say that the mechanism b is strongly effort-inducing (sini) if all Nash Equilibria (NE) of $\Gamma(b)$ entail effort by all agents with minimal benefit distribution.*

If the principal is not particularly worried with 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 alternative, satisfying the following

Definition 7 (Weak INI mechanisms) *We say that the mechanism b is weakly effort-inducing (wini) if there exists at least a NE of $\Gamma(b)$ such that $\delta = (1, 1)$, with minimal benefit distribution.*

2.3 Solving Stage 2

Figure 1 describes the game-form $G(b)$ agents face, once a given benefit profile $b = (b_1, b_2)$ is determined.

	0	1
0	0 0	$\alpha b_2 - c$ αb_1
1	αb_2 $\alpha b_1 - c$	$b_2 - c$ $b_1 - c$

Figure 1. The game-form $G(b)$

Without loss of generality, we assume $b_1 \geq b_2$. In other words, we index with 1 (2) the identity of the agents which receives the higher (lower) benefit. In the following propositions we solve the mechanism design problem facing the principal when we assuming that FSP parameters are common knowledge for all players in this game.

Proposition 8 *The optimal wini mechanism under FSP (3) is as follows:*

$$(b_1, b_2) = \begin{cases} \left(\frac{c(-1+\beta_2(-1+\gamma_1)+2\gamma_1+\alpha(-1+2\gamma_1)(-1+\gamma_2)-\gamma_1\gamma_2}{(-1+\alpha)(1+\beta_2-\gamma_1+\alpha(-1+\gamma_1+\gamma_2)}, \frac{c(-1+\gamma_1)(-1+\beta_2-\gamma_2+\alpha(-1+2\gamma_2))}{(-1+\alpha)(1+\beta_2-\gamma_1+\alpha(-1+\gamma_1+\gamma_2)} \right) \\ \qquad if \;\; \gamma_1 < \frac{1}{2} \\ \left(\frac{c(1-\gamma_1)}{1-\alpha}, \frac{c(1-\gamma_1)}{1-\alpha} \right) if \;\; \gamma_1 \geq \frac{1}{2}. \end{cases} \tag{4}$$

Proof. In the Appendix. ■

Proposition 2, is constructed by analogy with Proposition 1, adding to the linear programming problem (11-17) the additional constraint $u_1(1,0) \geq u_1(0,0)$.

Proposition 9 *The optimal sini mechanism under FSP (3) is as follows:*

$$\begin{cases} \hat{b}_1 = \frac{c(\alpha-(1+\beta_1)(1+\beta_2)-\alpha^2\gamma_1(1-\gamma_2)-\alpha\gamma_2)}{(-1+\alpha)\alpha(1+\beta_1+\beta_2+\alpha(-1+\gamma_1+\gamma_2)} \\ \hat{b}_2 = \frac{c(-\alpha(1+\beta_1)-(1+\beta_1)\beta_2+\alpha^2(-1+\gamma_1)(-1+\gamma_2)}{(-1+\alpha)\alpha(1+\beta_1+\beta_2+\alpha(-1+\gamma_1+\gamma_2)} \end{cases} \tag{5}$$

Proof. In the Appendix. ■

Corollary 10 *The optimal Wini mechanism is cheaper.*

3 Experimental design

In what follows, we describe the features of the experiment in detail.

3.1 Subjects

The experiment was conducted in 3 sessions in May, 2005. A total of 72 students (24 per session) were recruited among the student population of the Universidad de Alicante -mainly, undergraduate students from the Economics Department with no (or very little) prior exposure to game theory.

3.2 Sessions

The 3 experimental sessions were computerized.[5] Instructions were read aloud and we let subjects ask about any doubt they may have had.[6] In all sessions, subjects were divided into two *cohorts* of 12, with subjects from different cohorts never interacting with each other throughout the session.[7] In each session, subjects played three *treatments,* TR_1 to TR_3, of increasing complexity, for a total 72 rounds (24 rounds for treatment). This was done to gradually introduce subjects to the strategic complexity of the market environment (and to estimate, in the first and second treatments, subjects' preferences and beliefs, respectively). In any given treatment, within each round $t = 1, ..., 24$, group composition was randomly determined. Sessions lasted approximately 120'.

After each round each agent was informed of her own and her opponent's payoff. The same information was also given in the form of a *History table*, so that subjects could easily review the results of all the rounds that had been played so far.

3.3 Treatments

As we just discussed, each session was compounded of a sequence of three treatments, played 24 rounds each. Within each treatment, for each round t , the choice set $C_t = \{b^k\} = (b_1^k, b_2^k), i = 1, ...4$, was drawn at random as optimal solution of the mechanism design problem solved in Section 2 for some given randomly generated preference profile $\theta^k = \{(\beta_1^k, \gamma_1^k), (\beta_2^k, \gamma_2^k)\}$. Depending on the round t, the choice set C_t could be composed of i) 4 different *wini* or ii) 4 different *sini* or iii) the corresponding wini *and* sini generated by two profiles only. Let *period* $\tau_p = \{3(p-1) < t \leq 3p\}, p = 1, ..., 8$, be the subsequence of the $i-$th 3 rounds. Within each "period" τ_p, subjects experienced each and every possible situation, $i), ii)$ or $iii)$, the sequence selected within each period being randomly generated. We did so to keep under control the time distance between two rounds

[5] The experiment was programmed and conducted with the software z-Tree (Fischbacher [23]).

[6] The complete set of instructions, translated into English, can be found in the Appendix.

[7] Given this design feature, we shall read the data under the assumprion that the history of each cohort (6 in total) corresponds to an independent observation of the corresponding mechanism.

characterized by the same situation. Also player position (either player 1 or player 2) was randomly determined, within each agent pair and period. This implies that, in the choice of contracts agents faced in each round, the player position (either the higher paid agent 1, or the lower paid agent 2) was common to all contracts. Finally, we also fixed in a deterministic fashion the sequence of preference "types" (IAP, SSP and ESP) used to derive the optimal contracts.[8] The actual sequence of periods, common to all cohorts and session, is reported in Figure 2.

Fig. 2. Sequence of mechanisms

Figure 3 plots a scatter diagram of the entire contract space $C = \cup_{t=1}^{24} C_t$. As Figure 3 shows, there are two rather distinct "clouds" of points, depending on whether the corresponding coordinates (b_1, b_2) correspond to a *wini* or a *sini* contract. We also notice that the "*sini* cloud" is somehow more disperse.

Fig. 3. The contract space

We now describe in detail the specific features of each treatment, TR_1, TR_2 and TR_3.

3.3.1 TR_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. The timing for each round and cohort 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 determine player position.
2. Then, each agent, being acknowledged 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 period.

[8] Another possibility would have been to keep player position constant throughout the experiment. This may have created undesirable behavioral effects (e.g. players 2 not putting effort only for the sake of disturbing the "more favored" players 1) we could not properly control for.

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

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

3.3.2 TR_2 : Effort Game (24 rounds)

Phases 1 to 3 are identical to those of TR_1. Instead of Phase 4, we have

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

2. Monetary payoff are distributed according to the payoff matrix of Figure 1.

3.3.3 TR_3 : The Market (24 rounds)

This is basically the treatment we just described in the introduction. That is, prior to the agents' contract choice stage, 4 principals (selected at the beginning of the treatments and fixed for all 24 period) select one out of the four available contracts in C_t. Agents have then to choose with this subset $C_t^0 \subseteq C_t$ (all contracts offered by the principals may well coincide, as it actually happened, on occasions, through the course of the experiment).

3.4 Payoffs

In treatment TR_2 and TR_3 subjects always received their expected payoff, given the strategy profile selected in the effort game $G(b)$. As for monetary payoffs, Subjects received 1.000 (1500) ptas. (1 euro is approx. 166 ptas.) just to show up. These stakes were chosen to exclude the possibility of bankruptcy. Average earnings were about 18 euros, for an approximately 90' experiment.

3.5 (Testable) questions from the theory

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

1. *Who is choosing what?* That is, we want to measure the extent to which social preferences estimated in TR_1 affect contract and effort decisions in TR_2 and TR_3.

2. *What is the role of strategic uncertainty?* That is, to which extent does the (non) existence of multiple equilibria in wini (sini) affect agents' behavior in the effort game.

3. *wini or sini?* That is, which contract is more efficient (and/or popular) both on the demand and on the supply side?

4. *Does separation emerge?* That is, is the market able to separate (principals and) agents with respect to their interdependent preferences through an endogenous (supply and) demand of heterogenous contracts (i.e. heterogenous "corporate cultures")?

5. *Does separation increase the efficiency of the solution to the implementation problem*?

6. *Does Fehr and Schmidt's* ([20]) *model provide a reliable framework to estimate agents interdependent preferences?* Recall that this model has been subject to a strong critique, to which our evidence may provide interesting insights.

4 Results I: descriptive statistics

We shall present our experimental results in two separate sections. In what follows, we provide some descriptive statistics that summarize subjects' behavior on the two relevant dimensions, that is, choice of contracts and effort decisions. In the following Section 5, we shall build an econometric model in which subjects' choice are framed in the context of Fehr and Schimidt's [20] model of interdependent preferences.

4.1 TR_1 to TR_3 : agents (and principals) choosing contracts

We begin by looking at the contract choice issue. As we know from Section 3, agents and principals were facing, in all treatments, the same sequence of choice sets along the 24 periods, randomly selected following the balanced design of Figure 2. In this respect, for expositional purposes, it may be useful to define, for any given each choice set C_t (i.e. for any period t), the following three variables:

$$
\begin{aligned}
\rho_i &= \frac{b_i^{\bar{k}} - \min_k[b_i^k]}{\max_k[b_i^k] - \min_k[b_i^k]}, i = 1,2; k = 1,...,4; \\
\sigma_i &= \frac{\left(b_1^{\bar{k}} - b_2^{\bar{k}}\right) - \min_k\left(b_1^k - b_2^k\right)}{\max_k\left(b_1^k - b_2^k\right) - \min_k\left(b_1^k - b_2^k\right)}, i = 0,1,2; k = 1,...,4; \\
\tau_0 &= \frac{\left(b_1^{\bar{k}} + b_2^{\bar{k}}\right) - \min_k[b_1^k + b_2^k]}{\max_k[b_1^k + b_2^k] - \min_k[b_1^k + b_2^k]}, k = 1,...,4,
\end{aligned}
\tag{6}
$$

where $\bar{k} \in \{1,2,3,4\}$ denotes the contract selected by player $i = 0,1,2$ in the period under t consideration. By (6), we normalize players' benefits and costs, together with the induced inequality each contract implies, with respect to the choice set C_t. In other words, by choosing a contract for which $\rho_i = 1$ ($\tau = 1$) an agent (principal) goes for the option that, within the choice set available for that period, maximizes her own benefit (maximizes the total contract cost). By the same token, by selecting the contract by which $\sigma_i = 0$, (horizontal) inequality is minimized.

Figure 4 plots the evolution of the distribution of ρ_i (Figure 4a) and $\sigma_i, i = 1,2$ (Figure 4b) averaged out for each individual subject within each period $\tau_p, p = 1,...,8$, and disaggregated for treatments and player position. The connected line reports period averages, while the dashed lines trace time trends (estimated by ordinary least squares).

Fig. 4. Evolution of the agents' choice of contracts

As Figure 4 shows, for both agents and treatments, ρ_i are always increasing with time (time trends are always positive and significant). This effect is particularly strong in TR_1 (Player 2). By contrast, σ_i are always decreasing with time (again, time trends are always negative and significant, with the exception of Player 1 in TR_2).

By analogy with Figure 4, in Figure 5 we look at the trade-off between total contract costs and induced inequality from the principal's viewpoint, tracing the evolution of τ_0 (Figure 5a) and σ_0 (Figure 5b).

Fig. 5. Evolution of principals' choice of contracts

As Figure 5 shows, also for the principal, τ_0 and σ_0 have opposite time trends (both significant).However, it should be noted that, in this case, the interpretation of the trend (and the absolute values) of τ_0 is exactly the opposite of that of σ_1 and σ_2. As τ_0 goes to 1, principals opt for the most expensive contracts (i.e. the least advantageous for them). We interpret this evidence of principals' competition on the demand side.

We now move into the mechanism design issue, analyzing subjects' revealed preferences over the type of contract, *wini* or *sini*. As we just explained in Section 3, in 8 out of 24 periods t, evenly distributed across the timeline, agents and principals had to choose between two optimal *wini* and two optimal *sini* contracts, built upon the same pair of preference parameters. Figure 6 uses the information drawn from this subsample of observation to discuss more in detail the choice of mechanism issue, tracing the relative frequency of subjects' choosing a sini contract in the 8 rounds in which both types of contracts were available.

Fig. 6. Choice between wini and sini in the "mix" periods

As Figure 6 shows, in all treatments, *sini* is, by far, the most popular choice, and this is particularly true for Player 1. This strong preference for *sini* gets (significantly) stronger with time only in TR_1. As for principals, they also display a higher preference for *sini*, even though choice frequencies are much closer with those of the least advantaged Players 2.

4.2 TR_2 and TR_3 : agents choosing effort

We now move to analyze agents' effort decisions in TR_2 and TR_3. Figure 7 reports the relative frequency of effort choices disaggregated for player position, time period, mechanism type and treatment.

Fig. 7. Relative frequencies of effort decisions

Here we notice that effort is always (significantly) decreasing in time, for both player positions and treatments (this tendency is stronger for player

2 and in *wini*). In consequence, the difference in effort between subjects of different player position is increasing with time. Moreover, effort frequencies are basically constant over treatments.[9]

We now look at the extent to which individual effort decision affect aggregate outcomes (i.e. effort profiles) in Figure 8, in which we highlight in grey strategy profiles which correspond to a Nash equilibrium of the corresponding mechanism.

Fig. 8. Outcome dynamics in the effort game

As Figure 8 shows, relative frequencies of the efficient (all-effort) equilibrium are about twice as much in *sini* rather than in *wini.* In the latter, the inefficient (no-effort) equilibrium pools more than 1/3 of total observations (and is, for both TR_2 and TR_3, played more frequently than the efficient equilibrium). Also notice that about 30% of total observations corresponds to a (non-equilibrium) strategy profile in which only one agent puts effort. While this frequency stays basically constant over treatments and mechanisms, quite remarkably, the identity of the working agent, in this case, crucially depends on the mechanism being played (wini vs. sini): in sini the relative frequency of outcomes in which Agent 2 puts effort never exceeds 3% while, in wini, this frequency is five times as bigger. This is probably due to the strategic uncertainty created by the existence of multiple equilibria in wini (strategic uncertainty which is suffered by both agents).

5 Results II: social preferences and contracts

In this Section, we shall set up an econometric model by which we directly estimate *a*) in TR_1 F&S individual preference parameters and *b*) in TR_2 agents' beliefs in the effort game. We finally combine this information to interpret TR_3 experimental evidence.

[9]Another interesting dimension which is not taken into account by Table 7 is that of Dictators, that is, the extent to which being decisive in the choice of the contract influence the subsequent effort decision. As it turns out, being the Dictator seems to have influenced effort only marginally. This is the reason why the (rather small) difference in effort are not reported here.

5.1 TR_1: estimating (individual) social preferences

As we already noticed, in TR_1 (our Dictator Game), agents receives the (all effort) equilibrium payoff corresponding to the plan chosen by the dictator. In each period t, let L_{st} be a dummy variable which is equal to 1 if subject s has been assigned to player position 2 - the lower paid agent - and zero otherwise. Assuming that each subject s is characterized by her own parameters β_s and γ_s, her utility from choosing contract k at round t can be written as

$$u_{st}^k = (1 - L_{st}) \left[\pi_{1t}^k - \gamma_s \left(\pi_{1t}^k - \pi_{2t}^k\right)\right] + L_{st} \left[\pi_{2t}^k - \beta_s \left(\pi_{1t}^k - \pi_{2t}^k\right)\right]$$

According to this notation, subject s chooses contract k at round t if

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

(4 contracts are offered each period). Under the assumption of iid of the stochastic term and extreme value distribution, the probability that individual s chooses the contract k at round t is therefore

$$\Pr\left(y_{stk} = 1 | \pi_1(.), \pi_2(.)\right) = \frac{\exp\left((1 - L_{st}) \left[\pi_{1t}^k - \gamma_s \left(\pi_{1t}^k - \pi_{2t}^k\right)\right] + L_{st} \left[\pi_{2t}^k - \beta_s \left(\pi_{1t}^k - \pi\right.\right.\right.}{\sum_{k=1}^4 \exp\left((1 - L_{st}) \left[\pi_{1t}^k - \gamma_s \left(\pi_{1t}^k - \pi_{2t}^k\right)\right] + L_{st} \left[\pi_{2t}^k - \beta_s \left(\pi_{1t}^k - \right.\right.\right.}$$

Note that we allow parameter heterogeneity across subjects, therefore the iid assumption does not imply neglected individual unobserved heterogeneity, and it is consistent with the random ranking of the four contracts in the choice set of each round t. In Figure 10 we estimate individual preference parameters of (5.1).

Fig. 9.Estimating individual social preferences

Figure 9 plots the estimated social preferences for our subject pool. Figure 9 is composed of two different graphs: In Figure 9a) each subject corresponds to a point in the (β, γ) space, where we highlight the regions corresponding to the taxonomy presented in Section 3.1. As Figure 9a) shows, our subjects display significant heterogeneity in their distributional preferences. In this respect, the majority of subjects falls in the first quadrant (i.e. in the IAP case), followed by SSP and ESP. In many cases, the constraints on absolute values are violated (in particular, in the case of

IAP). Finally 10% of our subject pool displays both β and γ negative (a case never covered by the theoretical literature on these matters).

Figure 9b) reports, together with each estimated (β, γ) pair (as in Figure 9a), the corresponding 90% confidence intervals associated to each individual estimated parameter. As Figure 9b) shows, we have now many subjects whose estimated distributional preferences fall, with positive probability, in more than one region. Moreover, for some of them (about 20% of our subject pool), we cannot reject (at 10% confidence level) the null hypothesis of egoistic preferences.

We have two alternatives ways to summarize our results subjects' preference heterogeneity. First, we can partition our subject pool, depending on the quadrant their estimated parameters are most likely to fall in, grouping to an additional "EP" category those subjects whose the estimated β γ are jointly not significantly different than zero. Following this approach, Figure 10 assigns each experimental subject (principals and agents) to the corresponding "distributional preference type".

Fig. 10. Partitioning principals and agents with respect to their distributional "types"

As for many subjects falling in the first quadrant in Figure 9 the estimated β and γ are in fact not significantly different than zero, the biggest group in Figure 10 is now that of ESP (29.17% of the total), followed by SSP (22.22%).

Alternatively, we can compute the probability of a randomly drawn subject in the pool to be characterized by a pair (β_s, γ_s) belonging to one of the four quadrants. This is the purpose of Figure 11, in which these probabilities are calculated by averaging out the corresponding individual probabilities of the entire subject pool (disaggregated between principals and agents). Notice that, EPs do not appear in Figure 11 since, by definition, egoistic preferences have zero mass in our preference space. In consequence, in Figure 11, IAP turns out to be the most represented group (36% of total probability mass), followed by ESP and SSP, with almost the same representation (26% and 24% respectively).

Fig. 11. Social preference distribution

Finally, we can compare these results with those we obtain by estimating distributional preferences of a "representative subject", i.e. by estimating the distributional preferences of our pool under the constraint that β_s and γ_s are constant across s. In this case, estimated parameters of β and γ would be .104 and .436 respectively (with standard deviations equal to 0.018 and 0.065). The "representative agent" displays IAP distributional preferences in which guilt predominates over envy, a case not usually considered by the theoretical literature on social preferences. Moreover, given standard errors are comparatively small, the probability of our representative subject to display positive β and γ is equal to one.

5.2 TR_2: Estimating beliefs (I): the "revealed choice" approach

In this Section, we take for granted subjects' distributional preferences, and look at agents' decisions in the effort game to estimate their beliefs'. To this aim, two alternative models are considered. In this Section, we shall look at agents' effort decisions as the result of a process of expected utility maximization. Assuming distributional preferences are constant across treatments (i.e. we can use each subject's (β_s, γ_s) pair to parametrize her F&S utility function), the effort decision (partially) reveals each individual subjective belief over the effort decision of the opponent. We only condition these beliefs to player position and estimated preferences, obtaining (by maximum likelihood) subjective beliefs as polynomial functions of β and γ.

To this aim, we first set up the maximization process each player face to select her optimal effort decision. For notational convenience, in what follow we drop the subject and the period indexes (s and t respectively) . For each plan k at time , player i's utility function is

$$\begin{aligned} u_i^k(\delta) &= \pi_i^k(\delta) - \beta \max\left(\pi_j^k(\delta) - \pi_i^k(\delta), 0\right) - \gamma \max\left(\pi_i^k(\delta) - \pi_j^k(\delta), 0\right) \\ &= \pi_i^k(\delta) + (\beta + \gamma)\,\mathbf{1}\left(\pi_j^k(\delta) > \pi_i^k(\delta)\right)\left(\pi_i^k(\delta) - \pi_j^k(\delta)\right) - \gamma\left(\pi_i^k(\delta) - \pi_j^k(\delta)\right) \end{aligned}$$

where $\delta = (\delta_1, \delta_2)$, δ_i equals 1 if player i makes the effort, 0 otherwise.

The expected utility of playing $\delta_i^k = 1$ is then

$$
\begin{aligned}
E\left(u_i^k(1)\right) &= \pi_i^k(1,0) + \lambda_i^k\left[\pi_i^k(1,1) - \pi_i^k(1,0)\right] + \beta\left(\pi_i^k(1,0) - \pi_j^k(1,0)\right) \\
&\quad +\lambda_i^k\beta\left[\mathbf{1}\left(\pi_j^k(1,1) > \pi_i^k(1,1)\right)\left(\pi_i^k(1,1) - \pi_j^k(1,1)\right) - \left(\pi_i^k(1,0) - \pi_j^k(1,0)\right.\right. \\
&\quad +\lambda_i^k\gamma\left[\mathbf{1}\left(\pi_j^k(1,1) > \pi_i^k(1,1)\right)\left(\pi_i^k(1,1) - \pi_j^k(1,1)\right) - \left(\pi_i^k(1,1) - \pi_j^k(1,1)\right.\right.
\end{aligned}
$$

where λ_i^k is the player i conditional expectation on player j choice in plan k. Remind that the player knows if he's the "unlucky guy" $(i = 2)$ or not $(i = 2)$ and λ_i^k are conditional upon is role.

Given the plan k chosen by the dictator in the first stage

$$
\delta_i^k = \mathbf{1}\left(E_\Lambda\left[u_i^k(1)\right] > E_\Lambda\left[u_i^k(0)\right]\right) \tag{7}
$$

If we define

$$
\begin{aligned}
&K_i^k(1) = \left\{\left[\pi_i^k(1,1) - \pi_i^k(1,0)\right]\right. \\
&+\beta\left[\mathbf{1}\left(\pi_j^k(1,1) > \pi_i^k(1,1)\right)\left(\pi_i^k(1,1) - \pi_j^k(1,1)\right) - \left(\pi_i^k(1,0) - \pi_j^k(1,0)\right)\right] \\
&\left. + \gamma\left[\mathbf{1}\left(\pi_j^k(1,1) > \pi_i^k(1,1)\right)\left(\pi_i^k(1,1) - \pi_j^k(1,1)\right) - \left(\pi_i^k(1,1) - \pi_j^k(1,1)\right)\right]\right\}
\end{aligned}
$$

and

$$
K_i^k(0) = \left[\pi_i^k(0,1) - \pi_i^k(0,0)\right] - \gamma\left[\pi_i^k(0,1) - \pi_j^k(0,1)\right]
$$

the two expected utilities in (7) can be re-written as

$$
\begin{aligned}
E_\Lambda\left(u_i^k(1)\right) &= \pi_i^k(1,0) + \beta\left(\pi_i^k(1,0) - \pi_j^k(1,0)\right) + \lambda_i^k K_i^k(1) \\
E_\Lambda\left(u_i^k(0)\right) &= \pi_i^k(0,0) + \lambda_i^k K_i^k(0)
\end{aligned}
$$

We model subject s conditional expectation on her teammate choice in plan k at round t (λ_{ist}^k) as a logistic function of the subject characteristics (i.e. β_s, γ_s), her player position and of the plan characteristics $\left(b_{1t}^k, b_{2t}^k\right)$

$$
\lambda_{ist}^k = \frac{\exp\left(\psi_{i1} b_{it}^k + \psi_{i2}(b_{it}^k - b_{-it}^k) + \psi_{i3}\beta_s + \psi_{i4}\gamma_s\right)}{1 + \exp\left(\psi_{i1} b_{it}^k + \psi_{i2}(b_{it}^k - b_{-it}^k) + \psi_{i3}\beta_s + \psi_{i4}\gamma_s\right)} \tag{8}
$$

and assume

$$
\Pr\left(\delta_{ist}^k = 1 | \beta_s, \gamma_s, i, \left(b_{1t}^k, b_{2t}^k\right)\right) = \frac{\exp\left(E_\Lambda\left(u_{ist}^k(1)\right)\right)}{\exp\left(E_\Lambda\left(u_{ist}^k(1)\right)\right) + \exp\left(E_\Lambda\left(u_{ist}^k(0)\right)\right)}
$$

At this stage we take β_s, γ_s as given and we estimate λ_{ist}^k. The individual contribution to the pseudo-loglikelihood of an individual choosing plan k is

$$l_{ist} = \delta_{ist}^k E_\Lambda \left[u_{ist}^k(1)\right] + \left(1 - \delta_{ist}^k\right) E_\Lambda \left[u_{ist}^k(0)\right] - \ln\left(\exp\left(E_\Lambda \left[u_{ist}^k(1)\right]\right) + \exp\left(E_\Lambda \left[u_{ist}^k(0)\right]\right.\right.$$

Figure 12 reports the estimated values of ψ_{i1}, ψ_{i2} and ψ_{i3} in equation (8).

Fig. 12. Belief estimation I

5.3 TR_2: Estimating beliefs (II):the "frequentistic" (fictitious-play type) approach

In this Section, we estimate agents' beliefs by looking at the effort decisions *of their matched teammamtes.* This is to say, we assume that, along the 24 rounds of TR_2, agents look at their teammates' effort decision, and form their expectations conditional on their player position and the benefit pair (b_1^k, b_2^k) characterizing the ruling effort game $G(b^k)$. This information is used to predict player j actions according to the relation

$$\mu_{ist}^k \equiv \Pr\left(\delta_{jt}^k = 1 | L_{it}, \left(b_1^k, b_2^k\right), S_i, C_i\right) = \frac{\exp\left(f\left(L_{it}, \left(b_1^k, b_2^k\right), S_i, C_i\right)\right)}{1 + \exp\left(f\left(L_{it}, \left(b_1^k, b_2^k\right), S_i, C_i\right)\right)}. \tag{9}$$

where $f\left(L_{it}, \left(b_1^k, b_2^k\right), S_i, C_i\right) = \psi_0 + \psi_1 b_{-i} + \psi_2 b_{-i}^2 + \psi_3(b_1 - b_2) + \psi_4(b_1 - b_2)^2$. Notice that in this case the beliefs are necessarily conditional upon the set of team mates player i work with along the 24 periods, that is, we condition on the session (S_i) and cohort (C_i) player i belongs to. In Figure 13 we report the estimated values of ψ_0 to ψ_4 in equation (9).

Fig. 13. Belief estimation II

As Figure 13 shows, player i's beliefs are increasing (and concave) in the teammate's benefit, and decreasing (and convex) in the benefit's difference. We provide a graphic sketch on our estimated beliefs in Figure 14, which is composed of three different graphs. Figures 14a) and 14b) reports the contour graph of the estimated beliefs of player 1 and player 2, respectively, plotted in the $b_1 \times b_2$ space. In both graphs, we report the curve which corresponds to an estimated probability of $\frac{1}{2}$ with a dotted line. In Figure 14c) both lines are drawn on the same diagram, together with the contract space C. Depending on the region of Figure 14c) each contract (b_1, b_2) falls in, this implies the outcome which is most likely to be expected according to players' estimated beliefs (9).

Fig. 14. Estimated beliefs in the contract space

5.4 TR_3: Does separation emerge?

We are in the position to analyze data from our full-fledged model of TR_3, estimating how principals' (Section 6.4.1) and agents' (Section 6.4.2) contract and effort decisions depend on their individual estimates of β_s and γ_s.

5.4.1 TR_3 : Principals choosing contracts

We shall look at principals' decisions first. Remember that we cannot provide a complete formal analysis of principals' strategic situation, as each principal's decision cannot be abstracted from that of other principals within the same cohort. In choosing a plan, each principal, not only has to ensure that agents put the desired level of effort (possibly at minimal cost), but also has to face the competition of the other principals to attract the higher number of agents. Moreover, theory usually assumes that principals have no distributional concerns (i.e. they hold EPs). The exercise here, instead, is to check the extent to which their estimated preferences and beliefs are able to explain their contract choice.

To this aim, Figure 14 reports the estimation results of four different (tobit) regressions, which share the same structure:

$$y_{0st} = \vartheta_0 + \vartheta_1 \beta_s + \vartheta_2 \gamma_s + \vartheta_3 V_{st} + \vartheta_3 x_{st} + \vartheta_t + \varepsilon_s + v_{st}. \qquad (10)$$

The four regressions differ with respect to the dependent variable y_{0st} under consideration. In regression I the dependent variable is τ_{0st}, that is the variable we defined in (6) to measure the total contract cost relative to the available alternatives in C_t (whose evolution is traced in Figure 5).

In regression II, the dependent variable is instead $\theta_{0st} = \frac{1+\sigma_{0st}}{1+\tau_{0st}}$, a proxy of the trade off principals face between the (horizontal) induced inequality and total contract costs. Equations Ia and IIa use, as dependent variables, $E(\tau_{0st} \,|\mu)$ and $E(\frac{1+E(\sigma_{0st})}{1+E(\tau_{0st})} \,|\mu)$ respectively, that is the corresponding values of τ_{0st} and θ_{0st} conditional on the principals' beliefs (9). In the four regressions, the corresponding dependent variable y_{0st} is assumed to be a linear function of the subject's preference parameters (β_s, γ_s) and the (randomly generated) value for the principal V_{st}. A set of period specific dummy variables x_{st} are used to control for the heterogeneity of the choice sets across periods, as well as to control for cohort and for mechanism and preference profile for the choice set C_t, as derived from Figure 2. An individual time invariant (random) effect takes into account the unobserved individual heterogeneity. Assuming normality of the random components ε_s and v_{st} of equation (10) and strict exogeneity of the covariates, the parameters of interest can be estimated using a MLE for a double-censored tobit model for panel data. θ_0 is in fact bounded between 0 and 1 (regressions I and Ia) or 1/2 and 2 (regressions II and IIa). In Figure 15 we report the estimated values for ϑ_1 to ϑ_3.[10]

Fig. 15. Social preferences and contract choices (Principals)

As Figure 15 shows, principals characterized by higher β_s and γ_s (i.e. higher distributional concerns) tend to choose more expensive contracts, as the corresponding coefficients in regressions I and Ia are always positive and significant. The same conclusion holds both if we look at contracts face values (Regression I), or if we consider expected total costs, given our estimated system of subjective beliefs (Regression Ia). Analogous considerations hold when we consider the trace off between induce inequality and total contract costs (Regressions II and IIa): the higher β_s and γ_s, the lower relative inequality, as the corresponding coefficients are always negative (and significant, with the exception of γ_s in equation IIa). In other words, our estimates suggest that principals' choices vary with the parameters of the F&S utility function: the more the principal is sensitive to envy and guilty, the more equalitarian (both with respect to "horizontal" as well as "vertical" inequality) is the contract offered to the workers. On the other hand, conditional on the characteristics of the choice set and on

[10]The estimated coefficients for ϑ_0, ϑ_4 and ϑ_t are omitted in Figure 15, but available upon request.

the preference parameters, the project values V_{st} does not seem to play a relevant role.

5.4.2 TR_3 : Agents choosing contracts and effort

We now move to analyze agents' contracts and effort choices in TR_3. In this case, we are concerned on the extent to which agents' decisions are consistent with our theoretical model. To this aim, Figure 16 reports the relative frequencies with which agents acted so as to maximize their expected utility, subject to their (common) subjective beliefs evaluated by (9).

Fig. 16. Relative frequencies of agents' consistent decisions in TR_3

In Figure 16, relative frequencies of consistent decisions are calculated as follows:

1. We begin to evaluate, for each period and subject, her optimal effort decision (conditional on her individual estimated parameters β_s and γ_s, her current player position i, and estimated (common) subjective beliefs μ_i) for all the contracts offered by the cohort principals for that cohort and period);

2. We then check, in Figure 16a), the relative frequency of effort decisions which correspond to the best-reply of the effort game selected by the Dictator;

3. The expected payoff of the optimal effort decision corresponds to the *value* associated to each available contract. In Figure 15b) we calculate the relative of contract choices which maximize each subject's expected value.

As Figure 16a) shows, the relative frequency of "optimal" effort decisions (highlighted in grey in the table) always exceeds 3/4 of total observations. As for non-optimal effort choices, subjects in both player positions tends more not to put effort when they should do it otherwise (with this tendency being higher for Player 1). As for the contract choice, again, optimal decisions correspond, for both player positions, to more than 4/5 of total observations.

To summarize, in analyzing our TR_3 market dynamics, we find that a) subjects' distributional preferences provide a consistent framework to explain the (heterogeneous) composition of the contract supply, as well as b) contract demand and effort decisions.

6 Conclusions

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.

Also, 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) depends on whether the choice of the optimal contract is made *before* or *after* agents' being acknowledged of their player position in the game. If agents choose the contract before knowing their relative position within the pair (i.e. "under the veil of ignorance"), their decisions may also reflect individuals' actitude to risk, as well as distributional considerations. The exercise would then be to collect additional information of our experimental subjects on these two complementary dimensions, measuring how these dimensions interact in the solution of the decision problem subjects face in the experiment.

References

[1] Agell, J., Lundborg, P., (1999) "Theories of Pay and Unemployment: Survey Evidence from Swedish Manufacturing Firms", *Scandinavian*

Journal of Economics, 97, 295-307.

[2] Andreoni, J., Miller, J., (1998). "Analyzing choice with revealed preference: is altruism rational?," Working papers 14, Wisconsin Madison - Social Systems.

[3] Baron, J. and D. Kreps (1999), *Strategic Human Resources - Frameworks for General Managers*, New York NY, John Wiley & Sons.

[4] Bazerman, M., Loewenstein, G. and Thompson, L., (1989). "Social utility and decision making in interpersonal contexts", *Journal of Personality & Social Psychology*, 57, 426-441.

[5] Bewley, T., (1999), *Why rewards don't fall during a Recession*, Cambridge MA, Harvard University Press.

[6] Binmore, K. and J. McCarthy and G. Ponti and L. Samuelson and Avner Shaked (2002), "A Backward Induction Experiment", *Journal of Economic Theory, 104, 48-88.*

[7] Blinder, A., Choi, D., (1990), "A Shred of Evidence on Theories of Reward Stickiness", *Quarterly journal of Economics* 105, 1003-1015.

[8] G.E.Bolton (1991), "A comparative model of bargaining: Theory and evidence", *American Economic Review*, 81, 1096 –1136.

[9] Bolton, G and A.Ockenfels (2000), "ERC:A theory of equity,reciprocity and competition", *American Economic Review*, 90, 166 –193.

[10] Camerer, C. and E. Fehr (2001), *Measuring social norms and preferences using experimental games: A guide for social scientists,* Institute for Empirical research in Economics - University of Zurich WP 97.

[11] Campbell, C.M., Kamlani, K.S, (1997) "The reasons for reward rigidity: Evidence from a Survey of Firms", *Quarterly journal of Economics* 112, 759-789.

[12] Cabrales, A., Calvó-Armengol, A., (2002), *Social Preferences and Skill Segregation*, Universitat Pompeu Fabra and Universidad Carlos III. Mimeo.

[13] Card, D. and J.E. DiNardo (2002) "Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles," *Journal of Labor Economics*, 20, 733-783.

[14] Charness, G. and Rabin, M., (2002), "Understanding Social Preferences with Simple Tests", *Quarterly Journal of Economics*, 117(3), 817-869.

[15] Costa-Gomes, M. and K. G. Zauner (2001), "Ultimatum Bargaining Behavior in Israel, Japan, Slovenia, and the United States. A Social Utility Analysis", *Games and Economic Behavior* 34, 238-269.

[16] Cox, J., Friedman, D., (2002). "A Tractable Model of Reciprocity and Fairness". University of Arizona. Working Paper.

[17] Crémer, J. (1993), "Corporate Culture: Cognitive Aspects," *Industrial and Corporate Change* 3, 351-386.

[18] Kreps, D.M. (1990) "Corporate Culture and Economic Theory," in James Alt and Kenneth Shepsle, eds., *Perspectives on Positive Political Economy*, New York: Cambridge University Press.

[19] Lazear, E.P. (1995), "Corporate Culture and the Diffusion of Values," in Horst Siebert, eds., *Trends in Business Organization*, Tübingen, Germany: J.C.B. Mohr.

[20] Fehr, E. and K.M.Schmidt (1999), "A theory of fairness,competition and cooperation",*Quarterly Journal of Economics*, 114, 817 –868.

[21] Fehr, E., Schmidt, K., (2000), "Fairness, Incentives and Contractual Choices", *European Economic Review*, 44, 1057-1068.

[22] Fehr, E. and K. Schmidt (2003), "Theories of Fairness and Reciprocity: Evidence and Economic Applications," M. Dewatripont, L.P. Hansen, and S. Turnovski, *Advances in Economic Theory. Eigth World Congress of the Econometric Society*, Cambridge: Cambridge University Press.

[23] Fischbacher, Urs (1999), *z-Tree. Toolbox for Ready-made Economic Experiments*, IEW Working paper 21, University of Zurich.

[24] Rey, P. (2004). "Inequity aversion and team incentives," University College London, mimeo.

[25] Huck, S., Rey Biel, P., (2002), *Inequity Aversion and the Timing of Team Production*, University College London. Mimeo.

[26] Lopez-Pintado, D., G. Ponti and E. Winter (2004), *Incentives and Hierarchies: an Experimental Study,* Universidad de Alicante, mimeo.

[27] Ochs, J. and A. E. Roth (1989), "An experimental study of sequential bargaining", *American Economic Review*, 79, 355-385.

[28] Sobel, J. (2005), "Interdependent Preferences and Reciprocity," *Journal of Economic Literature,* 43, 392-436.

[29] Shleifer, A. and R. W. Vishny (1997) "A survey of Corporate Governance", *Journal of Finance,* 52, 2, 737-783.

[30] Winter, E. (2000), "Incentives and Discrimination", *American Economic Review,* forthcoming.

7 Appendix

7.0.3 Proof of Proposition 1

In the case of *wini*, the search of the optimal mechanism corresponds to the following linear programming problem:

$$
\begin{aligned}
& \min b_1 + b_2 \text{ sub} && (11)\\
u_1(1,1) & \geq u_1(0,1) && (12)\\
u_2(1,1) & \geq u_2(1,0) && (13)\\
\gamma_1 & \leq \gamma_2 && (14)\\
b_i \geq 0; i & = 1,2 && (15)\\
\beta_i \geq \gamma_i; i & = 1,2 && (16)\\
\gamma_i & < 1; i = 1,2 && (17)
\end{aligned}
$$

Assumption (14) is wlog. We begin by partitioning the benefit space $B = \left\{(b_1, b_2) \in \Re^2_+\right\}$ in four regions, which specify the payoff ranking of each strategy profiles in $G(b)$. This partition is relevant for our problem, since it determines, for each strategy profile, whether is agent 1 or 2 the one who experiences envy (guilt):

$$
\begin{aligned}
R_1 &= \left\{b \in B : b_2 \leq b_1 - \frac{c}{\alpha}\right\};\\
R_2 &= \left\{b \in B : b_1 - \frac{c}{\alpha} \leq b_2 \leq b_1\right\};\\
R_3 &= \left\{b \in B : b_1 \leq b_2 \leq b_1 + \frac{c}{\alpha}\right\};\\
R_4 &= \left\{b \in B : b_2 \geq b_1 + \frac{c}{\alpha}\right\}.
\end{aligned}
$$

Let $g^1(b_1) = b_1$ $\left(g^2(b_1) = b_1 - \frac{c}{\alpha}\right)$ $\left[g^3(b_1) = b_1 + \frac{c}{\alpha}\right]$ define the three linear constraints upon which our partition is built. The strategy proof is as follows. We shall solve the linear programming problem (11-17) in the four regions independently (since, within each region, social utility parameters are constant for each agent and strategy profile), checking which of the four solutions minimizies the benefit sum $b_1 + b_2$.

Let $\hat{b}^k \equiv (\hat{b}^k_1, \hat{b}^k_2)$ denote the solution of (11-17) in R_k.

Lemma 11 $\hat{b}^1 = \left(\frac{c(1+\beta_2)}{(1-\alpha)\alpha}, \frac{c(\alpha+\beta_2)}{(1-\alpha)\alpha}\right)$.

Proof. 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 (12-13) correspond to

$$b_2 \geq f_1^1(b_1) \equiv \frac{c(1-\gamma_1)}{(1-\alpha)\gamma_1} - \frac{1-\gamma_1}{\gamma_1}b_1; \qquad (18)$$

$$b_2 \geq f_2^1(b_1) \equiv \frac{c}{1-\alpha} + \frac{\beta_2}{1+\beta_2}b_1, \qquad (19)$$

Let x_i^k define the value of b_1 such that $f_i^k(b_1) = 0$. By the same token, let y_i^k denote the intercept of $f_i^k(b_1)$, i.e. $f_i^k(0)$. Finally, let τ_i^k denote the slope of $f_i^k(b_1)$. We then have $x_1^1 = \frac{c}{1-\alpha}$ and $x_2^1 = -\frac{c(1+\beta_2)}{(1-\alpha)\beta_2}$. Also notice that $\tau_2^1 = \frac{\beta_2}{1+\beta_2} < 1$ and $y_2^1 = \frac{c}{1-\alpha} > 0$. This implies that $f_2^1(b_1)$ and $g^2(b_1)$ intersect in the first quadrant (see Figure 1). On the other hand, $f_1^1(b_1)$ is never binding in this case, since $\tau_1^1 = -\frac{1-\gamma_1}{\gamma_1} < 0$ and $x_1^1 = \frac{c}{\alpha}$. This implies that $b_1 + b_2$ is minimized where $f_2^1(b_1)$ and $g^2(b_1)$ intersect, i.e. when $\hat{b}_1^1 = \frac{c(1+\beta_2)}{(1-\alpha)\alpha}$ and $\hat{b}_2^1 = \frac{c(\alpha+\beta_2)}{(1-\alpha)\alpha}$. ■

Lemma 12

$$\hat{b}^2 = \begin{cases} \left(\frac{c(-1+\beta_2(-1+\gamma_1)+2\gamma_1+\alpha(-1+2\gamma_1)(-1+\gamma_2)-\gamma_1\gamma_2}{(-1+\alpha)(1+\beta_2-\gamma_1+\alpha(-1+\gamma_1+\gamma_2)}, \frac{c(-1+\gamma_1)(-1+\beta_2-\gamma_2+\alpha(-1+2\gamma_2))}{(-1+\alpha)(1+\beta_2-\gamma_1+\alpha(-1+\gamma_1+\gamma_2)}\right) & \text{if } \gamma_1 < \frac{1}{2} \\ \left(\frac{c(1-\gamma_1)}{1-\alpha}, \frac{c(1-\gamma_1)}{1-\alpha}\right) & \text{if } \gamma_1 \geq \frac{1}{2} \end{cases}$$

Proof. R_2, the relevant constraints are as follows:

$$b_2 \geq f_1^2(b_1) \equiv \frac{c(1-\gamma_1)}{(1-\alpha)\gamma_1} - \frac{1-\gamma_1}{\gamma_1}b_1; \qquad (20)$$

$$b_2 \geq f_2^2(b_1) \equiv \frac{c(1-\gamma_2)}{1+\beta_2-\alpha(1-\gamma_2)} + \frac{\beta_2+\alpha\gamma_2}{1+\beta_2-\alpha(1-\gamma_2)}b_1. \qquad (21)$$

Notice that e $\tau_2^2 < 1$ since $\alpha < 1$. This implies, $x_1^2 = \frac{c}{1-\alpha}$ and $x_2^2 = -\frac{(1+\beta_2)c}{(1-\alpha)\beta_2}$. Also notice that $f_1^1(b_1) = f_1^2(b_1)$ (i.e. the constraint for agent 1 is unchanged). As for agent 2, we have $y_{21}^2 < y_2^1$ and $\tau_2^2 = \tau_2^1$. Since $\tau_1^2 = -\frac{1-\gamma_1}{\gamma_1}$; $|\tau_1^2| > 1$ if $\gamma_1 < \frac{1}{2}$. Let $\tilde{x}_i^k$denote a fixed point of f_i^k (i.e. a solution of

$f_i^k(x) = g^1(x)$). As for R_2, we have $\tilde{x}_1^2 = \frac{c(1-\gamma_1)}{1-\alpha}$ and $\tilde{x}_2^2 = \frac{c(1-\gamma_2)}{1-\alpha}$. Since (wlog) $\gamma_1 < \gamma_2$, we have $\tilde{x}_1^2 > \tilde{x}_2^2$. This, in turn, implies that, if $\gamma_1 < \frac{1}{2}$ ($\gamma_1 \geq \frac{1}{2}$) the solution is at the intersection between $f_1^2(b_1)$ and $f_2^2(b_1)$ ($f_1^2(b_1)$ and $g^1(b_1)$) (see Figure x). This completes the proof. ■

Lemma 13 $\hat{b}^3 = \left(\frac{(1-\gamma_1)c}{1-\alpha}, \frac{(1-\gamma_2)c}{1-\alpha}\right)$.

Proof. R_3, the relevant constraint are as follows:

$$\begin{aligned} b_2 &\leq f_1^3(b_1) = -\frac{c(1-\gamma_1)}{\beta_1 + \alpha\gamma_1} + \frac{1+\beta_1 - \alpha(1-\gamma_1)}{\beta_1 + \alpha\gamma_1} b_1; \qquad (22) \\ b_2 &\geq f_2^3(b_1) = \frac{c}{1-\alpha} + \frac{\gamma_2}{1-\gamma_2} b_1 \qquad (23) \end{aligned}$$

This imples $x_1^3 = \frac{c(1-\gamma_1)}{1+\beta_1-\alpha(1-\gamma_1)}$ and $x_2^3 = \frac{c(1-\gamma_2)}{(1-\alpha)\gamma_2}$. By analogy with R_2, we calculate $\tilde{x}_1^3 = \frac{(1-\gamma_1)c}{1-\alpha}$ and $\tilde{x}_2^3 = \overset{\sim 3}{x_2} \frac{(1-\gamma_2)c}{1-\alpha}$.Again, $\tilde{x}_1^3 > \tilde{x}_2^3$, since $\gamma_1 < \gamma_2$, the result follows. ■

Lemma 14 $\hat{b}^4 = \left(\frac{(\alpha+\beta)c}{(1-\alpha)\alpha}, \frac{(1+\beta_1)c}{\alpha(1-\alpha)}\right)$.

Proof. for R4, we have

$$\begin{aligned} b_2 &\leq -\frac{c(1+\beta_1)}{\beta_1(1-\alpha)} + (1 + \frac{1}{\beta_1})b_1; \qquad (24) \\ b_2 &\geq \frac{c}{1-\alpha} + \frac{\gamma_2}{1-\gamma_2} b_1 \qquad (25) \end{aligned}$$

This implies $x_1^4 = \frac{c}{1-\alpha}$ and $x_2^4 = \frac{c(1-\gamma_2)}{(1-\alpha)\gamma_2}$, from which the result follows. ■

We are in the position to prove Proposition 1.

Proof. roof of Proposition 1] We begin by showing 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, in case of $k = 2$ ($k = 1$). If x_i^{kl} solves $f_1^k(x) = g^l(x)$, then $x_2^{12} = x_2^{22} = \frac{c(1+\beta_2)}{\alpha(1-\alpha)}$, which, in turn, implies (see Figure xx)

$$\begin{aligned} \hat{b}_1^1 &= \frac{c(1+\beta_2)}{\alpha(1-\alpha)} > x_1^{11} = \frac{c(1-\gamma_1)}{1-\alpha} \geq \hat{b}_1^2 \text{ and} \\ \hat{b}_2^1 &= \frac{c(\alpha+\beta_2)}{\alpha(1-\alpha)} > x_1^{12} = \frac{c(1-\gamma_1)}{1-\alpha} \geq \hat{b}_2^2.. \end{aligned}$$

As for the comparison between $\hat{b}_i^4$ and $\hat{b}_i^3$,

$$\begin{aligned}
\hat{b}_1^4 &= \frac{c(\alpha+\beta_1)}{\alpha(1-\alpha)} = \frac{c(1+\frac{\beta_1}{\alpha})}{1-\alpha} > \frac{c(\alpha-\gamma_1)}{1-\alpha} = \hat{b}_1^3 \text{ and} \\
\hat{b}_2^4 &= \frac{c(1+\beta_1)}{\alpha(1-\alpha)} > \frac{c(1-\gamma_1)}{1-\alpha} = \hat{b}_2^3.
\end{aligned}$$

Last, but not least, we compare $\hat{b}_i^2$ and $\hat{b}_i^3$. In this case, we have

$$\begin{aligned}
\hat{b}_1^3 &= x_1^{21} = \frac{c(1-\gamma_1)}{1-\alpha} \geq \hat{b}_1^2 \text{ (see Figure xx) and} \\
\hat{b}_2^3 &= x_1^{21} = \frac{c(1-\gamma_1)}{1-\alpha} \geq x_1^{12} = \frac{c(1-\gamma_1)}{1-\alpha} \geq \hat{b}_2^2.
\end{aligned}$$

Since $\hat{b}_i^2 \leq \hat{b}_i^k, \forall k$, the result follows. ■

7.0.4 Proof of Proposition 2

In the case of *sini*, the search of the optimal mechanism corresponds to the *wini* linear programming problem (11-17) with a new constraint (implementation with a unique equilibrium):

$$u_1(1,0) \geq u_1(0,0) \tag{26}$$

We begin, just like in the case of w*ini,* by partitioning the benefit space $B = \left\{(b_1, b_2) \in \Re_+^2\right\}$ in four regions, which specify the payoff ranking of each strategy profiles in $G(b)$. Let $\hat{b}^k \equiv (\hat{b}_1^k, \hat{b}_2^k)$ denote the solution of (11-17) with the new constraint (26) in R_k.

Lemma 15 $\hat{b}^1 = \left(\frac{c(1+\beta_2)}{(1-\alpha)\alpha}, \frac{c(\alpha+\beta_2)}{(1-\alpha)\alpha}\right)$.

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

$$b_2 \geq f_1^1(b_1) \equiv \frac{c(1-\gamma_1)}{(1-\alpha)\gamma_1} - \frac{1-\gamma_1}{\gamma_1}b_1, \tag{27}$$

$$b_2 \geq f_3^1(b_1) \equiv \frac{c(1-\gamma_1)}{\alpha(1-\alpha)\gamma_1} - \frac{1-\gamma_1}{\gamma_1}b_1, \tag{28}$$

$$b_2 \geq f_2^1(b_1) \equiv \frac{c}{1-\alpha} + \frac{\beta_2}{1+\beta_2}b_1, \tag{29}$$

We first notice that (27) is not binding. This is becasue (27) defines a constraint which is parallel to (28), but with a smaller intercept ($y_1^1 < y_3^1$, since $\alpha < 1$). Also notice that (28) is not binding either. This is becuase, $\tau_3^1 < 0$, $\tau_2^1 > 0$, and $x_3^{12} = \frac{c(1-\alpha\gamma_1)}{\alpha(1-\alpha)} < x_2^{12} = \frac{c(1+\beta_2)}{\alpha(1-\alpha)}$.

This implies that, in R_1, $(b_1 + b_2)$ is minimized (like as for *wini*) where $f_2^1(b_1)$ and $g^2(b_1)$ intersect, i.e. when $\hat{b}_1^1 = \frac{c(1+\beta_2)}{(1-\alpha)\alpha}$ and $\hat{b}_2^1 = \frac{c(\alpha+\beta_2)}{(1-\alpha)\alpha}$. ■

Lemma 16

$$\begin{cases} \hat{b}_1^2 = \frac{c((1+\beta_1)(1+\beta_2)-\alpha(1-\gamma_2))}{\alpha(1+\beta_1+\beta_2-\alpha(1+\beta_1-\gamma_2))} \\ \hat{b}_2^2 = \frac{c(1+\beta_1)(\alpha+\beta_2)}{\alpha(1+\beta_1+\beta_2-\alpha(1+\beta_1-\gamma_2))} \end{cases}$$

Proof. R_2, the relevant constraints are as follows:

$$b_2 \geq f_1^2(b_1) \equiv \frac{c(1-\gamma_1)}{(1-\alpha)\gamma_1} - \frac{1-\gamma_1}{\gamma_1} b_1 \tag{30}$$

$$b_2 \leq f_3^2(b_1) \equiv -\frac{c(1+\beta_1)}{\alpha\beta_1} + \frac{1+\beta_1}{\beta_1} b_1 \tag{31}$$

$$b_2 \geq f_2^2(b_1) \equiv \frac{c(1-\gamma_2)}{1+\beta_2+\alpha(1-\gamma_2)} - \frac{\beta_2+\alpha\gamma_2}{1+\beta_2+\alpha(1-\gamma_2)} b_1. \tag{32}$$

Notice that, by analogy with R_1, condition (30) is not binding since $\tau_1^2 < 0$, $\tau_3^2 > 0$ and $x_1^{11} < x_3^{11}$. Also notice that $g^2(b_1)$ is not binding either, since $x_3^{22} = \frac{c}{\alpha}$ and $\tau_3^2 = \frac{1+\beta_1}{\beta_1} > 1$. 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. ■

Lemma 17 $\hat{b}^3 = \left(\frac{(1-\beta_1)c}{\alpha}, \frac{(1-\beta_1)c}{\alpha}\right)$.

Proof. R_3, the relevant constraint are as follows:

$$b_2 \leq f_1^3(b_1) = -\frac{c(1-\gamma_1)}{\beta_1+\alpha\gamma_1} + \frac{1+\beta_1-\alpha(1-\gamma_1)}{\beta_1+\alpha\gamma_1} b_1 \tag{33}$$

$$b_2 \leq f_3^3(b_1) = -\frac{c(1+\beta_1)}{\alpha\beta_1} + \frac{1+\beta_1}{\beta_1} b_1 \tag{34}$$

$$b_2 \geq f_2^3(b_1) = \frac{c}{1-\alpha} + \frac{\gamma_2}{1-\gamma_2} b_1 \tag{35}$$

Again, also for R_3 (33) is not binding, because $f_1^3(b_1)$ stays at the left of $f_3^3(b_1)$ in all R_3, since, by (1), $x_1^3 = \frac{c(1-\gamma_1)}{1+\beta_1-\alpha(1-\gamma_1)} < x_3^3 = \frac{c}{\alpha}$. Condition (1) also implies that (35) is not binding either, because, in R_3, $f_2^3(b1)$ stays on the right of $f_3^3(b_1)$, since $x_2^{31} = \frac{c(1-\gamma_2)}{(1-\alpha)} < x_3^{31} = \frac{c(1+\beta_1)}{\alpha}$ and slopes have opposite signs. This implies that $(b_1 + b_2)$ is minimized where $f_3^3(b_1)$ and $g^1(b_1)$ intersect, i.e. when $\hat{b}_1^1 = \hat{b}_2^1 = \frac{(1-\beta_1)c}{\alpha(1-\alpha)}$ ■

Lemma 18 $\hat{b}_1^4 = \frac{c(1+2\beta_1)}{\alpha}$ *and* $\hat{b}_2^4 = \frac{2c(1+\beta_1)}{\alpha}$.

Proof. R_4, we have

$$b_2 \geq -\frac{c(1+\beta_1)}{\beta_1(1-\alpha)} + \frac{1+\beta_1}{\beta_1}b_1 \tag{36}$$

$$b_2 \geq -\frac{c(1+\beta_1)}{\alpha\beta_1} + \frac{1+\beta_1}{\beta_1}b_1 \tag{37}$$

$$b_2 \geq \frac{c}{1-\alpha} + \frac{\gamma_2}{1-\gamma_2}b_1 \tag{38}$$

First of all, notice that (36) is parallel to (37), with $x_1^4 = \frac{c}{1-\alpha} < x_1^4 = \frac{c}{\alpha}$. This implies that, by analogy with all other cases, (36) is not binding. On the other hand, condition (38) is not binding either, since $\tau_2^4 < 0$, $\tau_3^4 > 0$ and also $x_2^{41} = \frac{c(1-\gamma_2)}{1-\alpha} < x_3^{41} = \frac{c(1+\beta_1)}{\alpha}$. This implies that $(b_1 + b_2)$ is minimized where $f_3^4(b_1)$ and $g^3(b_1)$ intersect, i.e. when $\hat{b}_1^4 = \frac{c(1+2\beta_1)}{\alpha}$ and $\hat{b}_2^4 = \frac{2c(1+\beta_1)}{\alpha}$.
■

We are in the position to prove Proposition 2.

Proof. roof of Proposition 2] We begin by showing that $\hat{b}_i^1 > \hat{b}_i^2, i = 1, 2$.

$$\hat{b}_1^1 = \frac{c(1+\beta_2)}{\alpha(1-\alpha)} = xx1[2] \geq \frac{c(\alpha - (1+\beta_1)(1+\beta_2) + \alpha^2\gamma_1(-1+\gamma_2) - \alpha\gamma_2)}{(-1+\alpha)\alpha(1+\beta_1+\beta_2+\alpha(-1+\gamma_1+\gamma_2)} = \hat{b}_1^2 \text{ and}$$

$$\hat{b}_2^1 = \frac{c(\alpha+\beta_2)}{\alpha(1-\alpha)} \geq f(xx1[2]) \geq \frac{c(-\alpha - (1+\beta_1) - (1+\beta_1)\beta_2 + \alpha^2(\gamma_1 - 1)(\gamma_2 - 1)}{(-1+\alpha)\alpha(1+\beta_1+\beta_2+\alpha(-1+\gamma_1+\gamma_2)} = \hat{b}_2^2$$

[***Double check from here***]:

It is easy to see that $\hat{b}_i^4 = \hat{b}_i^3$,

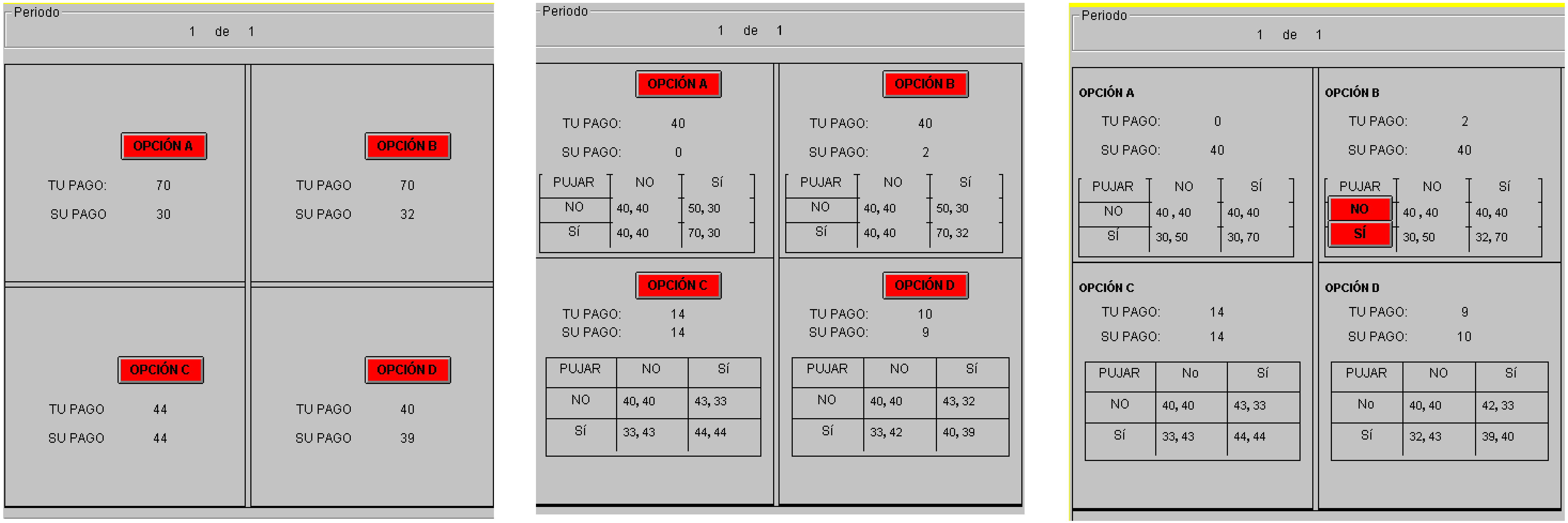
$$\hat{b}_1^4 = \frac{(1+(2-\alpha)\beta_1)c}{(1-\alpha)\alpha} \geq \frac{(1-\beta_1)c}{\alpha(1-\alpha)} = \hat{b}_1^2 \text{ and}$$

$$\hat{b}_2^4 = \frac{(1+\beta_1)(2-\alpha)c}{(1-\alpha)\alpha} \geq \frac{(1-\beta_1)c}{\alpha(1-\alpha)} = \hat{b}_2^2.$$

We need only to compare $\hat{b}_i^2$ and $\hat{b}_i^3$. In this case, we have

$$\begin{aligned} \hat{b}_1^3 &= \frac{(1-\beta_1)c}{\alpha(1-\alpha)} = xx0[1.2] \geq \frac{c(\alpha - (1+\beta_1)(1+\beta_2) + \alpha^2\gamma_1(-1+\gamma_2) - \alpha\gamma_2)}{(-1+\alpha)\alpha(1+\beta_1+\beta_2+\alpha(-1+\gamma_1+\gamma_2)} = \hat{b}_1^2 \text{ and} \\ \hat{b}_2^3 &= \frac{(1-\beta_1)c}{\alpha(1-\alpha)} = f(xx0[1.2]) \geq \frac{c(-\alpha - (1+\beta_1) - (1+\beta_1)\beta_2 + \alpha^2(\gamma_1 - 1)(\gamma_2 - 1)}{(-1+\alpha)\alpha(1+\beta_1+\beta_2+\alpha(-1+\gamma_1+\gamma_2)} = \hat{b} \end{aligned}$$

Since $\hat{b}_i^2 \leq \hat{b}_i^k, \forall k$, the result follows. ■


Periodo
1 de 1
OPCIÓN A
TU PAGO: 70
SU PAGO 30
OPCIÓN B
TU PAGO 70
SU PAGO 32
OPCIÓN C
TU PAGO 44
SU PAGO 44
OPCIÓN D
TU PAGO 40
SU PAGO 39
Periodo
1 de 1
OPCIÓN A
TU PAGO: 40
SU PAGO: 0
PUJAR NO SÍ
NO 40, 40 50, 30
SÍ 40, 40 70, 30
OPCIÓN B
TU PAGO: 40
SU PAGO: 2
PUJAR NO SÍ
NO 40, 40 50, 30
SÍ 40, 40 70, 32
OPCIÓN C
TU PAGO: 14
SU PAGO: 14
PUJAR NO SÍ
NO 40, 40 43, 33
SÍ 33, 43 44, 44
OPCIÓN D
TU PAGO: 10
SU PAGO: 9
PUJAR NO SÍ
NO 40, 40 43, 32
SÍ 33, 42 40, 39
Periodo
1 de 1
OPCIÓN A
TU PAGO: 0
SU PAGO: 40
PUJAR NO SÍ
NO 40 , 40 40, 40
SÍ 30, 50 30, 70
OPCIÓN B
TU PAGO: 2
SU PAGO: 40
PUJAR NO SÍ
NO 40 , 40 40, 40
SÍ 30, 50 32, 70
OPCIÓN C
TU PAGO: 14
SU PAGO: 14
PUJAR No SÍ
NO 40, 40 43, 33
SÍ 33, 43 44, 44
OPCIÓN D
TU PAGO: 9
SU PAGO: 10
PUJAR NO SÍ
No 40, 40 42, 33
SÍ 32, 43 39, 40

a) *b)* *c)*

Fig. 0

Period	1	2	3	4	5	6	7	8	9	10	11	12
Mech.	wini	mix	sini	sini	wini	mix	wini	mix	sini	sini	wini	mix
Pref. Type	IAP	IAP	IAP	mix	mix	mix	SSP	SSP	SSP	ESP	ESP	ESP

Period	13	14	15	16	17	18	19	20	21	22	23	24
Mech.	sini	mix	wini	mix	wini	sini	sini	mix	wini	wini	mix	sini
Pref. Type	IAP	IAP	IAP	ESP	ESP	ESP	SSP	SSP	SSP	mix	mix	mix

Fig. 2

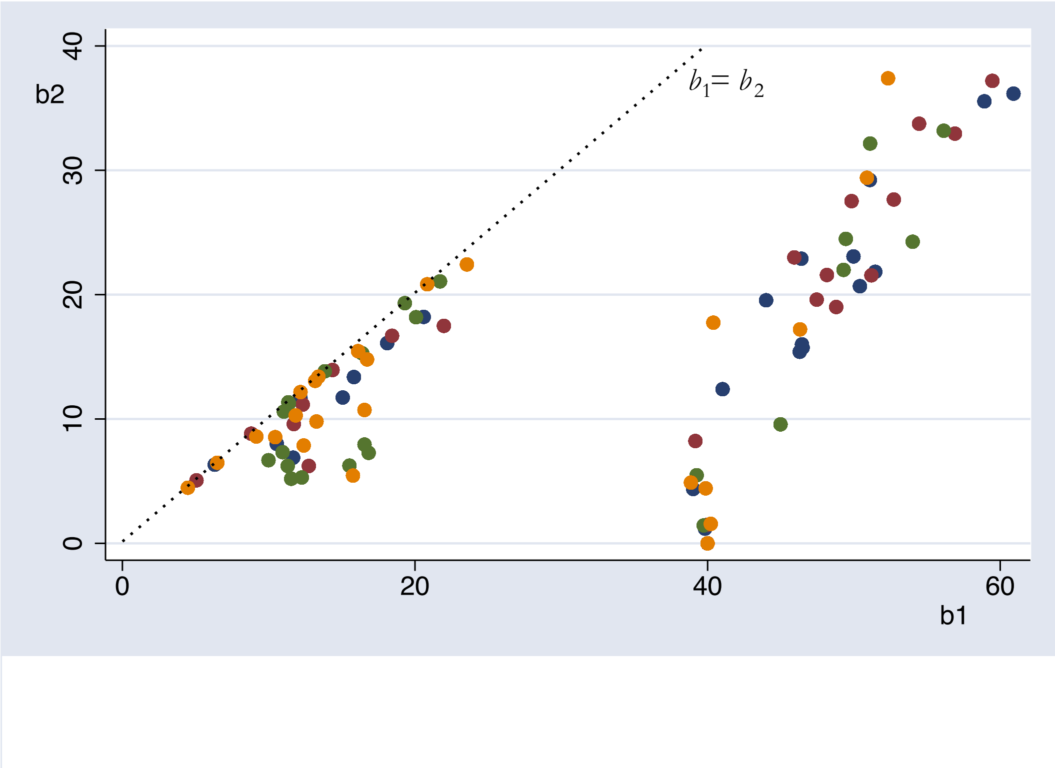


Figure 3

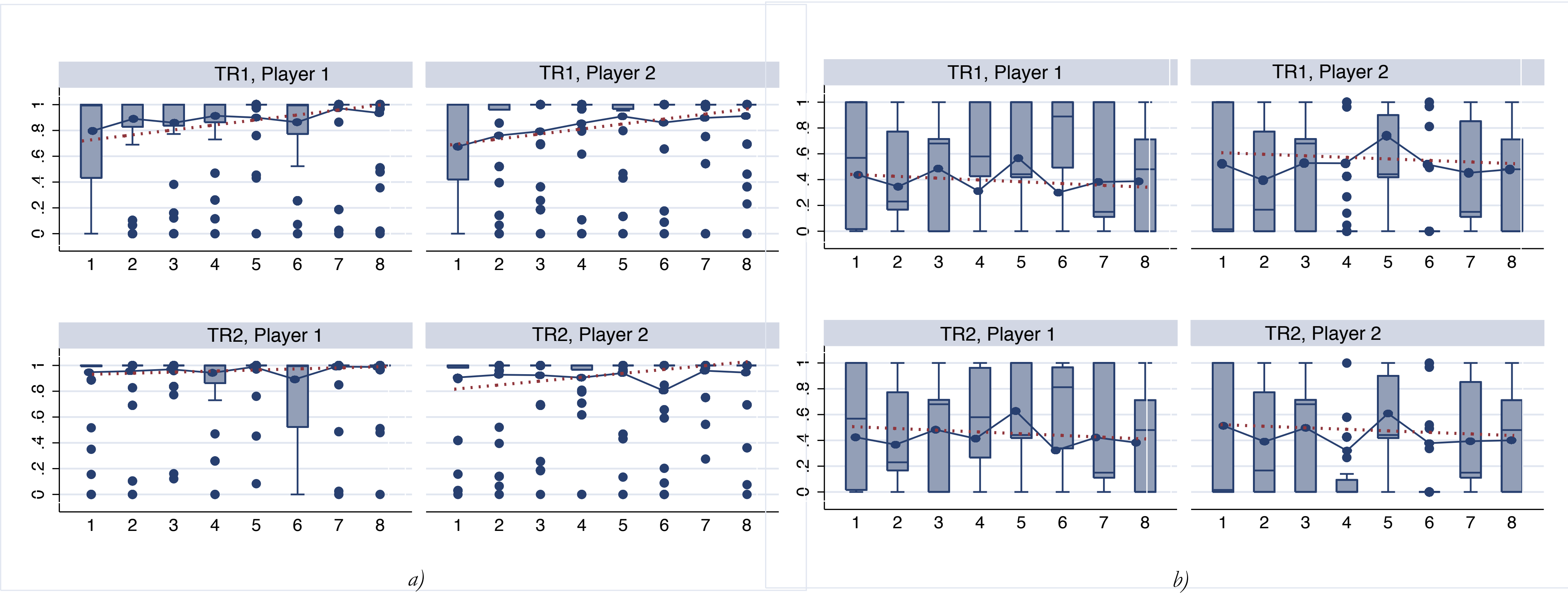

TR1, Player 1
TR1, Player 2
TR2, Player 1
TR2, Player 2
0 .2 .4 .6 .8 1
1 2 3 4 5 6 7 8
a)
TR1, Player 1
TR1, Player 2
TR2, Player 1
TR2, Player 2
0 .2 .4 .6 .8 1
1 2 3 4 5 6 7 8
b)

Figure 4

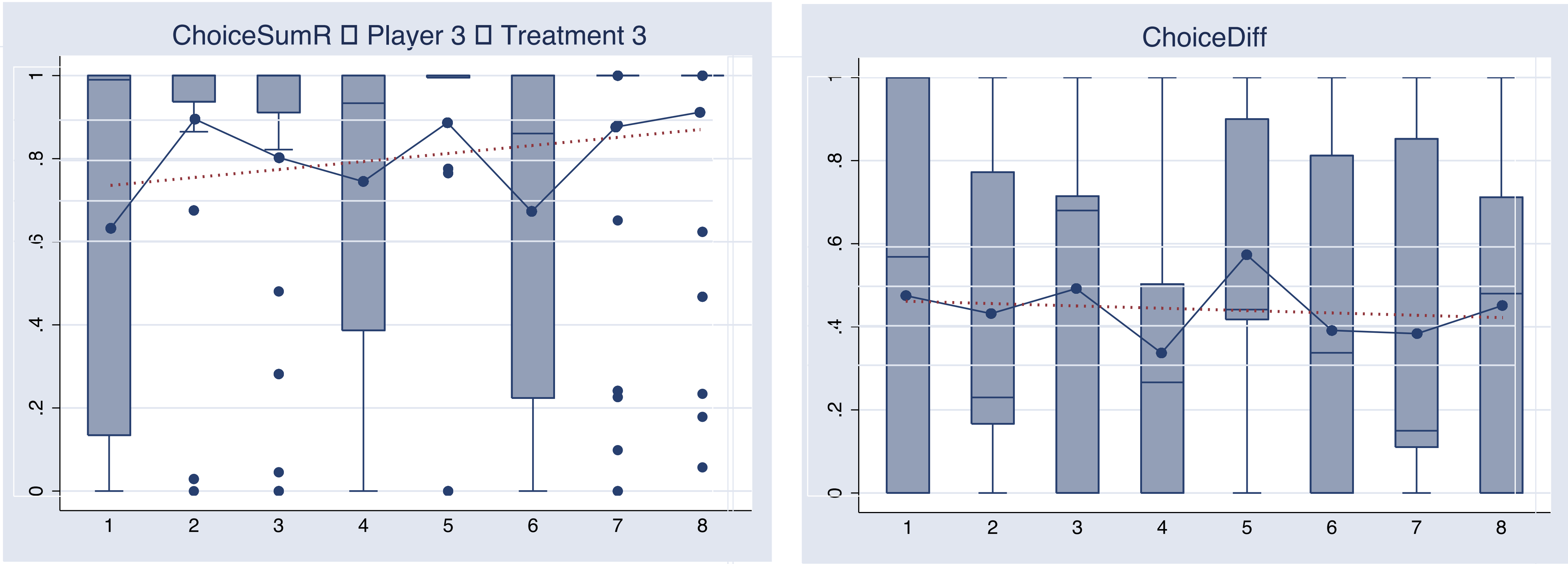

ChoiceSumR Player 3 Treatment 3
0
.2
.4
.6
.8
1
1
2
3
4
5
6
7
8
ChoiceDiff
0
.2
.4
.6
.8
1
1
2
3
4
5
6
7
8

Figure 5

	TR1: AGENTS				TR2: AGENTS				TR3: PRINCIPALS	
	Player 1		Player 2		Player 1		Player 2			
	wini	sini	wini	sini	wini	sini	wini	sini	wini	sini
First 12	**22**	**122**	**66**	**78**	**1**	**143**	**50**	**94**	**28**	**68**
	15.28	84.72	45.83	54.17	0.69	99.31	34.72	65.28	29.17	70.83
Last 12	**4**	**140**	**54**	**90**	**6**	**138**	**42**	**102**	**20**	**76**
	2.78	97.22	37.5	62.5	4.17	95.83	29.17	70.83	20.83	79.17
Total	**26**	**262**	**120**	**168**	**7**	**281**	**92**	**196**	**48**	**144**
	9.03	90.97	41.67	58.33	2.43	97.57	31.94	68.06	25	75

Fig. 6

	TR2				TR3			
	wini		sini		wini		sini	
	Player 1	Player 2	Player 1	Player 2	Player 1	Player 2	Player 1	Player 2
First 12	0,60	0,52	0,93	0,65	0,56	0,50	0,93	0,70
Last 12	0,42	0,35	0,91	0,58	0,31	0,36	0,89	0,57

Fig. 7

	TR2 - WINI				TR2 - SINI				TR3 - WINI				TR3 - SINI			
	n=0	Only Agent 2	Only Agent 1	n=2	n=0	Only Agent 2	Only Agent 1	n=2	n=0	Only Agent 2	Only Agent 1	n=2	n=0	Only Agent 2	Only Agent 1	n=2
First 12	44	24	37	63	10	8	83	163	35	15	22	42	6	7	46	115
%	**26.19**	**14.29**	**22.02**	**37.50**	**3.79**	**3.03**	**31.44**	**61.74**	**30.70**	**13.16**	**19.30**	**36.84**	**3.45**	**4.02**	**26.44**	**66.09**
Last 12	80	19	31	41	19	5	90	147	59	15	10	24	17	2	60	101
%	**46.78**	**11.11**	**18.13**	**23.98**	**7.28**	**1.92**	**34.48**	**56.32**	**54.63**	**13.89**	**9.26**	**22.22**	**9.44**	**1.11**	**33.33**	**56.11**
Total	124	43	68	104	29	13	173	310	94	30	32	66	23	9	106	216
%	**36.58**	**12.68**	**20.06**	**30.68**	**5.52**	**2.48**	**32.95**	**59.05**	**42.34**	**13.51**	**14.41**	**29.73**	**6.50**	**2.54**	**29.94**	**61.02**

Fig. 8

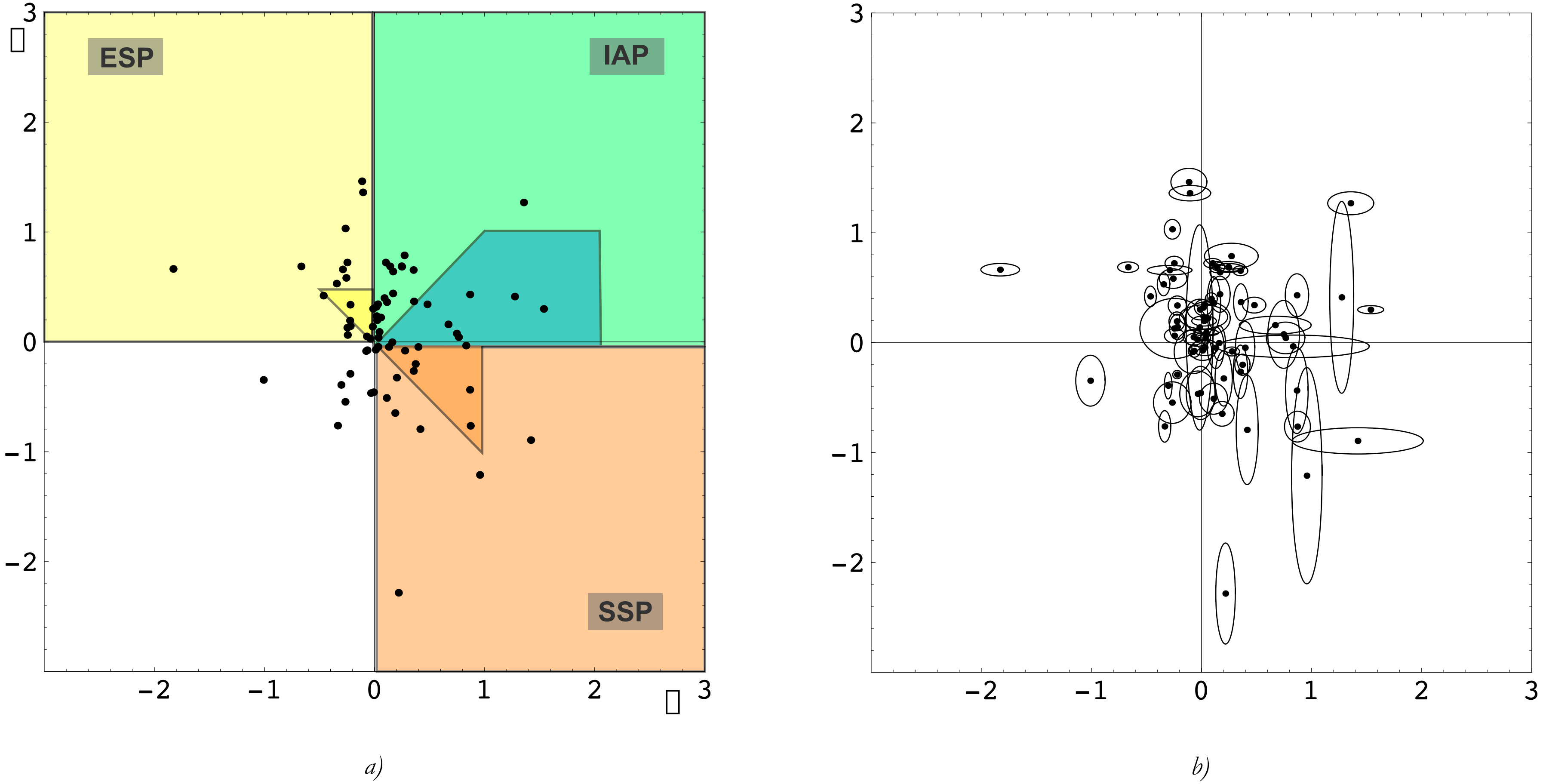


Fig. 9. Distributional preferences

	EGO	IAP	SSP	XXX	ESP
Agents	11	8	10	6	13
%	**22.92**	**16.67**	**20.83**	**12.50**	**27.08**
Principals	3	6	6	1	8
%	**12.50**	**25.00**	**25.00**	**4.17**	**33.33**
Total	14	14	16	7	21
%	**19.44**	**19.44**	**22.22**	**9.72**	**29.17**

Fig. 10

	IAP	SSP	XXX	ESP	Obs.
Agents	0,35	0,25	0,16	0,24	48
Principals	0,39	0,22	0,07	0,32	24
Total	**0,36**	**0,24**	**0,13**	**0,26**	**72**

Fig. 11

	Player 1			Player 2		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Myb	0,02	0,01	0,00	0,05	0,02	0,01
dif	-0,02	0,02	0,27	0,07	0,13	0,61
beta	0,55	0,22	0,01	1,10	2,22	0,62
gamma	-1,12	0,32	0,00	-3,99	2,38	0,09

Fig. 12

	Player 2's beliefs				Player 1's beliefs			
effort	Coef.	Std. Err.	z	P>z	Coef.	Std. Err.	z	P>z
mybb	.4967664	.0672846	7.38	0.000	.4682897	.0569912	8.22	0.000
mybb_2	-.0040376	.0008645	-4.67	0.000	-.0063952	.0012334	-5.19	0.000
myabsdiff	-.3775495	.0718138	-5.26	0.000	-.1411468	.0590848	-2.39	0.017
myabsdiff_2	.0058284	.0015229	3.83	0.000	.0039289	.0018469	2.13	0.033
_cons	-5,927794	.7787466	-7.61	0.000	-5,24932	.5569641	-9.42	0.000

Fig. 13

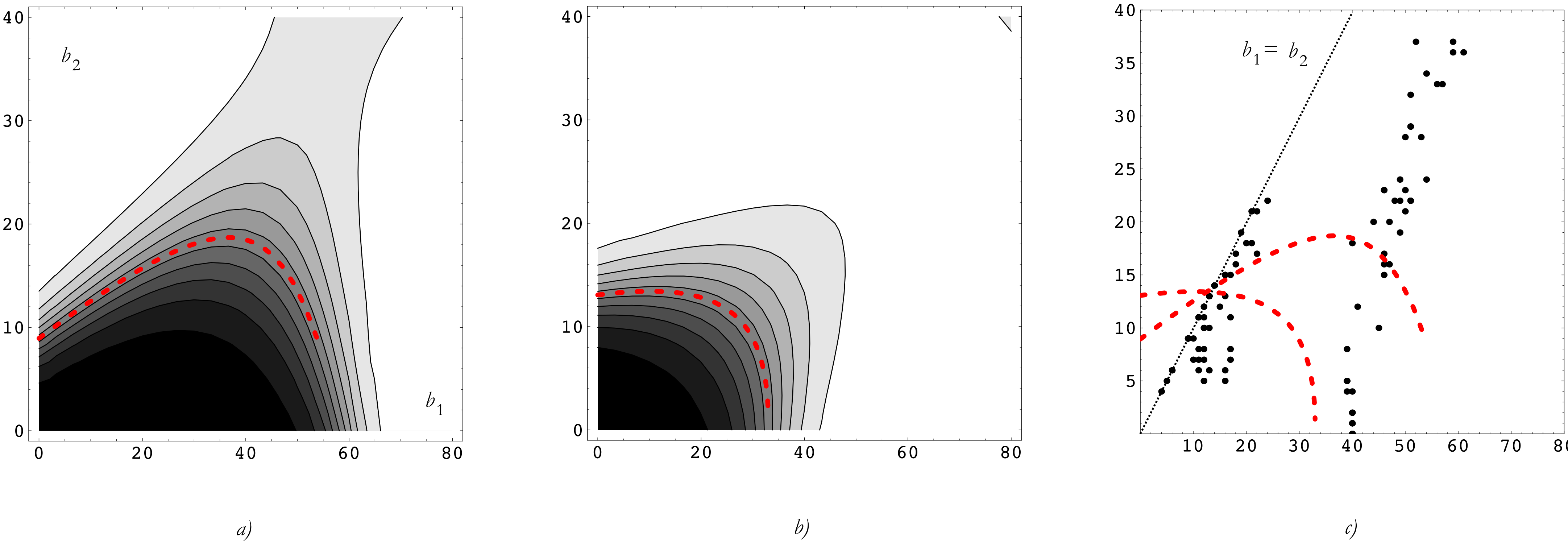


Fig. 14. Belief Estimation

	Regression I			Regression Ia			Regression II			Regression Iia		
	Coeff.	**Std. Err.**	**p-value**	**Coeff.**	**Std. Err.**	**p-value**	**Coeff.**	**Std. Err.**	**p-value**	**Coeff.**	**Std. Err.**	**p-value**
beta	0,242	0,067	0,000	0,291	0,072	0,000	-0,084	0,022	0,000	-0,040	0,019	0,036
gamma	0,183	0,084	0,030	0,228	0,090	0,011	-0,051	0,027	0,060	-0,018	0,023	0,430
V	-0,002	0,003	0,535	-0,002	0,003	0,475	0,000	0,001	0,839	0,000	0,001	0,882

Fig. 15

	Player 1		**Player 2**	
	BR=0	BR=1	BR=0	BR=1
δ=0	151	45	166	49
%	**77,04**	**22,96**	**77,21**	**22,79**
δ=1	56	324	76	285
%	**14,74**	**85,26**	**21,05**	**78,95**
Total	207	369	242	334
%	**35,94**	**64,06**	**42,01**	**57,99**

a)

	NO BR	BR
Player 1	91	485
%	**15,8**	**84,2**
Player 2	83	493
%	**14,41**	**85,59**
Total	174	978
%	**15,1**	**84,9**

b)

Fig. 16